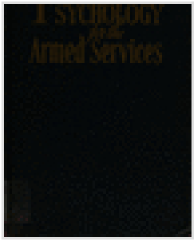

Psychology for the Armed Services (1945)

Pages
554

Size
5 x 8

ISBN
0309329507

Edwin G. Boring, Editor; Committee on a Textbook of Military Psychology; National Research Council

PSYCHOLOGY FOR THE ARMED SERVICES

PSYCHOLOGY *for the* ARMED SERVICES

Prepared by a Committee of
THE NATIONAL RESEARCH COUNCIL
With the Collaboration of Many Specialists

Edited by
EDWIN G. BORING
Harvard University

WASHINGTON
THE INFANTRY JOURNAL

First Edition

July 1945

PRINTED IN THE UNITED STATES OF AMERICA

COMMITTEE OF THE NATIONAL RESEARCH COUNCIL ON A TEXTBOOK OF MILITARY PSYCHOLOGY

GORDON W. ALLPORT, Harvard University

WALTER V. BINGHAM, Personnel Procedures Section, A.G.O.

IRVIN L. CHILD, Yale University

COLONEL JOSEPH I. GREENE, Infantry Journal

EDWIN R. GUTHRIE, University of Washington

HERBERT S. LANGFELD, Princeton University

COLONEL EDWARD L. MUNSON, JR., U. S. Army

MARJORIE VAN DE WATER, Science Service

EDWIN G. BORING, Harvard University, *Chairman*

Preface

Psychology has never had proper emphasis in American military development, training and combat. Psychology is the science that asks what man is, living, breathing man—why and how he does all that he does; hence there is no human activity, and therefore no military activity, that does not come within range of its investigation and of the application of its principles. Psychology as the study of man has extensive application in every military field.

There have been several reasons for the lack of attention to psychology within the Armed Services. In both World Wars the importance of the science became apparent, but the realization of its value to every wartime military endeavor was not immediate. Between the wars, interest in psychology was not sustained.

One reason for this failure is that the scope of psychology has not been clearly understood. This perhaps has not been entirely the fault of the Services. Psychologists, like military men, have had to create and use a technical language; and like military men, they have become fearful of inaccuracy and misinterpretation if their special terms and turns of speech are departed from in any great degree. In any science this attitude contributes to an underestimation of the need for keeping those men who do not speak the language of the science aware of developments within it.

It is true that there have been many books and articles published in recent decades whose authors have aimed to present psychology in a popular manner. But the greater number of these have been written by writers who lacked a reasonably expert background of psychology, professional writers who simply found in psychology some new things to write about; or else by men enthusiastic over untested or half-developed ideas about human beings and their relationships, who sought to help mankind, themselves usually included, through the spreading of a new doctrine. The distortions and inaccuracies in a great deal of such writing—much of it is not psychology in any scientific sense—has been as distressing to psychologists as similarly distorted and erroneous writings on military matters have always been distressing to the soldier. Among the trained psychologists themselves there have been but a few who have seen the necessity for clear as well as careful interpretation of their science through the use of modified technical language for the benefit of laymen, the military reader included. But these serious interpreters have largely been overshadowed by the writers of popular books filled with a dubious psychology, some of which have achieved immense circulation.

The result has been that many otherwise well-informed persons still do not realize the full scope of scientific psychology, the science that studies what man is and why he does what he does. Even among military leaders of rank this gap in general knowledge is to be found, though perhaps no more often among these leaders than among those of other professions. Too many persons in every field of endeavor think of "psychology" as a mixture of mind-reading and hypnotism of a mild form—a science that supposedly enables those who practice "good psychology" readily to understand and influence other people, a power it may be possible for a smart man or woman to obtain through the mere reading of one or two books. The science of psychology does indeed embrace the study of behavior of human beings, and this study may most certainly result in giving those who study it well a better understanding of themselves and their fellowmen. But psychology is no simple and quickly grasped source of inside information on human relationships. It is a broad vital science embracing all man's ways of thinking and acting and the complicated physical mechanisms by means of which he thinks and acts—his brain and the other parts of his nervous system, indeed his whole inseparable living mind and body.

For the military man psychology is not merely a special body of knowledge from which the soldier can draw a collection of tricks that he may apply in order to deal more successfully with his comrades, with the men he commands, and with the enemy. It is not just a source from which he can obtain certain isolated scientific findings that may help him improve the techniques of warfare. It is a science, the established principles of which, as this book shows, are as basic to war as leadership, tactics, strategy, and logistics.

A second reason why psychology has not been fostered within the Armed Services between the great wars has been the lack of books through which the military man might gain a clear idea of the manner in which the principles of psychology apply to everything he does. In some degree this lack may be attributed to the general inarticulateness of military men during years when the continued development of their own science was widely attacked as unnecessary and even as threatening to the peace of the world. There was also a lack of funds which prevented adequate research in every military field and greatly limited the courses of study at all the institutions of military education, including the highest.

On the other hand, it is fair to say also that psychology was not entirely a blind spot in the field of military thought. There were a few psychological studies in some of the military journals during the twenties and thirties. At the Command and General Staff School at Fort Leavenworth, there were lectures on "Military Psychology" for a number of years, and the study entitled *Psychology and War,* by Major John H. Burns, Infantry, was distributed as a text. But on the whole, in both Army and Navy, the general study of psychology was neglected. There was no full course in psychology at any official military or naval school, and there were no other developments through which "military psychology" was related to the whole field of the science of psychology, despite a considerable emphasis on the study of military leadership.

It may even be questionable whether the term "military psychology" is a valid one. It can be taken as implying that military psychology is different from other psychology—that perhaps certain psychological principles are applicable within the military sphere and not elsewhere. Psychology does indeed have certain well-established though overlapping subdivisions, such as child psychology, abnormal psychology, applied psychology. If it were customary to speak of "adult psychology" as distinguished from child psychology, it might be said that "military psychology" is adult psychology applied to military men. But the science of psychology relates to all men of all kinds and it should be thought of as holding general scientific knowledge of high value in every field of human endeavor. It is not possible to say of any department or phase of psychology: "This is purely military psychology." For example, the principles of child psychology have a direct bearing on the development of young men and women who may later serve in the Armed Services; and what is learned of abnormal psychology from the effects of the strain of combat on the minds of men has a bearing on the study and treatment of persons who break down under any strain of life. The psychology of efficiency is equally applicable in industry and in the Army and Navy.

Therefore, it is probably best not to think in terms of "military psychology" but rather in terms of "psychology *for* the military man."

Not until 1943 was any book written which endeavored to outline in ordinary language what the whole body of psychological knowledge held *for* the military man. This book was *Psychology for the Fighting Man,* of which several hundred thousand copies have been used in the Armed Services. Such a book would have been of great value throughout the years of peace, but it was a development that did not come until war had reawakened military men to the need for it and psychologists to the desirability of helping with such a project.

The present book, *Psychology for the Armed Services,* arose from the first book, which contained the minimum of technical explanation. *Psychology for the Armed Services* is intended as a textbook written on the college level, but also as a book in which the military and naval applications of psychological principles and the basic principles themselves are more fully developed than in the earlier work. It was believed that a single book might be equally useful as a textbook and handbook of psychology for general use by members of the Armed Services, not simply for instruction but also for individual reading and reference. The editor and all the others who have contributed to *Psychology for the Armed Services* have succeeded admirably in meeting both of these needs.

It is to be hoped that as far as a single standard work can be of influence this book will help in building a permanent realization in the Armed Services of the immense value of psychology to them. For this is not simply a war book; it is a work of broad and continuing military usefulness.

JOSEPH I. GREENE,
Colonel, Infantry.

Acknowledgments

This book has no author. It was based in the first place upon the content furnished by the sixty collaborators for *Psychology for the Fighting Man.* The contributions of these persons varied from an afternoon's hard work to what was practically a half-time job of an editor through many months. While the present text is indebted to all of these sixty persons, it does not seem proper to reprint their names. They must rest content with being its unmentioned ancestors.

The present book was prepared under the direction of the National Research Council's Committee on a Textbook of Military Psychology (a subcommittee of the Emergency Committee on Psychology), but the editor has been quite arbitrary in the way in which he has relied on certain members of the Committee for aid and left other members to other responsibilities not connected with this book. The participating members of this Committee are named in appropriate places in the following comment.

The editor has composed this text, even though he cannot claim to to be its author. He has had many critics. He has borrowed a few sentences and a few paragraphs from *Psychology for the Fighting Man;* but most of the material of that more popular book was not written in a style suitable for this larger undertaking.

The primary acknowledgment for aid must go to Colonel Joseph I. Greene, a member of the Committee and the editor of the Infantry Journal which publishes this book. At all times was he ready with literary and military advice, and the editor has constantly relied on his wise judgment, his astute insight and his never flagging alertness for detail.

The manuscript has been read entire and criticized by Colonel Edward L. Munson, Jr., Dr. Leonard Carmichael (Tufts College), Dr. Thelma G. Alper (Harvard University) and the editor's wife, Dr. Lucy D. Boring. Dr. Alper has rewritten many portions of it. The advice and comments of all have been most helpful and stimulating.

The first part of the book, the part on perception and efficiency (Chapters 2-10), received the special ministrations of Dr. Herbert S. Langfeld (Princeton University), who designed these chapters before the editor wrote them into their present form, who criticized them later, and who stood by to supply information and advice concerning them.

The remainder of the book—the part that deals with selection, training, motivation, morale, emotion, personal adjustment and all the mili-

tary social relations, including the assessment of opinion (Chapters 11-23)—was read critically by Dr. Gordon W. Allport (Harvard University) and Miss Marjorie Van de Water (Science Service) and the text has profited immeasurably by their help. Dr. Allport was the editor's constant advisor on all problems of personality and social psychology. Miss Van de Water also read the entire proof.

It seems best to list the other collaborators by chapters, although that method prevents a proper expression of appreciation for the particular rôle played by each person. The names already mentioned are not repeated here, and the omission of a chapter from this list means that it had no collaborators in addition to the persons cited in the foregoing paragraphs.

Chapter 1: The Scope and Nature of Military Psychology. Dr. Dael Wolfle (University of Chicago), Dr. Robert M. Yerkes (Yale University), Dr. Donald G. Marquis (Yale University).

Chapter 3: Visual Adaptation and Night Vision. Dr. Walter R. Miles (Yale University).

Chapter 9: Efficiency and Fatigue. Dr. Harold F. Rothe (University of Minnesota), Dr. Donald G. Paterson (University of Minnesota), Dr. T. A. Ryan (Cornell University), Dr. Dorothy H. Yates (San José State College), Dr. Walter R. Miles (Yale University).

Chapter 10: Physical and Physiological Conditions of Efficiency. Dr. Walter R. Miles (Yale University), Dr. T. A. Ryan (Cornell University), Dr. Ross A. McFarland (Harvard University).

Chapter 11: Selection of Men. Dr. Walter V. Bingham (Classification and Replacement Branch, AGO), Major Thomas W. Harrell (then of the Classification and Replacement Branch, AGO).

Chapter 12: Learning. Lieut. Colonel Morton A. Seidenfeld (Classification and Replacement Branch, AGO).

Chapter 13: Army Teaching. Lieut. Colonel Morton A. Seidenfeld (Classification and Replacement Branch, AGO).

Chapter 14: Motivation and Morale. Dr. Donald A. MacKinnon (Bryn Mawr College).

Chapter 15: Personal Adjustment. Lieut. Commander William A. Hunt (U. S. Naval Training Station, Newport), Captain Alfred L. Abrams (Field Artillery Replacement Training Center, Fort Bragg), Dr. Edgar A. Doll (The Training School, Vineland), Lieut. Colonel Morton A. Seidenfeld (Classification and Replacement Branch, AGO).

Chapter 19: Rumor. Robert H. Knapp (Office of Strategic Services).

Chapter 20: Panic and Mobs. Dr. Daniel Katz (Brooklyn College).

Chapter 21: Assessing Opinion and Discovering Facts. Dr. Allen L. Edwards (University of Washington).

Chapter 23: Differences among the Peoples of the World. Dr. Otto Klineberg (Columbia University), Dr. Irvin L. Child (Yale University), Dr. Herman G. Canady (West Virginia State College).

This list does not include the authors of the books which the editor consulted in his effort to round out the discussion or to supply the theoretical background with which every discussion begins. Such books are, however, cited in the references of the particular chapters.

In general, then, this book has depended in its writing upon the wisdom, enthusiasm and patriotism of the many psychologists who were asked to contribute to it and did contribute to it without thought of due acknowledgment of their efforts. In no instance did the editor fail to receive assistance when he requested it.

EDWIN G. BORING.

Contents

1. THE USE OF PSYCHOLOGY IN WAR 1
Seven Military Uses of Psychology 3
Psychology in Two World Wars 11
The Psychological Point of View 20

2. THE EYE AS A MILITARY INSTRUMENT 23
The Eye as a Camera 24
Visual Acuity 27
Glare 30
Visual Fatigue 32
Tridimensional Vision with One Eye 35
Tridimensional Vision with Two Eyes 39
Seeing Movement and Speed 46
Visual-Motor Coördination 48

3. VISUAL ADAPTATION AND NIGHT VISION 51
Cone Adaptation and Rod Adaptation 52
Seeing in the Dark 58
Rules for Night Observation 61

4. COLOR AND CAMOUFLAGE 63
Color 64
Color Blindness 69
Camouflage 74
Counter-Camouflage 93

5. THE EAR AS A MILITARY INSTRUMENT 97
Nature of Hearing 97
Physiology of Hearing 104
Deafness 107
Communication 112
Effects of Noise 118
Localization of Objects by Hearing 121
Sound Camouflage 126
Practical Rules for Hearing 127

6. SMELL IN WAR 130
Sensitivity 131
Recognition 132
War Gases 135
Camouflage of Odors 138

7. EQUILIBRIUM AND BODILY ORIENTATION . . . 141
THE VESTIBULAR SENSE . . . 143
ADAPTATION AND HABITUATION . . . 148
MOTION SICKNESS . . . 150

8. TOPOGRAPHICAL ORIENTATION . . . 154
MENTAL MAPS . . . 157
MENTAL MAP MAKING . . . 159
HOMING . . . 165

9. EFFICIENCY AND FATIGUE . . . 167
EFFICIENCY . . . 168
WORK HABITS . . . 170
FATIGUE . . . 173
BOREDOM . . . 186
SLEEP . . . 188
ACCIDENTS . . . 192

10. PHYSICAL CONDITIONS OF EFFICIENCY . . . 199
TEMPERATURE . . . 199
ALTITUDE AND ANOXIA . . . 208
ALCOHOL . . . 213
TOBACCO . . . 218
COFFEE AND TEA . . . 221
DRUGS . . . 222

11. SELECTION OF MEN . . . 225
GENERAL ABILITY . . . 226
SPECIAL ABILITIES . . . 234
JOBS . . . 237
INDIVIDUAL DIFFERENCES . . . 239
CLASSIFICATION . . . 253
ASSIGNMENT . . . 257

12. LEARNING . . . 264
PRACTICE . . . 265
MOTIVATION . . . 269
UNDERSTANDING . . . 272
NATURE OF LEARNING . . . 276
REENFORCEMENT AND INHIBITION . . . 278
EFFICIENT LEARNING . . . 280
STUDY . . . 287
RAPID READING . . . 289

Memorizing . . . 292
Problem Solving . . . 294
Plateaus . . . 295
Recognition . . . 297

13. ARMY TEACHING . . . 300
Rapid Training . . . 301
Methods of Instruction . . . 304
Special Training. . . . 308

14. MOTIVATION AND MORALE . . . 312
Needs . . . 313
Frustration . . . 319
Psychological Mechanisms and Frustration . . . 321
Determiners of Morale . . . 325
Control of Morale . . . 341

15. PERSONAL ADJUSTMENT . . . 344
The Recruit's Adjustment . . . 345
Adjustment to Combat . . . 348
The Psychological Mechanisms . . . 350
Defense Mechanisms . . . 353
Escape Mechanisms . . . 357
Mental Health and Mental Breakdown . . . 363
Head Injuries . . . 368
The Problem of Adjustment . . . 368

16. EMOTION: FEAR AND ANGER . . . 372
Physiology of Emotion . . . 374
Expression of Emotion . . . 379
Fear . . . 383
Fighting Fear . . . 386
Anger . . . 391

17. SEX . . . 395
Physiology of Sexual Need . . . 396
Sexual Need in Man . . . 398
The Fighting Man's Sexual Problem . . . 401
Homosexuality . . . 404
Resumé . . . 407

18. LEADERSHIP . . . 410
Leading and Being Led . . . 411

The Follower's Rôle in Leadership 415
The Attributes of Leadership 417
Selection of Leaders 425
Training of Leaders 428

19. RUMOR 432
Why Rumors Spread 433
Rumors as an Index of Morale 435
Rumormongering 436
Censorship and Rumor 438
Hardy Rumors 439
How Rumors Change 440
Uses of Rumor in War 441
Control of Rumor 442

20. PANIC AND MOBS 445
Mobs 446
Controlling Mob Action 451
Panic 452
Examples of Panic 456
Stopping Panic 462

21. ASSESSING OPINION AND DISCOVERING FACTS . 464
Public Opinion Polls 466
How to Poll 468
Other Methods for Discovering Facts and Opinions . 474
Interpreting Opinion 478
Military Importance of Knowing about Opinion . . 480

22. PROPAGANDA AND PSYCHOLOGICAL WARFARE . 485
Propaganda and Morale 486
Propaganda Aims and Targets 487
Propaganda Espionage 488
Propaganda and Events 489
Timing of Propaganda 490
Interpretation 491
Distribution of Propaganda 492
Black Propaganda 493
Combat Propaganda 495
Organization of Propaganda 496
Tactics of Propaganda 497
Formula for a Propaganda Victory 498

Chapter 1

The Use of Psychology in War

War is fought by men. Modern war is fought by men and machines—a great variety of machines, but also a great variety of men with various skills and abilities. Without men the machines are useless. Without the special skills and abilities of men for operating the machines and for performing all the other complex operations of war, the armed forces would be helpless. In other words, the Army and the Navy, in a very serious and specific manner, have to take account of human nature.

In a way, a man is himself a machine. That is to say, he is a complex organism with certain properties, capacities and abilities. Some of his abilities, as well as some of his deficiencies, he has inherited. For instance no man can see as well in the dark as in daylight, and every man who sees at all can see better at night after he has remained some time in the dark. This human ability and limitation, this property of the seeing eye, is inherited. Training alters the capacity only a little. There are, however, great differences in sensitivity among men. Some have much better night vision than others, and should, therefore, be the ones selected for making observations at night. The military problem here is first to know the capacities and limitations of the human eye and then to adjust the military requirements to them, so as to employ the maximal visual acuity without demanding the impossible. The specifications for the best seeing must be laid down. Then all observers must conform to the rules and the best eyes can be selected for the most difficult tasks.

Most human skills are, however, not inherited but learned. That is true of all complex skills. Men differ in their aptitudes for learning—for learning in general and also for learning particular skills. The armed forces—especially when a large Army and Navy must be recruited quickly for war—have to take account of two factors: the different skills that men have already acquired and the different capacities that they have for acquiring particular new skills quickly. Since you cannot create new men for war, you have to adapt the men already available. Thus it comes about that the great task of creating new forces is principally a matter of *selection* and *training*. It is necessary to choose the men who already have the needed skills or else to train them.

Actually the armed forces do both. If a civilian skill, like typewriting, is also a military skill, the men who already have the ability—the typists—can easily be selected. If there were not enough, others would have to be trained, but usually there are enough typists. If the military skill can be nowhere nearly supplied from the civilian stocks, as is the case with receiving and sending radiotelegraphic code, then almost all the men have to be trained. For training there are, however, differences of aptitude among the men. A mentally deficient man, although perhaps bright enough for a number of tasks necessary in the armed forces, could never learn code fast enough to make training him worth while. Many bright men, moreover, lack "code aptitude" and should not be trained when more apt men are available. Psychological tests can determine what capacity a man has for learning in a wide variety of tasks and for learning code in particular. Selection and training go hand in hand.

It does not matter whether aptitudes are inherited or learned. You have to take them as you find them. A learned civilian skill often constitutes an aptitude for learning a military skill. For instance, civilian truck drivers have aptitude for driving Army trucks, but still they need much further training.

These problems concerning human abilities and aptitudes are psychological. Often—not always—it is the psychologists who can help the armed forces to find out what human abilities are needed and how to acquire them by selection and training. Psychology is the study of human nature and wars are fought by human beings.

It is now time for us to become more specific, to inquire into the precise nature of a man. A man, regarded as a machine, is an extremely complicated, sensitive, and precise machine that is capable of perceiving, feeling, remembering, learning, thinking and acting. It is his action that counts in the end because it is what he *does* that makes him useful. What he does is, however, dependent on the other five functions. He can act in accordance with what he perceives—shoot and hit the target. He can act in accordance with what he has perceived in the past, that is to say, in accordance with what he remembers. He can choose his target today because he spotted it yesterday. He can also change his actions by learning. Today he can shoot straight because he learned in training. Today he learns that yesterday's new strange object is really a camouflaged gun emplacement. Thinking is his way of solving a new problem before action. Man's nervous system provides means by which memories and perceptions work together without action until some new idea that is not a mere memory evolves, an idea which may lead to some new action. That is thinking. All these capacities of soldiers and sailors are what the Army and Navy have available for combat. They are the matériel of human nature.

The armed forces, in so far as they seek to use men for the purposes of making war, have to take into account all the psychological functions, have to understand their possibilities and limitations in order to make the most of the available human resources. Military men must study the utilization of these capacities and thus of the efficiency of soldiers and sailors.

Psychological military problems also include the study of the other persons with whom the armed forces have to deal—the civilians on the home front who support the armed forces, the civilians of occupied countries who come in contact with the soldiers and sailors, the enemy civilians, and the enemy soldiers and sailors. Military men must know about the habits of thought and action of all these kinds of people; they are often concerned with their beliefs, their emotions, their prospective actions. The leaders use various means for assessing the opinions of such social groups, and then, knowing how the groups are thinking and feeling, they may try to alter their opinions and actions by psychological warfare.

SEVEN MILITARY USES OF PSYCHOLOGY

As a practical matter, the psychological business of the Army and the Navy with which this book is concerned breaks down into the following seven fields:

(1) *Observation*—the limits of accuracy in perception and the rules for getting the most accurate perception.

(2) *Performance*—action and movement, the acquisition of skills, efficiency in work and action.

(3) *Selection*—classification, the choice of the right man for the right job.

(4) *Training*—teaching and learning, the transformation of aptitudes into accomplished skills.

(5) *Personal adjustment*—the individual's adjustment to military life, his motivation, his morale and his reaction to stress and fear.

(6) *Social relations*—leadership, the effects and control of rumor, the nature of panic, the relations of peoples of different races and customs.

(7) *Opinion and propaganda*—assessment of public opinion and attitudes, psychological warfare.

(1) Observation. Perception and the use of the senses has great military importance. It is necessary in warfare to know about vision—

how accurately the eye can see, how easily seeing is fatigued and how fatigue can be avoided, how distance is perceived visually, the rules for the best seeing at night, the laws of color perception and the facts of color blindness, the psychology of camouflage and of counter-camouflage. It is important to know about hearing, too—the nature and causes of deafness, the effects of noise, the use of sound and spoken words in communication, especially over telephone systems, the rules for the best hearing. Smell has military uses, not only in the perception of war gases, but also in reconnaissance. For flyers the perception of bodily equilibrium is of great importance, not only because flyers use these perceptions but also because they must learn when they cannot safely depend upon them and must therefore ignore them. There is also a psychology of motion sickness. And finally there is the perceptual problem of topographical orientation, of finding your way when lost, of finding an objective in strange territory, a capacity which can be learned and which depends on the use of all the available senses. These topics make up a large division of the psychology with which military men are concerned.

When the basic psychology of all these perceptions is understood, then there are four ways in which to use it.

(a) The rules for the best observation can be laid down. Men can be told, for instance, how to observe most effectively in the dark.

(b) Since usually there are individual differences in perceptual capacity, the best observers in respect of any particular perception can be selected for the tasks in which their special ability is most useful. Some men are night blind and should never have important duties which require observation in the dark. Some men can perceive distance visually with greater accuracy than can others and have a special use in range-finding.

(c) In many cases training is indicated, for in many kinds of observations increased accuracy can be learned. The recognition schools for tanks and airplanes are cases in point. The capacity to find your way in strange territory can be greatly improved by practice with knowledge of the basic psychological principles.

(d) The military planners also need to know about perception because the facts enter into the design of instruments. For instance, adjustments that require precise movements of levers or handwheels should be provided with visual scales or indicators, for it is possible to be more accurate when vision is added to the muscle sense for guiding and checking the movement of the arm and hand.

All four of these uses of perception are, moreover, related. The best observers are selected for further training. The rules of best perception have to be learned and often practiced. And observers must be taught to use the special adjustments on instruments if they are to get the best returns from them.

(2) **Performance.** The motor as well as the sensory side of human nature is important in fighting. In fact, the ultimate interest of the armed forces in the capacities of men is to utilize what they *do*—the actual movements of their muscles. Keen perception is important because it enables the perceiver to *do* something that a less sensitive perceiver could not do. The bombardier must have good vision, but he must also have manual dexterity. The two capacities together enable him to operate the bomb sight precisely. In general, selection and training are used to get the right man in the right job. That means having in the right place at the right time the man who will make the correct movements as accurately as possible.

The particular psychological problems of performance boil down to the problems of *skill* and *efficiency.*

The necessary *skills* are got, for the most part, by selection of men already possessing these skills and by the training of others. These are matters that we shall discuss presently. The development of skills is also aided by the discovery of rules for the best and most precise performance. Sometimes these rules require practice for their learning. No soldier learns to squeeze a trigger instead of pulling it by being told just once what to do. He has to practice. On the other hand, it does not take much practice to learn to throw yourself into a ditch when bombing starts or not to light a match in the dark when the enemy may be watching. Some skills can be improved by the designer of instruments. Levers, handwheels, and knobs that require frequent and precise use should always be placed on a machine so that they will be at the height of the operator's waist. Then he will be least awkward, most skillful.

The other psychological motor problem is *efficiency.* The desire to get the most return for the least effort is a natural consequence of all human competition and war is the ultimate in competition. Especially is maximal efficiency demanded when large forces must be found and trained quickly for fighting. Efficiency must be basic to all military procedure.

The psychology of efficient work has many aspects. A great deal of military activity is repetitive; the same operations must be done over and over again. Here many lessons learned from industry as well as past military and naval experience apply. Soldiers and sailors must learn the best work habits, and their instructors must know how men can perform work with the least effort and the least fatigue. The various techniques for lessening fatigue become important, as do also the means for diminishing boredom in monotonous work. The psychology of accident prevention is even more useful in the armed forces than in civilian life. An accident that happens in the absence of the enemy is no less a casualty than one that is enemy-inflicted, and an accident not caused by the enemy may contribute to casualties from enemy action. Sleep is also a military problem—how much is needed, how little is allowable, what the sleepy sentry is to do, how sleepy troops can be waked up. Lack of sleep, fatigue, boredom and awkward habits—they are all factors in efficiency and require control.

Besides sleepiness and fatigue there are other bodily states which affect efficiency and which become extremely important in military situations. These states depend on external conditions or on substances that enter the body. What is the effect of cold on human efficiency? Of heat? How can the ill effects of extreme temperature be diminished? At what temperatures does the body function most effectively? What is the effect of high altitude upon the perceptual and motor functions and upon sensorimotor coördination in the precise movements of the pilot and the bombardier? The effects—and they are great—arise because of diminished oxygen in the blood. Psychological research furnished the facts and also the rules which keep the disabilities of oxygen-deprivation minimal. How does alcohol affect efficiency? It is bad for efficiency. Does it sometimes help morale? When may a fighting man drink? The same questions arise, with very different answers, about tobacco, coffee and tea, as well as certain stimulating drugs. Psychology and physiology together furnish the answers and the practical rules. For instance, tobacco aids military efficiency only because it helps morale.

(3) **Selection.** Because men differ so much from one another they have to be selected for their military jobs. They differ in their inherited capacities and in the skills which they have already learned when they are inducted. They differ in sensory capacity, in motor skills, in their abilities to learn rapidly and to remember what they have learned, in general intelligence, in specific knowledge and breadth of knowledge, in capacity for insight and originality, in emotional stability and susceptibility, and in a great variety of other ways that come under the vague

heading of personality. They may have the ability for performing a certain task, or, lacking the ability, they may have the aptitude for the job, the capacity for learning it quickly. Or they may lack both a specific ability and the aptitude for acquiring it.

Selection of men in accordance with their abilities and aptitudes is the work of the personnel services of the Army and Navy. Psychology furnishes these services with many of their methods and facts. The military jobs have first to be analyzed to find out what specific abilities are required in them. Then ways of assessing men for these abilities and aptitudes have to be discovered—tests, work samples, interviews, histories of actual achievements. Sensory tests will select men with the best night vision. Ability in truck driving can be demonstrated in actual driving over an experimental course. The abilities required by flyers can be broken down into sensorimotor coördinations and a number of other capacities, and aptitudes can be tested, so that the men who will make the best flyers can be chosen from among all the others. Leadership ought similarly to be analyzed and leaders then selected by tests, but at present the best technique for the selection of leaders is a review of the man's history as a leader.

These instances are examples only. The work of selection by the personnel services is basic in the assignment of the right men to the right jobs and it does not stop with the induction of new recruits. Men have constantly to be reassessed and reassigned as their abilities alter under training and as new military needs require new combinations of abilities.

(4) **Training.** Most of the work of the Army and Navy is training —training for eventual combat or for the support of combat. Actual combat is itself training for further combat, as the distinction between green and seasoned troops indicates, but before troops are ready for any fighting they have had a long course of schooling. The Army and the Navy are huge schools where training goes on incessantly.

Some of this training is practice in manual skills. Some of it is the acquisition of the abilities to handle complex machines and instruments. Some of it is book learning. Some of it is problem solving—indoors and in the field. Some of it is adjustment to military life. Leaders can be trained when they have the requisite aptitude. There is no end to the training that the successful making of war requires.

The psychology of making war, therefore, includes the psychology of learning. The leaders need to know how practice and habituation, how motivation and understanding, are essential in learning, and soldiers and sailors need also to know these facts and the best rules for efficient learning. Men need to learn how to learn, how to study, how to read rapidly, how to memorize, how to solve problems, and how to do all these things with the greatest efficiency. The leaders must apply the general principles of the approved methods of teaching—often the teaching of large masses of men together by inexperienced instructors when time is short and fatigue is great. Psychology exhibits the rules, lays down the limitations, discovers the techniques that are most efficient under military conditions.

(5) **Personal Adjustment.** It would be desirable if everyone—soldier and sailor, general and admiral, statesman and businessman, banker and laborer, leaders, teachers and parents—could be so conversant with the psychology of human motivation as to be able to apply its principles to an understanding of himself and of the persons with whom he comes in contact. Such universal psychological wisdom would make for tolerance and the success of the necessary social adjustments. It would not create a perfect world, because part of understanding human nature is to understand why a man cannot fully understand himself. He respects himself too highly to be fully objective about himself. The psychology of motivation is, moreover, not sufficiently advanced to solve every concrete problem of human need and inner conflict that arises. Still the knowledge so far acquired is useful, and if it cannot be given to everyone, it ought at least to be given to military leaders to help them in dealing with men. Any man capable of understanding it is likely eventually or at times to have responsibility for leading others. This information is also given by psychiatrists to men suffering from war fatigue, for self-knowledge is part of the cure, part of the means of getting such men back to their responsibilities.

For these reasons the psychology of *motivation* is extremely important in war. What does the psychology of motivation include? A knowledge of the nature of human needs and how they determine human thought and conduct, of how needs may conflict, of how conflict leads to frustration and frustration to aggression or defense, apathy or escape, of the psychological defense and escape mechanisms whereby men make unusual and unexpected adjustments in thought and behavior to extreme frustration or to fear. These are the matters that leaders need to have constantly in mind when they are dealing with the problems of men under stress, and that the men themselves, who for the most part want to make successful adjustments to their difficulties, would do well to know also.

In addition to the fact that everyone ought to know about human nature, there are certain concrete military problems of personal adjustment that arise.

There is, in the first place, the problem of *morale.* Morale is much more than having movies to see, books to read, dances to go to. It means the maintenance of healthy, well-adjusted personalities, coöperating under difficulties. The leader who can secure morale in his unit understands men.

There is the problem of *emotion,* and especially of fear. All fighting men should know about fear, respect it, not be ashamed of it, use it to make themselves efficient. The psychology of fear is an important item in the psychology of warfare.

There are the numerous problems related to the *sexual needs* of men. They all ought to understand about the nature of these needs and to have practical advice as to what to do about them, what psychological alleviations for loneliness there are, what the psychological consequences of certain actions are. It is an important topic, in which the avoidance of disease is only a tiny section. Leaders ought, moreover, to know about homosexuality, a difficult psychological problem in both the Army and the Navy.

And then there are the problems of *instability* and breakdown. Which men are likely to break down because of emotional instability? The psychiatrists are the experts for that, but the psychologists may help them. When men break under the stresses of military life, either in combat or before combat, what is to be done for them? How can they be brought back to responsible duty? What are the symptoms of breakdown? Leaders should know about breakdowns in order that they may refer cases for medical advice before the psychological injury becomes irremediable. It is not a doctor who sends you to the doctor in the first place.

(6) **Social Relations.** There are in the services certain social relations which need to be understood so that they can be controlled and made to operate in the military interests. Four very important topics of military significance are leadership, rumor, panic, and the relations between persons of different nations.

Leadership, since it extends all the way through the military hierarchy from the top to the bottom, is of special importance and, when the services are being rapidly built up, it is hard to find enough good leaders. Without good leadership morale and efficiency suffer. Psychology has a contribution to make to this problem. It can indicate ways by which leaders can be selected and by which men with aptitude for leadership can be trained. It can at present give some indication of the nature of leadership, an imperfect job analysis. There are at present no quick, easy certain tests for the selection of men with the ability or aptitude for leadership, but there is indication that elaborate and time-consuming analyses of personality could do this work if there were time—as there would be in times of peace, though not in the hurry of creating large forces for immediate war.

Rumor affects morale adversely. It flourishes when more reliable sources of information are lacking. News—correct information—may be available to no one, or it may be suppressed for reasons of security. Understanding the nature of rumor and its spread is the first condition of its control. Fighting men should have this understanding, and leaders should be prepared to borrow from civilian practices the various devices for encouraging their men to distrust rumor.

Panic can occur in the best disciplined troops. Its conditions must be known. Leaders must understand the psychology of mobs and of panicked crowds in order that they may lessen the chance of panic among fearful or disheartened groups. Psychology provides information about the causes of panic and the means of its control.

Difficulties of coöperation arise when men with *different cultural backgrounds,* with different habits of thought and action, come together. The strong convictions of one man appear as prejudices to another. These differences lie at the basis of race prejudice. They create the difficulties that arise between white persons and Negroes in the American forces. They create similar difficulties between the fighting men of allied countries, between occupying troops and the people of occupied countries. Such differences need to be understood, not only by leaders, but also by every fighting man. Understanding produces tolerance and makes coöperation easier. Military psychology, while it is not prepared to say just what are all the basic psychological differences between Frenchmen, Britons, Germans, Japanese and Americans, or between Moslems and Christians, can at present point out the differences in custom and convention and how they have come about, and provide many practical rules for achieving unitary effort in a common cause. This problem is at least partly solved when it is understood.

(7) **Assessment of Opinion and Propaganda.** War creates many situations in which it is important to know the opinions and attitudes of large groups of people with not all of whom it is possible to secure personal contact. There are various psychological techniques for obtaining this information. The public opinion poll of persons selected as a fair sample is only one method. These procedures need to be known and they can be applied with various modifications to both large and small groups—to the peoples of different countries, the important social groups within countries, or to units as small as a regiment or even a company. While such methods have been for the most part developed in civilian life, they are applicable in many ways within the services.

When the opinion of important groups is known, it may be part of warfare to influence it toward change. That is *propaganda.* Propaganda is directed ordinarily toward increasing morale in the home country or allied countries or toward lowering morale in enemy countries. When directed against the enemy it is called psychological warfare.

Psychological warfare has become an important branch of war. Part of it is left to the nonmilitary agencies of the government, but it is also conducted by the armed forces in the field. It is an essential auxiliary of military activity, especially of victory. Victories in battle are not ends in themselves. They must be used to create the will to surrender in the enemy people; they must be exploited by propaganda. Such propaganda takes the form of broad appeals to the enemy populace or enemy soldiers by radio or scattered leaflets, or it may be conducted on a narrow front, as when invitations to surrender and enjoy the comforts of being taken prisoner are given to a single group of discouraged enemy soldiers. There is a definite order of appeals which psychological warfare has to follow in order to produce results, and leaders should know how to use it. The men who are subject to enemy propaganda should also know about psychological warfare in order that they may resist its influence.

All of these things, then, constitute the psychological subject matter which military men need to know.

PSYCHOLOGY IN TWO WORLD WARS

Psychology, which had been a subject matter of discussion by philosophers, did not become an experimental science until the middle of the last century. Then it was realized, for the most part by physiologists, that the laws of sensation could be worked out experimentally. There were, however, no psychological laboratories until the 1870s when a laboratory was founded at the University of Leipzig in Germany and a less pretentious one at Harvard University in America. In the 1880s the problems of learning, memory, attention and action were added to those of sensation and perception as topics of psychological research. In the 1890s mental testing was begun, mostly in America. In the first decade of the present century intelligence tests were invented, other mental tests were developed, applied psychology came into being, and the university laboratories, of which there were then a great number at German and American universities, continued their studies of the laws of sensation, perception, attention, learning, memory, reaction and thought. At the same time animal psychology began to be extensively studied in the laboratories. That focused interest more on the behavior of living organisms, both men and other animals, whereas in the preceding century the stress on the perceptual functions had tended to leave action and movement out of experimental psychology.

The First World War. Psychology was undoubtedly ready to play a much more important rôle in the First World War than it actually did. The Germans who were then the leaders in human, general, theoretical, experimental psychology—"pure" psychology as it has sometimes been called—were not so far advanced as America in applied psychology and the use of mental tests. They seem to have developed no important psychology of warfare in 1914-1918 other than their efficient use of the art of propaganda.

When the United States declared war on Germany on April 6, 1917, the psychologists undertook at once to promote the useful application of psychology within the armed forces. Eventually seventeen committees on the psychological problems of warfare were formed under the jurisdiction of the National Research Council. It is interesting in reading the list of these committees to see how many of the psychological activities of the Second World War were anticipated at the time of the First. Here is a partial list of the topics in which research and application were undertaken: the psychological examination of recruits, especially with respect to intelligence and the psychological availability of men for military service; the selection of men in respect of their special aptitudes, selection which included the formulation of occupational and trade specifications, the development of trade tests, the techniques of classification and placement, and the rating of officers; the military problems of vision and hearing; the psychological problems of aviation, including the selection of flyers; the psychological problems of training and discipline, of the giving of military instruction in the Army and in the college; the treatment of emotionally unstable men; the reëducation of men incapacitated for further military service; and morale and propaganda. Not all of these undertakings were pushed far, but their importance was recognized in 1917-1918.

The most extensive undertaking was the examination of recruits under the Surgeon General. The psychologists developed there the group intelligence tests in which several hundred men can be tested at once and an intelligence score obtained for each. They created other tests for illiterate men and for men who do not understand spoken English. Altogether about 1,600,000 recruits were examined by these procedures. The results were used to exclude some men from military service, to place others in work suitable to their intelligence—labor battalions for those with the lowest scores, special responsibilities for those with the highest. The war ended too soon for the full possibilities of this procedure to be realized. Altogether 115 officers and 254 enlisted men—369 men in all—received special training in military psychology at Camp Greenleaf, Georgia, and were employed in this work in the various camps.

Equally important was the work on occupational assignment under the Adjutant General, who called on a Committee on the Classification of Personnel for expert advice in this field. This Committee undertook job analyses, the classification of standard occupations, the determination of the Army's needs for occupational specialists, the specification of the qualifications of the available men. It developed and used the trade tests. It established in the Army the Soldier's Qualification Card and the Officer's Qualification Card which are still in use, providing constantly in any unit an inventory of the abilities of its personnel. At the camps recruits were ordinarily received and their Qualification Cards made out and filed within two hours after their arrival. These data, along with the results of the intelligence tests, were used to assign men to special occupations, to limited service, to development battalions, to officer training schools, to other training schools, and at the ports of embarkation for balancing units in order to give each its proper complement of skills and abilities. This work too was cut short by the end of the war, but it furnished a sound basis for later procedures in peacetime and in the Second World War.

In aviation there was a great deal of research on the selection of flyers. This work was hampered because it met with the general conviction—presently discovered to be false—that the best aviators are those who are most sensitive in their bodily reactions to rotation. Actually flyers become habituated to repeated rotation and do not show its effects as fully as do novices.

When the First World War ended in November 1918, military psychology had made a good start under the determined efforts of many psychologists, but it was not thoroughly established in the Army and hardly at all in the Navy. The psychologists went back to their universities, the research stopped and the accepted procedures remained about where they were. The problems, however, continued to exist and responsible persons knew what they were.

The situation was summed up excellently in 1919 by a psychologist who had been engaged in psychological research for the Navy during the war. He wrote then:

> The military danger in the next few years of peace is that, with the passing of the present crisis, so few military officers are capable of carrying on the mental researches. I fear that some other nation may take up the mental analyses where we left them when the emergency ceased, and may develop a real military psychology that will be more deadly than 42-cm. guns. Our efforts, however excellent and however valuable, are only the first crude beginnings of such a military psychology.

His prediction was right. The Germans did take up psychology of warfare and the Americans dropped it, but the situation in the Second World War became quite different. There are now many military men who have become psychologists, who understand that the study of human nature is a military subject.

German Use of Psychology For Warfare. During the interval between the two world wars the relation of psychology to warfare became an important topic in Germany. The Germans were seeking for an explanation of their defeat in 1918 and for the means of victory when the opportunity should come again. They concluded—insofar as it is possible to say that anything is concluded in the give and take of argument—that Germany had lost the war because of weakness, because the political and military bodies were insufficiently integrated, because there were traitors who betrayed the Army, because the people lacked the strength and courage to enforce victory. Thus there grew up in practical social philosophy in Germany the conception of *total war*—total war by the state with every individual giving himself to the purposes of the state.

The threat of war and the conduct of war when threats fail were to be regarded as the natural instruments of a dominant state, and every civilian, as fully as every soldier, was admonished to regard himself and his life as devoted to this service of the state.

This philosophy of the state came to the fore in Germany in the 1920s. The Nazis did not invent it. They found it ready made for their purposes, and the success of the Nazis was due, not to any original conception of Hitler's, but because he could become the symbol and agent of a frustrated people with an urge for dominance and a conviction that they were destined to lead the world. When Germany under Hitler began rearmament for total war in 1934, it was inevitable that psychology should enter into the calculations of its leaders.

In total war—so the theory of it runs—the entire population fights in the service of national policy. For efficient action it is as necessary that all members of the state think alike in important matters as it is that the motives of an individual should be integrated, that he should know what he wants and not strive to achieve incompatible ends. So total war begins with the education of the people in accordance with the plan of a dominant group or a dictator. The Nazis sought to inculcate in every German the acceptance of this philosophy of the state, the belief in Germany's mission of leadership, and the spirit of courage, aggression, and tough-minded insistence on the common purpose, a will to dominance subject only to established discipline within the hierarchy of the state. In other words, the state undertook to control the thoughts and attitudes of its subjects in the interests of efficient unitary action. Such control is, of course, a problem of psychology.

So the German state called on its psychologists and often—though not always—took their advice. The leaders analyzed, with Teutonic thoroughness, the many psychological problems that these concepts of the state and of total war involve. The Government established a Psychological General Staff group functioning under the High Command by way of the Ministry of Propaganda and the Secret Police. The Psychological General Staff group organized divisions of (a) Research, (b) Tests, (c) Defensive Morale and (d) Offensive Morale. Defensive Morale had to do with upholding the morale of Germans—the soldiers and the civilians; Offensive Morale with breaking the morale of the enemy.

It would not be profitable to list here all the topics that the Germans considered as belonging in the psychology of warfare and placed under the business of the Psychological General Staff group. They did not consider in this connection the problems of perception and reaction, but for most of the important topics in the latter half of this book (Chapters 11-23) they did attempt to lay down rules and principles. The psychology of mobilization. The psychology of leadership. The selection of personnel. The psychology of military life (indoctrination, relations between soldiers and officers, homesickness, suicide, sex, the treatment of eccentrics and recluses, clumsiness, cowardice, desertion, religion). The psychology of combat (aggression, morale, fear, isolation, superstition, surprise, waiting for attack, gas warfare, panic, surrender). Defensive morale (civilian and military). Offensive morale (rumor, propaganda, national differences in attitudes and motivations).

German psychology has always been mixed with philosophy, whereas American psychology has taken its place among the biological sciences. The difference between a philosopher and a scientist seems to be that the philosopher trusts his own insight and intuition more than does the scientist, verifies his beliefs less often by experiments that are independent of his own predilections. So in the German psychology of warfare there has been less use of tests for the selection of men and more use of the judgments of superiors than in the American Army and Navy.

This distinction is, however, by no means absolute. The Germans use tests. They use standardized situations under which they make judgments of men, putting them, for instance, under emotional stress to see how they stand up, giving them problems that can only be solved with ingenuity and observing the results. And the Americans use such methods, too. Nevertheless it is true that German military psychology has been less definitely controlled by the methods and techniques of experimental science, has relied more on the judgments of leaders and wise men. American psychologists regard this difference as a defect in the German use of psychology, believing that the American methods are more objective, their facts more readily subject to validation.

The Second World War. When America approached the Second World War with the drafting of recruits in 1940, it could be said that Germany was far ahead of America in the use of psychology for the support of war. She did not long remain so. The First World War had set the problems, as we have seen. The psychologists were ready to serve in the national emergency. The Army, the Navy and other departments of the Government were all ready to accept scientific aid wherever it was available. The preparation in 1917-1918 helped a great deal. The

German example helped some. The fact that total war was forced on America helped also, for it made war highly mechanized and threw the military leaders back upon science for all the aids to victory of which the laboratories were capable.

It is much too early at the present writing to begin a historical account of America's use of psychology in the Second World War. Much of the research and its applications are still restricted for reasons of security. Those basic facts that are public information are printed in this book. Nevertheless it is possible to give some idea of the scope of these activities.

Within the Army the most important psychological service would seem to have been in the selection and placement of men. The Classification and Replacement Branch of the Adjutant General's Office, working with regard to procedures in its Personnel Research Section, undertook to classify all recruits, to assign them properly, and to reclassify and reassign them as special training changed the specifications of any man. This service started in where the intelligence testing and the personnel placement of the First World War left off. It developed the Army General Classification Test, first in a simple form and later in an improved form which also gives some information about different basic abilities. It worked out procedures of testing and interview for directing men into the hundreds of special jobs which the Army had to fill. Eventually it undertook responsibility for classification at the Induction Stations, the Reception Centers and the Replacement Training Centers, assigning men to basic training, special training units, or specialists training. At one time the service was prepared to give seven classification tests, eleven aptitude tests, thirteen educational achievement examinations and five trade knowledge tests, besides other technical examinations. Later other tests and examinations were added. Especial attention was given to the most important needs, like mechanical aptitude, aptitude for the use of radiotelegraphic code, and the driving of trucks. There never before were so many men so well tested and examined, but the specialization of total mechanized war required it. These procedures are discussed in Chapter 11.

The magnitude of this undertaking created a critical shortage of trained psychologists and in 1943 the Army undertook in a Specialized Training Program in Advanced Personnel Psychology to train about 1,300 men in personnel psychology, most of whom were later employed in personnel work or other psychological duties.

The Air Forces created a special problem because great numbers of men had to be given a long and expensive training. There was no civilian pool of flyers from which to draw. The selection of flyers was undertaken by the Psychological Branch of the Office of the Air Surgeon, which maintained at one time several research units and examining centers. These research units worked out aptitude tests for pilots, bombardiers and navigators, tests which were employed before training was begun. Special attention was given to the improvement of methods of training for the specialized tasks.

The Navy, although starting later than the Army, developed a similar program of classification and training under the Bureau of Naval Personnel. The administrative procedures are different from the Army's, but the purpose and results are similar.

In general, the work of psychologists in the Army and Navy is contributory. In the work of classification and assignment it is primary because psychological procedures are essential for the assessment of abilities and aptitudes. In other branches of the services psychological techniques become auxiliary to larger tasks.

Thus in the Medical Department it is the psychiatrist who is competent to say whether a man is to be rejected or discharged for mental deficiency or on neuropsychiatric grounds (as an NP); yet the psychiatrists lean heavily on psychological tests for determining the extent and nature of both these defects, especially of mental deficiency (feeblemindedness and low-grade general intelligence). The two professions work together but the final responsibility remains, of course, with the medical man.

As the rate of induction decreased later in the war and the wounded began to return home, many psychologists were shifted from classification and personnel duties to hospitals and convalescent centers, where they worked with the psychiatrists in the clinical examination and retraining of disabled soldiers and sailors.

Much of the technical research for the Army and Navy was undertaken by civilians working under the auspices of the National Research Council and later the Office of Scientific Research and Development, which has as its two branches the National Defense Research Committee and the Committee on Medical Research. Psychological research on sensory and perceptual functions, the design and testing of equipment and weapons, and the selection and training of military specialists was scattered through the many sections of these two committees. A committee on the military problems of vision was also formed. These researches for the most part were concerned with the topics considered in Chapters 2-13 of this book.

The Army's Division of Information and Education (once called the Special Services Division and later the Morale Services Division) has accomplished a great deal of important psychological work in assessing the needs and preferences of soldiers in respect of information, recreation and education, using special methods of interview designed to elicit frank replies. It has also experimented with educational programs, especially films. A film is prepared with certain objectives—for instance, the better understanding of an ally. The attitudes of the soldiers toward the ally are assessed in advance, the film is shown, and then the attitudes are reassessed a couple of weeks later. Thus the Army finds out whether the films are having the desired effect and how much effect.

In addition to that used in strictly military problems, there is a great deal of psychology which has been promoted in the United States in the Second World War by various government agencies. For the most part these activities have to do with the assessment of opinion in large social groups—the enemy abroad and the people at home. Polling studies at home were conducted by the Office of War Information and also by the Department of Agriculture. Other surveys of home opinion were conducted by the War Production Board, the Office of Price Administration, and the Bureau of Agricultural Economics. The Foreign Broadcast Intelligence Service concerned itself with the analysis and interpretation of foreign broadcasts picked up by monitoring stations. Determination of ways of giving out war information came particularly under the Office of War Information and the Office of the Coördinator of Inter-American Affairs; and the preparation and dissemination of propaganda directed toward our enemies came under the Office of Strategic Services. Psychologists and psychological techniques played important rôles in all of these undertakings.

The War Manpower Commission also deserves mention here because of its coöperation in the analysis of thousands of military jobs. Selection of men for special jobs cannot be made until the requirements of the jobs are accurately specified.

Lists of services and agencies make dull and uninteresting reading, and in the course of the war specific psychological activities often shifted from one service or agency to another. The preceding paragraphs give, however, some indication of the extent and diversity of psychological work in and for the armed forces and in the other agencies devoted to the prosecution of the war.

There is no sharp line dividing psychology from physiology, on the one hand, or from the social sciences on the other, and for that reason there is no way of saying just how much of the war effort is properly called psychological. The fact is, however, that psychologists and their skills and techniques were greatly in demand in the prosecution of the war, that there were not nearly enough trained psychologists to meet the demands, that psychology was nevertheless used extensively where it was most needed and in the manners indicated.

In January 1944 there were 986 professional psychologists in the armed services and 276 other professional psychologists in full-time employment in government war agencies. That makes 1,262 of the 4,500 men and women psychologists of all ages in the United States, but the men in the services included actually about two-thirds of all the professional male psychologists under thirty-nine years of age. If you add to these persons 900 men who received special training in personnel psychology and continued in some sort of psychological work, you have an over-all total of about 2,000 psychologists devoting full-time work to the war, in addition to the many older men who were giving part of their time to research and other war activities. In psychology, as in other fields, America did not fail to make use of its technical proficiency for the prosecution of the war.

There is at present no exact information about what other nations have done with psychological knowledge and technique in the Second World War. It is certain that the British have done a great deal. The Russians have furthered research on the problems of perception, observation and other psychological functions as they are important in warfare. The total picture for the allied nations and their enemies can be seen only much later. It is not wholly clear even for America yet.

THE PSYCHOLOGICAL POINT OF VIEW

Psychology is a point of view. It is a way of regarding man as having certain capacities and limitations, some of which are subject to change in certain limited and specified degrees. There is no part of psychology which could not theoretically be a part of physiology or physics or anthropology or sociology, but the fact is that workers in these other sciences do not have in such insistent manner the psychological point of view. What is sometimes called "military psychology" has resulted simply from bringing the psychological point of view to bear on military problems.

This point of view is in order wherever problems of human nature exist. When you know human limitations, you do not ask the impossible of men, but adapt requirements to what is possible. When you know human capacities, you know with what you have to work and you can utilize all the available human resources. When you know the causes of human behavior, you can often find the means of changing behavior by altering its causes. You can sometimes change a man's capacities by changing things in his situation, improving his night vision with vitamin A perhaps, or improving his morale by scotching rumors. You may change him by training, but not always. You have to know what he can learn and how fast, and also how in these respects he differs from the next man.

This point of view toward man's capacities is the psychologist's point of view. It would be a good thing, as we have noted before in this chapter, if everyone could have it. It would add greatly to his power in dealing with other men. Everyone who will study psychology can, however, gain the point of view to whatever extent his interest in the subject dictates, and the purpose of a text on military psychology is the promotion of this point of view among military men.

The possible applications of the psychological point of view are very numerous indeed. Again and again a psychologist discovers, when he becomes involved in some new endeavor where the human factor is important, that he has contributions to make. There is nothing mystical about his knowledge. Often it seems, after it is applied, nothing more than good sense. He has, however, the special advantage over others in that he knows the facts about human capacities, insofar as they are known, and he knows the special techniques that have been used in the past for the purposes of assessing human capacity or controlling human behavior. He finds, again and again, that these old techniques are applicable in new situations, and presently, as he applies them, he is likely to develop new techniques.

In other words, the psychologist is a human engineer. He seeks to do with human material what other engineers do with other material. It is not likely that any great war can ever again be fought without dependence on the engineer—the mechanical engineers, the electrical engineers, the chemical engineers and the human engineers. The rôle of psychology in the Second World War would not be diminished in another great war. At least the leaders would have to have the psychological point of view, and it would be better if all the soldiers and sailors could have it, too.

REFERENCES

For the history of the use of psychology in the First World War:

1. War Department, Adjutant General's Office. *The personnel system of the United States Army.* Washington: Government Printing Office, 1919. Vol. 1, *History of the personnel system.* Pp. 713. Vol. 2, *The personnel manual.* Pp. 342.
2. R. M. Yerkes. "Report of the Psychological Committee of the National Research Council." *Psychological Review,* 1919. Vol. 26. Pp. 83-149.
3. R. M. Yerkes, ed. "Psychological examining in the United States Army." *Memoirs National Academy of Sciences,* 1921. Vol. 15. Pp. 890.
4. C. S. Yoakum and R. M. Yerkes. *Army mental tests.* New York: Henry Holt, 1920. Pp. 303.

On the Germans' use of psychology in war:

5. ~~S.~~ L. Farago. *German psychological warfare.* Second edition. New York: Putnam's, 1941. Pp. 133.

For early reports of the use of psychology in the Second World War:

6. S. H. Britt and D. G. Marquis, eds. "Psychology and the war." *Psychological Bulletin,* 1942. Vol. 39. Pp. 255-260, 306-313, 370-410, 525-528, 617-670, 759-772, 865-881. 1943. Vol. 40. Pp. 37-68, 125-143, 203-221, 269-304, 355-380, 427-453, 497-535, 589-605, 685-713, 757-790. 1944. Vol. 41. Pp. 45-63, 103-126, 167-186, 237-260, 307-331, 385-399, 457-489, 502-579, 653-669, 795-802.

This section includes over a hundred articles by a great variety of authors, summarizing psychological activities in the war and giving bibliography to other articles. Especial attention may be directed to:

"Personnel research in the army." *Psychological Bulletin,* 1943. Vol. 40. Pp. 129-135, 205-211, 271-278, 357-371, 429-435, 499-508.
"Aviation research in the army." *Psychological Bulletin,* 1944. Vol. 41. Pp. 103-114, 237-245, 307-321, 385-394.
"Social psychologists in national war agencies." By D. G. Marquis. *Psychological Bulletin,* 1944. Vol. 41. Pp. 115-126.

On social psychology see also:

7. G. W. Allport and H. R. Veltfort. "Social psychology and the civilian war effort." *Journal of Social Psychology,* 1943. Vol. 18. Pp. 165-233.
8. G. R. Schmeidler and G. W. Allport. "Social psychology and the civilian war effort: May 1943-May 1944." *Journal of Social Psychology,* 1944. Vol. 20. Pp. 145-180.

Chapter 2

The Eye As a Military Instrument

The human eye is one of the most important military instruments that the armed forces possess. An army has to see to fight and see well to fight well. A navy depends so much on vision that men with poor vision are not even accepted for regular service in it.

A good eye is an extraordinarily sensitive instrument for discriminating tiny amounts of light and tiny objects. It is more sensitive to light than are most physical instruments. As to size, it can perceive a thin wire whose width fills less than a second of the arc of vision, is only as wide as 1/500,000th of the field of vision. Not all eyes are so good, however, and old eyes are much poorer than young. Since the ability to see faint objects and small objects is of inestimable military importance, youth has this as well as so many other advantages in fighting.

Under the right conditions men can see surprisingly well in almost complete darkness, but the conditions must be right. Night fighters and lookouts must observe these conditions. Nor are all men equally keen in night vision; the worst must be rejected for the jobs that require visual perception at night.

The eye also is needed in perceiving colors and this capacity to see color helps in the seeing of objects. Signal flags are distinguished from their background in part by their color, and naval signal flags are also distinguished from one another by color. Some eyes are, however, color blind, and others are color weak. Such eyes will not do a good job in interpreting signals or may fail completely. Color differences also aid to some extent in the distinction of objects from their surroundings, and the obliteration of such differences aids camouflage. A color blind man is therefore not a good reconnaissance observer. He would be likely to miss seeing even a red object lying on green grass.

Distance can be perceived by vision—to some extent with one eye, better with two. Men differ also in their accuracy in this regard. The ability to perceive distances accurately is important in estimating ranges for small-arms firing.

Men also differ in the degree to which their vision is disturbed by glare, in the degree to which their eyes fatigue. There are also rules for lessening visual fatigue. All such matters have military importance.

It is therefore highly desirable for soldiers and sailors to know about the eye, how it works, what it can do, how it can be fooled, and also about how men's eyes differ from one another.

THE EYE AS A CAMERA

The eye is like a camera (see Fig. 1). It is a tough-walled, spherical ball which is kept from collapsing by being filled with a gelatin-like substance between the lens and the retina and a watery fluid in front between the lens and the cornea. Fig. 1 shows the cornea, a transparent window at the front of the eyeball, with the lens, suspended by a ring-shaped muscle, behind it. In front of the lens is the iris diaphragm with an adjustable hole in the middle of it. The hole is the pupil. The back of the eye is covered with a sensitive nerve filament, the retina.

Light passes through the cornea, the pupil, and the lens, and is focused by the lens on the retina. The lens turns the image on the retina upside down, just as a lens does in a camera. If you are looking at a tree, then the image of the tree at the back of the eye is upside down. Nevertheless it does not matter that the image on the retina is upside down because seeing is not accomplished by the retina alone, but involves the brain which receives nerve signals from the retina, and which has learned that signals from the top of the retina carry information about objects near the ground, and those from the bottom of the retina information about objects near the sky.

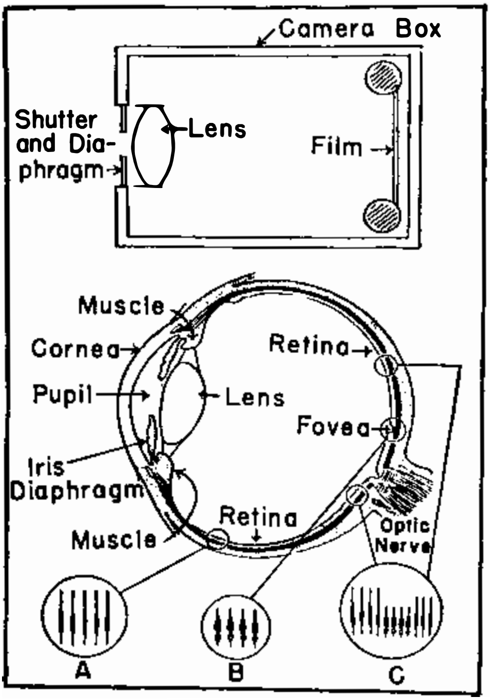

Fig. 1. THE EYE AND ITS SIMILARITY TO A CAMERA
A: rods only, at outer part of retina. *B:* cones only, in fovea. *C:* rods and cones, in intermediate parts.

The pupil of the eye automatically controls the amount of light entering the eye. When the illumination is bright, the pupil contracts to to keep down the amount of light that falls on the retina. In the dark the pupil gets large. The diaphragm of a camera works the same way and for the same purpose. Too much light fogs the plate in the camera and too much light blurs the image on the retina.

The lens is not, however, quite like a camera's lens, because it is elastic. The rigid lens of a camera has to be moved back and forth to change the focus. The lens of the eye changes its shape. When the muscles attached to it are relaxed, the eye is at rest, being focused on objects far away. When the muscles contract they allow the lens to bulge more, changing the focus to near fixation. That is why it is more of a strain to keep looking at near objects than at far. The lens muscles have to keep contracted when one is reading a book.

The retina is packed full with two kinds of tiny nerve endings, *cones* and *rods*. The cones work in daylight and allow a man to see both colors and brightnesses. The rods work at night and allow him to see only blacks, grays and whites—no hues. See Fig. 1 which shows how the cones and rods look at three different parts of the retina.

The cones, of which there are about 7,000,000 in a retina, are packed closest together in a spot in the very center of the eye, a spot called the *fovea.* This is the place of clearest vision. To look at an object is to move the eye so that the image of the object falls on the fovea, where it can be seen most clearly. The cones lie, however, so close together in the fovea that they leave no room for rods. Hence on a dark moonless night, in a blackout when you can only just barely see objects at all, when only the rods are working, you cannot see an object by looking directly at it. You have to look alongside of it.

Light falling on the retina creates a chemical change in the nerve-endings. The resulting excitation then travels along the fibers of the optic nerve at a rate of about 140 miles an hour. The nerve impulse consists of series of tiny electrochemical "explosions" which pass, one after another, along the nerve fiber. The brighter the light, the more quickly do these "explosions" follow one another.

In the brain many different connections are made. The principal visual center lies in the cerebral cortex in the back of the head at the base of the skull, the occipital region. The cerebral cortex in man is the largest part of the brain, the part that is essential for all complex intellectual activities and, as it happens, for vision.

Fig. 2 shows how the connections to the cortex are made from the retinas of the two eyes. Nerve fibers from the left half of each retina go to the left half of the visual center, crossing over for the right eye from one side to the other at the optic chiasm, and not crossing for the left eye. Similarly the fibers from the right halves of the two retinas go to the right half of the visual cortex. Since the rays of light from an object

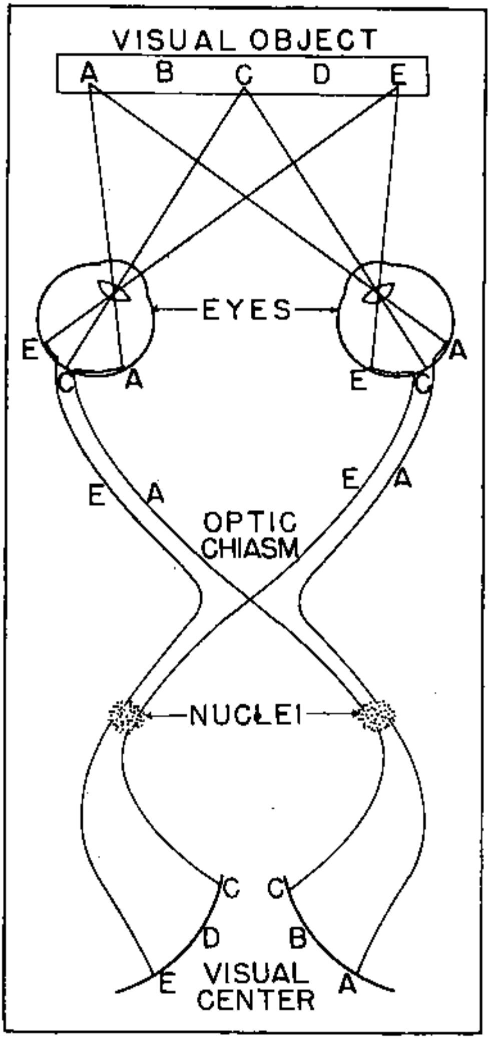

Fig. 2. Projection of Nerve Fibers from the Two Retinas upon the Visual Center in the Cerebral Cortex of the Brain.

The left half of the field of vision is projected optically upon the right halves of the two retinas, and these right halves are both projected neurally upon the right half of the visual center. And conversely. The course of events from the visual object to the brain is *A-AA-AA-A* and similarly for *B, C, D,* and *E*. In the figure the visual object is shown too near the eyes (about 1½ inches distant), for the eyes could not converge enough to perceive so near an object clearly, as a single object. For this reason the corresponding points on the two retinas differ too much in their positions.

cross in the eye at the lens, in the manner that they cross in a camera, it follows that the left half of a large object is seen with the right half of the brain, and conversely. In Fig. 2 the course of events runs from point *A* on the perceived object to the points *AA* on the two retinas, then via the nerve fibers *AA* to a nucleus, and then to the point *A* in the visual cortex where the object is projected on the visual center.

Injury to the visual cortex may cause blindness. A small injury results in a spot of blindness, whose shape and size depend on the shape and size of the injury. Complete destruction of the visual cortex on one side makes a man blind in the field of vision on the opposite side. He becomes completely blind if the visual area in the cortex on both sides is destroyed. From Fig. 2 it is possible to discover how an injury to one or both retinas, to different parts of the nerve paths or of the visual center, would result in different patterns of blindness.

The eye can see very small objects and details. *Visual acuity* is its accuracy for detailed vision.

The optician measures acuity with a chart of test types. The chart is placed 20 feet away from the testee under a standard illumination. A normal eye ought at least to read block type in which the width of the lines of the letters occupies an angle of one minute of arc. Such acuity is called 20/20 vision. At 20 feet a man can see what he ought to be just able to see at 20 feet. That is correct terminology for both the Army and the Navy, but the two services measure visual acuity in slightly different ways. In the Army the testee stays put at 20 feet from the chart. If at 20 feet the best he can do is to read large letters twice as tall as the letters normal for 20 feet, letters which a normal eye could read at 40 feet, his vision is called 20/40. It is "half" normal. In the Navy the testee, if he fails for the 20-foot letters, walks up toward the chart until he can read them. If he has to advance to 10 feet, his vision is 10/20. It too is "half" normal. Both services use similar systems for indicating acuity that is better than normal. For instance, 20/10 means that the testee can read at 20 feet small letters which would have to be within 10 feet for the normal eye to read. That is acuity which is "twice" normal. See Table I for sets of representative measures. The Navy, in which visual acuity is very important for observation at sea, required 18/20 acuity at the beginning of the Second World War for those men who were to serve in general duty, but the standards change and much poorer vision is satisfactory for many special naval duties.

A better test of acuity is the Landolt ring shown in Fig. 3. This ring has a break in it and can be rotated to different positions. The testee is

TABLE I

MEASURES OF VISUAL ACUITY

The fractions for the Army and Navy are always equivalent for the same degree of acuity, but the actual numerators and denominators differ. Normal = 20/20 = 1.

Army	*Navy*	*Visual acuity*
20/40	10/20	½ normal
20/30	13/20	⅔ normal
20/20	20/20	normal
20/15	20/15	1⅓ normal
20/10	20/10	Twice normal

required to say where the break is, whether at the top or the right or in-between or where. If he succeeds with one size of ring, he is tried out with a smaller one, and succeeding with it, with a still smaller one, until he fails. The ring avoids the differences of legibility of the different letters and the possibility of doing some guessing when the letters are put together into words and sentences.

Fig. 3. LANDOLT RING FOR TESTING VISUAL ACUITY
Rings of different sizes, rotated into different positions, are shown the testee who must indicate correctly the position of the break in the ring. The tester finds out what size of ring is too small to have its break correctly perceived.

Acuity of vision is greatest in the fovea of the retina where the cones are packed closely together, and it is best under good illumination when all the cones—the less sensitive as well as the more sensitive ones—are brought into use. One might think, therefore, that a space that is less than the separation between two adjacent cones could not be perceived. That, however, is not the case, for the cones are interconnected by nerve-fibers and the final discrimination takes place in the visual center in the brain where patterns of excitation are formed. Very small differences in certain patterns can be perceived.

For instance, a straight line that is broken in the middle with one half set off just a little to one side, can be perceived as not continuous where the displacement of the one half from the other is as little as 5 seconds of arc, about 1/700th of a degree. Five seconds of arc corresponds to an image on the retina about a third of a micron (1 micron = 0.001 mm.) in size. At their closest the cones in the fovea are about 2 ½ microns apart. Thus one is really in this case observing on the retina a distance that is only about ⅛ of the distance between cones. That is possible because the nerve mechanisms in the eye and the brain are well adapted to perceiving straight lines, and average out, as it were, into two straight lines the spotty excitations that come from the cones.

This perception, by which the brain manages to be more acute than the retina although using the data furnished it by the retina, is utilized in accurate measuring instruments which employ micrometer or vernier scales. Such scales depend on the ability to see which of several adjacent broken lines forms most nearly a continuous line.

As a matter of fact, a man can perceive tiny objects which occupy less than 5 seconds of arc when the contrast between the brightness of the object and its background is properly chosen. Under good conditions of illumination one can see a dark wire against a light background when the width of the wire fills only half a second of arc. That happens because the image of the wire on the retina is much wider than half a second of arc (1/30 of a micron), due to the fact that the light from it is scattered by the air and by the imperfections of the transparent media in the eye. The interesting fact here is that a rather diffuse retinal image of a band is changed by the brain into the narrow line of the wire.

It is this fact—that the brain tends to accentuate in perception long continuous lines—which makes roads, railways, and the smooth continuous contours of objects stand out in observation of the ground from the air. You can see a railroad from the air when a shed or some other object with irregular outlines but several times the width of the railroad track would remain invisible. Camoufleurs know this fact and try always to break up continuous lines.

Acuity of vision depends primarily on brightness contrast. Black on white stands out best, as on the printed page. White on black is not quite so good. Color contrast does not help much in the perception of separate objects unless there is also brightness contrast. A dark red print on a light yellow ground shows up well, but red print on a green ground of similar brightness becomes almost invisible at very little distance, although red and green are contrasting hues. A state once tried that red-green color combination for its automobile license plates—tried it once and never again. Of course, difference in hue does help somewhat in the perception of objects. A color-blind man is not a good observer for air reconnaissance. But hue is secondary. Acuity and spatial discrimination depend primarily on difference of brightness.

Visual acuity also depends upon total illumination. When the printed page becomes illegible in twilight, you turn on the light. The cones are not equally sensitive and greater illumination brings more cones into use, thus making possible better spatial differentiation of the image on the retina. The change in acuity with increasing illumination is slow at first, then rapid, and then, when almost all the cones are working, slow again.

If the illumination is too brilliant, acuity gets worse. That is partly because the contrast is reduced. A black object begins to reflect so much light that it affects the cones almost as much as does the white background. The effect is also due to glare, the scattering of light in the eye due to the eye's imperfections. Brilliant illumination on a shiny page or direct sunlight on the surface of water may make small dark objects disappear entirely.

In daytime an airplane with its underside in shadow shows up as dark against a light sky, nor is there any white paint bright enough to make the shaded underside of the plane as bright as the sky. There is simply not enough light on the underside of the plane to make it match the sky, no matter what proportion of the light that is there is reflected by it. But a plane looked at with the sun in the observer's eyes may be invisible because of glare, or more often because the observer has to turn his eyes away.

At night a plane painted black and caught in the beam of a searchlight is visible because even flat black paint reflects more light than the night sky gives.

It is best to make observations of a surface that has relief on it at times when the light is coming from one side, because such lighting introduces contrasting shadows and makes the raised objects stand out from the background (see Fig. 31, p. 87). Air reconnaissance with a rising or setting sun may reveal raised objects that would never have been visible at midday.

Everyone knows that acuity is best in direct vision, in the fovea where the cones are closest together, and that it gets poorer toward the outlying regions of the retina where the cones are distributed more sparsely. That is why you automatically look right at an object in order to see it best—in cone vision in daylight. At night, when the rods are the principle organs of vision, you have to look alongside an object, for there are no rods in the fovea, and outdoors on a moonless night acuity is zero in the exact center of the visual field.

Acuity also gets worse with advancing age, as optical defects increase in the eye and as sharp focusing of the lens gets more difficult. In certain researches by the Navy on the visual acuity of young people with vision good enough to pass the Navy's requirements for lookout duty, it was possible to make measurements of acuity as dependent upon the size and illumination of objects, but older people—some of them older Naval officers—would sit with the twenty-year-olds, hear them make their judgments as to what they saw and where they saw it, and never be able to see anything at all. Young eyes are needed by scouts, lookouts, reconnaissance observers and patrols, and older officers who have difficult observations to make had better take a pair of younger eyes along with them.

Perception of detail is favored by all the conditions that favor acuity —youth, illumination, contrast, continuous lines or contours.

GLARE

Glare occurs because light from a brilliant source is scattered all over the retina, thus obscuring on the retina the outlines of the images of objects. This scattering is produced both by conditions in the environment, such as fog or haze, dirt on windshields or glasses, and also by conditions within the eye itself. As the light rays pass through the eyes' transparent media, they strike small imperfections and opaque particles and are scattered over the retina. Eyes differ in their susceptibility to glare. Some men can drive at night against the headlights of approaching cars much better than others can.

The best way to avoid glare is to keep the bright light which produces the glare out of your eyes. When there is a choice, it is best to observe with the sun at your back, and to come at the enemy so that the sun's glare will be in his eyes and not in your own. If that is not possible, the observer can cover the sun with a shield.

If the objects to be observed can be illuminated by light brighter than the light that causes the glare, they may become visible. Sometimes this defense against glare is possible, but it is not a praticable way to settle the problem of headlight glare with automobiles. If your own lights are brighter than the lights of the approaching driver, you may be able to see clearly, but the other man will not. Your safety depends as much on his clear vision as on your own.

There are two ways in which Polaroid glasses can be used to reduce glare. Polaroid is a substance that polarizes light waves, screens out all the light except waves which vibrate in one particular direction. Ordinary light has its waves vibrating every which way. If it is passed through Polaroid it vibrates in only one plane, and, if the Polaroid glass is turned through an angle, the plane of vibration for the light is rotated through the same angle. Only the waves that vibrate in the plane determined by the Polaroid can get through it.

Light reflected from shiny surfaces tends to become polarized—light from the surface of water, from metal or glass, from smooth roadways. For the most part such surfaces are horizontal, and an observer can wear Polaroid glasses that will cut out the polarized light from horizontal surfaces.

Another device, which was about to be put into commercial use when the Second World War began, is designed to reduce headlight glare. To make this device work the headlights of all automobiles must have in them Polaroid films so arranged that the light is polarized in a diagonal plane, say from lower-left to upper-right as you sit behind the light looking ahead. Then the driver must wear glasses of Polaroid, or else look through a Polaroid screen on his windshield, and the glasses or screen must have the same plane of polarization. The driver is then able to see objects with the light that comes from his own head lights. But the light from the headlights of an approaching car, which comes from an opposite direction, is polarized in the plane from upper-left to lower-right as seen by the man facing the light head-on. Thus its light will not pass through the Polaroid glasses or screen of the driver facing it. Each driver can then see objects perfectly with the light from his own headlights, but light from the approaching car is cut entirely out of his vision. The approaching headlights actually look dark.

VISUAL FATIGUE

The eyes are hardy organs. Ordinarily they go on, day after day, seeing, changing focus, reading, moving back and forth with the most precise adjustments, all without any appreciable fatigue at all. Reading good print in a good light does not tire them. In a recent experiment, subjects were required to read clear text in good illumination continuously for six hours, while all their eye-movements were recorded electrically. There was no impairment of the perceptual function. It looked almost as if the eyes could not be tired out, although some of the readers complained that their eyes felt fatigued.

Certainly eyes can be tired if they are continuously called upon to perform unusual tasks or strained to perceive at or just beyond their limits of acuity. These are the conditions that tire the eyes.

(1) Change of focus back and forth for a long period produces fatigue—occasionally in vision such as the pilot has to use when he shifts constantly between observation of the ground, the sky, and his instrument board. Presumably this fatigue comes from the muscle that controls the focus of the lens, although it might come also from the muscle that changes the size of the pupil, since the pupil gets smaller for far fixation.

(2) Work in very uneven illumination tires the eyes. To look back and forth from a well illuminated book to a dark room, or from a bright instrument board to the dark outside of a plane, may be fatiguing. People differ, however, in this regard. Some need the whole room well illuminated; others get along well with a good light only on their work. Since the pupil changes size with illumination, this fatigue probably arises from its muscle.

(3) Looking at unclear objects, objects that are obscure because they are too small (fine print) or because they are blurred by being too near the eyes or too far away, or actually blurred in their own outlines,

those conditions are all fatiguing. They tire the eyes because there the observer has always to be making an effort to focus a little more sharply than he can easily do or even more clearly than he can do at all. A special effort of the lens muscles, near the limit of their capacity, is required.

(4) Glare produces fatigue because it obscures objects and makes special efforts of focusing necessary, and because it occurs when there is uneven illumination.

(5) It is doubtful that the muscles outside the eyeballs, the muscles that move the eyes, very often cause fatigue. Undoubtedly they would if it were necessary ever to hold the eyes for a long time in an extreme position—up or down or to one side. That, however, seldom happens because it is nearly always easy to move the head and thus keep the eyes within the range through which they can move easily. Still they must have become fatigued when you begin to see double.

The symptoms of eye-fatigue are blurring of vision, and, sometimes, seeing double. The first may come from the fatigue of the lens muscle, the second from the external muscles which control the convergence of the eyes in such a way as to keep vision single. In extreme fatigue headaches arise, and sometimes the eyes get red and the eyelids sore.

It is not always safe to trust the statements of men about the degree with which they are experiencing fatigue of the eyes. If a man gets a prejudice against a certain kind of duty that is constantly required of him—say, the reading of print which is not readily legible—he will complain about fatigue when there is no evidence that his perceptual performance is in any way impaired. He might even complain himself into a headache because he has to read dim carbon copies of long reports. Experiments on legibility, for instance, do not confirm people's belief about what kinds of printing are really the most legible.

The cure for visual fatigue is rest, and rest is secured in the dark. The eyes can be shut or bandaged over, or the person can be put in the dark. If there is nothing to see, the eyes rest. Otherwise they will continue to perform the adjustments of seeing involuntarily.

In extreme cases hot or cold compresses may be put on the eyes and eye-washes may be used to moisten the eyeballs.

Here are the practical rules for increasing comfort in the use of the eyes:

(1) *Avoid looking at small objects.* It is not always possible to follow this rule when reconnaissance requires the constant use of the maxi-

mal capacity of the eyes, but sometimes one can choose the size of print, or change its size with a reading glass.

(2) *Use good illumination,* not enough to produce glare, not so little as to reduce acuity. The best illumination is not the same for everyone, but a man can usually tell what is best for himself. Not all the printed rules are correct. Some suggest the use of more light than is necessary or even desirable.

(3) *Do not look back and forth between dark and light objects.* It may be that the men who work well without fatigue in uneven illumination are the ones who seldom look away from their work at the surrounding dark.

(4) *Do not look back and forth between far and near objects too frequently.* Look off into the distance when there is nothing to do, for in that fixation the lens muscle is relaxed.

(5) In reconnaissance, *learn to scan,* to look regularly from one part of the visual field to another. *Limit your attention to one part of the field at a time,* but *do not limit it too narrowly.* If you limit the attention too much you may miss the larger significances, the big objects and the related objects. If you spread it too wide, you miss the details within it. And in scanning, you should move the eyes slowly, allowing time for the complete perceptions to form themselves in each position.

(6) *Blink often.* Blinking lubricates the eyeball and also gives fixation a fresh start—prevents the strain of staring. When vision gets blurred, either from too dry an eyeball or from a strained fixation, one blinks and starts over with clearer vision. Why blinking helps to a renewed good fixation is not clear, but it does. Mostly blinking occurs automatically, but it is also well to know the rule and, when vision begins to fail, to blink voluntarily occasionally but not too often.

(7) *Avoid general fatigue.* The whole body gets tired together. Waste products from other muscles may affect the eye-muscles.

(8) *Avoid headaches, indigestion, nausea, dizziness and intoxication.* Eye strain may cause nausea, but indigestion may cause blurred vision and thus eye strain. These physiological states are all tied up together, and the state of the eyes is sometimes an effect of them, not a cause. Alcohol affects the visual nerve centers.

(9) *Avoid emotion.* The effects of emotion are not fatigue, but it is certain that strong emotion blurs vision, reduces acuity. In "blind rage" the angry man actually cannot see so well, although most of this phenomenon consists in the blunting of judgment by anger.

The perceived visual world is tridimensional. Objects in it are seen as solid. Space has depth as well as height and breadth. We see directly the distances between far and near. Since a retinal image projected on the brain is only two-dimensional, the brain has to recreate solid space from various incidental data—clues—that lie in these images and in the movements of the eyes.

The most effective clues for the perception of depth and distance are binocular; they depend upon the use of two eyes. The third dimension can, however, be perceived—though less vividly—with a single eye. Let us consider these monocular clues first.

There are seven important monocular clues to the perception of distance and depth. In calling these items *clues,* we do not mean that an observer seizes upon them, notes them, and then consciously reasons out from them that one object is farther away than another, that the shaded thing down on the ground is a ridge and not a ravine. What happens is that these "clues" are utilized by the nervous system instantaneously to form the representation in the brain of solid space and of nearness and farness. The nervous system works *as if* it were making an inference from available data, were playing the detective, but it works instantaneously, automatically, and unconsciously to give the immediate perception of solidity and distance.

(1) When you know the *size* of an object, then the size of its image on the retina is sometimes a clue to its distance. If you see a man a quarter of a mile away down a straight stretch of road, he looks small and therefore fairly far away. As he approaches, he seems to get larger, and so nearer. The size of his image on your retina tells your brain how far away he is.

This rule holds only for large changes in the size of the retinal image. One does not notice small changes of familiar objects at all. A man 40 feet away looks about as large as a man 20 feet away, never only half as tall—as on the retina. In fact, for distances up to 200 feet and perhaps greater, the brain, having other clues to the distance, corrects the perception, making the distant man look just as large as the near man in spite of the small size of his retinal image. In such cases, instead of the retinal size of the object giving the distance, the known distance gives the correct size of the object.

All familiar objects of definite size—horses, automobiles, railroad cars—tend to look the same size at different distances when the difference in distance is not great. At great distances the retinal image is, however, too small to be corrected by the brain, and the object looks little or tiny.

Familiar objects that come in different sizes, like airplanes, may provide misleading clues. A small training plane not far off may look like a big bomber at a great distance. Unfamiliar objects which have no definitely known size are the most misleading. A stranger, seeing the Washington Monument for the first time, may think it only a short walk away. The size of its retinal image cannot be a clue to distance because he is not familiar with the Monument.

(2) *Perspective* is a second clue to the perception of distance and solidity. Railroad tracks seem to get closer together in the distance, for the distance is so great that the brain does not correct for the tapering size of the image.

A book, lying on the table, seems to recede from the observer because the retinal image of its far end is shorter than the image of its near end. In this case the brain corrects for the images, since the book does not seem to taper although the image of it does taper. The book looks rectangular, and a book with its far end so much larger than its near end that the retinal image of it would be rectangular would not *look* rectangular. Nevertheless the retinal sizes are a clue for the brain and help to make the book look solid, extending away from the observer in the dimension of depth.

(3) Hazy objects look farther away. This clue is called *aerial perspective.* The near hills are clear in outline and show a certain variety of color. The far hills are blurred by haze, have less color, tend to look blue. In a dry climate, where there is little haze, men may misjudge distance, undertake to walk to a hill that is really twenty miles away but looks much nearer.

(4) Near objects often cover up part of the objects that are farther away. *Interposition* thus becomes a clue to the perception of distance. If you can see all of the front of a barn except the space on it that is obscured by a tree, then the tree must be nearer than the barn.

(5) *Relative movement* is another clue, one which cannot be used in paintings, but which appears in moving pictures. If you are looking at a tree and a pole and cannot tell which is nearer, you can often decide by moving your head or by taking a few steps to one side. The more distant object tends to move with your head, the nearer object goes the other way. If you fix your eyes on a distant object on one side of you and then walk along, the object at which you are gazing seems to

stand still. The far objects move with you, the farther away the faster. The near objects go backwards, the nearer, the faster.

Similarly, if you are riding in a train and looking at a tree a mile away, the more distant hills move steadily ahead, and the rising moon behind them travels along still more rapidly. A fence between you and the tree moves backwards, and the telegraph poles close to the track snap backwards.

Often in the movies great depth appears when the camera has been moved while the picture was photographed. In this case all the objects in the picture are moving at once in relation to each other, and only objects at the same distance keep the same relation to each other. The brain solves that problem by placing objects that do not change their relations at the same distance. Such a picture would be chaotic if it were not perceived as lying in tridimensional space.

This clue is of great importance in maneuvering a ship or in landing a plane.

(6) *Shadows* furnish another clue for the perception of solidity and depth. If the shadow is on the side of the sun, you are seeing a hollow, perhaps a shellhole. If it is on the side away from the sun, it is a hillock or a camouflaged gun. If there is no shadow and the sun is not directly overhead, then you are looking at something flat on the ground.

Fig. 4 is a photograph of the old monitor, *Lehigh,* after it had been used for target practice. Light and shade provide the clue to the depth of the dents in the turret, because one naturally takes the light as streaming down from above. If the page is turned upside down, the dents become bulges, and the rivet heads dents, provided the light is still seen as coming from above. It is possible, however, to turn the dents into bulges without inverting the page, if one can but think of the light as streaming up from below, as if the turret were illuminated by footlights.

(7) *Focusing* the eye's lens also provides an effective clue to distance for objects not more than six feet away, a clue that seems, however, to be less important than the others. One can measure range with a camera, by seeing how the focus must be set to give a clear image on the ground glass. Similarly the adjustment of the lens of the eye indicates something about the distance of the object on which it is focusing.

It is possible in this way for a man, looking with but one eye through a tube at the edge of a card to judge with fair accuracy the distance of the card. Size is not a clue here, because the edge, being an edge, is merely a line with no breadth. Nor do the other clues enter in. When

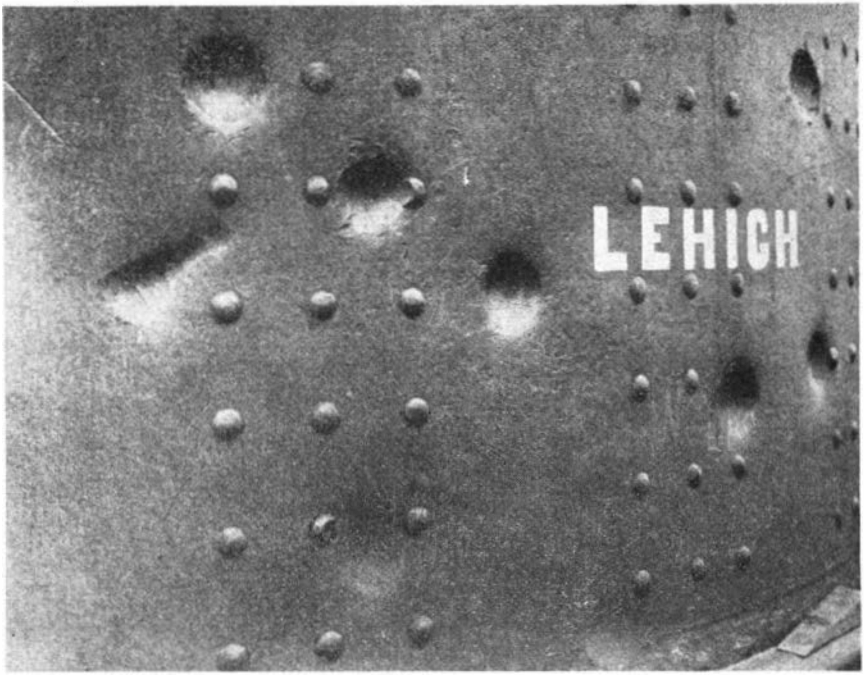

Fig. 4. DEPTH AS DETERMINED BY LIGHT AND SHADE

The dents in the monitor's turret appear as dents if the light seems to come from above, and turn into bulges if the page is turned upside down, provided the light still seems to come from above. If the light can be imagined as streaming up from below, then the dents turn into bulges without inverting the page. (Reprinted by permission of C. H. Stoelting Company, Chicago.)

some of the other clues are present, he becomes, however, much more accurate.

The man with only one eye sees a great deal of depth, although not so much as the two-eyed man. He sees all the depth that can be got into a picture. When the parts of the scene or picture move in relation to each other, he may see depth very well indeed. An airplane pilot, who has lost one eye, finds himself at first at a great disadvantage in landing his plane, but he can learn again to land it, learn to use the clues from monocular vision.

It is fortunate that the clues from focusing the lens are not very important in the perception of distance, because focusing becomes more and more difficult as men get older and the lens of the eye becomes less elastic. This fact is illustrated by the tendency of older men to become farsighted, by their inability to get a clear focus of near objects. Near fixation requires the lens muscle to contract so as to relax its pull on the lens and thus to allow the lens to become more spherical under its own elasticity—provided the lens is still elastic enough to work in this fashion. You can pretty nearly determine a man's age by measuring the shortest distance at which he can read print clearly and by then applying the following table:

Age	*Distance*
10	Under 3 inches
20	Under 4 inches
30	Under 5½ inches
40	Under 8½ inches
50	Under 15¼ inches
60	Over 39 inches

The greatest change occurs between 40 and 50, the age at which so many people begin to wear glasses.

TRIDIMENSIONAL VISION WITH TWO EYES

Binocular tridimensional vision is much more precise than monocular. There are two binocular clues to the perception of depth and distance. One is *convergence:* the two eyes converge differently as they fixate near and far objects. The other is *binocular parallax:* the two eyes, viewing objects from different positions, see different images of the scene.

(1) **Convergence.** When the two eyes look at a distant object the lines of their vision are parallel. For a nearer object the lines converge: the nearer the object, the greater the convergence of the eyes. The learned Frenchman, Descartes, as long ago as 1637, said that the eyes thus "feel out" the distance of an object by their degree of convergence, as a blind man with a staff in each hand might feel out the distance of an object by touching it with both staffs, and then noting the angle between the staffs.

Convergence does not furnish effective clues to the distance of a perceived object when the object is more than 50 to 65 feet away, that is to say, when the angle between the two lines of vision is less than a quarter or a fifth of a degree. Accommodation of the lens of the eye —the clue from focusing—works only up to about six feet and is much less effective than convergence. At a distance of a few feet the discrimination of distance would be about one-quarter as accurate with one eye as with two provided only the clues from accommodation and convergence were available. On the other hand, the clues from stereoscopic vision (see below) may ideally be effective at distances greater than a mile.

The effect of these clues is easily demonstrated. Walk toward some object that has a great deal of depth to it—a gun visible under a camouflage net. At 200 feet the whole setup has a great deal of depth, owing to the monocular clues and to the stereoscopic effect. At distances less than 60 feet—at 20 feet, say—it has acquired a great deal more depth because the clues of convergence are working. Now shut one eye, eliminating the effect of convergence and the stereoscopic effect, and the object flattens out, becomes more like a picture without the vivid depth dimension. Get quite close, keeping one eye shut, and the object again gains some depth because of the clues from focusing. Then open the other eye and depth is restored to the perception in its full amount because convergence and stereoscopic vision are working again.

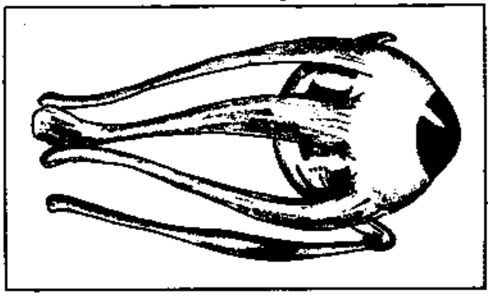

Fig. 5. Eye and Its Six Muscles (Adapted from *Life* (1939), vol. 7, no. 25, p. 29.)

(2) **Stereoscopic Vision.** The two eyes, being about 2 ½ inches apart, get somewhat different views of the same object. The right eye sees a little bit around the right corner of the object and the left eye a little around the left corner. See Fig. 6, where the right eye is shown as viewing some of the right side of a cube and none of the left side, and conversely for the left eye. This difference of view is known as *binocular parallax,* and it results in *disparity* of the images on the two retinas. The right retina receives image *C* (Fig. 6), the left eye image *B.*

Similarly Fig. 10 (p. 45) shows the retinal disparities for the perception of a hollow truncated pyramid when seen from the outside (convex) or the inside (concave).

Nevertheless, in all such circumstances we see a single object. We do not perceive a confused plane pattern, such as would be formed by superposing image *B* upon image *C* in Fig. 6, or by superposing the right and left images in Fig. 10. The brain restructures the double image into a single perception of solidity. Some psychologists think that the brain actually forms in these cases a tridimensional pattern of excitation out of the clues which retinal disparity provides. However our brains do it, we do not see, in ordinary binocular vision, a doubling of contours. We see single objects with single clearly defined outlines, and we see the objects as solid. When that fact was discovered a hundred years ago, it constituted an astonishing psychological fact. It is still astonishing, for no one knows just how the brain does its job of getting solidity out of retinal disparity, out of two slightly different images on the retinas at the same time.

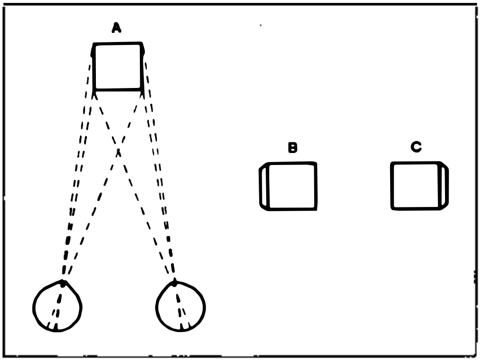

Fig. 6. BINOCULAR PARALLAX AND RETINAL DISPARITY

A shows how binocular parallax gives to each eye a different image of a cube. *B* and *C* show what the images in the two eyes would be like.

This reconstitution of solidity out of retinal disparity is called *stereoscopic* vision, and the fact of its occurrence can readily be demonstrated by the *stereoscope.* If the patterns *B* and *C* in Fig. 6 (or the left and right figures in Fig. 10) are drawn separately on a card, and the card is viewed in a simple instrument with lenses—a stereoscope—in such a way that one drawing is seen only by the left eye and the other only by the right eye, and the drawings are spaced so that the two images fall on corresponding portions of the two retinas, then you perceive a solid object—a cube or a pyramid. At first there may be some confusion in so simple a perception, but in a few moments the perception becomes solid and you can even see the glassy transparent surfaces that appear to form the sides of the object. Stereoscopic vision is much easier, more immediate and quite inescapable when the images are filled in with details, as they are on two photographs. If you want to show the world photographically, just as it looks to the two eyes of a man who stands where the camera is, then you must take two pictures from two positions, about 2 ½ inches apart—since 2 ½ inches is the distance between the eyes—and view these pictures through a stereoscope. That gives you the perception of a solid world with depth in it.

Physicians can arrange for stereoscopic X-ray photographs, so that, using a stereoscope, they can see a bullet lying within a man's body in three-dimensional relation to his bones and any of his internal organs that show. By the use of polarized light and Polaroid glasses for every spectator, movies can be made stereoscopic. The two views are projected on the screen on top of each other, with the light for one view polarized horizontally and for the other polarized vertically. Then the spectator puts on Polaroid glasses, adjusted so that each eye sees only the picture intended for it. Without the glasses a man sees only confusion. With them he sees solid depth. He may see the trees of a wood extending far in back of the screen, or, if the two pictures on the screen are so adjusted as to make his eyes converge on a point between him and the screen, he sees the objects out in space on top of the heads of the spectators in front of him. It is startling to see a waterfall pouring down on the head of the man in the third row.

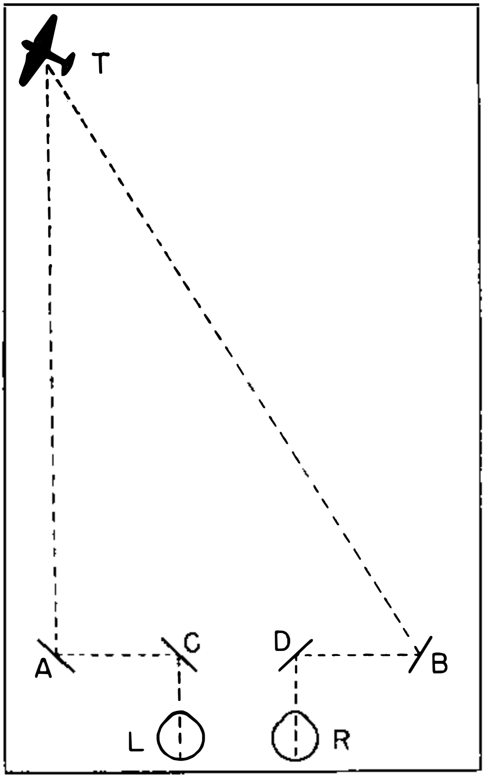

Fig. 7. Telestereoscopy and Range Finding
A, B, C, and *D* are mirrors. The two eyes, *L* and *R,* see the target, *T,* from the points of view of mirrors *A* and *B.* Interocular distance is increased to the distance *AB.* In range finding, the mirror *B* is rotated to change the parallax until the image of *T* is brought into the middle distance in a reticle, and the setting of the instrument then indicates the actual distance of *T.*

You can exaggerate this perceived depth by putting the cameras farther apart. That increases the parallax, has the effect of separating the eyes by more than 2 ½ inches. You can see the moon as a solid ball if you combine stereoscopically two photographs of the moon taken at points on the earth 8,000 miles apart. That has the same effect as would placing the two eyes 8,000 miles apart and creates the corresponding parallax. You can even see the rings of the planet Saturn stand out as solid from photographs taken at different positions of the earth on its orbit.

In the same way it is possible to exaggerate perceived depth and distance as seen near the earth's surface. This principle is used in the *telestereoscope* and the *telestereoscopic range finder.* See Fig. 7. The object or target *T* is seen by the two eyes, *L* and *R,* reflected from mirrors *A* and *B*, by way of mirrors *C* and *D.* This arrangement has the effect of letting the eyes view the target from the positions *A* and *B,* of separating them and increasing the parallax. In the range finder, also a height-finder, of Fig. 8, the mirrors are at the ends of the long barrel and the observer looks into the center of the instrument. If such an instrument were sighted along the surface of the earth, it would exaggerate the third dimension at a distance, make it possible to see the difference in distance of two objects both of which are far away. It would then be acting as a simple telestereoscope.

When the instrument is directed at an aerial target, however, there are usually no other objects in the field of view to be seen as nearer or farther away. Such objects are, therefore, provided artificially by lines in a reticle through which the observer looks. These lines are arranged in pairs, one for each eye, with the parallax different for different pairs. That makes the singly perceived lines appear to the observer at different distances. By changing the angle of the mirror *B* (Fig. 7), he is able to make the target seem to move in among the lines that the reticle provides. He brings the target, by adjusting this mirror, to a distance which looks to him the same as the distance of one of the sets of lines.

Fig. 8. RANGE FINDER OR HEIGHT FINDER
F: height finder. *T:* tracker. *C:* truck with computer and altitude converter in it. *G:* antiaircraft gun. See text for description. (Courtesy of Bell Telephone Laboratories.)

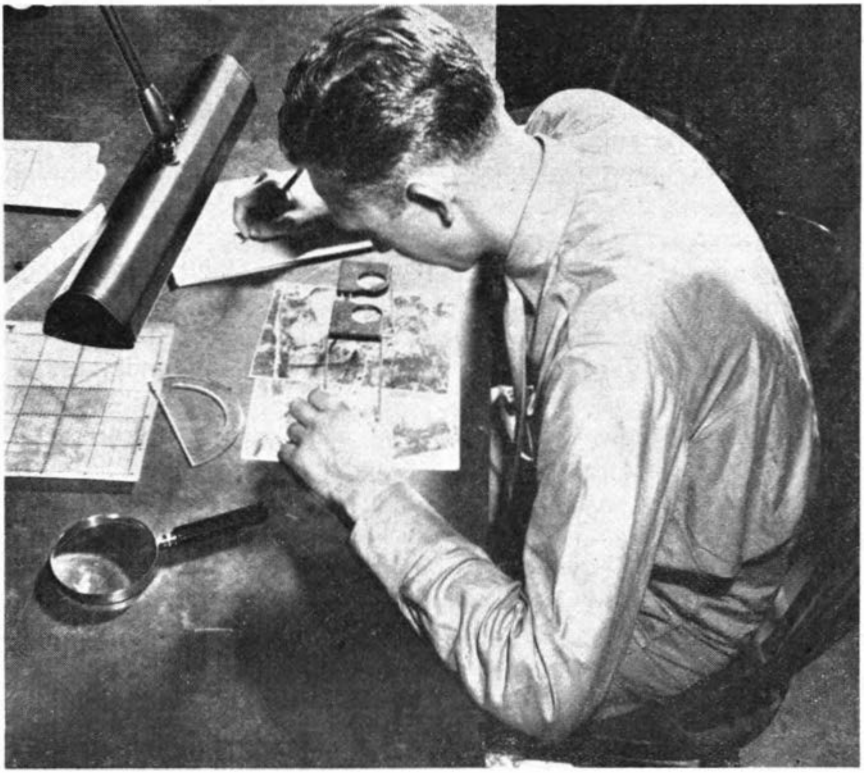

Fig. 9. Stereoscopic Examination of Reconnaissance Aerial Photographs

Fig. 8 shows the range or height finder at *F*. In this figure *T* is the tracker, another visual instrument by means of which observers follow the course of a plane. *G* is an antiaircraft gun. The "electrical brain" or computer is in the truck at *C*. It, in conjunction with an altitude converter (another electrical device), almost instantaneously plots the distance, course and speed of the target, aims the gun, and sets the fuse of the shell so that it will burst at the proper place and time for a hit. The computer takes into consideration all such important items as the muzzle velocity of the gun, the shell drift due to spin, the speed of the shell, the pull of gravity on it, and the direction and velocity of the wind. The human brain plays a relatively small rôle for it works too slowly. The electrical brain is more rapid and accurate. Nevertheless tridimensional vision is still required. Perception and the action of a nervous system are not entirely eliminated.

Men differ greatly in the speed and accuracy with which they can make these stereoscopic adjustments. Therefore, observers have to be selected for stereoscopic aptitude and then trained in the required skill.

Photographic aerial reconnaissance also makes use of stereoscopic vision. The reconnaissance plane takes continuous photographs as it flies over the terrain. These successive photographs overlap, have common parts which have nevertheless been photographed from different angles. By combining two such views with stereoscopic lenses (Fig. 9), the topographer at the base can see the depth in the picture, can distinguish hills from ravines, mounds from holes, or even see curbstones projecting upward. If the selected views were taken far enough apart, the depth is exaggerated. A curb can be made in this way to look two feet high, and a low hill like a high one.

Sometimes the necessary parallax is secured by mounting two cameras out on the two wings of a plane, taking pictures simultaneously with both cameras. This method does not, however, work at high altitudes, for then the cameras are not far enough apart to give enough parallax.

There are limits to stereoscopy. If the parallax is too great, the disparity of the retinal images also becomes too great and the disparate images will not combine into a single view. That means that you cannot unduly exaggerate depth as related to breadth. On the other hand, in telestereoscopy it is always possible by telescopic enlargement and choice of proper parallax to get distant scenes to appear near with depths proper to their apparent distance.

All the other clues for depth and distance can aid or hinder stereoscopic perception. That is why photographs combine more easily in stereoscopy than do simple geometrical drawings: the monocular clues reenforce retinal disparity.

If the stereoscopic images are reversed for the two eyes, it is possible similarly to reverse the depth of the perception. This sort of perception is called *pseudoscopy.* Fig. 10 shows how the two

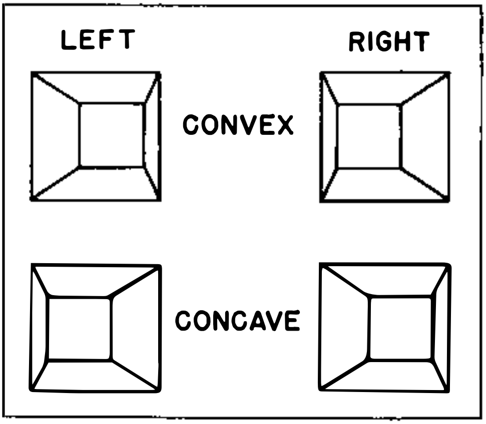

Fig. 10. Disparity of Retinal Images for Convex and Concave Views of a Truncated Pyramid

retinal images would look for a truncated pyramid aimed at the observer with the small end nearer him. Such a pyramid would be "convex." If, however, the two drawings are interchanged in the stereoscope, and thus the two retinal images interchanged in the two eyes, the pyramid then becomes "concave"; you seem to be looking inside of a hollow pyramid with the truncated end farther away than the base. Actual objects can also be observed pseudoscopically if a single pair of mirrors is arranged so that the right eye views the object from a mirror-position to the left of the left eye, while the left eye looks directly at the object. Under such observation a tennis ball looks concave, the inside of a teacup looks like the outside, and the outside of a mask like the inside. It is, however, practically impossible to view a human face in this fashion and make it look concave, like the inside of a mask. Familiarity here works against retinal disparity and our perception fails. Concave living faces are too preposterous for the brain to entertain the perceptual pattern.

Pseudoscopy seems to have no military use, but the limitations under which it works show how all the clues to depth and distance work together in perception.

SEEING MOVEMENT AND SPEED

The eyes and the brain working together can perceive movement. They perceive it ordinarily when the image of an object moves upon the retina. This statement sounds simple and seems obvious until it is supplemented by the statement that a moving retinal image always produces a blur unless it moves quite slowly. How then is it possible to see a rapidly moving object clearly? There is more than one answer to this question.

If an object at rest moves and comes to rest again, it is seen to move and it is seen clearly in its initial and the final positions. In between there is a blur. It is, in fact, seen to move just as well if it disappears from the initial position and reappears in the final position. That is the sort of movement shown in the movies, where objects appear in successive positions and not in the intermediate positions. Discrete displacement of this kind, when the conditions of speed and illumination are right, gives just as good a perception of movement as does actual continuous movement. You can for instance show a man a vertical line and then suddenly substitute a horizontal line for it, and he will perceive the vertical line moving to lie down in the horizontal position.

Sometimes the eyes move along with the moving object, thus keeping the object's image fixed on the retina. In that case the background is blurred, but since the observer's attention is on the object, he does not notice the blurred background. When he does notice it, his eyes stop moving and fixate the background, and it in turn becomes clear.

Usually when you see movement the object's image is moving across your retina or is moving in relation to its visible foreground or background. You cannot, for instance, see clouds moving unless some clouds move in relation to other clouds or to objects like trees and houses. If the moon is shining through the clouds, then the clouds may be seen scurrying across the face of the moon, or else the moon seems to scurry in the other direction behind the clouds.

When two or more objects thus change position in relation to one another, it is very difficult to predict which of them will seem to move, which to stand still. The most general rule is that the object fixated, the object with which the eyes move, appears to stand still. This is the case when you look steadily at a tree from a moving train and the more remote objects move with you and the train, while the nearer objects move backward. This rule generally works for the moon and the clouds also, but there are many exceptions to it, and knowledge of which object really is moving does not always determine what will appear to move. Sitting in a train with another train starting to pull out of the station, one may see the station platform moving and the other train standing still, for all that one knows what must actually be happening.

If there is no visible background at all, if you are in pitch darkness with only a single tiny point of light showing, you would think that you could not perceive any movement. The point of light cannot be seen to move across a background which is not visible, and, if the point actually moved, the eyes, fixating it, would be expected to move with it. As a matter of fact, however, the single point may indeed appear to move about in haphazard fashion even though it actually is stationary. This strange phenomenon is called *autokinetic movement.* It is conceivable that it might on rare occasions cause an airplane accident—when a pilot, flying on a black night with only a single spot of light outside to orient him, tries to guide his plane by the light instead of by the instrument board.

Very slow movements cannot be perceived as movements. The hour hand of a clock does not seem to move, although the movement of the minute hand of a large clock can sometimes just be perceived. An object has to move about a tenth of an inch a second when the object is 10 feet away if its movement is to be perceived. A remote object has, of course, to move much faster, because it is really speed across the retina that counts for this perception. To be seen as moving, an object 1,000 feet away would have to be moving 100 inches or 8.3 feet a second.

Very fast movements also cannot be perceived as movements. The object is just a blur, unless the eyes have time to fall into movement with it. A stone falling past a window is a blur when seen through the window.

Defense against low flying airplanes is difficult because they seem to come over so fast. At the same speed at 10,000 feet elevation the plane might appear to move only very slowly. This difference is due to the fact that a plane at 10,000 feet takes 100 times as long to move through a given visual angle as does a plane only 100 feet up. If the observer kept his eyes still, the image of the low plane would move across his retina 100 times as fast as the image of the high plane. Or, if he moves his eyes and head to follow the plane, then he has to move them 100 times as fast. The field of vision fills a given angle, not a given distance that can be measured in feet or miles, and it is angular speed that determines perceived speed.

Not only can observers usually see movement; they can also estimate speed fairly well. Unless his range-finder can do the job for him with its "lead computing sight," an antiaircraft gunner has to estimate the speed of his target and aim ahead of it, "lead" it, if his shell and the plane are to arrive at the same place at the same time. A truck driver has similarly to estimate speed so that his truck and another will not arrive at the same place at the same time. These judgments are complex, and men differ in their abilities to make them with accuracy. One of the tests for aptitude for driving trucks measures the accuracy with which a man can predict where a moving truck will be at a given time or how the movements of two trucks will presently bring them into relation to each other.

VISUAL-MOTOR COORDINATION

In the business of living, the coördinations between visual perception and bodily movement, between the eyes and the muscles, are very numerous and astonishingly accurate. You see an object; you reach out and take hold of it. Even that simple act is a complex coördination. A baby cannot manage it, but an adult can. You walk along the street, see yourself approaching a curb, and adjust your steps so that you come out even without having one of your feet project over the edge of the curb. The change of step takes little thought, yet it is done with precision.

You can swing a hammer through the air and hit a nail on the head, provided you have had some practice at the job. All use of tools requires practice but with practice it becomes precise. Lacking practice you may not, with your eyes shut, be able to bring your two forefingers together, end to end, in front of you, yet that too you can learn with a little practice. All these coördinations are learned. Most of them have to be learned in the complex business of daily living.

There are many complex coördinations that are required in the performance of military skills. Driving a truck is one. Shooting a rifle is another. Piloting a plane and landing it are others. The learner has to acquire these skills and fix them so well that they become almost automatic. The finger must squeeze the trigger by itself, as it were, when the sight is on the target. The foot must be on the brake at once when the danger of collision shows up. These are familiar examples of how coördination works and how necessary it is. Such complex action is not inborn and never comes easily. It has to be acquired by much repetition in practice.

The Air Forces has discovered that visual-motor coördinations are so important in learning to fly that it uses tests of aptitude for learning these coördinations. Since not all men learn them with equal ease, the best can be chosen by tests for training in the necessary skills.

The SAM Complex Coördination Test (originally called the Mashburn Serial Reaction Test) is such a device. The testee is given a control stick to move with his hand and also a rudder to manage with his feet. He is presented with three sets of lights, arranged in pairs of red and green. When three red lights come on, he must move the stick and rudder so as to make the three corresponding green lights light up. Left-right movement of the stick controls a horizontal row of green lights, back-forth movement of the stick a vertical row of green lights, and the rudder controls another horizontal row of green lights. He must make the three green lights that are paired with the three lighted red lights come on and hold them on for a moment. Then the machine automatically sets him a new problem by lighting three other red lights. A clock measures the time that it takes him to make a predetermined series of these adjustments. The apt man completes the series of coordinations more rapidly than the inept. The practiced man can perform the task much more rapidly than a novice. The experienced pilot has learned to make similar coördinations in a plane accurately and almost instantaneously.

Another test for pilots is the pursuit meter. A rotating phonograph disk has inserted in it, flush with its surface, a small metal disk about the size of a nickel. The testee is given a metal rod, loosely hinged in a handle, and asked to keep the end of this rod in contact with the small metal disk as it rotates. An electric clock shows the amount of time that he manages to keep contact during a specified total time. In still another test the testee controls the movement of the contact-point by turning two left-hand feed screws, one of which moves the contact back and forth, and the other right and left. Both of these tests measure aptitude for acquiring visual-motor coördinations.

Perhaps none of these coördinations is so astonishing as those of the man who has learned to shoot accurately from the hip. He can relate the position of his arm and hand to what he sees in both direction and distance. An organism that is capable of such a fine adjustment is capable of a multitude of skills. It has, indeed, to be trained, but it can be.

REFERENCES

1. E. G. Boring, H. S. Langfeld and H. P. Weld, eds. *Introduction to psychology.* New York: Wiley, 1939. Pp. 652.
   Chapters 13, 14, 16, 17, pp. 411-473, give accounts, written by selected authors, of the phenomena of visual perception and sensation at an advanced but nontechnical level.
2. H. A. Carr. *Introduction to space perception.* New York: Longmans, Green, 1935. Pp. 413.
   Eight of the eleven chapters in this book deal with the visual perception of spatial relations and visual coördination in a clear, nontechnical manner.
3. C. T. Morgan. *Physiological psychology.* New York: McGraw-Hill, 1943. Pp. 623.
   Chapters 9 and 10, pp. 161-218, give a clear, though somewhat technical, exposition of the psychophysiology of vision.
4. L. T. Troland, *Principles of psychophysiology.* Vol. 2, *Sensation.* New York: Van Nostrand, 1930. Pp. 397.
   Chapter 14, pp. 51-205, gives an excellent technical account of the facts of the psychophysiology of vision.
5. R. S. Woodworth. *Experimental psychology.* New York: Henry Holt, 1938. Pp. 889.
   Chapters 22-24, pp. 539-622, give clear, nontechnical accounts of the phenomena of visual sensation and of eye-movements.

There is no single book on the phenomena of vision that is detailed and scientifically sound, and addressed to readers with no previous knowledge of the subject. These chapters (except for Troland, which is somewhat technical) most nearly satisfy this specification.

Chapter 3

Visual Adaptation and Night Vision

The eye is an amazingly sensitive organ. Not only can it perceive very tiny objects, under the conditions noted in the preceding chapter, but it can also respond to the most minute quantities of energy when all the conditions are just right. When the eye is in the dark and has been in the dark for half an hour, becoming accustomed to it, a small luminous speck, like a star, can be perceived when the light is but 100 million millionths of a watt. That happens only when the speck, or star, is seen out of the corner of the eye, the region of the retina that becomes especially sensitive in the dark. If the speck flashes or the star twinkles, perception is still easier. It has even been argued that a single quantum of light is enough to excite a single rod in the retina and that one can perceive the result of half a dozen quanta acting on half a dozen or more rods. A quantum of light is the smallest quantity of light that can exist by itself.

No less remarkable, however, is the extent of the range of energies to which the eye can adapt itself in the perception of objects. If we call this least illumination which the eye can perceive under favorable circumstances, the brightness *threshold,* then we may note that the illumination of white paper in direct sunlight reflects about 7 thousand million times as much light as is necessary to reach this threshold. A tungsten filament in an electric light radiates about one million million times as much light as the threshold value, and the sun from a spot of the same size about 67 million million times as much. The sun itself is too bright to look at. It injures some eyes, perhaps all, if directly fixated for more than a few seconds. Certainly it is not wise to look directly at the sun, and vision is blinded while looking at it and disturbed afterward if one looks even briefly. Nevertheless there is a range of illumination from the threshold to a million million times the threshold where vision occurs without danger of injury. Such extreme values are, however, not often used in vision. There is a famous experiment, in which the sensitivity of the eye was systematically investigated at eight "normal" intensities, and in which the maximal intensity was about 250,000 times the minimal intensity. In the ordinary routine of living, the range is still less; then illuminations may vary only a hundredfold.

To work accurately throughout this wide range of intensities of light the eye has to adjust itself to every new level of general illumination into which it is introduced. This adjustment is called *adaptation.*

Adaptation takes time—most when the change is from light to dark, less when the change is from dark to light. Adaptation has, therefore, great military importance, because night vision, seeing in the dark, depends upon it and the process of dark adaptation is relatively slow, requiring time. The soldier going from lighted barracks to an observation post at night, the lookout leaving his quarters to go on deck at night, the officer going from the chart room to the bridge at night, the night fighter looking from his lighted instrument board to the dark outside the plane, all these men need time to become sensitized to the dark before they can observe accurately. They must, therefore, know about adaptation in order to take it into account.

CONE ADAPTATION AND ROD ADAPTATION

Since the pattern of lights that falls upon the retina is nearly always changing with the movement of the eye, the retina in every part is always undergoing adaptation. In good illumination, when the cones are working without the rods, adaptation is of two kinds: color adaptation and brightness adaptation.

Color adaptation consists in the continuous loss of sensitivity to a color as long as that particular color stimulation persists and in the consequent sensitization of the affected part of the retina to the complementary color. The complementary of a hue is another hue which, when mixed in the proper proportions with the first hue, cancels it and gives a gray. If you look at a red disk on a gray card continuously without moving the eyes, the red becomes steadily poorer and poorer, most rapidly at first and more slowly later. It may even in time—though you can seldom hold your eyes still long enough to produce this effect—turn into a gray like its background. If then you look away at a gray card without any color on it, you will see there a bluish green disk, which appears because the part of the retina that was adapted to red is now sensitized to its complementary, bluish green. The illusory bluish green disk that you see is a *negative afterimage.*

The same thing happens if the entire retina is exposed to colored light, if a man puts on red goggles or goes into a room illuminated by red light. Everything looks reddish to him at first, and then, as adaptation takes place, his eyes become fatigued to the excess red and other colors approach their natural hues—provided the red light is a mixture containing some of the other wave lengths besides red. With goggles that admit only red light to the eyes the tendency is for all objects to appear less well colored, grayer. If later the man with the goggles takes them off, he will get an aftereffect; everything will for a little while be too bluish green.

Brightness adaptation works in the same way. A black spot on a white ground begins to show less contrast if it is fixated steadily for a full minute. Afterward, if the observer looks at a uniformly gray card, he sees a light spot on a dark ground—a negative afterimage. When you go from the dark to the light, the light is at first dazzling but becomes rapidly dimmer as adaptation takes place. When you go from the light to the dark, the dark is at first very black indeed, but presently it gets grayer and objects begin to become visible.

The retinal cones are the sense-organs of daylight vision, and the rods the organs of night vision. *Dark adaptation* is the passage from daylight or cone vision to night or rod vision. There are seven changes that take place as this process occurs.

Fig. 11. CONTRACTION AND DILATION OF THE PUPILS WITH CHANGE OF ILLUMINATION

The upper picture shows the pupils dilated after the eyes have been in the dark for a while. The lower picture shows the pupils contracted after the eyes have been in good illumination for some minutes.

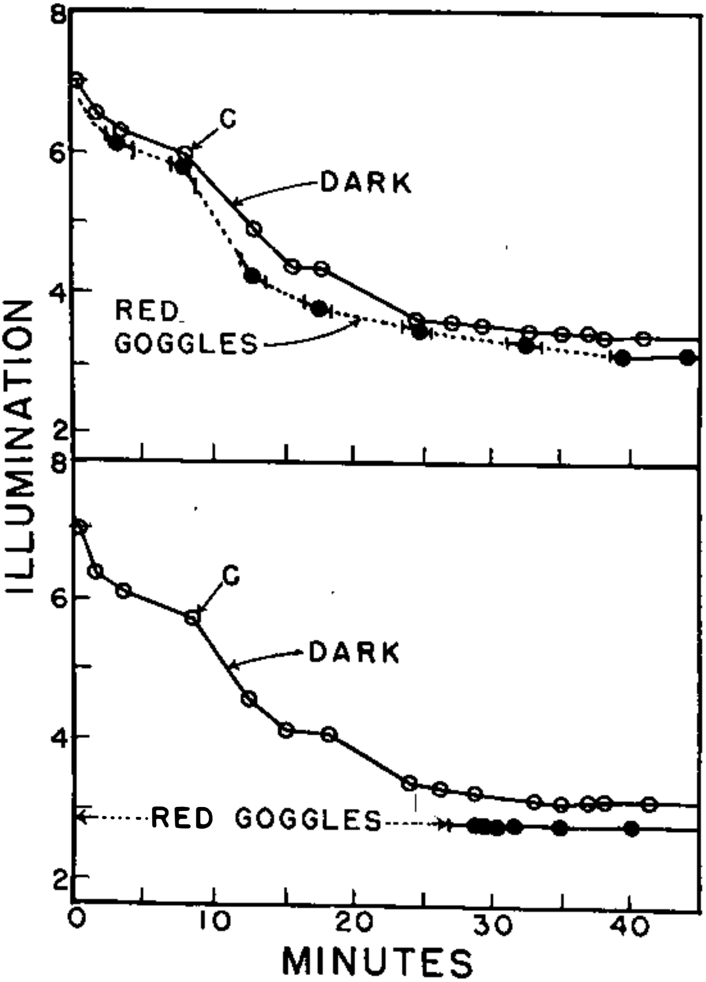

Fig. 12. DARK ADAPTATION WITH AND WITHOUT RED GOGGLES

The curves labelled "Dark" show how the brightness threshold of the retina diminishes when the eye remains in the dark. They are curves for dark adaptation. The adaptation of the cones is most effective at first and up to the point *C;* therefore adaptation depends mostly on the rods.

In the upper diagram the dotted lines show the time when the person tested wore special red goggles, which allow the rods to undergo adaptation without stopping cone vision. The tests for sensitivity to light were made in the dark where the solid circles are shown with bits of solid lines through them.

In the lower diagram are shown the results of wearing the special red goggles continuously for 27 minutes and thereafter testing for sensitivity in the dark.

The two curves show that, with these red goggles, rod adaptation takes place as well as it does in the complete dark. The curves seem to show that the red goggles work even better for adaptation than does complete darkness, but more recent experiments indicate that adaptation is really the same in the two cases. (Adapted from W. R. Miles, *Federal Proceedings,* 1943, 2, 112f.)

(1) The pupils of the eyes dilate. See Fig. 11, where the upper pair of eyes have dilated pupils because they have been in the dark for some time, and the lower pair have contracted pupils because they have been in the light. The pupil acts like the iris diaphragm of a camera (see Fig. 1, p. 24), letting in more of a low illumination, less of a high. The dilated pupil in the dark also cuts down acuity of vision somewhat, just as it reduces sharp definition in the camera, but then vision is never so acute with the rods as with the cones.

(2) For the first eight or ten minutes of dark adaptation the dominant change occurs in the cones. They become more sensitive to light. The dark appears lighter and grayer. The upper curves on each half of Fig. 12 show how sensitivity to light increases, how the brightness threshold diminishes, under dark adaptation. From the left of these curves, where the process of adaptation begins, to the point marked *C*, the change is due more to the adaptation of the cones than of the rods.

(3) Adaptation of the rods, however, goes along with adaptation of the cones. There is a substance in the retina which is associated with the rods and which gradually becomes purple in color as the process goes on. It is called the *visual purple,* and it seems to help in the absorption of light, favoring the violet end of the spectrum. This process is relatively slow. The adaptation curves of Fig. 12 are dependent mostly upon it from the point *C* on to the right, and the curves show that the change is very nearly complete after 30 or 40 minutes, when rod vision has come to prevail without cone vision. Actually the adaptation process can be shown to continue slowly with small amounts of change for hours. But the soldier, sailor or pilot who wishes to be ready for night observation needs to have stayed in the dark for only half an hour in order to have gotten his eyes near their maximal sensitivity.

(4) Two related kinds of visual sensitivity increase steadily, rapidly at first and more slowly later, when dark adaptation takes the eye from daylight vision to night vision. (a) The eye becomes sensitive to light, can see differences of brightness which were at first quite invisible. Many people know how hard it is to get a room perfectly dark indoors in daytime. The room that seems dark at first turns out, when dark adaptation is complete, to have in it all sorts of leaks. (b) The acuity of vision also increases. The eye can see spatial differences more easily. Thus invisible objects appear. Small objects become differentiated from other small objects. These two functions together make up the increased sensitivity of the eye at night or in a blackout. A light-adapted man, suddenly thrust into the dark, is astonished at the ease with which a

dark-adapted man can guide him about—astonished, until he too becomes dark-adapted and gets his night vision.

(5) As illumination fails, objects change colors. The reds get darker and presently disappear into the dark as blacks. The blues get lighter and persist, often quite brilliant, the longest of any colors. This phenomenon is called, after its discoverer, the *Purkinje shift,* and is due to the fact that the cones and rods are differently sensitive to the different wave lengths of light. The two bell-shaped curves of Fig. 13 show the sensitivities of cones and rods to different wave lengths. The cones are most sensitive to a slightly greenish yellow light. The rods are most sensitive to a slightly yellowish green light. Red light is almost invisible to rods, but can be seen pretty well by cones. On the other hand, rods can see violet light (to the left of the blues) which is almost

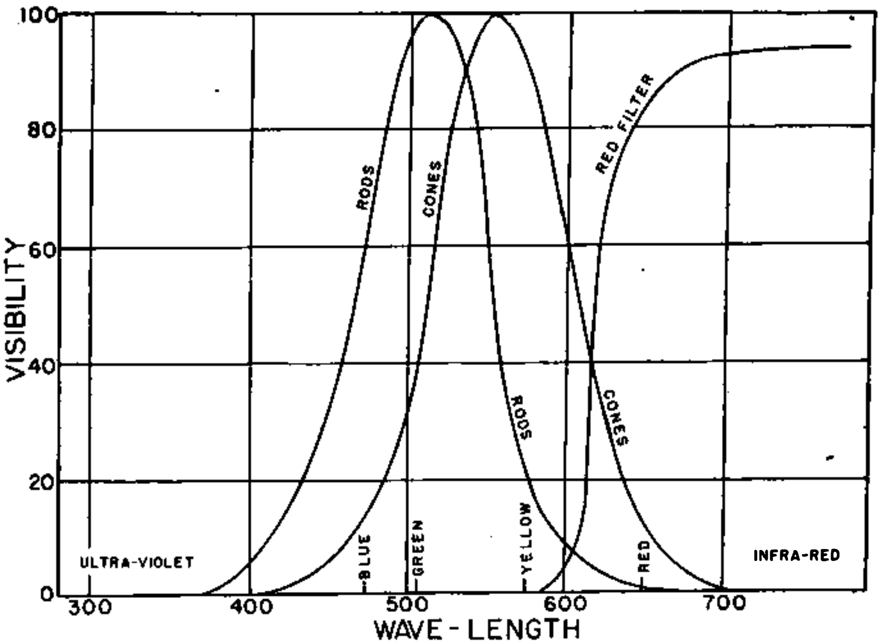

Fig. 13. Sensitivity of Rods and Cones to Different Wave Lengths of Light

The bell-shaped curves show the sensitivities of rods and cones to lights of different wave lengths. The hues named at the bottom of the diagram are the hues that these wave lengths arouse in cone vision. No hues are seen in rod vision, only grays and blacks.

The curve at the right shows how special red goggles cut off intensities of different wave-lengths to the left of the curve and allow wave-lengths to the right of the curve to pass. This red filter leaves the rods practically in the dark, but permits enough of the light that can effect the cones to pass, so that cone vision can be used through the goggles while the rods are undergoing dark adaptation. (Adapted from W. R. Miles, *Federation Proceedings,* 1943, 2, 110.)

black to cones. This fact is basic in the use of red goggles to obtain rod adaptation without eliminating cone vision, a technique which is described later.

(6) In complete night vision no hues can be seen as such. The spectrum looks like a band of grays, black at the red end, lightest near green light, fairly light for blue light, and, of course, black for the ultraviolet and infra-red lights which are out at the two extremes of the spectrum and invisible to both rods and cones. These statements must be considered carefully. In night vision one can perceive green *light* but not the *hue* green. Green light looks gray, not green. Red light looks black, not red, being practically invisible if it is far enough along in the spectrum.

(7) In night vision the fovea is blind. It is, as we have seen, packed full of cones with no room left for rods. Outside the fovea the cones become less and less numerous from the center of the retina to its outer edges, while the rods become more and more numerous. Hence, in complete night vision, one cannot see an object at all by looking directly at it, because only the rods are working and there are no rods in the fovea. One has to look alongside of the object in order to get the retinal image onto the rods.

If one comes out of the dark into the light, then the entire process of dark adaptation is reversed in *light adaptation*. The cones come back into function and the rods are used less or not at all. The visual purple is bleached out into a yellowish substance. The pupils contract.

Light adaptation is much more rapid than dark adaptation. Its speed depends on how bright the light is, but one minute in a bright enough light can spoil most of the advantage gained by thirty minutes in the dark. The soldier or sailor, called from sleep for outside work, should not turn on his light to dress or even to see where his things are. He should keep his dark adaptation for use outside.

There are great differences among men as to their speeds of dark adaptation and also as to the sensitivities of their eyes to light and their visual acuities after dark adaptation. Some men adapt rapidly and others slowly, and age seems to make a difference. In one study of the problem men over forty required twice as long for dark adaptation as men between twenty and thirty. Persons with very poor rod vision are said to be *night blind*. In all three of these capacities the differences are so great that it is desirable to test fighting men in respect of them, especially the night aircraft fighters in whom rapid adaptation and sensitive night vision are extremely important.

Persons deficient in vitamin A are apt to have poor vision, especially poor night vision. In a study of aircraft pilots it was found that the administration of vitamin A for from five to eight weeks to men with high brightness thresholds reduced their thresholds to 1/5 or even to 1/25 of their previous values. The greatest improvement was, quite naturally, in the man with the poorest night vision. On the other hand, there is no evidence that men who are possessed with the normal reserves of vitamin A are benefited visually by the administration of more.

Night vision gets worse when oxygen is diminished at high altitudes. So do other sensory and motor capacities.

Good observation at night is, however, something more than the possession of sensitive rods. It requires sensitive rods, keen attention and good judgment. Anything that affects attention or judgment can therefore also diminish the effectiveness of night observation. Noise, fatigue and physical discomfort have been found to interfere with the best observation at night, but it is not clear whether they act on the rods or on the higher psychological functions which interpret the information furnished by the rods and translate it into action.

SEEING IN THE DARK

The main requirement for seeing well at night is dark adaptation of the retinal rods. The man who expects to need to use his night vision stays in the complete dark for from thirty to forty minutes—half an hour is usually ample time.

Since light adaptation can rapidly undo the work of the slower dark adaptation, it is important that a man, called from the dark for night observation, should not expose himself, even briefly, to bright light. He should not turn on the electric light near his bunk for a moment in order to find something or to look at a map. Outside he should not strike a match and look at it, and especially should he not light a cigarette for then his eyes would look directly at the light. Experienced gunners, working at night, know better than to watch their own gun flashes. The flash of a six-inch gun may dim vision for a full minute. The flashes of rifles are not, however, so bright as to make much trouble.

When men are awake and waiting for outside duty in the dark—are to go on deck or on patrol—they become bored with nothing to do. They want to have light to work, read, play or talk in. Bridge officers, moreover, need to read charts in the chart room and then go out on the bridge for observation. Is there any way in which you can use your eyes in the light and still stay dark adapted?

One scheme is to wear a black eye-patch over one eye and to use the other eye in the light for reading charts, maps or books, or for games. Then, when the observer goes out into the dark, he slips the patch around and uses his dark adapted eye. This scheme seems to work fairly well, but it is not recommended by the Navy for the reason that it limits the night observer to monocular vision, until the other eye also becomes adapted. The one-eyed lookout cannot distinguish distance nearly so well as the binocular observer, as we have seen in the preceding chapter.

A much better and quite satisfactory scheme is to wear special red goggles. Not any red glass or gelatin will do in these goggles, for ordinary red transparencies let through all the wave lengths of light with the red predominating. There are, however, special red goggles available that let through only the light at the very red end of the spectrum, keeping out all the shorter wave lengths.

The curve at the right of Fig. 13 shows how such a good red filter cuts off light. It lets through all the truly red light to the right of it, keeps out all the other wave lengths to the left of it. Thus, as can be seen in Fig. 13, it lets through the red light that affects the cones but almost no light that affects the rods, practically putting the rods in the dark, while leaving enough light for the cones to read a book or a chart by. (It will not be possible to see all the colors on the charts though.) In this way the rods get dark adapted and ready to work in the dark, while the cones are functioning in the light.

This scheme works well. The goggles usually issued by the Navy do not cut off as much of the orange light as the filter for which the curve is drawn in Fig. 13. Hence the Navy's goggles do not give quite as good rod adaptation as would this better filter. They are, however, good enough, especially if followed by five or ten minutes in the dark before duty is begun.

Fig. 12 shows the adaptation curves for the red goggles for which the curve is drawn in Fig. 13. In the upper half of Fig. 12 the dotted line shows how adaptation occurs with the red goggles on. The solid circles with the bits of solid line through them represent brief periods in the dark when the tests for sensitivity were being made. In the lower diagram the red goggles were worn continuously for 27 minutes, and then successive tests for sensitivity were made in the dark. It is clear from both diagrams that adaptation of the rods takes place as rapidly with the red goggles as in the complete dark. The solid lines with the open circles show the similar process for continuous complete darkness.

At the beginning of the Second World War it was commonly supposed that blue light would be least visible in the dark. Battleships were illuminated inside with blue light. Air-raid wardens used blue filters on their flashlights. Fig. 13 shows that this supposition was an error. The rods see blue light much better than red. So the battleships, when this fact was finally made clear, changed to red illumination, and the wardens got red filters for their flashlights. The point is that a red light near by may be bright enough to stimulate the cones and enable men to see objects, whereas a red light far off may be too faint for the cones, and is inadequate to the rods because it is red.

Since the fovea, having no rods, is blind in night vision, the night observer must learn to observe objects by looking alongside of them and not directly at them. A small object disappears entirely when the gaze is turned directly at it in the dark. Children sometimes learn to fear the dark because they see objects out of the corners of their eyes, objects which mysteriously disappear when they then look directly at them. Snipers in the dark can learn to use vision just outside of the fovea (see Fig. 14).

Visual acuity is not so good in rod vision as in cone vision. You never

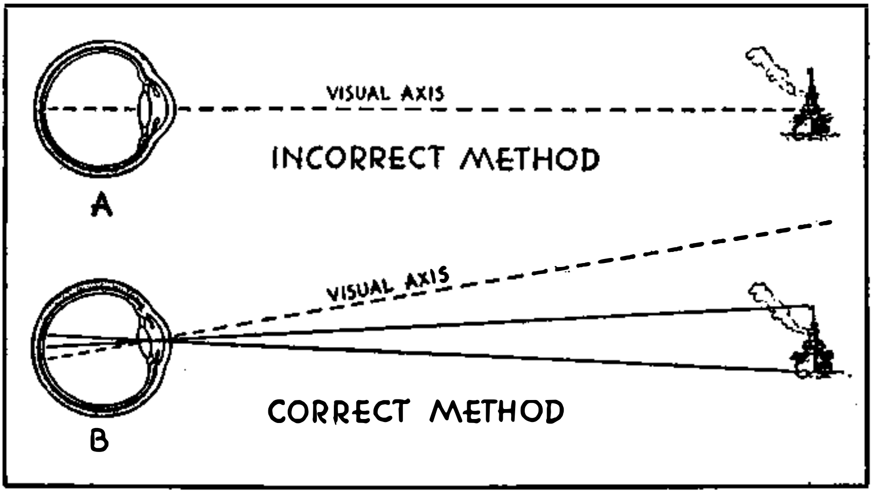

Fig. 14. Correct and Incorrect Observation of a Target at Night
Since the fovea is blind in rod vision, the night observer learns to look to the side of a target in order to observe it.

see so well at night as you can in daylight. Small objects disappear easily. An airplane may be invisible 1,000 feet away, or even at 500 feet if seen on edge. Objects look smaller in the dark, too.

Since contrast makes an object stand out, since it thus makes up for poor acuity, an observer should seek for contrast when there is something he can do about finding it. An airplane may be visible against light clouds and not against a black sky. Glare reduces acuity because it reduces contrast. Windshields on planes or cars should be kept clean and free from dirt, salt, fog or scratches.

RULES FOR NIGHT OBSERVATION

(1) Get yourself *tested for night vision,* if possible. If you are night blind or even deficient in rod vision and dark adaptation, try to get a job that does not require night vision. At any rate do not try to become a night fighter in an airplane.

(2) *Stay in the dark* for half an hour before night observation, or stay in special *red illumination* (not *any* red light but one with a special filter), or else wear the special *red goggles* before observing. Be dark adapted.

(3) Keep your eyes from bright *illumination,* no matter how brief it is, before you go on duty and while you are on duty. A brief illumination spoils a long dark adaptation.

(4) *Never look directly at any light* or at any illuminated object, except in red light, before you go on night duty and while you are on it.

(5) *Look to the side of what you would observe.* See out of the corners of your eyes. Let your attention always be to the side of "straight ahead." The fovea is blind.

(6) *Keep your eyes moving.* Scan. Do not sweep them over large areas too rapidly for you to notice details, yet do not stare continuously at one spot while the image fades.

(7) *Choose a contrasting background* for observing an object, whenever you have a chance to choose.

(8) For this reason, *keep your windshield spotless,* for glare reduces contrast.

(9) *Keep yourself wide awake and on the alert.* Rest enough beforehand. Good observation depends on good attention and good judgment, as well as on good rods.

(10) *Keep in good health.* Be sure you are not deficient in vitamin A. Most men in the armed forces are not deficient if they get the normal rations.

(11) *Practice recognition of essential targets.* Learn to recognize the usual types of planes from any angle.

(12) *Practice all the rules* for seeing at night until they become second nature. Use every available device for aid.

It is the night fighter and the night lookout with the best night eyes and the best night habits who see the enemy target first.

REFERENCES

1. E. G. Boring, H. S. Langfeld, and H. P. Weld, Eds. *Introduction to psychology.* New York: Wiley, 1939. Pp. 652.
   Pp. 537-550 give an elementary account of adaptation and night vision.
2. L. T. Troland. *Principles of psychophysiology.* Vol. 2, *Sensation.* New York: Van Nostrand, 1930. Pp. 397.
   Pp. 66-81, 93-97, 116-139 give a quite technical account of the psychophysiology of adaptation and night vision.
3. R. S. Woodworth. *Experimental psychology.* New York: Henry Holt, 1938. Pp. 889.
   Pp. 545-550 and 556-565 give a clear but somewhat technical account of adaptation and night vision.

There is no extended account of these phenomena that is not quite technical.

Chapter 4

Color and Camouflage

In a way all perception is an illusion, a useful illusion. You call a perception an illusion when you perceive something other than is directly presented to the senses. Movement in a moving picture is illusory because the successive presentation of an object in slightly different positions is not the continuous movement that you perceive. That illusion is actually truer than the discrete displacement which gives rise to it, for in it the brain has used clues from the film to perceive what is really going on. It is not often that the brain perceives exactly what is presented to it, for it is constantly making over sensory data into the perceptions of objects. A square looks square and a circle circular, no matter from what angle they are viewed, what shape their images have on the two retinas. A man does not seem to get smaller when he walks away. The perception of him keeps its size although the retinal image of him shrinks. Snow looks white, coal black, grass green and blood red, no matter how much light they reflect or what color the illumination is.

In this sense, color itself is illusory. We do not directly experience wave lengths of light, which is all that color is before it reaches the eye. We experience sensations. Literally there is no such thing as white light. When Sir Isaac Newton in 1672 reported to the Royal Society that white is always a mixture of wave lengths, the Royal Society ridiculed him for such an absurd suggestion. Yet he was right. The brain interprets certain mixtures of lights as white or gray, according to the laws of color mixture.

The fact is, then, that a man, as he goes about the business of living, sees *objects*—that is to say, he does not see the confusion of wave lengths of light that come to him, but he sees what his brain makes out of them. He sees, as it were, the meanings that the sensory data have for him. Instead of a changing confusion he perceives permanent things. Out of constant change his brain deduces the existence of the unchanging objects which are all-important to him.

The problem of camouflage is not, therefore, to create illusion, for illusion already exists, is normal to all perception. Camouflage tries to substitute new illusions for old, to fool the brain in its deductions, to replace true illusions—since the brain's illusions ordinarily enable it to perceive what is true—by false illusions. Camouflage puts wrong objects into perception, where without it correct objects would have been. Counter-camouflage corrects these falsifications and brings back the true illusions, the ones that man can trust. Camouflage, therefore, depends upon the laws of the formation of objects in perception. We must study them.

And the laws of the perception of objects depend upon shape, size, brightness and hue. We must therefore also study color, as well as the individual deficiencies that occur in the perception of color, that is to say, color blindness. The perception of shape and size is equally important but it is subject to less variability from person to person than is the perception of color.

COLOR

The stimulus to color is light, radiant energy, electromagnetic waves of different wave lengths. Actually there is a continuous series of these waves that extends from the very long carrier waves of radio, to the shorter waves of heat, to the still shorter light waves, to the X-rays and cosmic rays that are shortest of all. Only a small portion of this series can stimulate the retina and is called light.

The visible waves constitute what is called the visible *spectrum,* which extends from waves about 760 millimicrons long (a millimicron is a millionth of a millimeter), which, giving rise via the retina to the sensation red, are called *red light,* to the short waves about 390 millimicrons long, which, giving rise to the sensation violet, are called *violet light.* The invisible "light" beyond the red end of the visible spectrum is called *infra-red,* and the invisible "light" beyond the violet end *ultra-violet light* or sometimes "black light." Ultra-violet light affects most photographic plates, and infra-red light affects special photographic plates especially sensitized to it. Since photographic plates can in these ways see more than the retina, they can sometimes penetrate the camouflage which has not taken such photographic possibilities into account.

Fig. 13 (p. 56) shows how cones and rods respond to the different wave lengths of light and the points in the spectrum at which light becomes invisible. The cones are most sensitive to a greenish yellow light with a wave length of about 554 millimicrons, and the rods to a yellowish green of about 511 millimicrons.

Although the spectrum runs continuously from the long red waves to the short violet ones, the hues that are seen appear as if they were arranged on a circle and were getting on back toward the red starting point at the violet end of the spectrum. Violet is a reddish blue. The series of hues—red, orange, yellow, green, blue, violet—starts with red, gets far away from it, and then in the violets seems to be returning

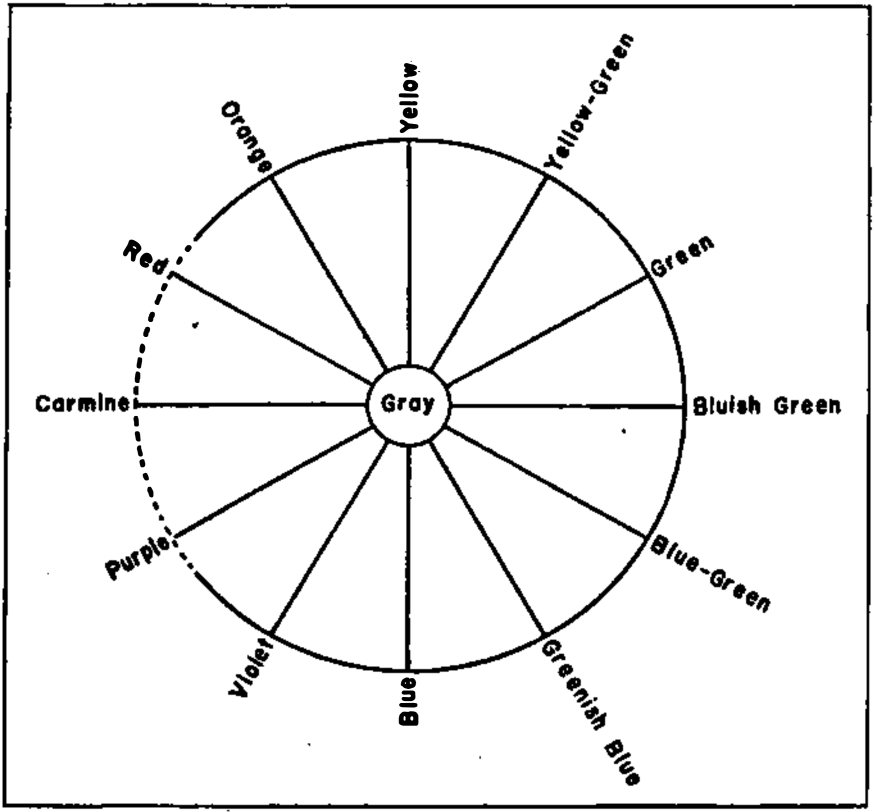

Fig. 15. Color Circle

The series of hues. The solid part of the circle shows the series for which there are pure spectral lights. The dotted part, the region that is got only by a mixture of long waves (red) and short waves (violet). Complementary hues are placed opposite each other. Mixtures can be thought of as placed approximately on lines connecting the components. Hence gray is in the middle, halfway between complementaries, and the radial lines are saturation series, each for a single hue.

toward red again—although every one of these hues can be produced by light of the appropriate single wave length, and orange light is not a mixture of red and yellow lights. The circle can as a matter of fact, be closed by mixing red and blue light to give the purples, for which there is no pure light of a single wave length. Blue-violet-purple-red take the circle all the way back to its starting point.

Fig. 15 shows this color circle of hues. The solid part of the circle shows the hues that can be produced by light of a single wave length—pure monochromatic light, it is called. The dotted portion shows the region for which there are no pure lights but for which the hues can be obtained by mixing red with blue light. The psychological primary hues in this color circle are red, yellow, green and blue. The wave lengths for them are as follows:

Primary red:	nonspectral
Primary yellow:	574 millimicrons
Primary green:	505 millimicrons
Primary blue:	478 millimicrons

The best red in the spectrum is a little yellowish, a little toward the orange. You have to mix some blue in with it to get primary red, the red that looks neither yellowish nor bluish. Around the color circle it is possible to distinguish, under the best conditions of observation, 156 different hues.

Like the purples, the grays and whites are nonspectral colors. They can only be got by mixing lights. The whole spectrum together gives a white, or if the lights be weak, a gray. The laws of color mixture, which are discussed below, show the other ways in which these sensations are aroused.

The blacks, grays and whites form a continuous series of sensations. There are about 570 discriminably different brightnesses in this series, or even more if one considers the range from the blackest black that can be seen up to the brightest illumination that will not injure the eye. Black is really a sensation, although it comes in the absence of light. You get the blackest black by looking at a perfectly lightless hole for a brief instant, after you have been light adapted to a very bright light or to white, and before adaptation can change the black much. Even that black can be made blacker by contrast if it can be surrounded with a field of the whitest white. In other words, black is not a stimulus, but a psychological phenomenon that depends on all the laws of color.

Colors have three *attributes:*

(1) *Hue,* what changes around the color circle of Fig. 15.

(2) *Brightness,* what changes in the black-gray-white series. Other colors also have brightness. A red or a green can be dark, light or of medium brightness. This attribute is sometimes called *value.*

(3) *Saturation,* the richness or poorness of a color. If you mix a red with a gray that is neither lighter nor darker than the red, you cannot change the red's brightness, but you will make the red poorer, less red, grayer, less saturated. There are color series of saturation extending from gray to the maximal saturation of every possible hue. This attribute is sometimes called *chroma.*

Such saturation series can be added in Fig. 15 if we think of a gray at the center of the color circle and the lines of saturation extending radially from it to the outside. In such a figure one could also draw concentric circles, each having all the hues at a diminished degree of saturation—the smaller the circle, the less the saturation.

It is also possible to imagine a solid figure that would add the brightnesses to the hues and saturations. If Fig. 15 represents all the saturations of all the hues at one middle brightness, then one could make another circle for a greater brightness, and another, piling the circles on top of one another. These circles would get smaller as brightness gets greater, because there are fewer hues and saturations distinguishable at great brightnesses. One could also build down with darker brightnesses, and then, too, the circles would be successively smaller. The result would be the double cone of Fig. 16 with its base at a middle brightness. The black-gray-white axis runs vertically up through its center. Brightness is indicated vertically, saturation radially, hue circumferentially.

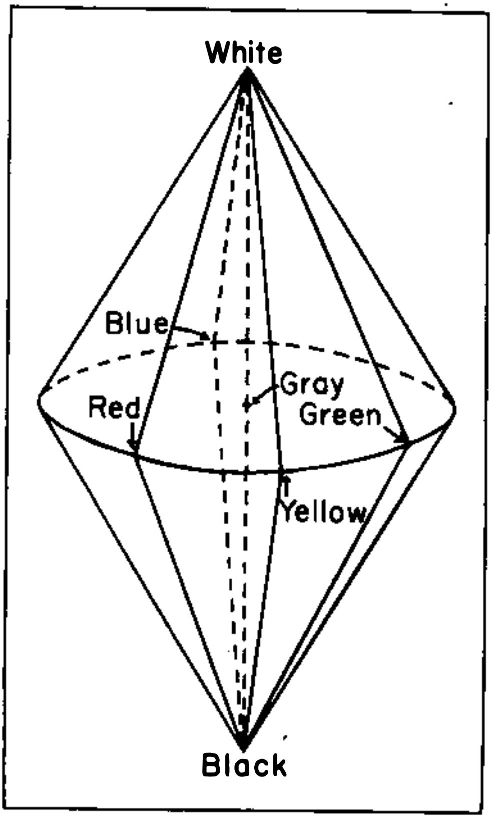

Fig. 16. Color Cone

The base of the cone is the color circle (Fig. 15). The black-gray-white axis runs vertically through the center. Hue varies circumferentially around the figure; saturation varies radially, out from the axis; brightness varies vertically.

Since a color can vary in respect of any one of its three attributes, there are a great many discriminably different colors—somewhat over 300,000. The double cone of Fig. 16 contains not less than 300,000 different colors.

In *mixture* the colors follow certain laws. Here are the two principal laws.

(1) For every hue there is a *complementary* hue, which, if mixed with the first in the proper proportions, gives a gray, and, in other proportions, an unsaturated color of the hue of the stronger component. The complementary hues are shown opposite each other in the color circle of Fig. 15. This law holds not only for monochromatic lights, but also for colors that are got by the mixture of lights—that is to say, for all colors.

(2) If two hues not complementary are mixed, the resultant hue will be intermediate on the color circle, and will be less saturated the more remote the two component hues. This law amounts to saying that the mixture of two hues will lie on a line connecting the two components in the color circle. The more remote the hues, the nearer this line lies to the center of the circle, where zero saturation (gray, white) lies.

In fact, the first law is really the limiting case of this second law, for if the colors are as remote from each other as possible (opposite on the circle, and therefore complementary), then the mixture can (in proper proportions) give zero saturation (gray).

You cannot, except for color-blind persons, get all the hues from less than three components, but you can get them in fair saturation from three. Choose three widely separated hues on the color circle. Then all the hues will lie on the three lines connecting them, and proper mixtures will give them all, as well as the poorer saturations that can be imagined as lying inside the triangle formed by the three lines. Since the triangle is smaller than the circle, you never get the best saturations of all the colors in mixtures of only three components. You do better with four components, still better with more.

These laws of color mixture work out accurately when lights are mixed by projecting them in superposition on the same surface, or by combining them in an optical system, or by spinning sectors of colored paper so rapidly on a motor that the colors fuse.

The laws do not, however, always work with paints, for then the light reflected from a particle of one component is transmitted through particles of the other component. Thus primary yellow and primary blue, being complementaries, give, when mixed in the right proportions, gray. Yet everyone knows that yellow and blue paints, when mixed, make green. That is because yellow paint reflects red, yellow and green light, with a preponderance of yellow, and blue paint reflects green, blue, and violet light, with a preponderance of blue. As the lights are reflected back and forth among the pigment particles and transmitted through them, the blue pigment cuts out all but the green light that comes from the yellow pigment, and the yellow pigment cuts out all but the green light that comes from the blue pigment. So the two pigments together end up by looking predominantly green. For such reasons, the mixture of paints is quite different from mixing lights.

The color of an object depends upon the wave lengths it reflects and the way in which these lights combine under the laws of color mixture. A white or gray object may reflect all the colors of the spectrum, or just one pair of complementaries, or some other combination of lights. An orange object may reflect only orange light, or only red and yellow light, or all the wave lengths in such proportions that they mix to give orange. Thus a blue object will look blue in *ordinary* red light, because ordinarily a light that looks red has in it all the wave lengths, including some blue. On the other hand, a blue object in *pure* red light—the light that would come through the filter of Fig. 13 (p. 56)—would never look blue because there is no blue light to be reflected by it. It would ordinarily look red, because most blue objects reflect all wave lengths in some degree, including red. If you had an object that would reflect only pure blue light and illuminated it only with pure red light, then the object would look black, for it would not reflect any light at all.

These matters have great military importance in camouflage. For instance, green grass and foliage reflect green light, hardly any spectral red light, and a great deal of infra-red light. Green paint, that matches foliage to the eye, reflects spectral red light (unless it is a special camouflage paint) and not much infra-red light. A concrete strip on an airfield, painted with ordinary green paint to match the summer grass next to it, may be invisible to the unaided eye of the reconnaissance observer but yet be visible to a photographic film which will detect infra-red light. The grass will be photographed as white and the paint as a much darker gray, for the film responds differently from the retina to the two differently mixed greens. No paint is safe as a camouflage match, unless the composition of the light which it reflects is the same as the composition of light reflected by the object which it ought to match.

COLOR BLINDNESS

Only rarely is a man totally color blind, unable to see any of the hues, obliged to perceive the world as mere blacks, grays, and whites, seeing it as it appears in an ordinary photograph. A few score of such cases have been described, no more. These people are apt to be blind in their foveas, having to twitch their eyes as they look about. Perhaps their retinas have no cones, have to depend on the rods for daylight vision. Such cases are, however, too few to be of military importance.

Color blindness, as the phrase is commonly used, means partial color blindness. Color-blind persons are called *dichromats,* said to have dichromatic vision, because all the hues of the spectrum can for them be matched by the mixture of only two wave lengths of light. Normal color vision is called *trichromatic* because to match all its hues requires the mixture of not less than three wave lengths.

A dichromat sees no reds and greens nor the colors in which they are blended—the oranges, yellow-greens, blue-greens, violets and purples. He sees only yellows and blues in all their saturations and brightnesses, and, of course, the blacks, grays and whites. That is a very considerable limitation of his vision, for he is able to distinguish only two hues instead of 156.

There are two kinds of dichromats, *deuteranopes* and *protanopes.*

The *deuteranope* sees the spectrum as a band of yellows and blues with its brightest point at a wave length of 554 millimicrons. In other words, he sees lights with the spectral distribution of brightnesses shown for the cones in Fig. 13 (p. 56). He sees, if he looks from the long-wave end of the spectrum to the short-wave end, poorly saturated yellows first, then bright yellows, then poor yellows, then gray (where green would have been), then poor blues, then better blues, and finally poor dark blues. Since there is some hue (yellow) at what is usually the red end of the spectrum but only gray where green should be, he is most apt to notice the deficiency in the region that should be green. He is, therefore, often called *green-blind,* although he is really blind, to both red and green.

The *protanope* is like the deuteranope, except that he sees the brightnesses distributed for the different wave lengths according to the curve that usually belongs to the rods (Fig. 13, p. 56). His maximal brightness occurs at 511 millimicrons. For him the gray at the region which should have been green is very light or even white, and, since white seems more like a hue than gray, his deficiency here may pass unnoticed. At the long-wave end, on the other hand, his spectrum is cut off short, as it always is for the rods. He sees nothing or black, and that deficiency gets itself noted, causing the man to be called *red-blind,* although he too is blind to both red and green.

Actually there are many different degrees of color blindness. The tests, most of them, are arranged so that a testee either passes or fails, and goes away labelled *color blind* or *normal.* Accurate measurement shows, however, many degrees of color sensitivity in between complete dichromatic vision and perfect trichromatic vision, and the Navy does use some tests that indicate degree of color capacity. If there were time enough to measure the color sensitivity of all recruits or officer candidates instead of applying the simple all-or-none tests, we should probably abandon this sharp distinction of men into color blind and normal, putting on every man's qualification card a number to indicate his degree of color sensitivity. Then we should know—and for the first time—just how color capacity is distributed in the population.

The tests indicate, nevertheless, some intermediate cases.

There are *red-weak* men (anomalous protanopes) and *green-weak* men (anomalous deuteranopes). It is their existence that makes it so difficult to say just how many men are color blind. In general, however, as the tests test them, about one man in every twenty appears to be color blind, and one other in every twenty color weak. The rest get by.

That is true of men but not of women. Color blindness seems to be inherited and sex-linked. Women carry the potentiality of color blindness but are not often color blind. Men inherit the defect from their mothers, who may have had the defect to pass on to their sons from their color-blind fathers, or from their mothers' color-blind fathers. There are, however, exceptions to this rule. About one woman in a thousand is color blind, but then some women have other masculine characteristics.

Color-blindness Test. Color-blind men seldom know that they are color-blind unless they have been tested. They see all the objects that other people see and they know what colors the objects are said to have. They learned the names of the colors of particular objects when they were children. Occasionally a chance remark reveals the fact that a man has difficulty in distinguishing colors. Someone may say: "Isn't it hard to see ripe cherries on a cherry tree, when the cherries look so much like the leaves." Of course. He is seeing bluish gray cherries among gray leaves. Someone else will remark: "Why do they put red flags on green golf courses, when red and green look so much alike?" Of course. That man is probably seeing pale yellow flags against pale yellow grass. John Dalton, the color-blind chemist, who discovered his defect and described it in 1794, remarked: "Blood appears to me . . . not unlike that color called *bottle green*."

So you cannot trust to the use of words for detecting color blindness, because words mean what the child was being shown when he learned the words. In fact, no one knew that the color blind see only yellows and blues until 1880, when a man turned up who was color blind in one eye and had normal vision in the other. *He* could learn the color names with his better eye, and then describe in words what he saw with his defective eye.

The best brief and simple tests are the *pseudisochromatic tests.* These tests consist of series of printed colored charts. Each chart shows many flecks of color printed on a white background. The flecks vary at random in shape, size, brightness and saturation. One chart, for instance, is made up almost entirely of bluish flecks of this sort, but has in it a set of carmine flecks arranged to form the number 32. Can a man read this number correctly? If he can, he can tell red from blue and is not color-blind. A color-blind man sees only a mass of bluish flecks, whose size, shape, brightness and saturation vary irregularly, giving him no clue as to the number. One chart is not enough, but a series of charts makes a pretty good distinction between one level of color sensitivity and another.

The *worsted test,* the matching of dozens of little skeins of colored yarns, does not work well because the yarns are of all sorts of different degrees of saturation and it is hard to interpret the results. Also the yarns fade with use.

There are other tests which use carefully colored *metal chips,* which the testee has to match or arrange in series. These chips work better than the worsteds because they do not fade easily and can be fixed accurately in respect of the three attributes of color.

The ideal test would be the measurement of sensitivity to color by the use of pure spectral lights, and also the determination of whether the testee is a dichromat, *i.e.,* whether he can match any sensation from the spectrum by the mixture of some two lights—a long wave with a short wave. When such measurements of sensitivity are made, it generally turns out that men who are classified as color blind by the conventional tests can nevertheless see intense reds and greens and are, therefore, not completely red-green blind. The men who cannot see the well saturated reds and greens of traffic lights are not so numerous as one in twenty.

Since some men, however, fail even on traffic lights, there is a convention which is used quite generally. The red traffic light is placed above the green light. For them the upper bright yellow means "Stop," and the lower bright yellow means "Go."

The Navy, interested in colored signals, sometimes tests its men out with red and green signal lights. That has sense in it. Show a man what you want him to be able to see and find out whether he can see it. The Navy has, however, also to present these lights as they would appear at a distance and as seen through fog, and more men fail this test than would fail on traffic lights, seen close by with good visibility.

Color in War. It is obvious that color helps to make objects visible by making them different from their backgrounds, and also that it helps to make objects identifiable. Thus color is useful in all observation. The color-blind man is, however, not so inept in observation that he is at a great military disadvantage. He sees all that an ordinary photograph shows and more. He perceives in all twenty or thirty different steps in his yellow-blue spectrum. He sees all the brightnesses, and difference in brightness is what is most important in making objects stand out from their backgrounds.

His defect may become crucial in certain activities. You would not pick a color-blind man for air reconnaissance, nor should he allow himself to be picked. He will miss more objects than does the trichromat. He will with unaided vision penetrate camouflage less frequently. A gun crew does not allow brown paths to be trod through the grass to their gun emplacement. From the air such paths would catch the normal eye at once; but the color-blind eye would be likely to miss them, might fail to see these yellowish paths through the yellowish grass.

The color-blind man is also at a disadvantage with colored signals. He may not be able to recognize code flags. He may do better with lights and rockets, if they are intense, when visibility is good. He remains, nevertheless, at a disadvantage here too, and the degree of disadvantage depends on the degree of his defect.

It is sometimes said that a color-blind observer can distinguish objects in aerial reconnaissance that the normal observer cannot see. In considering this question we must remember that color blindness is a deficiency and not a proficiency. The color-blind man never makes any color discrimination that could not be made by a normal observer who had his attention on the same spot. On the other hand, it is true that attention, as well as retinal sensitivity, enters into observational skill. Suppose that a gun emplacement has been camouflaged with foliage and that the camoufleur has carelessly let the foliage wither until it has become a grayish bluish green. The normal observer sees the landscape as a variegation of yellows, greens and browns. This one drab patch does not catch his attention among the profusion of colored patches.

To the color-blind man the landscape appears much more uniform, perhaps a field of poorly saturated yellows. The grayish bluish patch for him is unique and for that reason it catches his eye. At such a moment he is the better observer, but there are not enough such moments to make it wise to employ him regularly for reconnaissance.

CAMOUFLAGE

The business of camouflage is to make objects disappear.

Objects are put together by the brain, strange as that statement may sound. The visual pattern that comes to the retina is not in itself neatly divided off into separate objects. It is pretty much an unclassified mass of hues and brightnesses. The brain of the man who owns the retina sorts the colors out into objects, sees their varying nature as indications of the existence of certain permanent things outside of himself. Definite laws and principles operate in this interpretative sorting of his, and some of the clues that enable him to distinguish objects are, indeed, furnished by the physical objects themselves. Camouflage undertakes to distort these clues in such ways as to prevent him from perceiving the objects or to make him perceive wrong objects that are not really there.

If we are to understand camouflage and how it works we must, therefore, understand how a man selects among his impressions and alters them in his seeing of objects.

The important thing about an object is the action of attention on the mass of available visual impressions. Attention selects certain impressions, excludes others, and may even add, in imagery, details that are not in the original. Look at Fig. 17. You see a parallelogram and a rectangle and nothing else except a couple of unnecessary lines. Fig. 18, however, shows three hidden constitutents of Fig. 17. The digit 4 is not easily seen in Fig. 17 because attention selects the two geometrical figures and that uses up most of the 4. You can see the 4, however, after your attention has been directed to it.

Fig. 17. OBJECT PERCEPTION: PARALLELOGRAM, RECTANGLE AND HIDDEN OBJECT

Fig. 18. OBJECT PERCEPTION: CONSTITUENTS OF FIG. 17

Look at Fig. 19. Do you see two black profiles on a white ground or a white goblet on a black ground? Only with difficulty can both be seen at once. Attention selects either one or the other, and, when it has been sensitized to both, the two tend to alternate.

Fig. 19. AMBIGUOUS PERCEPTION: GOBLET OR PROFILES?

Nor does the selectivity of attention necessarily have regard to different parts of the visual field. Examine Fig. 20 carefully. You can see an old woman, large chin sunk on breast, heavy nostril, bangs awry over her left eye. Or you can see a young woman in profile as seen from behind and to the side. The black ribbon around her neck is the old woman's mouth. Her left jaw and chin are the old woman's nose. Her left ear is the old woman's left eye. The lashes of her left eye are the lashes of the old woman's right eye. Attention picks out one set of impressions and puts them together into one object, or it picks out the other set, some of which are the same items, and puts them together into another object. It is a mystery how attention works, or just what is changed when the ribbon changes to a mouth, but the whole psychology of object formation is experienced in the alternation that this ambiguous picture provides.

Fig. 20. AMBIGUOUS PERCEPTION: WIFE OR MOTHER-IN-LAW? (From W. E. Hill, *American Journal of Psychology*, 1930, vol. 42, p. 444, by permission.)

In the odd patches of Fig. 21 we seem only to see nonsense, until told to view the picture as a general mounted on a spirited horse. Then the camouflage is penetrated, and we find attention linking the patches together, emphasizing the parts that

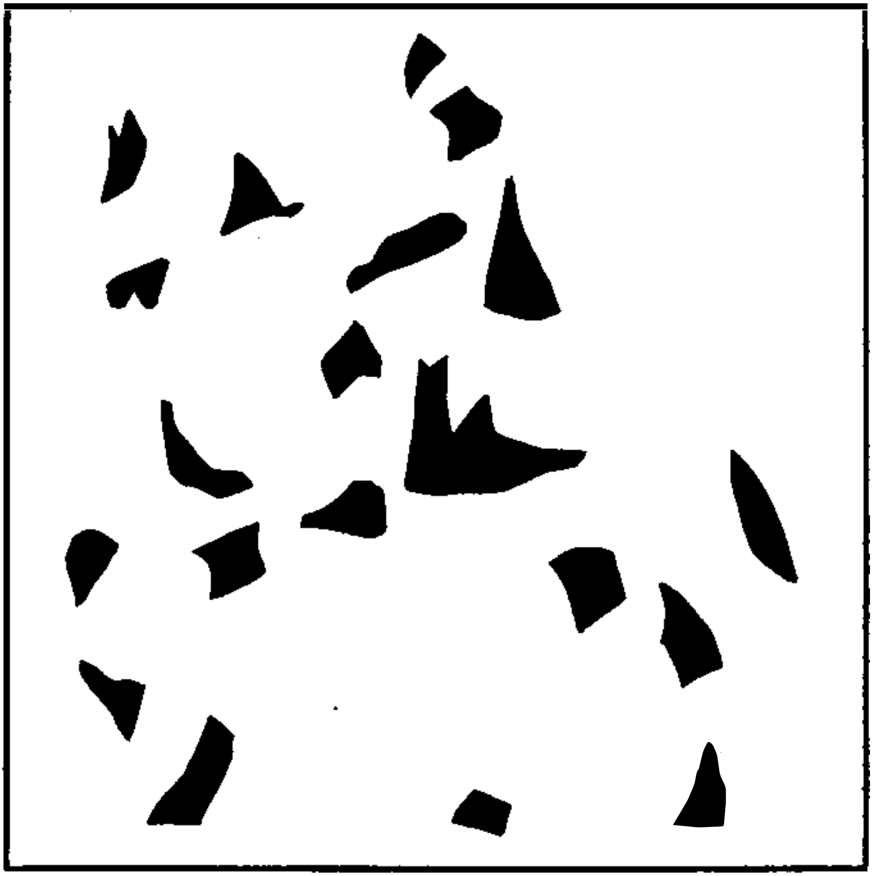

Fig. 21. Nonsense Figure with Hidden Perception

join the patches and rejecting the rest of the white space between them, completing the fragmentary picture with the necessary imagery.

Usually an object occupies a definitely limited space and is surrounded by a *contour* which cuts it off from the ground upon which it is seen. That is not always true, for a smudge or a mist or a wave may have no contour, but even such objects are somewhere, separate from their backgrounds.

It follows that an object to be seen needs to be different from its background and that the perception of a contour helps to separate it off. Camouflage, therefore, seeks to make objects match their backgrounds so that the two will blend and the object be lost. It also tries to break up contours by making them unnatural or, since straight lines and smooth curves are most easily seen, irregular. Shadows help to enhance the perception of objects, because they emphasize the contours by contrast or else provide relief that makes the object stand out as solid from its background. These principles, as well as the other principles of attention and perception that enter into object formation, all appear in the rules for camouflage which are given below.

Another important technique of camouflage is *confusion,* and the removal of means of identification of a vital object by its duplication. You could camouflage the Washington Monument if you built forty-nine other dummy monuments in the vicinity, so that a bomber could not tell which of the fifty was the real monument. And you can distract attention from ill-concealed airplanes if you have some batches of dummy planes showing plainly in other positions. Gas tanks, which are very hard to camouflage, can be hidden in this way.

There are two basic rules for camouflage: I. Discourage attention to the object to be concealed. II. Try to destroy the perception of the real object. All the other rules and principles fall under these two. There is perhaps a third rule: III. Make Rules I and II apply to the perception of photographs as well as to the objects as seen directly by the eyes.

Here are the rules—and the principles.

I. Discourage attention to the object to be concealed.

(1) **Misdirect attention.** That is what the magician does in order to conceal a crucial object or action. He gets the spectators to look elsewhere. Planes may be camouflaged poorly and yet escape attention if dummy planes are visible somewhere else. Dummy gas tanks, dummy buildings, dummy roads, especially if they resemble the object to be hidden, may direct bombs or shells to spots where they will do no great harm. When you see what you are after clearly in one place, you are not apt to hunt for it in other places, although the experienced observer or bomber learns to be suspicious, to suspect always the presence of dummies.

(2) **Avoid movement.** Movement, especially sudden movement or fast movement, attracts the attention. An object whose image lies near the edges of the retinas is not often noticed; but let it move rapidly ever so little and at once it catches the attention and the eyes turn toward it. Animals often escape detection because they "freeze" when they become aware of the presence of an enemy. They become rigid, transfixed, as if with fright, and their motionlessness is extremely useful to them. For the same reason moving signs make good advertising.

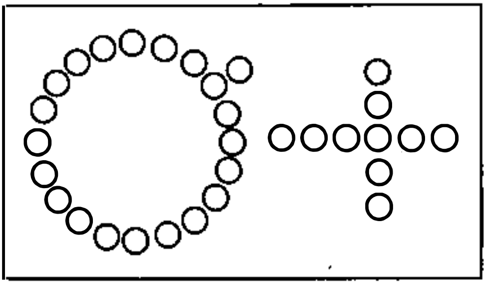

Fig. 22. UNIQUENESS: FLOWER-POT ARRANGEMENTS

A pot in the circle of pots is lost. It cannot be found after the gaze has left it, unless it has an identifying mark on it or there is some indicator in the surroundings. The pot outside the circle is unique in position; a man or a crow can find it at once. The extra pot on the end of the left arm of the cross is lost to a crow but not to a man. It has some uniqueness, not much.

Movement is, however, effective only when it contrasts with stillness. If a man, standing in the edge of a clump of trees, raises his hand to his face, he may easily be noticed, provided the trees are still. If the trees are being lashed with a gale, he may then raise his hand with little chance of being noticed. A single man running up a hill is the most obvious thing in sight, but in a skirmish line advancing by rushes up the same hill no one man stands out, since all are moving.

The speed of the movement is what counts—the speed of the movement of the image on the retina. Move very slowly and you may escape detection. And you may move more rapidly when you are far off from the enemy because at ten times the distance your movement on his retina is only one-tenth as fast.

(3) **Avoid lights.** A match struck in the dark is visible for many miles. Blackout is the best camouflage. Move under cover of darkness when possible. Move in shadow in daytime when possible. Wear dark clothes, except when they would contrast with your background, with snow or desert sand. Avoid bright objects or shiny brasswork that would catch the sunlight. Keep away from white walls or other surfaces that would reflect bright light on you.

(4) **Be small.** Small objects are harder to see than large ones. Men flattened on the earth or in low crouching positions make difficult targets. A man standing on the ground is more obvious than a head projecting from a foxhole.

Many small objects make a large object. A squad of men marching in close order is visible six times as far away as the same men widely separated. Deploy and scatter. Eight little men may be missed when one big squad would be seen.

(5) **Avoid uniqueness.** The basic law of attention is that the unique catches attention and compels it. You notice movement when everything else is still. You notice a strange face among the familiar, a familiar face among the strange. You cannot help noticing silence when noise has been long prevailing.

The unique object is isolated. It can get attention. Attention to each of ninety-nine similar things is impossible, but attention to the one that is different from them is easy—and natural.

It is, moreover, important for animals and men to notice the unique. What is common is generally safe. What is unique had better have attention. It breaks the rule of its surroundings and may need to have something done about it. A cow in the barracks. Your old boot tied to the barrel of a gun. A bottle of champagne in a foxhole. Such objects demand attention, attracting it before their nature is fully realized.

It is because it loses its uniqueness that a crucial object, that cannot otherwise be camouflaged, is nevertheless hidden when a score of similar dummies are arranged near it.

Arrange twenty flower pots in a circle and let a man see you put a dollar bill under one of them. Let him go away and come back. Can

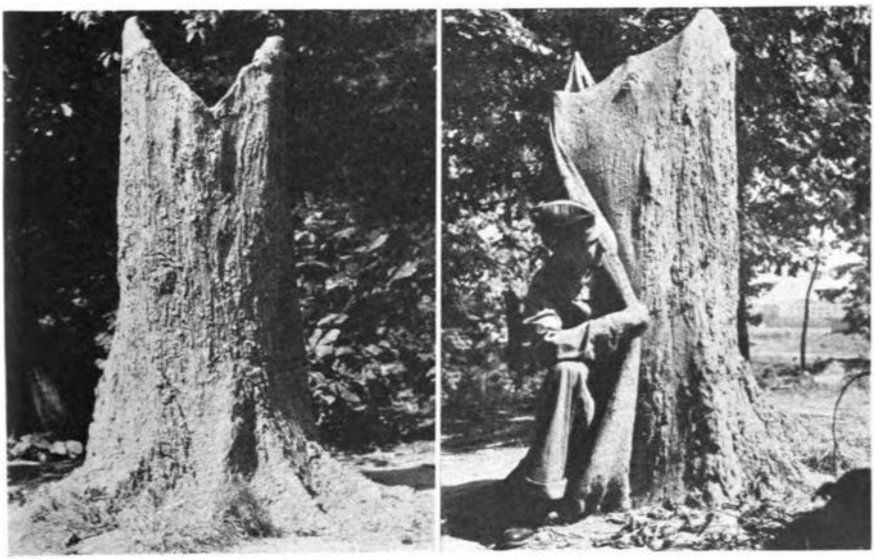

Fig. 23. CAMOUFLAGE TREE TRUNK

Good camouflage in a wood where it is not unique; bad in a field where it is unique. (Photo from U. S. Marine Corps.)

Fig. 24. RUBBISH-HEAP CAMOUFLAGE
The rubbish, supported by netting, covers the tents of a company of Engineers. The rubbish is easily visible but not unique; hence it is good camouflage. (Photo from U. S. Army Signal Corps.)

he find the bill at once? Not unless he has noticed a difference among the pots or a designating mark in the surroundings, one that indicates the crucial pot. A dog or a bird would have more trouble because they would not often note landmarks for the particular pot. But put the bill under a twenty-first pot that is placed outside the circle, as in Fig. 22, and the man can find it again at once. Similarly a crow, who has seen a juicy tidbit put under this extra pot, can fly to the pots and pick the right one without trouble. The pot outside the circle has uniqueness; it stands out from the rest. A pot in the circle lacks uniqueness; it is lost unless it has some special label.

So it is with the cross at the right of Fig. 22. Nine pots are arranged in a cross, and then a tenth pot is placed at the end of the left-hand arm. A man can find this tenth pot, but a crow cannot. It has some uniqueness but not much.

The dummy tree trunk in Fig. 23 is good camouflage for the man inside it, if it stands among other trees. It would not be good in the middle of a field, for then it would become unique, attract too much attention and perhaps be discovered as a fake.

The rubbish heap of Fig. 24 covers the tents of a company of Engineers. There is nothing unusual about a rubbish heap in many places in war. The camouflage is good.

The field gun in Fig. 25 is well camouflaged with foliage except for the wheel and the straight horizontal gun barrel. A wheel in the woods is unique. So also is a horizontal stick. Even though the gun barrel looks like a small tree trunk, its level position is unique.

(6) **Avoid conspicuous patterns.** Certain forms and patterns when unique stand out in perception with especial clearness because of their

Fig. 25. Field Gun Camouflaged with Foliage

The camouflage is good except for the wheel and gun barrel, which are unique in a wood. They might not be unique in a rubbish heap. (Photo from U. S. Army Signal Corps.)

Fig. 26. A Telephoto from Wright Field
The straight lines of the roads stand out with especial clarity. (Photo from Army Air Forces.)

form. Straight lines, smooth continuous lines and circles are especially conspicuous. Regular geometrical patterns, if unique, seldom escape attention.

A circular pond in among a number of irregular ponds would be noticed first. A spherical tank is almost always seen. The circular wheel and straight gun barrel of Fig. 25 have also this advantage for perception, this disadvantage for camouflage.

Thus the long straight roads in the reconnaissance photograph of Fig. 26 are the first thing to catch the eye. Roads and railroads are always obvious unless covered with trees. We have seen elsewhere (pp. 28f.) how a long straight wire remains visible even when its thickness in perception is much smaller than the separation of the cones on the retina.

In part it is the straight lines of the rifle barrels that give away the snipers in Fig. 27.

Barracks, tents, tanks, or men, arranged in neat rows or any other regular geometrical pattern, attract attention, and can be seen at great distances. They should be irregularly dispersed and scattered. Dispersal breaks up the pattern and also breaks up the large object (the pattern seen as a whole) into many little objects (its components).

II. **Destroy the perception of the real object.**

Either make the object disappear or else make it look like a different object.

(7) **Avoid brightness contrast.** Brightness contrast—light on dark, dark on light—tends to make objects and to give them contours. The profiles and the goblet of Fig. 19 have contours, are objects determined by the pattern of brightness in the picture.

Do not stand on a ridge where your dark outline will be silhouetted against the bright sky, nor place a gun in such a position. Ski troopers dress in white so as not to contrast with the snow. Soldiers wear drab

Fig. 27. Snipers

The men blend into the background quite well, but the contours formed by the shadows and the straight lines of their rifles give them away. (Photo from U. S. Marine Corps.)

when they fight on sand or dusty soil, and dark green in the woods. You have to learn to think constantly about your background, always to stand, when exposed to the enemy, where the background will look most like you.

Even when a uniform matches its background there is sometimes one item that stands out as too dark or too bright, either because it does not match the uniform or because the light strikes it in a special way. The men in Fig. 28 have made themselves small but they are not invisible because the sun shines on their helmets. They should have covered their helmets with foliage.

Fig. 28. Brightness Contrast: Troops with Bright Helmets

The presence of troops is revealed because the light on their helmets makes them contrast with their background.

In Fig. 26 the roads show in part because of contrast, in part because they are straight lines, in part because they are unique. Similarly dark wheel tracks on a concrete emplacement or airplane strip stand out, in part, by contrast.

(8) **Avoid differences in texture.** Texture is the depth or roughness of a surface as compared with its smoothness. Black velvet and black paper—the blackest black paper—differ in texture. The velvet will look darker than the paper because its deep pile traps the light that strikes it so that it reflects less light. Texture therefore makes a difference in brightness.

The following objects are arranged in order according to the depth of their texture, and therefore according to their brightness when they are equally illuminated: the surface of a quiet pool, an unpainted tin roof, a painted tin roof, a stretch of smooth gravel, a lawn with the grass cut, a field of hay, the top of a hardwood forest, the top of a pine forest. A pine forest seen from an airplane is blacker than the blackest paint on a smooth surface. It traps more light in its dark depth than any black paint can absorb.

Water reflects the most light and is hardest to conceal. Even by starlight a river is a light streak, and in moonlight it becomes the perfect guide to the enemy plane. You can cover water with coal dust, but it will be carried away by a current, and may be blown to one shore by the wind.

A man walking once through long grass to a gun emplacement leaves behind him a light trail that is visible from a plane, because the grass bent over has a different texture from the upright grass. He should walk backwards and try to pull the grass up behind him. No gun, no matter how well camouflaged at the emplacement, is obscured if it has many visible paths leading toward it.

In Fig. 29 the antiaircraft gun and its emplacement are covered with sugar cane so that they match their background in texture, as well as in general appearance.

Fig. 30 shows a netting over some guns. The netting is woven with strips of cloth to make it match its surroundings in texture. The strips are dyed green to match the foliage in hue, but an infra-red camera would pick out the green dye unless it is of a very special kind.

Fig. 29. Antiaircraft Gun Camouflaged with Sugar Cane

The sugar cane makes the gun match its surroundings in texture and also in other respects. (Photo from U. S. Army Signal Corps.)

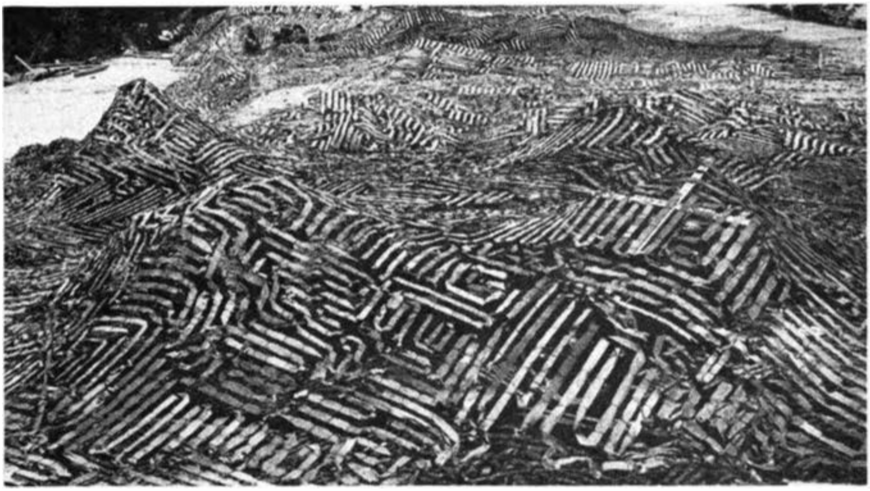

Fig. 30. Guns Camouflaged under Nettings
The netting, woven with cloth strips, provides a texture that matches its surroundings. (Photo from U. S. Army Signal Corps.)

(9) **Avoid shadows.** Shadows are the camoufleur's worst problem. The top of a building can be made to match its surroundings with sod and bushes, and yet its shadow will show it up as a high square object. If the position of the shadow changes from morning to afternoon, then there is no longer any doubt that the object is not a patch on the ground.

Shadows also enhance contours since they create brightness contrast at one side of the object. Shading may also establish a perception of solidity (see Fig. 4, p. 38). It makes a hill look like a hill, shows it is not a hollow.

You cannot match a shadow with black paint. No black paint in sunlight is nearly so black as a real shadow. No airplane painted dull black and caught in a searchlight beam is ever so black as the cloudless night sky. Painted shadows cannot, moreover, be moved about and shortened and lengthened with the changing position of the sun throughout the day.

Nevertheless, there are things to do about shadows. Objects can be flattened out by attaching to them long sloping sides—camouflage nets, perhaps—that make with the ground an angle that is not greater than fifteen degrees. Such an object will cast a shadow only when the sun is very low—an hour after sunrise and an hour before sunset.

These long shadows after dawn and before twilight are especially troublesome. The reconnaissance planes try to get photographs at these times. Fig. 31 shows an embossed strip with overhead light and with light from the side. With no shadows the embossing disappears. With shadows it appears and also shows its relief.

When a hut or other structure is erected, it is best to have its long dimension run east and west. Then the shadows, when they come, will be as small as possible.

Another camoufleur's device is to mask shadows with the shadows of nature. Place the crucial object so that it and its shadows will fall within natural shadows of hills, trees, boulders, ravines. Let a large shadow shade the object so that it will have no special shadows of its own.

A similar technique is to absorb the shadow with stuff of deep texture. Surround the crucial object with bushes and trees, that will look like bushes and trees and thus not suspicious, and that, appearing dark on account of their texture, will not be further darkened by the shadows of the object.

(10) **Break up contours.** If the contours, which surround an object and separate it from its background, are broken, the object may disappear into its background.

Irregular outlines are less likely to form contours than straight lines,

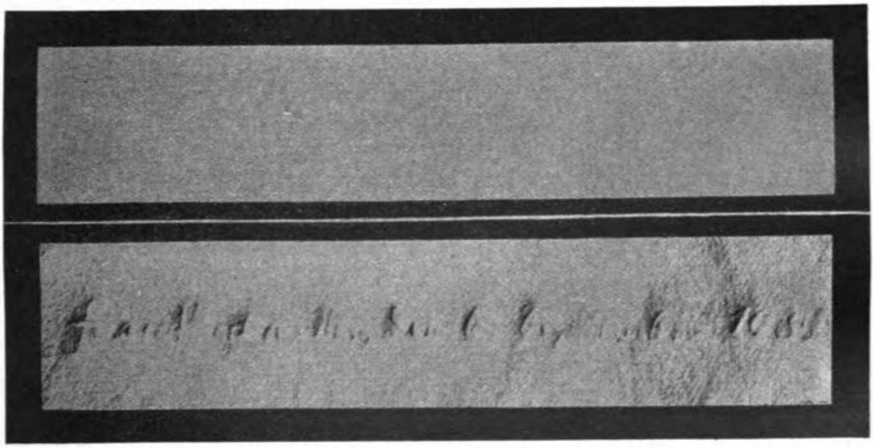

Fig. 31. Shadows Give Relief
With light from above (upper picture) the embossing does not show, but with light from the side (lower picture) it stands out in relief.

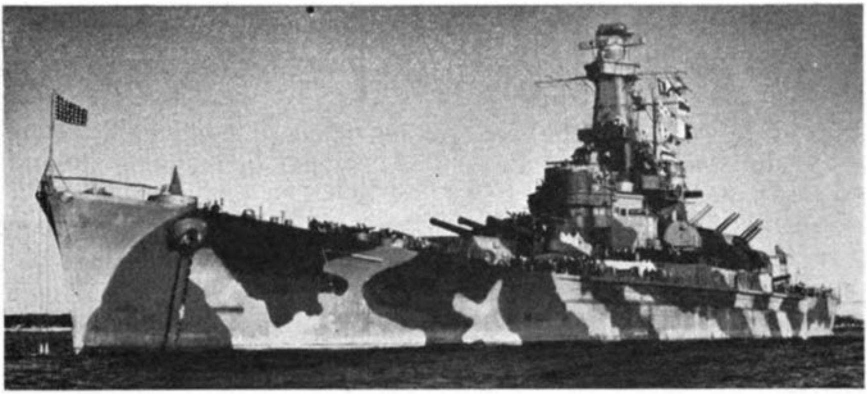

Fig. 32. Dazzle Painting: Disruptive Camouflage

The battleship *Alabama*. The camouflage makes the length and form of the hull difficult to distinguish quickly, for instance, by a submarine aiming a torpedo. (Official U. S. Navy photograph.)

smooth curves and circles. Let the edges of a rectangular roof have all sorts of queer projections. Do not cover tents with a neatly circular rubbish heap. Uniforms with ruffles and flounces (or tears) would really be less visible than trim uniforms. Camouflage with irregular nettings or foliage usually spoils contours. The net on the helmet should hang over the edge so that it may break the contour of the rim and the contour of the face.

It is also possible to destroy true contours with false. That is disruptive camouflage—the dazzle painting of ships (Fig. 32), the contrasting broad irregular stripes on motor vehicles. With strong contrasting differences the object may fall apart and become other nonsensical objects. The best system is where the camouflage contours not only disrupt the object but also make parts of it blend with its surroundings. That is why a zebra, seen on the top of a hill against the bright sky, may look like a grating. The white stripes are continuous with the sky, so that you see only a set of dark bars.

In the dazzle painting of a ship (Fig. 32), the ship is not lost to view because it still does not match the sea, but it is disrupted as an object. Knowing that it is a ship, you still may not be able to tell what kind of ship it is, or what course it is following, or often even what direction it is going. The disruption can be enough to make observation of these essential details impossible, especially when observation must be rapid—as it must be in a submarine about to launch a torpedo.

(11) **Match the background.** No rule of camouflage is more important than having the object match its background. That is why foliage is the best thing to use to camouflage guns, helmets and everything else in regions surrounded by foliage. That is why jungle fighters daub their uniforms with spots of green to match the jungle with the light filtering through and also why leopards are spotted. That is why the splotched uniforms in Fig. 33 blend with the rocks and make it hard to count the number of men. That is also the use of the sugar cane above the gun in Fig. 29. If you can make yourself look like your surroundings, you cease to be separately distinguishable, just as much as one of the pots in the circle of pots in Fig. 22 loses its identity.

The sniper in the spider trap of Fig. 34 is almost invisible because he matches his background. Only the circular end of the gun barrel

Fig. 33. CAMOUFLAGED UNIFORMS
The spotted uniforms of the men make them blend with the lights and shades of the rocks. It is not easy to count the thirteen men who show in this picture. (Photo from U. S. Army Signal Corps.)

Fig. 34. Spider Trap
The sniper matches his background, is almost invisible, except for the circular gun barrel, which stands out to an observer close enough to see it. (Photo from U. S. Marine Corps.)

stands out and gets attention from the observer close enough to see it. The soldier of Fig. 35 in a slit trench in the snow with a white cloth over him will also almost surely escape attention from a distance, even though the black shows contrasts with the snow, for the black might be a rock sticking through. Especially would this camouflage be effective if there were dark rocks showing in the neighborhood.

The advancing soldiers in Fig. 36 should follow the ravine where the trees and bushes are (right), not deploy over the hilltop (left). In the ravine they make nothing more than a few additional dark specks and do not show. In the field they stand out because they do not match their background.

In general, a column marching down a road with trees on either side should divide to escape attention, marching near the trees in two columns. Even though there are wide spaces between trees, the men will not show, but will pass for bushes or little trees. On the smooth road they do not match their surroundings at all.

III. Camouflage against cameras as well as eyes.

Camouflage is directed against counter-camouflage. Hence the camoufleur must keep in mind all the devices of penetrating camouflage and attempt to thwart them. Some of the techniques of counter-camouflage are discussed in the next section.

The most useful weapon to use against camouflage is the camera. Photographs give time for leisurely observation. Direct observation seldom does. Photographs do not fade as memory does. They are still there when the reconnaissance observer has become confused as to what he saw. Photographs show changes that occur from day to day, or month to month. They thus show new construction. Successive pho-

Fig. 35. Snow Camouflage
The soldier is on patrol in a slit trench in the snow and uses a white cloth to make himself match the snow. (Photo from U. S. Army Signal Corps.)

Fig. 36. Matching the Terrain
The soldiers deployed in the field are easily visible and attract attention. The soldiers following the ravine among the trees and bushes almost disappear, as if they were so many more bushes.

tographs from an airplane can be viewed stereoscopically and will then reveal depth. A patch on the ground then becomes a mound with gently sloping sides and may thus be recognized as a gun covered with a camouflage netting.

The infra-red camera is especially effective in penetrating the color camouflage because it will reveal differences in reflected light that are not apparent to the retina. Especially does this technique become important when ordinary green paint or dye has been used to match chlorophyll—the green coloring matter in leaves and grass. Ordinary green paint has in it a great deal of red light and very little infra-red light. Chlorophyll has in it very little red light and a great deal of infra-red light. If you match grass with common green paint on a runway, then, of course, they do match to the eye; but to the infra-red camera—the camera with film specially sensitized to infra-red light—the runway is dark, lacking the infra-red, whereas the grass is white, since the infra-red energy affects the plate, although not the retina.

In Fig. 37 there is shown at the left a spherical gas tank, which, although surrounded by trees, is fairly obvious. In the central picture the tank has been camouflaged—not with ordinary paint—but with special infra-red green paint, made to reflect light in the way light is reflected by chlorophyll. The tank is less obvious, although visible. The picture at the right is the infra-red photograph, in which paint and foliage appear as white and the tank is practically invisible.

The camoufleur must, therefore, use special paints if he is to fool the camera. If the paint reflects exactly the same wave lengths of light in the same proportions as does the object it is supposed to match, then no camera or eye will ever detect the difference on the basis of wave length or color. On the other hand, eyes are more numerous than cameras, and ordinary paint is more common than the special paints made to match special objects. It is better to use a camouflage that is not so good as the best than to use none at all.

COUNTER-CAMOUFLAGE

The most useful instruments for penetrating camouflage are intelligence and experience, used along with special training. The trained reconnaissance observer with good eyes can see what the novice misses. The photographic expert can often see more. If you know what certain camouflaged objects are apt to look like from the air and in photographs, then you may defeat the enemy's camoufleurs.

There are, however, certain special techniques of counter-camouflage, most of which have already been indicated in the preceding discussion. Here are the more important devices.

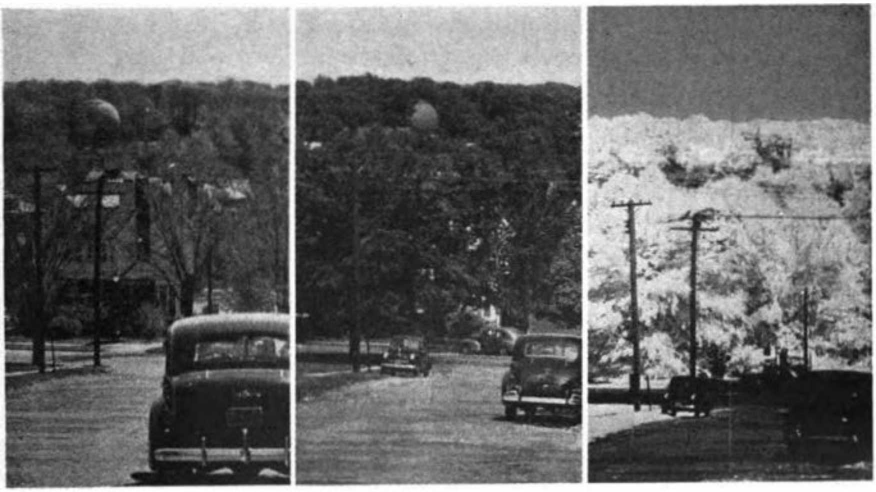

Fig. 37. Infra-Red Photography

Left: spherical tank with aluminum paint is obvious among the trees in any photograph. Middle: the tank with infra-red green paint is still visible but less obvious. Right: with infra-red paint the tank disappears in an infra-red photograph because both paint and foliage reflect enough infra-red light to appear white. (Photo from Science Service.)

(1) **Photography.** Even without the special photographic techniques, the observation of aerial photographs at leisure is apt to be better than direct observation during flight. There is time to examine a photograph carefully. The observer is freed of the emotions of combat or of possible attack. Although the range of his attention is limited to any one instant, he can use successive instants to study the whole field. What he misses another observer may see. For all these reasons a photograph is better than the fleeting original, even though it lacks color; and a photograph may have color, may reveal through haze more color than can be perceived by the eye.

(2) **Depth Photography.** By taking successive photographs of the terrain and combining them later in pairs that involve a desired parallax, it is possible in a stereoscope to see depth (see pp. 40-45). The depth can be magnified telestereoscopically so that it appears when unaided binocular vision would not have shown it. It can be exaggerated beyond reality. With a camera of 250 cm. focal length, correct depth is seen if the plane has flown a distance equal to a quarter of its height from the ground between the two photographs which are to be combined stereoscopically. A greater distance gives exaggerated depth.

Such observation reveals elevated camouflage even when its shadows have been eliminated by gently sloping sides or by masking them in other shadows. It can reveal the difference between real airplanes and dummies that lie flat on the ground.

(3) **New Objects.** When two photographs of the same terrain, seemingly identical but taken at different times, are available, then it is possible to discover whether any new object has been introduced in the region during the time that has elapsed between the takings of the two pictures, or whether any object that appears in both pictures has been radically altered in appearance.

The photographs are adjusted in a special instrument designed for viewing them alternately, and arranged so that the view of one can be instantaneously substituted for the view of the other. If nothing seems to move at the moment of substitution, there has probably been no large visible change in the field. On the other hand, if there has been a change, then something moves in the changed region, just as two different views of an object in the moving pictures give the perception of movement when one is shown instantly after the other. Movement attracts attention, is one of the very best conditions for getting attention. The observer will seldom fail to see such movement, even though he might not have found the change with hours of search by looking back and forth from one photograph to the other. Having found the suspicious place, he can then study the change in detail, trying to find out what the enemy has been doing.

The astronomers first used this method for discovering changes in the heavens. You cannot very often, by studying two negatives, each with thousands of stars showing on it, tell whether one new star has appeared somewhere. But, if one star among a thousand moves or flashes in where it did not exist before, then that movement will catch the eye at once. The astronomers then know where to look to find out more about something celestially new.

(4) **Long Shadows.** Observation in the early morning or late afternoon, when the sun is low, will reveal the long shadows from objects lighted from the side (see p. 86f). Especially by the comparison of photographs taken when the sun is high and when it is low can a great deal of camouflage be penetrated.

(5) **Filters.** An observer can wear goggles with colored filters in them, filters that will select the light that gets through them. He may thus detect differences in lights that match to the naked eye. An observer, wearing the special red goggles for dark adaptation (p. 59f) would see chlorophyll as brighter than ordinary green paint.

The use of goggles is not, however, recommended under ordinary circumstances because they reduce visual acuity and prevent the observation of other details. In general, it is better to use cameras with filters or infra-red film for these special analyses of color.

Filters can be used on cameras to enhance contrast, as every experienced photographer knows. Since contrast is one of the conditions for the perception of objects, this technique is good.

(6) **Infra-red Photography.** The use of infra-red photography has already been discussed (p. 92f). Although it is most effective in distinguishing between chlorophyll and green paint, it may also reveal other differences between objects that appear identical to the eye.

Infra-red photographs also show heat from chimneys which emit no visible smoke, for radiant heat is infra-red light.

In general, however, every camoufleur is a counter-camoufleur. If he knows what makes his tricks work, what are the rules for preventing the observer from seeing objects, then he knows also the conditions under which the rules will fail and the objects will be seen. The constant battle between the defense (camouflage) and the offense (counter-camouflage) is just as unending in this "arm" as in any other branch of warfare.

REFERENCES

Perception of Color and Objects:

1. E. G. BORING, H. S. LANGFELD AND H. P. WELD, EDS. *Introduction to psychology.* New York: Wiley, 1939. Pp. 652.
   Pp. 523-542 give an elementary account of color perception; pp. 552-555 of color blindness; pp. 420-433 of perceptual stability of objects; pp. 462-470 of the perception of size and shape.
2. J. H. PARSONS. *Introduction to the study of colour vision.* Second edition. Cambridge, England: University Press, 1924. Pp. 323.
   Part II, pp. 170-202, gives an extremely technical but full account of the phenomena of color blindness.
3. L. T. TROLAND. *Principles of psychophysiology.* Vol. 2, *Sensation.* New York: Van Nostrand, 1930. Pp. 397.
   Pp. 55-74 and 139-167 give a technical account of the psychophysiology of color.
4. R. S. WOODWORTH. *Experimental psychology.* New York: Henry Holt, 1938. Pp. 889.
   Clear discussions of the perception of color, pp. 539-544, 550-554; of color blindness, pp. 554-556; of color constancy in perception, pp. 595-622; of illusions and the perception of form, pp. 623-650.

Camouflage:

5. R. P. BRECKENRIDGE. *Modern camouflage.* New York: Farrar & Rinehart, 1942. Pp. 280.
   Principles and practice of military camouflage, well illustrated, the best popular book on the subject except the War Department's manuals (see below).
6. H. FRIEDMANN. *Natural-history background of camouflage.* Smithsonian Institute War Background Studies, 1942, No. 5. Pp. 17.
   All the principles of camouflage as they occur in nature for the concealment of animals.
7. E. SLOANE. *Camouflage simplified.* New York: Devin-Adair, 1942. Pp. 62.
   Camouflage of buildings in respect of color, texture, disruption, disguise, absorption of shadows, falsification, and duplication of objects.
8. WAR DEPARTMENT. *Technical Manuals* 5-20A to 5-20H. Washington: Government Printing Office, May 1, 1943. Supplements: June 1, July 1, August 1, etc.
   The best practical information written for Army Engineers and covering principles and practice, beautifully illustrated.

Chapter 5

The Ear as a Military Instrument

The ear serves primarily for communication. Listening to speech as it comes from the mouth of another man or from a telephone is the most important activity of coördination among men, units or armies. It is hard to see how the armed forces could make war if they had to depend solely on visible signals and written words.

Besides speech the ears transmit other information of military value. Sound can reveal both the nature of an object and its location. The enemy soldier, infiltrating through the jungle, may be heard when not seen. Unaided hearing is not a good range-finder, but it will tell whether the sound of a shell comes from the left, the right or in front. With special devices hearing can be used to locate by underwater sound the direction of submarines and ships. The ear, though it may be used less in warfare than the eye, is an essential weapon.

The fighting man should, therefore, know how his ears work, know their capabilities and limitations. He should know about deafness, how much it handicaps a man, what causes it, when it is temporary, when it is permanent, how it may be avoided. He should know how objects are located by sound, how tell-tale sounds can be masked, how to use his ears to the best advantage. These things are what this chapter is about.

NATURE OF HEARING

Sound as a Physical Stimulus. When there is a quick sudden movement anywhere, the event is apt to set up wave motion in the surrounding objects, waves which spread in all directions until they die out. That is *sound*—physical sound, the kind of sound that occurs whether there is anyone around to hear it or not.

Mostly sound spreads through air, because air is almost everywhere, in contact with everything. It travels at about the rate of 1,125 feet per second, or 750 miles per hour, depending on the temperature and humidity of the air. That rate is as fast as a very fast plane in a power dive, faster than the nerve impulse in a man, much slower than a bullet.

Sound will also travel through solid objects. When the Indians put their ears to the ground to hear galloping horses in the distance, they were making use of this fact. If a sound gets into the bones of the skull, it is heard without the intervention of the outer and middle ears, because the inner ear, where the nerve endings lie, is imbedded in the skull bones. In this way one ear may hear by bone conduction some of the sound that arrives through the air at the other ear.

Sound also travels through liquids. The swimmer with his head under water is disturbed by the vibrations which occur when someone else knocks two stones together under water. Submarines and other vessels can be detected by sounds that travel through water, and, with suitable apparatus, can be located as to their distance and direction. Underwater sound is an important subject of military scientific research.

In short, everything is a physical sound if it is a mechanical disturbance that could be transmitted to an ear and would excite the nerve endings for hearing if it were so transmitted. It does not matter how the disturbance gets to the ear. There are also other physical sounds that are inaudible—some of them too high in frequency ever to be heard by a human ear.

Analysis of Sound. The ear is an analyzing organ. To understand this fact we must understand something about harmonic motion and resonance.

The simplest way in which an elastic body, like the air, can vibrate is in the wave form of a sine curve, like the two upper curves, *C* and e^2, of Fig. 38. Such motion is called *simple harmonic motion.* A pendulum also swings in simple harmonic motion. If its motion back and forth could be traced across a moving piece of paper, it too would be a sine curve, like the two upper curves in Fig. 38.

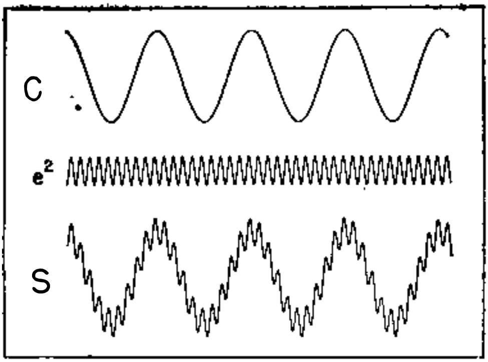

Fig. 38. Combination of Tones

C: wave form for tone of given frequency and amplitude. e^2*:* tone of frequency 10 times as fast as *C,* and ⅛ the amplitude. *S:* sum of *C* and e^2, wave form in air when the two tones sound together.

Very simple objects, like a pendulum, tend to vibrate in simple harmonic motion. A tuning fork vibrates thus if it is but lightly sounded. Most objects, however, are not simple and vibrate as if they were trying to respond with a number of different frequencies of simple harmonic motion at the same moment. A piano string, for instance, responds with fair intensity with at least nine simple harmonic motions all superimposed, one on another. The actual motion of the string is, therefore, the sum of all these motions. Fig. 38 shows two simple harmonic motions, *C* and e^2, with the frequency of e^2 ten times that of *C*. They might be the musical notes with these names, e^2 being three octaves and a third above *C*. If these two motions are present at the same time, you get in the air a wave *S* which is the sum of the two waves *C* and e^2. Fig. 39 shows an irregular wave form *S*, which is really the sum of six simple harmonic components shown in *H*.

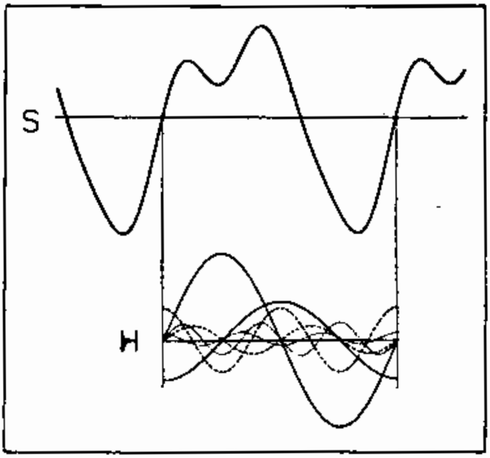

Fig. 39. Tonal Analysis of a Violin Note
S: complex wave form. *H:* the six harmonic components of *S*.

Any irregular wave can be analyzed into a number of simple harmonic components. You can trace on paper the profile of a girl's face, regard it as a wave form, analyze it into the sum of a large number of sine curves, and write the mathematical equation of the girl's profile.

There are three ways in which such an analysis can be accomplished. (a) It can be made *mathematically* if the wave form can be drawn on paper. There is a mathematical law which shows that such an analysis of an irregular wave is always possible, and that it is the only analysis that can always be made of any wave form. (b) It can be made *by resonance.* Resonance occurs when one object that has a natural rate of vibration begins to vibrate because impulses at its natural rate come to it from another object. A child's swing resonates to the pushes of a person on the ground if that person pushes at the right rate, always at the right moment. Pushes at a different rate will stop the swing. In the same way you can tune a resonator—an acoustic one or the electrical one on the radio—by altering its natural rate, so that it will respond to any particular frequency. By such tuning it is possible to analyze a complex sound into its components. One simply finds what frequencies, what tunings, respond to the sound, for every component in it will set up its separate resonance. (c) This same analysis can also be made, approximately, *by ear.* For an irregular wave, one may hear out all the separate components. That fact shows that the ear is acting as a resonating organ, that it responds separately to the various frequencies to which it is tuned.

Thus if *S* in Fig. 39 is a sound wave, the ear can hear each of the six tones shown in *H*. *S* was produced by a violin string. If *S* were an electrical wave, the tuning of a radio could pick out the six frequencies in *H* and no others.

Even when sound is not a continuous wave, but a sudden sharp disturbance of the air, like an explosion, the ear's resonators will react selectively to it and make it into a set of frequencies. A boom has low frequencies, mostly. A pop has high frequencies, mostly. The heard pitches correspond to the various frequencies. Booms, thuds and rumbles are low-pitched noises. Pops, cracks and hisses are high-pitched.

When a musical instrument, like a piano string, gives off a continuous sound, that sound, apart from accompanying noises, is a fusion of what are called *harmonics*. Strike low *A* on the piano. The string will vibrate as a whole, giving off the fundamental or first harmonic, which has a frequency of about 110 vibrations or cycles per second (cps). It will also tend to vibrate in halves at twice the frequency and thus to give the second harmonic at 220 cps. The higher harmonics—the third, fourth, fifth, etc.—represent frequencies of vibration of 330, 440, 550, etc. The tenth harmonic is 1,100 cps. All these rates are superimposed in a complex wave on the string and in the air, but resonators will pick them out separately. The ear, acting like a system of resonators, will also be able to hear them separately. These harmonics correspond to the notes called A, a, e^1, a^1, etc. The second harmonic is an octave above the first, the fourth an octave above the second, and so on—for doubling the cycles per second always increases the pitch an octave.

A simple harmonic wave in the inner ear would probably give a pure tone; but pure tones are almost never heard, because the ear itself puts in harmonics even when the outside tone is pure. All musical instruments give off fusions of harmonics. Almost everything else gives mixtures of frequencies that are not harmonic to each other. Nevertheless, because the ear is an analyzing organ, we can best describe the effect of a sound upon it by analyzing the sound into the frequencies which it combines, whether the frequencies be harmonics or not.

The low-frequency tones have long waves, the high-frequency ones have short. Long waves can bend around objects more easily than short. Short waves tend to go straight. It is, for example, the short radio waves that can be beamed to a particular place on the face of the earth, because they do not bend so easily as the long waves. In sound this principle means that the low pitches usually travel farther than the high, which do not bend so easily around intervening objects. The noise of an airplane close by contains many high frequencies and is deafening and uncomfortable, partly because it is so loud and partly because these high pitches are especially unpleasant. At a distance, however, the noise becomes simply a low roar or rumble; the sound is not so loud and the high pitches get obstructed by objects. In fact, the pitch of a familiar sound may give some indication of how far away the sounding object is—the lower the pitch, the farther the object.

Sound as What is Heard. Because the ear is an analyzing organ, what we hear is always tones and complexes of tones.

Tones have two attributes: (a) *pitch,* the highness or lowness of the tone, and (b) *loudness,* its strength or weakness. Pitch depends almost entirely on the frequency of the vibrations (cycles per second), being altered only slightly by change of energy when frequency is unchanged. The high tones have rapid frequencies, the low tones slow. Loudness depends primarily on the energy of the tone and thus on the amplitude (height) of its wave, but it also depends on frequency, because two differing frequencies of the same energy do not have the same loudness. This relationship is discussed later.

Complexes of tones have what is sometimes called (c) *quality,* a recognizable difference that is, in a musical note or a human voice, dependent on the degrees in which the different harmonics are present. An oboe differs from a flute in the pattern of harmonics that every note has.

Noises are complex combinations of inharmonic component tones. Some noises are *continuative,* like roars, rumbles, rattles, murmurs, screeches and hisses. Other noises are abrupt and short-lived, *explosive* noises, like the booms, thuds, bangs, cracks and pops. All these noises in both lists have approximate pitches, ascending in pitch in the order named. Roars and booms are low, hisses and pops are high.

The components of tonal complexes *blend* with one another, when the components are harmonic and also when the complexity of combination is so great that analysis becomes difficult or impossible. Notes from musical instruments are combinations of harmonic components so well blended that analysis by ear is difficult although possible. Noises, both continuative and explosive, show how complexity of the combination of inharmonic components makes precise analysis by ear impossible.

The Tonal Stimulus. Not all frequencies can be heard. The eye responds only to a limited range of light waves; similarly the ear responds only to a limited range of sound waves. It is somewhere near the truth to say that frequencies below 20 and above 20,000 cycles per second cannot be heard. Very weak tones lie below the intensity threshold, lack enough energy to be heard. Very loud tones make the ear uncomfortable by producing a feeling of pressure in it or even causing pain. Still more energetic stimulation may injure the ear.

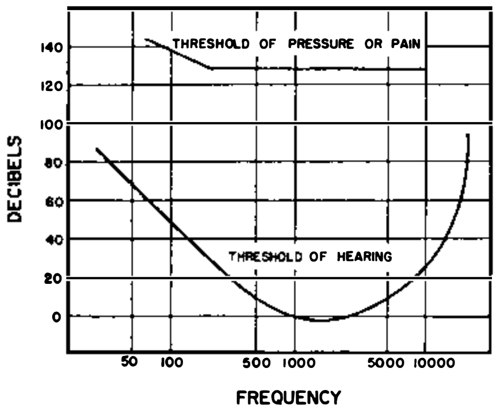

Fig. 40. AUDIOGRAM

The lower curve shows what energy of sound (decibels) is just audible (the threshold) at the different frequencies. The upper curve shows at what energies pressure or pain begins to be felt in the ear.

These facts all appear in Fig. 40, an *audiogram* which illustrates the range of audible frequencies plotted across from left to right and the energies of the tonal stimulus vertically. The frequencies are in cycles per second (cps), the energies in decibels (db). The decibel is a ratio-unit, so arranged that when you double the energy of a sound it is increased by about 3 db, no matter whether the original sound is faint or loud. In this scale zero (0 db) is taken very near the least energy that can be heard, the *threshold.* As a matter of fact, the decibel is a convenient unit because it represents very nearly, at any energy, the smallest difference in loudness that the ear can sense.

The curve at the bottom of Fig. 40 is the threshold curve, the function that shows the least number of decibels that can be heard at every audible frequency. This is really a sensitivity curve for the ear, like the sensitivity curves for the cones and rods of the eye in Fig 13 (p. 56). The ear's greatest sensitivity lies in the middle of its range of hearing, near 3,000 cps. Lower and higher frequencies require more energy if they are to be heard; the curve rises, though at different rates, on each side of the minimum. The limits of hearing are placed near 20 and 20,000 cps because at these frequencies the energy must be great to induce a sound, and may need to be so great as to elicit a pressure sensation or pain before it induces any sound. It is apparent that the threshold for energy and the limits of audible frequency are thus interdependent.

The upper curve in the figure shows approximately the energy which elicits pressure or pain. Energies greater than this upper threshold are uncomfortable, and much greater energies become injurious. All the pitches and loudnesses useful in ordinary hearing thus lie in between these two curves. There are about 300,000 of them. Deafness is measured by determining what percentage of these 300,000 tones the deaf person can hear.

It requires amazingly little energy to create an audible sound in the region of frequencies where the ear is most sensitive. At about 3,600 cps the threshold is so low that sound remains audible when the eardrum moves only one-thousandth of a millionth of an inch. If the threshold here were but ten decibels lower than it is, the tiny movements of the molecules of the air could actually be heard.

The limits of audible frequencies are not exact and they change with age. The range gets less as a man gets older. Especially does the upper limit diminish with age. A young man of twenty may, if he is somewhat exceptional, be able to perceive a frequency of 24,000 cps, provided it is intense enough. By the time he is thirty or forty his limit will have dropped, perhaps to 18,000 or even 16,000, a limit that is still far above the upper range of the musical scale and adequate to all speech sounds. At fifty his upper limit may be down to 10,000 cps, and then he may begin to have difficulty in hearing certain sounds and occasionally in understanding speech. When his limit is still further decreased with age, he is likely to have difficulty with the *s*-sound, which requires frequencies near 8,000. He may, indeed be able to hear only as well as a good ear hears over a poor telephone or dictaphone, which transmit high frequencies badly and are apt to chop the *s* off a plural.

Some animals can hear frequencies much too high to be heard by people. There are "silent" whistles for dogs, whistles silent to people but perfectly audible to dogs.

Bats guide themselves around in dark caves by these humanly inaudible sounds, and even avoid wires stretched across the course of their flight in the same manner. The bats in flight continuously utter cries which are too high in pitch for the human ear to hear, and the echoes of these "supersonic" sounds from walls and other obstacles are heard by the bats, enabling them to avoid collisions. Similarly, a blind man avoids obstacles by constantly snapping his fingers or tapping on the ground with his cane, taking account of the echoes. In the same way "supersonic" sounds are sent out under water by ships, a beam of inaudible noise from an acoustic searchlight. If an echo comes back, it indicates the presence and direction of some underwater object, like a submarine.

PHYSIOLOGY OF HEARING

The organ of hearing has three parts—the outer ear, the middle ear, and the inner ear, which includes the cochlea and the semicircular canals (see Fig. 41).

The *outer ear* consists of the external shell and the auditory canal which leads into the eardrum. The shell is aimed forward. Sound, caught by it, is directed along the auditory canal to the eardrum. The drum vibrates in response to it.

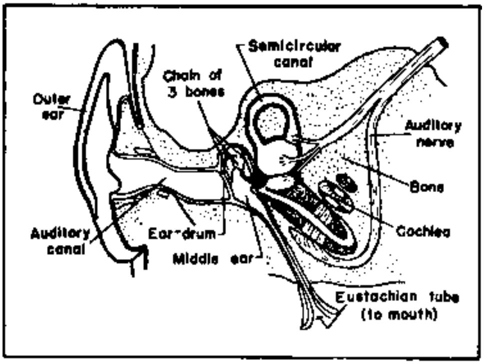

Fig. 41. Human Ear
The cochlea and semicircular canals constitute the inner ear.

The *middle ear* is an open cavity, filled with air and connected with the back of the mouth by a tube, the Eustachian tube (Fig. 41). This tube is normally closed by the elasticity of its tissues, but it opens, ordinarily when a person swallows or when there is a great difference in air pressure between the middle ear and the outside. The tube is closed most of the time in order to prevent infection from reaching the middle ear, causing earache and, in extreme cases, mastoiditis. It opens to adjust differences in air pressure. Persons ascending or descending in an airplane swallow voluntarily, or else they chew gum to make themselves keep swallowing, so that the air pressure on the two sides of the eardrum can be constantly equalized. Unequal pressures are uncomfortable and also diminish the sensitivity of hearing.

A person expecting a loud explosion—of a bomb or a gun—does well to keep his mouth open so that the pressure of the explosion can operate almost simultaneously on both sides of the eardrums—through the auditory canal and through the Eustachian tube. That lessens the chance of the drum's being ruptured.

Bridging the middle ear there is a chain of three small bones, called

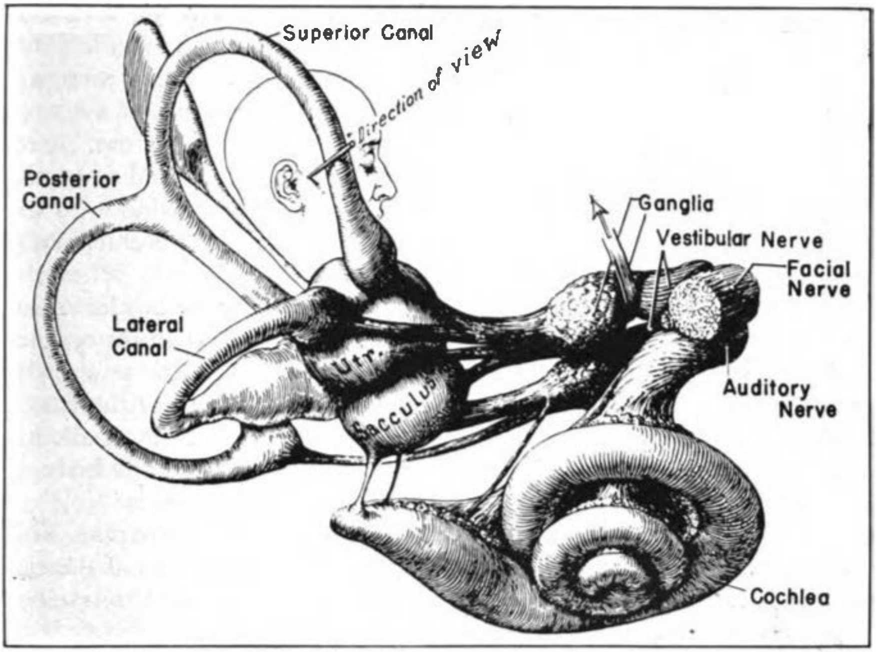

Fig. 42. Inner Ear

Cochlea, vestibule (utricle, saccule), three semicircular canals, auditory and vestibular nerves. (Adapted from Max Brödel and reproduced by permission of Stacy R. Guild. From Mary Hardy, "Observations on the Innervation of the Macula Sacculi in Man," *Anat. Rec.*, 59: 403-417, 1934.)

ossicles. They act mechanically to transmit the vibrations of a sound from the eardrum to the oval window of the inner ear. Attached to these bones are two small muscles, which pull against each other in such a way as to adjust hearing for different intensities of sound. These muscles thus help to protect the ear from very loud sounds, and also to sensitize it for very faint sounds. They are the listening muscles, the muscles which give rise to the feeling of straining when one listens intently for an expected faint noise.

The *inner ear* consists of the semicircular canals and the cochlea (Figs. 41, 42). The semicircular canals have no auditory function. They aid balance and mediate the perception of bodily rotation. Their function is considered in Chapter 7.

The *cochlea* is so called because it resembles a snail shell. It consists of a tube, a long cavity, coiled in a spiral of two and a half turns. This "tube" is divided into an upper and lower half by a partition that is partly bone and partly membrane—the basilar membrane (see also Fig. 43).

At the base of the cochlea, between it and the middle ear, there are two windows, each covered with a membrane. One is the *oval window,* which is the means whereby sound usually enters the inner ear. It receives the vibrations from the third of the three ossicles and transmits them to the upper half of the cochlear tube. The other window is the *round window,* which lies between the lower half of the cochlear tube and the middle ear. The cochlea is filled full with a liquid. When the ossicles press the oval window in, the liquid presses the basilar membrane down, and that presses the round window out. When the ossicles pull the oval window out, the basilar membrane is pulled up and the round window is pulled in. If the round window were not there as a means of physical relief, the oval window could not move at all, for the ossicles would be pressing through it against an immobile body of liquid.

The nerve-endings lie in cells that rest on the basilar membrane. This membrane is essential to the resonating, analyzing mechanism of the ear, the mechanism that resolves complex waves into component tones. The membrane is about 30 mm. long, narrow at one end, broader at the other. It is kept taut by a ligament that persistently pulls upon it crosswise. The narrow end of the membrane is at the large end of the cochlea, near the middle ear. The broad end of the membrane is at the small tip of the cochlea (see Fig. 43).

In general, it appears that the basilar membrane acts like a series of resonating stretched strings. The short fibers that run across the narrow end of the membrane respond by resonance to high frequency tones. They respond thus because they are short, because they are the most taut, being stretched by the largest part of the stretching ligament, be-

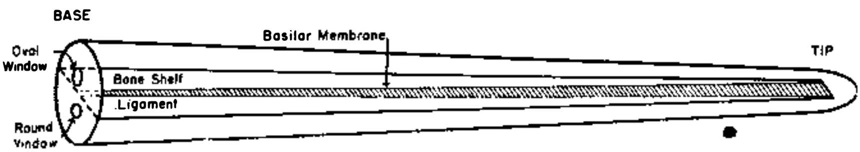

Fig. 43. Schematic Diagram of the Cochlea

The cochlear "tube," much simplified, is shown unrolled from its spiral of two and a half turns. The horizontal partition across the tube consists of the the basilar membrane, attached on one side to a bony shelf, and stretched on the other by a ligament. The long cross-fibers of the basilar membrane are at the tip of the cochlea, the short fibers at the base. The nerve-endings are not shown; they lie in cells that rest upon the basilar membrane. Sound vibrations, entering at the oval window, displace the basilar membrane and the round window. Another membrane, above the basilar membrane, is omitted from the diagram.

cause, being near the base of the cochlea, they are but lightly weighted by the volume of liquid that has to be moved in order to make them move. On the other hand, the long basilar fibers are adapted to resonate to low frequencies, because they are long, because they are under less tension, having only a small ligament to stretch them, because, being up at the tip of the cochlea, their movement is weighted by the entire mass of liquid in the cochlea. It is well known that injury to the base of the cochlea, where the short basilar fibers lie, produces deafness to high tones. It is not so clear that injury to the tip of the cochlea always produces deafness to low tones.

Presumably this account of the operation of the inner ear is too simple. Low tones seem to spread in their action pretty well over the entire cochlea. All the parts of the inner ear work together in determining resonance. Nevertheless, this picture of cochlear action is close enough to the truth to give understanding of the essential facts of hearing.

Now what happens when a sound is heard? Suppose that two tones sound at once. They might be a *C* and the e^2 that is a little more than three octaves above it. That would put in the air a sound wave like the one labelled *S* in Fig. 38. The eardrum, the ossicles, the oval window and the round window would vibrate like *S* in the figure. Almost certainly some extra harmonics would get added in the middle ear, but we can ignore them. The basilar membrane would, however, vibrate differently at different places (see Fig. 43). One part, tuned to the frequency of *C* in Fig. 38, would respond with that frequency and stimulate the nerve-endings that lie adjacent to it. Another part, somewhat nearer the base of the cochlea, would respond with the frequency labelled e^2 and stimulate its own set of nerve-endings. Each of the component tones would thus be put onto a different set of nerve fibers, and the brain, taking account of this difference, would set up the perception of a fusion of two quite distinguishable tones.

DEAFNESS

Rupture of the eardrum may produce slight deafness, or, if the rupture is great, considerable deafness. Complete loss of the drum may reduce hearing by 20 db; that is to say, the threshold of hearing is increased 20 db. Still a 20-db diminution of hearing is not so great as to be very serious. Loss of the ossicles in the middle ear along with the eardrum may cause more serious deafness, yet even that does not entirely destroy hearing. A man can get along with the sounds impinging directly on his oval window.

Injury to the cochlea, the basilar membrane or the nerve-endings in the inner ear, by accident, disease, deterioration in old age or stimulation by prolonged loud sounds, causes deafness, which is apt to differ for different frequencies of sound. Injury to the base of the cochlea makes trouble for high-pitched tones, to the tip for low-pitched tones.

The audiogram of Fig. 44 describes three cases of deafness. Each curve shows in decibels the hearing loss at different frequencies. Total loss of hearing at every frequency is represented on this diagram by the dotted line which resembles the threshold curve of Fig. 40. A person with "total" loss of hearing never hears any sound without pain or discomfort—his loss is the total loss of comfortable hearing. Case *A* in Fig. 44 has a loss of about 10 db for frequencies up to 500 cps, and almost normal hearing for higher tones, except that there is considerable loss above 8,000 cps. Such a man would not be called "deaf." Case *B* is an old man. For him there is some loss for the low tones, more for the middle pitches, and then, above 2,000 cps, a great falling off. Frequencies well above 4,000 he cannot hear. This man would have trouble with the *s*-sounds, in distinguishing plurals from singulars. He

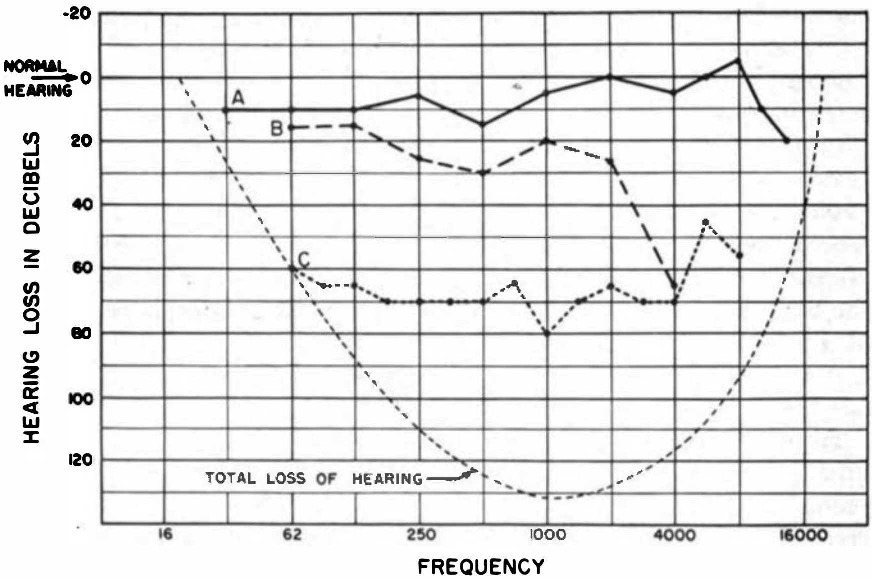

Fig. 44. Audiogram for Deafness

Three cases of deafness, showing loss of hearing in decibels for different frequencies. The loss is more apt to be for the high tones, and is accompanied by a lowering of the upper limit of hearing.

must have some degeneration of the organ of hearing at the base of the cochlea. Case *C* shows very serious deafness throughout the range of hearing—from 60 to 80 db. Actually this deaf person does a little better with some of the high tones, but not well with any.

Curves of hearing loss in old age often show a dip in the region of the high tones. Not only is the upper limit of hearing reduced, but there is also a region of deafness somewhere below the upper limit. Tones higher than this region as well as lower can be heard, but tones falling within the region cannot be heard unless they be very intense. Such a region is called a *tonal gap,* and the limited stretch of audible frequencies above the gap is called a *tonal island.* It is very easy to demonstrate such deafnesses with old people. There is actual deafness in the region of the gap for faint tones, although loud tones at these frequencies may be heard.

Long continued or repeated exposure to loud sounds may cause permanent deafness by injuring the mechanism of the cochlea. Boilermakers and flyers frequently suffer in this fashion. Animals exposed for days to deafening sound show, when their ears are examined microscopically after death, cochlear injury. The injuries tend to occur near the base of the cochlea when the deafening sound has a high pitch, further along toward the tip for lower pitches.

Continued loud sounds—in an airplane or a tank—may cause temporary deafness for a few hours or days. Fig. 45 shows what happened after half an hour's exposure to airplane noise. If the airplane noise is 100 db above the normal threshold of hearing, the loss is slight—only a few db in the region of 1,000 to 5,000 cps, although 100 db is a loud noise. If the noise is 110 db, the loss is much greater, and at 120 db, still greater. All frequencies above 1,000 are seriously affected. The loss is greatest between 2,000 and 8,000. At first the man exposed to these noises is badly deafened. He cannot, even in quiet, understand speech, unless the speaker shouts. He is deafened most for sounds of little and moderate intensity, although he can hear the shouting quite well. After half an hour, however, if he has had only this single exposure, his hearing will have recovered half way to normal. After a day he will be all right again.

The effect of gunfire upon hearing depends on the position of the hearer in relation to the gun. If a big gun is being fired and the hearer is near the muzzle and a little to one side in advance of it, he will never hear anything again. His eardrums will be ruptured, his ossicles wrecked, his cochlear mechanism permanently injured. In this position the pres-

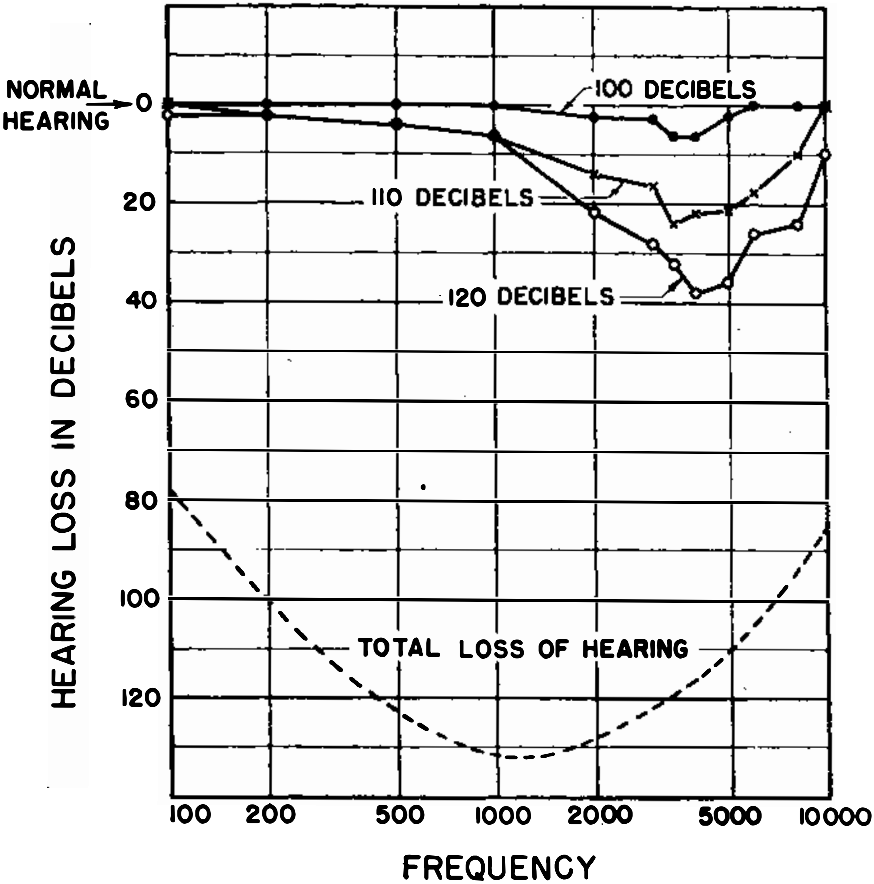

Fig. 45. AUDIOGRAM FOR TEMPORARY DEAFNESS DUE TO EXPOSURE TO AIRPLANE NOISE

Temporary loss of hearing in decibels for a half hour's exposure to airplane noises of 100, 110, and 120 db above the threshold. The man is at first seriously deafened by 110 and 120 db, recovers half his normal hearing in half an hour, all of his hearing in a day.

sure of the sound on the eardrum is tremendous, about forty-five times the normal pressure of the atmosphere. If the hearer is farther away, he may get off with only a ruptured drum and temporary deafness of the inner ear. Still farther away he may experience nothing but the temporary deafness, like that which follows an exposure to airplane noise.

The man behind the gun is in a more advantageous position, for the sound pressure is not so great there and the gun-shield may also protect him somewhat. He is, moreover, expecting the noise, will have opened his mouth to help equalize the pressures on the two sides of the drum, will have adjusted his middle-ear muscles for loud sounds. Nevertheless, he will do well to wear earplugs or to put cotton in his ears, and thus to avoid the temporary deafness that would otherwise occur.

Earplugs are a great aid, not only for gunners, but also for the men in airplanes who do not wear the headsets of a communication system. It is best for all the men in a gun crew to wear the plugs, for, if some wear plugs and others not, the men with the plugs may not hear the commands or speech of the men without them, since the men without them, hearing easily, will almost inevitably forget to shout. A man with plugs in his ears never forgets to shout. He wants to hear himself talking and he has to shout to hear himself.

In an airplane you can hear shouting better with plugs in your ears than without, strange as that may seem. With no plugs the shouting may be loud enough to reach the threshold for pain, and no man wants to shout loud enough to hurt himself. The plugs in the listener's ear, moreover, keep the loudness of the sound down in the region where the ear responds best to differences in intensity. Sounds near the pain threshold tend to lose precise differentiation. So the plugs throttle both the airplane noise and the shouting down to a reasonable loudness, and, if the shouting is almost as loud as the airplane noise, it can be easily understood.

In general, speech can be better understood above such loud continuous noises as those of airplanes and of machine guns when the ears are plugged than when they are unplugged. Stick your fingers in your ears if you want to hear speech in a racket! For the same reason deaf people can often hear better in the noise of a subway than can people with normal hearing. A "deafening" racket may actually undeafen the deaf!

Men sometimes fake deafness in order to avoid being drafted or to escape some unwelcome assignment. That is one form of what is called *malingering.* It can usually be detected by tests.

A man attempting to simulate deafness usually claims that one of his ears is deaf and that he can hear fairly well with the other. Otherwise he cannot explain why his deafness has not been noticed by others. Let us say that a man undertakes to simulate deafness in his left ear. The examiner blindfolds the testee, takes a tuning fork and determines at what distance from the man's right ear the fork can just be heard, a threshold distance. He then tries this procedure with the left ear, but the testee, of course, says that he does not hear it at all with that ear.

Next the examiner holds the sounding fork quite near the left ear. The testee hears it but says he does not. Then he holds a second fork of the same frequency opposite the right ear, nearer to it than the threshold distance, farther away than the fork on the left side. The testee now actually hears one single tone, which he localizes on the left side. Thinking that all the sound comes to the left ear, he says that he hears nothing. If he were truly deaf in the left ear, he would be hearing the fork at the right ear and would say so. This test depends on the fact that if two tones of equal frequency enter the two ears at the same time, the hearer hears a single tone, which seems to come only into the ear on the side of the louder fork.

There is also *hysterical deafness.* Men who suffer from war shock may develop peculiar symptoms. They may become deaf, or blind, or anesthetic in some part of the body, or paralyzed. The blindness may affect one eye or both, the deafness one ear or both. Such deafness does not follow simple physiological laws, but rather the laws of emotion or fear. A hysterical person could be deaf to the sounds of guns and yet hear voices perfectly well. He might even be unable to hear the voice of an officer and yet hear the speech of his own father. Hysterical deafness always seems as if it were faked, but actually its victim cannot help himself. He is at the mercy of his emotions and fears, is a victim of war shock. This matter is discussed later (pp. 360-362).

COMMUNICATION

Besides deafness there are three things that interfere with the accurate communication of oral speech: (1) the simultaneous presence of noise that masks the speech sounds; (2) the limitations of transmission through telephone systems; (3) the characteristics of certain speech sounds themselves.

Masking. Loud sounds tend to drown out faint. When the mechanism of the inner ear is occupied with the large vibrations that the loud sound sets up, the minor fluctuations, superimposed by the weak sound, are relatively ineffective.

Sounds of one frequency, while they may reënforce other sounds of the same frequency, tend to mask or drown out sounds of other frequencies, having the most effect on sounds of very similar pitches, more effect on higher pitches than on lower. These facts are shown in Fig. 46, which charts the number of decibels by which the threshold of hearing is raised at every frequency in the presence of masking tones of

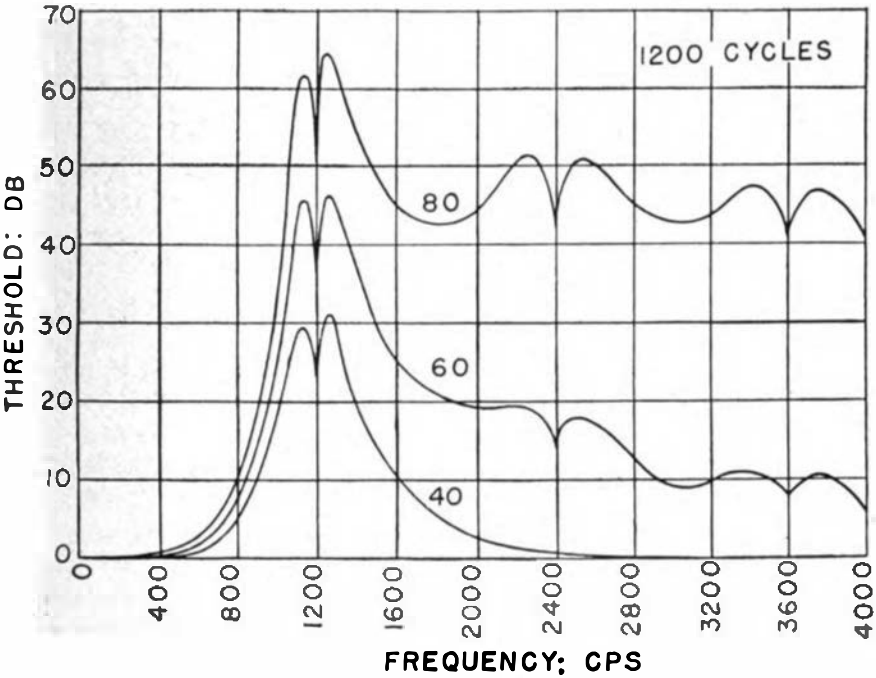

Fig. 46. Masking of Tones

The number of decibels by which the threshold of hearing is raised at every frequency by a masking tone of 1,200 cps at intensities of 40, 60 and 80 db. (Adapted from Wegel and Lane, *Physical Review*, 1924, vol. 23, p. 271, by permission.)

1,200 cps at 40, 60 and 80 db. It is apparent that the masking tone of 1,200 cps has a greater effect the louder it is, that the effect is greatest in the region of 1,200 cps, that the masking diminishes rapidly for lower frequencies, becoming almost zero at 400 cps, that the masking continues in considerable degree (greatest for the loudest masking tone) at the higher frequencies throughout two octaves. The figure also shows that the effect is diminished somewhat for the harmonics of 1,200, *i.e.,* for 1,200, 2,400 and 3,600 cps.

In other words, you cannot converse inside a tank or a plane, where the low-pitched rumble or roar drowns out the higher pitched sounds of speech. On the other hand, it would take a very great many crickets to mask an ordinary conversation.

Fig. 47 shows what airplane noise does to speech. It shows the normal threshold of hearing in quiet and the threshold of pressure or pain,

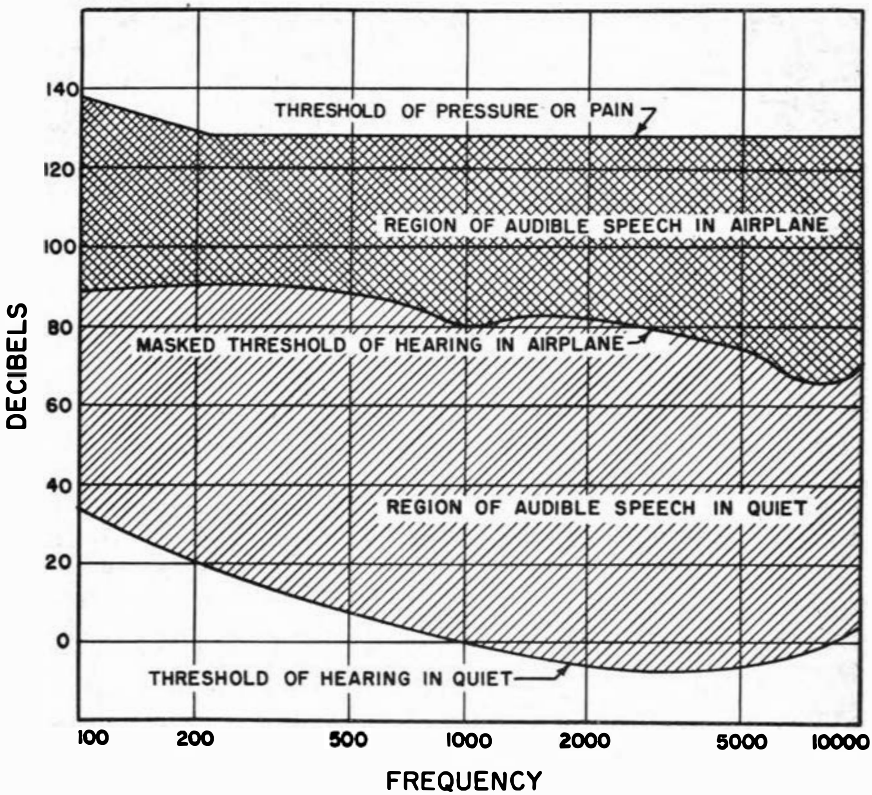

Fig. 47. Masking of Speech by Airplane Noise

The threshold of audible speech in quiet is raised 80 to 90 decibels by an airplane noise, and the number of intensities at which frequencies are audible is greatly diminished.

and it shows how the masking airplane noise moves the threshold for audible speech up 80 or 90 db. The loudnesses at which speech is audible in a plane are much fewer than the audible loudnesses in quiet.

For this reason other means of communication have to be substituted for ordinary speech inside planes, tanks and gun turrets. Visual or tactual signals can be used, or the soldiers' or sailors' ears can be protected from the din by telephone receivers which shut out the noise and put the speech sounds directly into their ears. We have already noted that plugging the ears may help the understanding of speech (p. 111). In the noises of battle visual arm signals are used. In a tank the gunner communicates with the driver by pressing him with his foot.

A man with a bass voice may use frequencies as low as 90 cps in speech. A woman's shrill voice may go as high as 300 cps. Both voices, however, also include much higher harmonic frequencies. Component tones as high as 3,000 cps are common, and certain consonants and vowels involve important frequencies near 4,000 and higher. These higher components are important for the intelligibility of speech. If all the frequencies below 500 cps are cut out, then you have eliminated the fundamental tones of all voices, yet their speech remains intelligible. Understanding is reduced by only two per cent. On the other hand, if the frequencies above 1,500 are eliminated, then intelligibility is reduced about 35 per cent. Since masking tends to affect the higher frequencies most, a low-pitched noise seriously disturbs communication, even when it is not very loud.

Telephonic Communication. Telephonic communication is used when distance or masking noise makes ordinary speech inaudible or insufficiently intelligible. There are telephone systems in ships, tanks and planes. Outside there are field telephones and the walkie-talkie.

The telephone tends to cheat on high frequencies, and a poor receiver is worse in this respect than an expensive good one. If intelligibility of speech is reduced 35 per cent when frequencies over 1,500 cps are eliminated, it is plain that a telephone must transmit frequencies of 2,000 and 4,000 if it is to work well.

The hiss of *s* depends on frequencies in the neighborhood of 8,000 cps. Thus *s*'s often get in trouble over telephones, and you may get a tank when you wanted tank*s*. High frequencies are also necessary for *th*; *z, t* and *f* also require high frequencies, although not frequencies as high as *s* and *th*. A telephone that obscures *s, th, z, t* and *f* is not a good means of communication. Intelligibility would be greatly reduced by these failures alone.

The vowels are characterized by certain pitches which are put into the total voice by the mouth cavity; that is to say, the mouth cavity adds them on to the fundamental pitch which is determined by the vocal cords. Fig. 48 shows what these pitches are for the five important vowel sounds, *oo, oh, ah, ay, ee.* Say *oo-oh-ah-ay-ee* and you hear the pitch go up. It goes up even though you sing the series with descending pitch. Sing *ee-ay-ah-oh-oo* and you hear the pitch of the vowels go down, even though your voice goes up in singing them. That is proof enough of the pitch of vowels. You can, moreover, realize that the mouth cavity gets smaller as you go through the series from *oo* (mouth large, tongue lowered) to *ee* (mouth small, tongue near the roof).

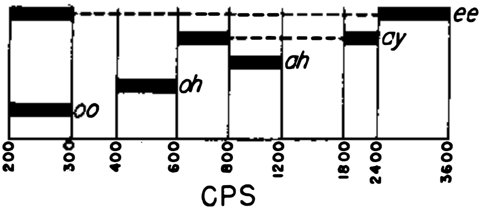

Fig. 48. Pitches of Vowel Sounds

Pitch regions characteristic of five vowel sounds as determined by the mouth cavity in speaking. Two sounds, *ay* and *ee,* are double vowels, require two characteristic resonances, which are joined in the chart by a broken line. There are other vowel sounds; for instance, *aw* lies between *oh* and *ah;* and *i (high)* is a dipthong, *ah-ee.*

It appears, moreover, from Fig. 48 that *ay* and *ee* are "double vowels," that they require two pitches, a low and a high. In fact, *ee* needs the same pitch as *oo* with a high pitch added. The consequence is that *ee,* heard over a poor telephone, may have the frequencies above 2,400 pretty well cut out, so that it turns into *oo.* Telephone operators, for this reason, are taught to trill the *r* in *three* for, if the *ee* turns into *oo* and the *th* gets confused with *t,* then *three* will sound like *two* unless the *r* provides the difference.

One of the engineering tasks of the Second World War has been the building of good telephone receivers that will transmit speech faithfully and yet are small enough to be put in the tiny space available inside a helmet.

Telephone commmunication is so important on battleships and in bombing planes that both the Navy and the Air Forces use tests for determining the intelligibility of different talkers over intercommunication systems and prescribe training for less intelligible talkers. The Captain's Talker on a battleship has a very important function to fulfill, and on bombers all members of the crew communicate only by telephone. The tests consist of telephone interviews and the rating of the men in respect of those characteristics of good speech which are listed in the next section of this chapter. The training consists of instruction in articulation, rate of speaking, loudness of speaking, and the position for holding the microphone.

Speech Sounds. Speech sounds differ in intelligibility. They have to be tested and rated—for ordinary communication, with masking noise, over telephones. While it is possible to test them by asking a man questions and seeing whether sensible answers result, it is much more useful to work analytically, getting testees to write down the particular sounds, syllables and words that they think they heard. Then one can subtract the number of their errors from the total number of sounds or words, and compute a percentage of intelligibility.

We have already seen that certain consonants and vowels get into trouble when high frequencies are masked or when they are eliminated by telephone receivers.

Military communication often uses code words to convey important information, and such words need to be spelled out in order that there shall be no error in transmission of information or orders. Spoken letters of the alphabet are not safe from confusion, as everyone knows. It is better to use a word that begins with the letter. "H as in Henry; T as in Thomas." Considerable research has been undertaken to find the best words, the least unintelligible ones. Good words are *Adam, Baker, Charlie, Dog, Easy,* etc. The armed forces have now, however, better words than these, words which cannot at the present time be printed in this book.

Numbers should be said digit by digit, and each digit should be pronounced in the best way. *Zero* is better than *oh. Nyner* is better than *ni-yen* for nine. And so on through the list. Over the telephone, the best word sometimes depends on the kind of transmitter or receiver used.

In the same manner it is possible to prepare vocabularies of especially intelligible words for use in communication, particularly in code. No word is ever 100 per cent intelligible, though some rate as high as 96 per cent. Here are nine words whose intelligibility over a military telephonic system ranges from 90 to 10 per cent.

90 agree	60 tower	30 ranch
80 equal	50 court	20 bimbo
70 puppy	40 creak	10 voile

These differences cannot be reduced to general acoustic principles. The particular words have to be tested out under particular conditions.

In general, intelligibility depends upon seven factors:

(1) The *speaker,* his educational level, his dialect, the country or region of the country to which he is native. The speaker must also be considered in relation to the listener. American speaking to American or Briton speaking to Briton is more intelligible than Briton speaking to American or American speaking to Briton.

(2) The *listener,* his dialect, his educational level, his native region, as well as his relation to the speaker.

(3) The *context.* It is a familiar experience that context determines intelligibility. Sometimes a sentence remains for several seconds quite

unintelligible, and then suddenly the context works and the listener knows what words have been said.

(4) The *communication system.* Ordinary speech near and at a distance, good and bad telephone receivers, different kinds of microphones, all make a difference. Words that are maximally intelligible in one system may not be in another.

(5) The *background noise,* its loudness and its pattern of frequencies, both of which determine its masking properties for various speech sounds.

(6) The *loudness of the speech.* Very faint and very loud speech are less intelligible, but there is a wide range of optimal loudness between the extremes. Speech of intensity from 10 to 60 db, with a quiet background, is intelligible. The optimum is near 60 db. Below 10 db speech can be heard, but intelligibility drops off rapidly. Above 70 db the capacity of the ear is getting saturated and discrimination is poorer. Against a 120-db noise, however, optimal intelligibility lies at about 110 db.

(7) The *rate of speaking.* Intelligibility is less if speech is too fast or too slow. The best rates lie between 120 and 150 words per minute.

EFFECTS OF NOISE

A sudden new noise commands the attention—the report of a gun or even the crisp command "AttenTION!" A loud continuous noise tends to compel attention until the hearer gets accustomed to it. Thus noises tend to act as distractions, although the effort to resist attention to them or to do something about them may actually turn them into stimulants. Whether they distract or stimulate, they are apt to produce, if long continued, effort and consequently fatigue. For similar reasons they get themselves associated with the emotional states of war shock and other neuroses and can bring on emotional seizures in those patients for whom the proper treatment is "rest and quiet."

Distraction. To a loud sudden noise, like a pistol shot, every normal person gives instantaneously the startle response, an inherited automatic set of movements that come in a fraction of a second, before the person knows what he is doing or can exercise his will about the matter (see p. 381 and Fig. 85). The pattern is inherited. Even an infant blinks at a loud sound.

Sound has, then, this attention-getting power. When the sound is new and sudden its effect is irresistible. On the other hand, long continued sounds, which do not indicate danger, lose their power as attention-getters. The fighter pilot presently forgets the noise of his plane just as fully as the steel worker in a rolling-mill ceases to notice the roar of the mill.

Some high-pitched sounds have especial attention value. The hiss of a stream of air will throw a rat into a special kind of convulsion —*audiogenic seizures* they are called. It is hard to ignore a locomotive whistle that has got stuck, hard to work with someone crackling wrapping paper in the next room. It is also very difficult to ignore a scream, but then a scream means pain or terror and thus, by implication, danger.

Any attention-getter is a potential distractor. Attention to one thing necessarily means withdrawal of attention from everything else—for attention is limited. It is the mind's spotlight. Thus it happens that noises, especially high-pitched noises, are good distractors and tend to interfere with attention to anything else.

One cannot, however, count on the distracting effect of a noise. Motivation may reverse its action. A man is studying a difficult book in an easy chair. He is making slow progress. Suddenly a noisy machine outside his open window starts operation. He is at first distracted. Then he resists the distraction. He sits forward in his chair, clenches his fists, frowns, assumes a generally uncomfortable position, tries to concentrate—and actually does concentrate. He works better because of the noise. The distractor is not distracting him but is acting as a spur to his attention. Not all loud noise, then, distracts; yet spurred attention is fatiguing. The man does a better job but with more effort.

Persons who like to study with the radio turned on are probably somewhat spurred by the radio's sound. Certainly at first, when this habit is being formed, they put more effort into work by resisting attention to the radio. Later they will have formed a work habit. They need the radio's sound just as much as they need the familiar desk and chair to put them in the mood for study.

When a noise is integrated with work, it helps and does not hinder. A band is not a distraction to marching men. The roar of battle may add to the energy of soldiers who are charging. In these cases the sounds are almost as much part of the work in hand as music is part of dancing, or the sounds of words part of conversation.

Fatigue. Fatigue comes from muscular action or tension. The feeling of fatigue produced by difficult mental work arises because the student contracts his muscles to help his attention. He frowns or scowls, he clenches his teeth, twists around in his chair. When a noise tends to act as a distractor and a man has to fight it in order to keep his attention on the job, he fights it in part with his muscles, and then he becomes fatigued.

There is no conclusive evidence that a fighter pilot, alone in an airplane, is fatigued by the plane's noise. There are plenty of other things to fatigue him, including the plane's vibrations which affect his body directly. There is also a constant strain on his attention, and there are the emotional stresses that arise from the possibility of attack and the danger of losing his course.

On the other hand, men working together in continuous loud noise will get fatigued because communication, partially masked by the noise, requires extra effort. They may have to shout or come near together in order to speak intelligibly. Or they may forego conversation when they wish to speak, and that in itself is frustrating and, therefore, fatiguing. Whatever validity lies in the movement for noise abatement in large cities must arise in part from the fact that noise interferes with normal social communication and has to be overcome with fatiguing effort.

Emotion. The facts of the startle pattern in man and of the audiogenic seizures in rats imply that sound may be an especially effective stimulus in setting off certain emotional reactions. It is certain that quiet is good for war-shocked patients, and that many of them can be startled and emotionally shocked by a sudden loud noise. The dropping of a pan in a hospital ward where such men are sleeping may bring them all out of sleep, half of them sitting up in bed and the other half instantly out on the floor. This case may not, however, be psychologically different from that of the tired "nervous" man who, distracted by some persistent noise which he cannot fight well enough to keep it out of his attention, falls into a fit of anger.

War is, of course, noisy. It is not surprising that noises should often be associated with the emotional events that have caused war shock, nor that noise should then become especially disturbing to the war-shocked patient.

In battle noise is terrifying to the green soldier but not to the veteran. When the Germans first used dive bombers against the British and French troops in France, the noise itself tended to throw the troops into panic. Later the soldiers learned that dive bombers often are not very effective offensive weapons against troops, and for them the noise lost its terror. Most of the emotional effect of noise depends, not on the noise itself, but on the meaning that it has to soldiers and sailors.

LOCALIZATION OF OBJECTS BY HEARING

Men can localize the direction of a sounding object by hearing. They may even perceive its distance and thus its position. Hearing is not, however, nearly so good a localizing sense as is sight. Ordinarily it furnishes the first vague clues as to the position of an object, and then sight makes a precise localization. Ventriloquists make use of this fact. You hear a voice issuing from the neighborhood of the ventriloquist. You look, and you see Charlie McCarthy's mouth moving as he sits on the lap of Edgar Bergen whose lips are still. So it is Charlie who must be making the sound. Edgar Bergen leaves the position of his voice indeterminate within a given region, as it naturally is, and then throws the sight of the audience to a particular spot within the region, Charlie's mouth.

You hear a rifle shot to your right. You face to the right and wait. If the next shot comes now from in front, you have verified the general direction of the sniper. Then, with caution, you look and look. If you can see the sniper, you have localized him accurately. Otherwise you have to be content with the knowledge that there is a man with a gun "somewhere off in that direction."

A man has two eyes and yet does not ordinarily see double. Similarly he has two ears and yet ordinarily hears objects as single. Conversely, if the sights to his two eyes are incompatible, if the sounds to his two ears are very different, then he has a double perception. With a whistle sounding somewhere at his right and a horn sounding somewhere at his left, he hears a whistle at the right and a horn at the left. They do not fuse. On the other hand, if two identical whistles sound, one at his right and one at his left, then he hears a single whistle halfway between the right and the left, most often in front, sometimes behind or overhead.

Singleness of vision is explained by the fact that the fibers from corresponding parts of the retinas lead to the same parts of the brain. In hearing it seems that fibers from each inner ear pass to both halves of the brain, duplicating each other. Each half of the brain is, apparently, a spare for the other half. Take away one half of the cerebral cortex and you lose half the field of vision, but you probably would keep all your hearing.

Right-left auditory localization of objects is the most accurate because the ears lie at the sides of the head, to the right and left of each other.

They create a sort of horizontal acoustic parallax. A noise from the right gets to the right ear sooner. It is also louder in the right ear. These differences provide the clues for the perception of it at the right. It is easy to tell at once whether a sound comes from the right or the left or from some position in between, but it is difficult to tell whether it is from in front or in back, high up or low down, near or far away. When a sound arrives at the two ears at the same instant and with the same intensity, then it is normally localized "in the median plane," that is to say, half-way between right and left. If, however, the right ear is deafer than the left, then such a sound is localized toward the left.

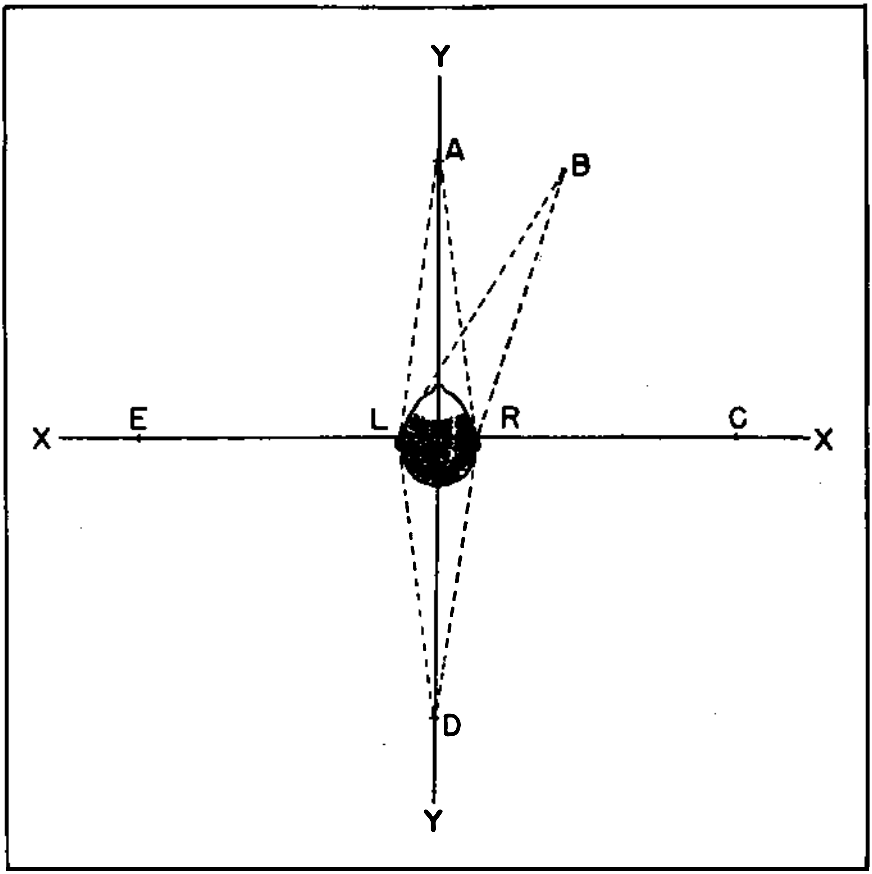

Fig. 49. Left-Right Localization of Direction of Sound
X-X: aural axis. *Y-Y:* median plane.

It would have to be intensified in the right ear in order to be localized in the median plane.

Ordinarily a man helps his localizing by moving his head. He gets, with his first interest in a sound, a rough localization of it. Then he faces it and checks, moving until he perceives it as directly in front. He can also determine the height of sound by bending his head to one side, so that the "acoustic parallax" is turned through an angle, with "up" to the left of his head, and "down" to the right.

It is remarkable how well the brain manages to work out instantly the logic of these clues. There is an experiment in which a man stands at the center of a horizontal circle of telephone receivers. The receiver in front of him gives out a continuous noise. The man turns himself about, and, as he turns, the apparatus is so controlled that the noise always comes from whatever receiver is in front of him, no matter which way he faces. Does he hear a noise which rotates along with him as he turns? No. He hears a noise from overhead, for that is the position from which a noise would continue to affect both ears in the same manner no matter how much the man turned horizontally.

Distance is the most difficult item to determine by hearing. The eyes can see distance by triangulating the objects, converging more or less as the object is near or far. Sound, not traveling in straight lines like light, does not offer this possibility. If you know how loud a sound is when near, you can make a guess as to its distance by noting its actual loudness. Since low frequencies travel farther than high, you may guess distance by noting whether the pitch of a complex noise—the sound of airplanes—is low or high. These clues are not, however, very reliable and need to be supplemented by others—by vision, by the use of instruments, or by inference, as when one counts the seconds between the flash of a gun and the arrival of its sound.

Right-left Localization. Fig. 49 shows how the right-left perception of direction occurs. A man's head is shown from above. *X-X* is his aural axis. *Y-Y* is his median plane. A sound coming from *A* or *D* in the median plane affects his two ears equally, and median localization results. Coming from *C*, his right ear is favored and localization is at his right. *E* gives a correct left localization. *B* is intermediate between median and right. The sound from *B* has a shorter path to his right ear and gets there a little sooner. His left ear is partly in the sound-shadow of his head, so the sound is louder at his right ear. One or the other or both of these factors determine the localization. Time-difference and intensity-difference furnish the clues.

If the sound is a continuous tone, time-difference may nevertheless furnish the clues. That is because nerve impulses work as successive little explosions. As one wave of the tone operates in the inner ear, the intensity due to the wave gets greater until it discharges the nerve fibers which it is stimulating. Thereafter, these fibers are not affected until the next wave arrives, when they are discharged again. And so on, for every successive wave—provided the frequency is less than 1,000 cps, for nerve fibers cannot discharge more rapidly than 1,000 times a second. If the frequency is higher than 1,000, then the fibers take turns. Some go off for the first wave, others for the next, still others perhaps for the third, until 1/1,000 of a second has passed, when the first set of fibers is ready to go to work again. It thus appears that a tone is physiologically like a very rapid series of noises. If there is a tone sounding at *B* in Fig. 49, every wave will get to the right ear a little sooner than its corresponding wave will get to the left ear, and this time-difference can determine the localization.

For low tones under 1,000 cps, the time effect is the more important. The waves are long for low tones and there is thus more chance for the difference in time to be effective and to keep from getting mixed up. The low frequencies, moreover, bend around the head so easily that there is not much difference between the two intensities with which they reach the two ears.

On the other hand, for high tones over 5,000 cps, the intensity effect is the more important. High frequencies do not bend easily, and the ear that is shielded from the tone by the head receives a less intense stimulus. The waves, moreover, are short and allow less time for the time-difference to become effective.

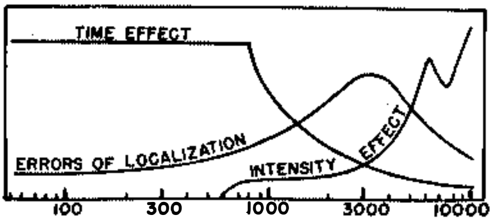

Fig. 50. Errors in Localizing a Tone as Dependent upon the Frequency of the Tone

Relative time of arrival at ears is most effective up to 1,000 cps. Relative intensity at two ears is most effective above 5,000 cps. Errors of localization are greatest around 3,000 cps, where total of time effect and intensity effect is least.

Fig. 50 shows how these two clues are related. One curve shows the time effect as it works for different frequencies, diminishing at the high frequencies. Another curve shows how the intensity effect becomes essential at high frequencies. The third

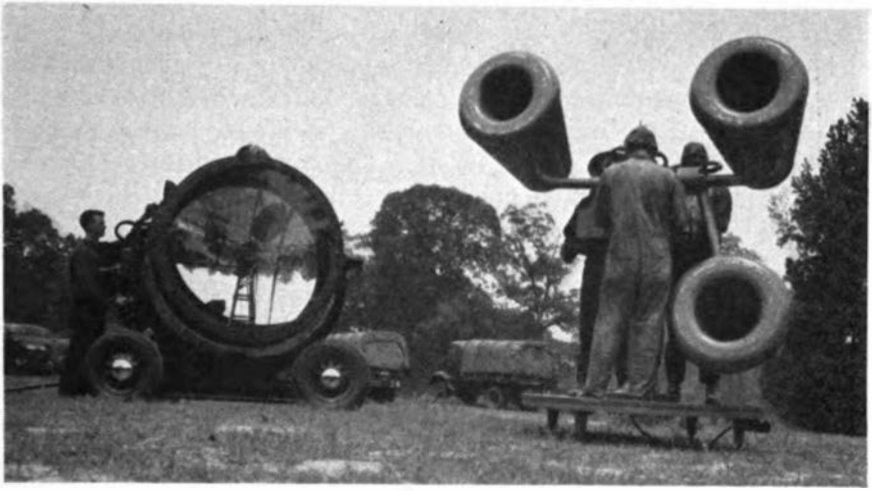

Fig. 51. Direction Finder
The operator sits in the apparatus and aims himself at the sound. The pair of horizontal artificial "ears" are for horizontal directions; the vertical pair, for direction in height. (Photo from U. S. Army Signal Corps.)

curve shows how errors of localization vary. They are most numerous in the neighborhood of 3,000 cps, where the time effect has fallen off and the intensity effect not yet become very pronounced. If a sound camoufleur wants to choose a sound that would be localized with the greatest difficulty, he had better choose a tone near 3,000 cps.

Direction Finding. The two ears form a natural direction finder. Their power can be increased, however, by increasing the effective distance between them, just as the increase of the parallax of the eyes in telestereoscopy improves the perception of distance (pp. 40-45). Fig. 51 shows one such acoustic direction finder. It has three "ears," a right-left pair for finding horizontal directions, and an up-down pair for vertical directions. The operator, who listens through these artificial ears, must assume a natural listening and direction-finding attitude. He must move himself and his instrument around, trying to locate and face the sound, as he would do if he were standing free and using only his own outer ears. He must forget for the time being the content of this section of this book and put his attention on the sound, as something "out there" or "up there." He must not try to guess what is coming through to each ear in order to compare them, nor think about intensity-difference and time-difference or how pitch affects localization. He must think only about the object that makes the sound.

Nature has so well developed this capacity for immediate localization, without any awareness of the clues on which it is based, that it is better to let nature and brain work in their own way, without trying to help out with scientific sophistication about the processes. On the other hand, the man who is not operating the machine but is, perhaps, responsible for its operation, had better understand how nature works. He should know, for instance, that an operator must have equal sensitiveness in both ears or else have a correction made for the difference.

On the other hand, this kind of direction finding is now much less important than it used to be, for it is, wherever possible, supplanted by radar.

In the First World War this same principle was used for the underwater direction-finding of ships and submarines. The operator wore a headset with telephone receivers connected to underwater microphones at the bow and stern of his ship. He had thus separated his ears effectively by the length of his ship, and had a greater chance of detecting the direction of another vessel. There is still need for the sailor with good ears for this kind of differential hearing, even though the method of underwater location of ships has been radically changed since the First World War.

SOUND CAMOUFLAGE

Silence is the best sound camouflage. Masking is almost as good. You will not be detected if you shoot your rifle during an artillery barrage. Low flying airplanes have been used to mask the sound of approaching tanks.

Confusion destroys auditory localization. With a hundred rifles firing from a hundred positions, it is not possible to localize any one rifleman by the sound of his shots.

Ruses are a kind of camouflage. One man can draw the attention and shots of the enemy by shooting his rifle and then taking shelter in a foxhole or behind a tree, while his comrades somewhere else creep stealthily up on the other enemy flank. They make some noise, but not enough to distract the enemy from the soldier who is acting as a decoy for the enemy's attention.

It is not at present clear to what extent loud speakers, sounding from specially prepared records, could simulate false military sounds, thus misdirecting the enemy's attention while preparations for some quite different action go forward elsewhere—masked both acoustically and attentionally.

PRACTICAL RULES FOR HEARING

Here are the rules and practices for making or keeping hearing acute.

(1) Keep the wax cleaned out of your ears. It can deafen you and is especially likely to cause trouble in hot weather and hot climates. A medical officer should take it out, for an inexperienced man may injure his auditory canal or his eardrum.

(2) Avoid colds. If you have a cold, avoid airplane flight when possible. The cold may stop up the Eustachian tube that leads from the middle ear to the mouth and prevent the equalization of pressures on the two sides of the eardrum when the outside pressure changes on ascending or descending. Unequal pressures dull hearing and are uncomfortable. If the change of pressure forces the tube open, then the infection may be carried to the middle ear, and earache or even more serious trouble may follow.

(3) When flying without a cold, keep swallowing, or chew gum in order to keep swallowing, for swallowing opens the Eustachian tube and keeps the pressures equal on the two sides of the eardrum.

(4) If possible, avoid close exposure to loud sounds—heavy gunfire, airplane noise—if immediately afterwards it is going to be necessary to listen for faint noises. Continued or repeated loud sounds cause temporary deafness which may last for hours or, in extreme cases, for days.

(5) To avoid temporary deafness induced by your own rifle fire plug your left ear with ear defenders or clean damp cotton. It is the left ear that receives the explosion pulse from your own rifle.

(6) In the midst of loud noise you can hear shouting speech better if you plug your ears with wet cotton or stick your fingers in them. The plugging brings the noise and the shouting down to a level of loudness at which the ear differentiates sounds better.

(7) A gun crew had better all plug their ears with wet cotton or earplugs. If one man is without plugs, he may forget to shout when he speaks. If his ears are plugged, he will shout to hear himself, and the others with plugged ears will hear him, too.

(8) When earplugs are used, they should have no metal parts. Metal parts in earplugs sometimes injure the auditory canal.

(9) It is well to get interested in sounds, so that you can recognize them. The eye goes to recognition school in order to learn how to recognize tanks and airplanes under all possible conditions (pp. 297-

299). A man can run his own recognition school for his ears. By practice he can learn to distinguish different kinds of airplanes by the sounds of their motors. Men experienced in combat learn to tell the differences between the sounds of a number of weapons firing and between those of different shells and bombs. In the jungle there are hundreds of different human and animal sounds which the experienced jungle fighter or woodsman eventually learns to recognize.

To these nine rules on how to hear well and wisely can be added four others on how to protect your hearing from very loud sounds.

(10) Keep away from the places where the sounds of gun-discharges are greatest. Especially keep away from any position ahead of the muzzle of a gun. Face in the direction from which the sound will come, turning neither ear directly toward it. The head itself is a good protecting screen, but, when it shields one ear, it exposes the other. Another practice is to plug one ear with a finger and turn it toward the noise, letting the head shield the other ear.

(11) When a loud sound is expected, hunt for objects to screen the ears. Keep behind a wall, or lie down in a hollow, a foxhole. On the ground lie prone, for the explosion pulse generally rises from the ground.

(12) Plug the ears if the noise is continuous, to protect them as well as for the reasons given in rules (6) and (7). Plug them even within a helmet, which may protect your ears from blasts, but not from noise.

(13) Open your mouth when an explosion is coming. It helps to equalize the pressures on the two sides of the eardrum and may thus prevent a rupture of the drum.

Modern warfare produces many loud sounds—some, sudden explosions, others, continuous roars. You should be prepared to make intelligent use of every aid, trivial as it may seem, that scientific knowledge provides, in order that the racket of war may impair the effectiveness of your hearing as little as possible.

REFERENCES

1. E. G. Boring, H. S. Langfeld and H. P. Weld, eds. *Introduction to psychology.* New York: Wiley, 1939. Pp. 652.
   Chapter 18, pp. 561-599, gives a brief elementary account of the psychology and physiology of hearing.
2. H. Fletcher. *Speech and hearing.* New York: Van Nostrand, 1929. Pp. 331.
   An excellent, quite technical account of the psychology of hearing and the acoustics of speech.

3. D. C. MILLER. *The science of musical sounds.* New York: Macmillan, 1926. Pp. 286.

A somewhat technical account of the physics of sound analysis and the nature of speech sounds.

4. S. S. STEVENS AND H. DAVIS. *Hearing.* New York: Wiley, 1938. Pp. 489.

The most recent authoritative book on the psychology (Stevens) and the physiology (Davis) of hearing, but not easy reading.

5. G. WILKINSON AND A. A. GRAY. *The mechanism of the cochlea.* New York: Macmillan, 1924. Pp. 253.

Not new, but a full discussion of the way in which the cochlea works.

6. R. S. WOODWORTH. *Experimental psychology.* New York: Henry Holt, 1938. Pp. 889.

Chapter 21, pp. 501-538, gives a clear, brief, elementary account of the psychology of hearing.

7. NAVY DEPARTMENT. *Telephone Talkers' Manual.* (Restricted.) Washington: Bureau of Naval Personnel, 1944. Pp. 46.

Provides a standard basis for training telephone talkers in the United States Fleet.

Chapter 6

Smell in War

Smell, like sight and hearing, gives information about objects some distance away from the smeller—occasionally about quite distant objects. Many animals use smell extensively, seem to depend on it almost as much as they depend on vision; but men do not. There is, however, no evidence that smell has degenerated in man as he evolved. Rather, it would seem that man, with a capacity to use smell much more than he does, merely fails to make use of his natural ability.

There are three reasons why men do not pay much attention to odors or use them extensively for the perception of objects.

(1) In the first place, smell is a ground sense. The tiny particles that objects emit and that are the stimulus to smell settle to the ground. Man walks erect, keeps his nose in the wrong place for efficient smelling. Crawl along a jungle trail with your nose near the ground, or merely lie on the dining room floor after a varied dinner has been served, and you will find an amazing wealth of odors. Those Malayans, who follow enemy trails by smell, have to put their noses near the ground every now and then to get the scent strongly enough.

(2) Men are also handicapped against the use of smell by the prevalence of colds and catarrhal conditions in modern civilized life. The olfactory organ, located up at the top of the nasal cavity, is often obstructed by mucous or congested membranes. It does not get a full chance to operate effectively, even when the nose is near the ground.

(3) The third cause of our limited use of smell is that we are not interested in odors, or else we believe that it is not good form for us to seem interested in them or to talk about them. Odors are often taboo as a topic of conversation. That situation may have come about because, on account of the prevalence of colds, not all men are equally sensitive and perceptual information cannot therefore be communicated so reliably in terms of odors. The reason that it seems, at times, improper to talk about smells is undoubtedly that the most important objects in the world are other people, that people have definite body odors, and that these body odors are apt to be unpleasant, especially unpleasant when strong. It is not, therefore, good manners to tell a man that you knew he was coming because you smelled him.

There are actually four different senses in the mouth and nose. (a) First, there is *smell*—the fragrant-ethereal-spicy-resinous-burned-putrid perceptions, that come from the olfactory organ in the nostrils. (b) Then there is *taste,* which includes only the qualities of sweet, sour, salt and bitter, and which is aroused by the stimulation of nerve endings in the crevices of the tongue and, sometimes in children, in the cheeks. (c) There is also a *"chemical sense"* which accounts for the cold of peppermint, the prickle of carbonated drinks, the sting of ammonia, the irritation of chlorine gas. (d) And finally, there are the ordinary *tactual* qualities in the mouth, which include the warmth and cold of food and drinks, the oiliness of salad dressing or even of coffee, the peculiar sensations which dissolving sugar gives in addition to its sweetness, and a host of other tactual perceptions.

All four of these senses contribute to the *flavor* of food—what is so often called "taste." Smell contributes more to flavor than does any other sense because it is the most varied in its capacities. A bad cold which rules smell out entirely makes food flat and uninteresting. Hold your nose and compare the "taste" of a dilute solution of quinine with some coffee, breathing out so that the odors do not get into your nose from your mouth. The two substances may be quite indistinguishable, or, if distinguishable, the difference will depend on the fact that the coffee is a little smoother and greasier than the quinine.

Unlike taste and touch, smell is a distance receptor. It gives information about objects that are not in contact with the sense organ. It does in animals and can in man inform about quite distant objects—especially when the wind is right.

In man smell is used especially to give warning of the presence of undesirable objects. The foul, putrid odors of decaying animal matter command full attention and usually produce reaction, the reaction of avoidance.

In military life it would seem that odors could have more use than they usually do. They could be employed for useful purposes other than to give warning of decaying matter and of war gases. If the soldier's nose were to be sent to recognition school—and he could conduct the school himself if he were interested—it could learn to tell him much about his surroundings, could sometimes even inform him that the enemy is much nearer than he thought.

SENSITIVITY

The olfactory organ, when unobstructed, is remarkably sensitive. A grain of musk can go on scenting a bureau drawer for years with only a barely detectable loss in weight. You can smell one-hundred-millionth of an ounce of artificial musk. You can smell two seven-hundred-million-

millionths of an ounce of mercaptan, an evil smelling, especially powerful substance. Man's nose, like his eye and his ear, is an astonishingly efficient organ.

Often a person, who has become interested in odors, is able to tell you—instantly and as a matter of course—which members of his family have recently been in the room. There was a boy once who kept his clean clothes in the same bureau drawer with his brother's. The shirts and socks used to get mixed up, but the boy always knew which were his own. He just smelled them. Discriminations of that sort could become common if people were interested in cultivating them.

The newspapers have said that American soldiers in the South Pacific could smell a battalion of Japanese soldiers half a mile away. That is a plausible performance when the wind is right. It was also said that the Japanese were especially odorous because they were living on a diet of fish. That, too, is plausible. Whether the Japanese could do as well in smelling Americans, with or without a fish diet, is not clear. Different races are believed to have different odors, perhaps in different degrees. A warm climate tends to enhance body odor. On the other hand, every man is much more likely to notice a strange odor than his own or odors similar to his own.

Odors undergo *adaptation* readily and rapidly. Sensitivity falls off as the olfactory stimulus is continued. The threshold value of an odorous substance may be increased to five or even ten times its original amount by a minute's exposure to a fairly strong concentration of the substance. A complex odor—and most odors are complex—may change under adaptation as different components in it weaken or fade out. Cheap perfumes sometimes become foul when smelled continuously or are reduced to the mere odor of alcohol.

It is important, therefore, for the man who makes important use of smell to come fresh to his observation, to try to assess his olfactory experience as soon as he has placed his nose in a new position and not after he has left it there for many minutes.

RECOGNITION

Odors have no satisfactory common system of names. They are generally indicated by the names of the objects which give rise to them—the odor of violets, of lemons, of coffee, of garlic. The best system that has as yet been worked out for them puts them into six related primary classes and tells the smeller that an odor can be placed in one of the classes or in a position intermediate between them. Here are the classes:

Fragrant (F)—the odor of violets, of many other flowers.
Ethereal (E)—the odor of oranges, of many other fruits.
Spicy (S)—the odor of cloves, of many other spices.
Resinous (R)—the odor of balsam, of some other piney substances.
Burned (B)—the odor of warm tar, of many animals.
Putrid (P)—the odor of rotten eggs, of much decaying matter.

These six groups of odors can be thought of as lying at the corners of a triangular prism, as in Fig. 52. Other odors lie between the corners—on the edges, in the surfaces, but not inside. Using the letters of the preceding table to designate the six principal corner groups, we can give examples of the odors which lie on the nine edges of the prism and in the three square faces:

FE:	geranium	*FP:*	skunk cabbage	*RB:*	incense
FS:	thyme	*PB:*	most animals	*FESR:*	cedar
ER:	pine	*SB:*	roasted coffee	*FPSB:*	garlic
SR:	cinnamon	*EP:*	almonds	*EPRB:*	grapefruit

This system is, however, not nearly so good as is the double cone for the colors (Fig. 16, p. 67). The smell prism is only approximately correct. Objects with the same name often smell differently, and the same object may smell differently at different times or to different people. We should not have done so well with colors either, if we had not had the spectrum to help us, if we had had to name the primary colors *blood, sun, grass* and *sky,* instead of *red, yellow, green* and *blue.* An observer unpracticed with odors could not tell you that thyme lies between violets and cloves, that almonds belong between lemons and rotten eggs—in the way that orange comes between red and yellow, and purple between red and blue. The

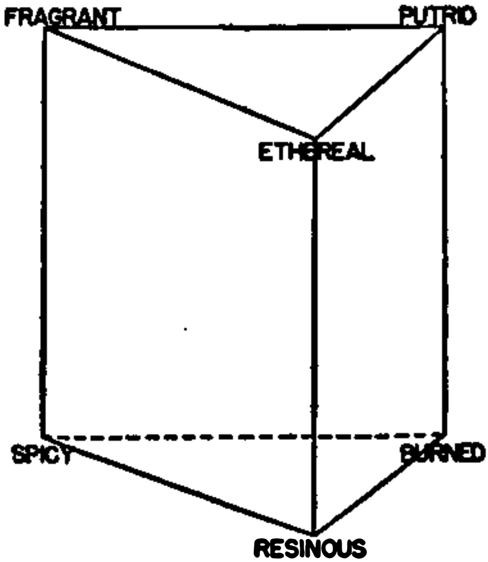

Fig. 52. Smell Prism

scheme is useful since it helps in thinking about odors; but the person who is going to rely on smell in crucial situations must, nevertheless, have had experience with the actual odors of actual objects.

The man who wants to learn to use odors for guidance and information, who wants to send his nose to recognition school, as it were, has first to get interested in smell and to overcome the almost universal habit of ignoring smells and not talking about them. He must fight the taboo against smells in his private thinking. Some few people use olfactory experience habitually, distinguish objects and other persons by odor, sort the family wash by the aid of smell, note who has recently been in the room; but even they do not talk about the odors of other people because of this taboo. There were once two parents who decided that their son should learn to use and appreciate the olfactory richness of his world, and they taught him always to sniff at every new object as well as to see it, handle it and listen to it. That seemed to be wise training until the son began to go around sniffing at new guests in the home.

Learning to recognize objects by their odors is, however, more than fixing an odor in mind and remembering what object produces it. Odors from a single object keep changing. They change with temperature and humidity. They change with the adaptation of the smeller. They are different when they are strong to the nose near the ground from when they are weak to a nose five feet above the ground. They may even be different in the right and left nostrils of the same man. They are changed by mixture with other odors, sometimes altered in quality, sometimes reduced in intensity. The odor-using man must learn to recognize the particular object or substance as the source of this variety of olfactory experience which he may get from it. The acquisition of such skill would seem to be difficult.

It is not, however, any more difficult than the establishment of any other sort of recognition. A man learns to recognize the actual colors of familiar objects, even though what happens in his retinas varies a great deal with the color and intensity of the illumination. That fact is called color-constancy—the ability to see coal in sunlight as black, paper in shadow as white. The general rule is that familiar objects tend to be perceived as they really are—of the right shape and size, no matter what the exact shape and size of their images as projected on the retina. Similarly in recognition school a man learns to see airplanes or tanks as what they are, no matter from what angle he sees them nor what is the exact pattern of excitation given to his retinas. That skill is object-constancy—"airplane constancy," "tank constancy." So too, there is object-constancy for odors. Recognition is nothing other than the ability to translate any of a variety of clues into an instant knowledge of the object whose presence they indicate.

Here, then, lies another reason why the smell prism (Fig. 52) is an inadequate guide for olfactory recognition. The odor-minded man cannot simply place an object at one spot in the prism and remember it by its position, any more than the color-minded man can learn to identify violets by placing them in the spectrum. Nor would he have to know how an object can shift around through a region of the prism. He learns recognition simply by having enough interested olfactory experience with odoriferous objects. For war gases he can go to recognition school and smell the gases in weak concentrations. For jungle odors, he must conduct his own school in the jungle, and not hesitate to put his nose to the ground to smell out what is there. If he has the will, he can learn.

In the process of learning to use odors for information, the interested smeller will discover that he frequently runs into new odors which he has never smelled before. No one ever sees a brand new color or hears a brand new tone. Colors and tones are so simple that every adult has seen or heard them all. New color patterns and new noises are, however, common enough, and new odors arise in a similar manner as the result of novel combinations of olfactory stimulations. Chemists often create odors which have never existed before by creating new substances. The soldier who travels about the earth will find new odors in new places, and sometimes all the traveling he needs to do is to lower his nose to the ground.

WAR GASES

For those war gases that evaporate rapidly and are odorous, no chemical indicator is as sensitive as a normal unobstructed nose.

All of the odorous gases listed on pages 136-7 in Table II, except mustard gas and lewisite, can be detected by smell in concentrations too weak to be dangerous. For them the nose is the best and most convenient detector. Mustard gas can, on the other hand, injure the eyes in the course of an hour when it is present in dilutions too weak to be smelled at all; and lewisite, which has arsenic in it, can be fatal without having been smelled at all. The soldier is, therefore, not wholly protected even by a wise and well trained nose.

The table of war gases attempts to describe the odors of these gases, but it is not a safe guide. The soldier has to learn to recognize these

TABLE II
WAR GASES

Agent	*Symbol*	*Odor*	*Other Immediate Effects*
Blister Gases			
Mustard Gas	H	Garlic or horse-radish.	Is absorbed in skin or lung tissue, then produces burns.
Lewisite	L	Geraniums, then biting.	Is absorbed in skin or lung tissue, then burns and liberates M-1 oxide which poisons the body.
Ethyldichlorarsine	ED	Biting, irritating, somewhat fruity odor.	A powerful sneeze gas; causes paralysis of the fingers.
Nitrogen Mustards	HN	From slightly fishy to practically odorless.	Causes blindness in from 1 to 6 hours; blistering action may be delayed 24 hours.
Choking or Suffocating Gases			
Phosgene	CG	Like ensilage or fresh-cut hay.	Burns the lower respiratory tract; causes edema.
Chlorine	Cl_1	Pungent.	Burns upper respiratory tracts.
Chlorpicrin	PS	Sweetish, like flypaper.	Lacrimates, irritates nose and throat; produces nausea and lung irritation in order as concentration increases.
Diphosgene	DP	Like phosgene, but more irritating and choking.	Burns lower breathing apparatus, causing edema; irritates the eyes.
Tear Gases			
Chloracetophenone	CN	In low concentrations, like apple or locust blossoms.	Irritates eyes and skin.
Chloracetophenone Solution	(CNS)	Like flypaper.	Violent eye irritation, vomiting, skin itching.
Brombenzylcyanide.	BBC	Like sour fruit.	Lacrimation and nose irritation.

gases at first hand, and the Chemical Warfare Service of the Army has sets of some of the gases in weak dilutions which he can use, under instruction, when they are available. It does not matter that the strong concentrations sometimes have a different odor from the weak dilutions, because it is the weak odors that the nose must learn to detect. Its task is to keep the soldier from ever breathing the strong concentrations. The soldier cannot, however, use too great care in his efforts to identify the presence of gases, for the odors of some of the gases are changed by a change of the solvent used with the gas. For instance, in the First World War the German mustard gas smelled like mustard and thus received its name, but the Allied mustard gas, using a different solvent, smelled like garlic. It is always possible that the enemy may have found some such way of camouflaging a familiar gas odor.

TABLE II—*Continued*

WAR GASES

Agent	*Symbol*	*Odor*	*Other Immediate Effects*
Vomiting Gases or Irritant Smokes			
Adamsite	DM	Burning smokeless powder; coal smoke.	Irritating to nose and throat; headache, vomiting, violent sneezing, followed by temporary physical debility.
Diphenylchlorarsine	DA	Shoe polish.	Sneezing, vomiting, headache; followed by temporary physical debility.
Diphenylcyanarsine	DC	Irritating; suggestion of bitter almonds.	Same as DM and DA, but more intense.
Blood and Nerve Poisons			
Hydrogen Cyanide (Prussic Acid)	AC	Resembles bitter almonds.	Paralyzes central nervous system.
Cyanogen Chloride	CC	Sharp, penetrating.	Systemic poison and eye and lung irritant.
Screening Smokes			
White Phosphorus	WP	Like matches.	Solid particle burns flesh; vapors are very poisonous, causing bone decay; smoke is relatively harmless.
Hexachlorethane Mixture	HC	Acrid, suffocating when very dense.	None from solid; slightly suffocating action by heavy smoke.
Sulphur Trioxide Solution	FS	Acid or acrid.	Liquid burns like strong acid. Smoke causes pricking sensation on skin.
Titanium Tetrachloride	FM	Acrid.	Liquid burns like strong acid; vapors and smoke irritating to the throat.

Rules for Detecting War Gases by Smell. Gas sentries need certain rules to use in the detection of war gases, and every soldier can profit by knowing them when gas warfare is on. These are the rules.

(1) Beware of differences in olfactory sensitivity among men. Some men are less sensitive than others because of past disease or infection of the nose or perhaps naturally. A gas sentry should be normally sensitive to odors, and every soldier would do well to get some idea of his own sensitivity by comparing himself with others.

(2) A cold diminishes sensitivity, and a bad cold may entirely abolish smell. No man with a bad cold should be posted as a gas sentry. A soldier with a bad cold should especially beware of gas.

(3) Adaptation is rapid for smell. The nose becomes quite insensitive to long continued odors, but is refreshed by breathing pure air. Do

not therefore keep sniffing at a suspected odor. Sniff once or twice, then if possible rest the nose in fresh air. When an odor seems to disappear, be sure it has really disappeared and not merely vanished under adaptation. When you can no longer smell the odor that you thought was there, let someone else try.

(4) Gasoline fumes dull olfactory sensitivity. Gas sentries should keep away from parking areas and gasoline tanks.

(5) Tobacco smoke dulls sensitivity. Gas sentries should not smoke on duty. Non-smokers make better gas sentries. Other men should not be allowed to smoke near gas sentries.

(6) When phosgene degenerates, it gives off a substance that dulls sensitivity. Beware of this false security in a phosgene attack.

(7) Some explosives give off nitric oxide which also dulls smell. Again beware.

(8) Since most war gases tend to settle in hollows, ravines, dugouts and foxholes, do not try to test for the presence of gas on high ground. Test on low ground, and, if you have to enter a low pocket, test again.

(9) Learn the odors of the different kinds of gases from weak dilutions of the gases themselves, either by the use of a recognition kit of the gases, or ultimately in actual experience with what the enemy provides.

(10) A test for gas is best made as follows. The soldier takes a moderate breath while wearing his mask. He stoops and brings his face close to the ground without kneeling. Then he inserts two fingers under the mask's facepiece at one cheek and draws a little air in under the mask *by sniffing,* not by breathing. If he smells gas, he must then clear the mask by holding the outlet valve and forcing air out under the raised facepiece. Then he must breathe pure air through the mask in order to recover from adaptation. After recovery, he may test again.

CAMOUFLAGE OF ODORS

There are various ways in which odors can be obliterated or changed. When these effects are used intentionally, they may constitute gas camouflage. When they occur unintentionally, they are still important for the soldier to know, since such knowledge makes him wary of trusting his nose.

(1) **Specific Adaptation.** Adaptation to a gas in weak concentration may reduce sensitivity enough to make a stronger concentration seem weak. It is possible for the enemy in this way to shoot over stronger

and stronger concentrations of the same gas without the troops who are becoming adapted to it realizing that the concentration is becoming great enough to be injurious or deadly.

(2) **Attentional Adaptation.** When the enemy repeatedly sends over weak concentrations of a gas, the men get accustomed to its being around and cease to be concerned about it. They may not have true adaptation for it, if it is present only in the hollows of the ground; they can still smell it when they approach it. If then a deadly concentration arrives, it may not produce a prompt response—especially with green troops. The warning is not shouted immediately, the gas masks are not put on at once. The Germans used this ruse successfully against green troops in the First World War.

(3) **Selective Adaptation.** Since adaptation may be selective among the various components of a mixed odor, the odor of a substance or object may change as one component fades out before the others; or adaptation to one odor may change other odors which are smelled afterwards. Certain changes in odors are known to be induced in this way by the products of some explosives, by the odors of swamps, pinewoods, orchards and flowers, by the odors from dumps, field kitchens, hospitals and garbage.

(4) **Masking.** One odor may cover up another, mask it. The solvents used for mustard gas sometimes mask the characteristic odor of the gas itself. Carbon tetrachloride will mask many different kinds of odors. In fact, almost any strong unimportant odor may, if strong enough, mask an important one.

(5) **Mixing.** An odor may be changed by mixing it with another. Nitrobenzine, when used as a solvent for mustard gas, changes the odor of that gas to the odor of bitter almonds.

The moral is: Beware! The nose can be an excellent and most sensitive detector when it has been trained to recognize objects from the great variety of olfactory clues which every object furnishes. These clues vary with external conditions and also with the smeller's adaptation. Nevertheless the nose is not infallible. A man needs first to learn about the capabilities of the nose in order to be persuaded to use it to its full capacity; then he must learn its limitations so that he does not trust it too far. Because of adaptation, the nose does better in telling a soldier when to put on his mask than in telling him when it is quite safe to leave it off.

REFERENCES

1. G. H. Parker. *Smell, taste, and allied senses in vertebrates.* Philadelphia: Lippincott, 1922. Pp. 192.

   Chapters 1-3, pp. 13-91, give a clear elementary account of the physiology of smell.

2. Brig. Gen. A. H. Waitt. *Gas warfare* (revised edition). New York: Duell, Sloan & Pearce, 1944. Pp. 327. (Also, Fighting Forces Edition for the armed services only. Washington: Infantry Journal, 1944. Pp. 228.)

   Chapters 4, 5, and 6 contain complete descriptions of war gases including their odors. Appendix I includes data on the degree of concentration at which each gas is detectable by the average man's sense of smell.

3. R. S. Woodworth. *Experimental psychology.* New York: Henry Holt, 1938. Pp. 889.

   Chapter 20, pp. 477-495, gives a clear, elementary account of the psychology of smell.

Chapter 7

Equilibrium and Bodily Orientation

Most animals adjust themselves to gravity. A snail or a young rat on an inclined plane always crawls upwards, changes his course if placed on the plane headed toward one side. A cat, dropped from a few feet above the ground, rights herself in a fraction of a second to land on her feet. Men stand and walk in an upright position. They have first to learn as infants, but they are provided with sense organs that enable them to learn and to make these adjustments constantly and instantly, unless some special condition upsets their feel of gravity or their visual perception of the vertical.

These adjustments of position and posture in man and the higher animals are unconscious and automatic. They depend ordinarily upon vision, touch, the muscle sense and organs in the inner ear. Neither vision nor the inner-ear organs are essential, for blind men can stand and walk, and so can deaf mutes who lack these organs in their inner ears.

The organs of the inner ear respond to any mechanical force that can act upon them. There are two such forces which commonly affect them: gravity and inertia. Gravity operates all the time in a single direction. Inertia enters into the picture to change the effect of gravity whenever there is a change in the rate or direction of the motion of the head.

When a man is erect, he usually does nothing about it. All the perceptual clues are satisfactory to him. If, on the other hand, he is tilted toward one side, the clues change, inform him of his altered position, and instantly set up automatic movements that tend to right him. Tilted, the pressures on his feet, if he is standing, or on the seat of his pants, if he is sitting, have changed. Vision, if his eyes are open and he can see an outside world that is not tilted, also informs him of his altered position. The inner-ear organs are displaced from their neutral position and act as the stimuli to righting movements. They do not give rise directly to conscious sensations, but they initiate changes of which the man is at once conscious. It takes, on the average, only seven-tenths of a second for a change in the inner ear to initiate these adjustive movements of the muscles.

Eyes, ears and body are all tied together by close nervous connections, most of which are made in the brain's cerebellum. The adjustment of bodily posture is accurate and rapid and keeps going on perpetually during almost every second of the waking life of a man. Trouble arises for him whenever the different clues contradict one another. For instance, in a "crazy house" in an amusement park, where the floors are all tilted at an angle, vision and the clues from gravity conflict. The visitor to such a house finds walking difficult. The "haunted swing," where a man sits still in a swing while the room is rotated about him, creates a similar conflict, although here vision may prevail and the "swinger" may think that he is actually swinging at first high up, and then finally completely over the top. Underwater swimmers depend mostly on their inner-ear organs, for pressure from the water is alike in all directions and vision reveals little to them. For this reason deaf mutes who lack these organs should not try to swim under water, for they may swim to the bottom when trying to get to the surface.

Similar neural events occur when the rate of movement changes. When an elevator starts down, the pressure on the feet of the passengers lessens, their inner-ear organs lag from inertia, and they realize they are descending. When a dive bomber dives, pressure decreases on the seat of the pilot's pants and his inner ears are also affected. A change of speed, up or down, right or left, forward or backward, can be perceived in this way if it is great enough to be above the perceptual threshold.

In an airplane inertia may completely overcome gravity. When a pilot is upside down at the top of a loop, he may feel right side up, for the centrifugal force pulling him, his inner-ear organs, his viscera and his blood upward more than counteract gravity. He may even look "up above" himself at the ground and find that the ground actually seems to be where the sky should be, so completely can these clues overcome vision.

Change of direction, in the rotation of a rotary chair for testing these perceptions or in evasive flying in a plane, has similar perceptual and adjustive effects even though there be no change of speed. Vision, pressures on and in the body and forces in the inner ear account for them all.

In evasive flying, the flyer perceives inertia working in a similar fashion, not only on his whole body, but also on other objects in the plane. Loose objects rise up and hit the ceiling (actually the plane is then falling or diving), or they hurry through the air from one end of the plane to the other (because the plane is changing speed or direction or both). In a dive a man becomes very light, and his head may even hit the ceiling if his straps do not hold him down. In coming quickly out of a dive (sudden change of direction) he becomes very, very heavy, due to his inertia. He is pressed down into his seat, and his blood is drained down into his abdomen away from his brain, causing him momentarily to lose consciousness, to "black out." When a flyer "blacks out" he is four or five times as heavy as he is normally—he weighs perhaps 600 or even 1,000 pounds.

To all these changes, except such extreme changes as diving in a plane, the body has two kinds of response. The first response is *adjustment.* By automatic movements the body immediately tries to assume a natural position—a position that would be upright in relation to the forces acting. A man knows what his position is with respect to these forces because he perceives how he is adjusting, and because the tactual and visual clues from the change are conscious in their own right. If the clues conflict, then the man becomes confused. Dizziness and nausea are the best known aspects of this confusion.

If some of these changes are long continued, then the man undergoes *adaptation* to them, gets accustomed to them. He no longer perceives them, nor does his body any longer try to adjust to them. It is, of course, not possible to keep speeding up or slowing down indefinitely, but it is possible in rotation to change direction indefinitely, and it is also possible to keep a changed position, like a tilt, for an indefinitely long time. Under such circumstances adaptation means that the body accepts the new system of forces as normal and no longer tries to alter its position. The man ceases to perceive his tilt or his movement, unless vision provides the necessary clues.

When truly normal conditions are reëstablished after adaptation, they will seem abnormal. The flyer who has flown for a long time with one wing higher than the other, feels tilted when he is again erect. The blindfolded man, who has been rotated until adaptation makes him feel at rest, perceives himself rotating backward when he stops rotating. Adaptation is a useful kind of adjustment for it means that the body gives up its postural righting responses when they are not soon effective, but it leads to poor adjustment in these cases of flying. The flyer simply dare not trust his senses to tell him his position. He must learn to rely on his instrument board which does not undergo adaptation and which can thus correct the false perceptions to which adaptation leads.

THE VESTIBULAR SENSE

The inner ear consists of the cochlea, the organ for hearing, and the vestibular apparatus. We have already learned about the cochlea in Chapter 5. It is continuous with the vestibular apparatus, which itself consists of two chambers, the *saccule* and the *utricle,* and the three *semi-*

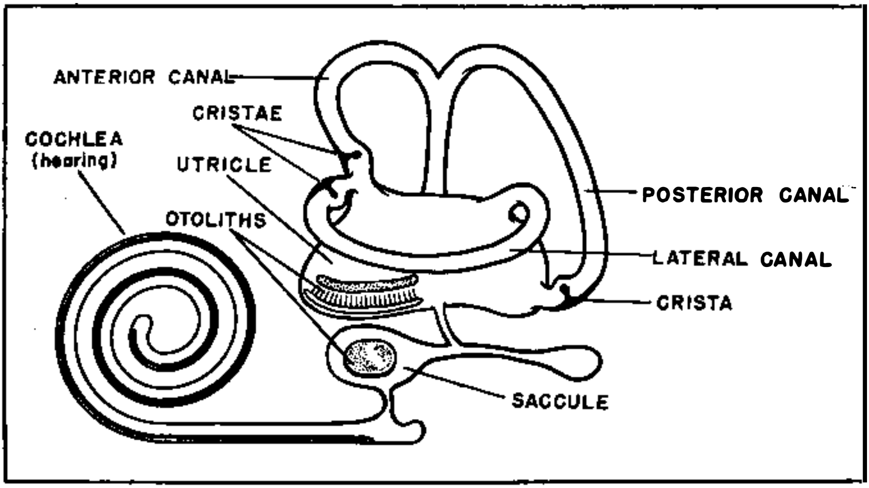

Fig. 53. INNER EAR: VESTIBULAR APPARATUS AND COCHLEA

The vestibular apparatus consists of the otoliths in the saccule and utricle and the three semicircular canals. Cf. Fig. 42, p. 005. (From M. Camis, *The physiology of the Vestibular Apparatus.* Oxford University Press, 1930, by permission.)

circular canals (see Figs. 53 and 54; also Fig. 42 (p. 105)). All six of these organs—cochlea, saccule, utricle and the three canals—are filled with a liquid lymph, which in the canals performs an important function.

In the saccule and utricle there are *otolith organs.* They are groups of cells with projecting hairs that support otoliths (stones) of calcium carbonate on their ends. They are top-heavy organs, and act as would a slender springy pole, held erect at the lower end with a heavy weight fixed at the upper end. If you had such a pole and moved the lower end, the weight would lag behind, but would move up presently if the new position of the pole were maintained. The otolith organs work in some such way. They provide most or many of the clues for the perception of straight-line change of speed and for adjustment to change of position and posture. The human body starts moving or speeds up or slows down or stops, and the otoliths, lagging or keeping on by their inertia, deflect or depress the hairs in one direction or another. Since the nerve fibers run from these hair cells, it is certain that displacement or movement of the hairs gives rise to nerve impulses that lead to bodily adjustment or to the perception of change of speed.

It is also probable that the otolith organs operate in the maintenance of erect posture. If the body or head is tilted to one side, then the otoliths are displaced and an automatic adjustment to an erect position of the body follows, unless the tilting has been voluntary.

The semicircular canals operate when the body rotates, whenever it changes its direction of movement. Each of these canals has a bulge in it, and in each bulge is a tuft of hairs called a *crista.* These cristae have no otoliths, but are moved by the pressure or movement of the liquid lymph in the canals. Nerve fibers run from their hair cells to the brain.

In the First World War the Bárány chair was used for testing the sensitivity of these organs in flyers. Let us see how the cristae work when the chair is used. The chair is arranged so that a man can sit in it and be rotated at any desired rate, speeded up, slowed down or stopped at will.

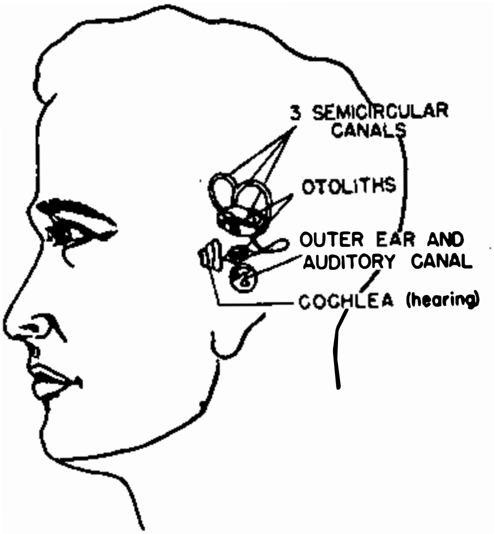

Fig. 54. Inner Ear: Position in the Skull (Adapted from M. Camis, *The Physiology of the Vestibular Apparatus.* Oxford University Press, 1930, by permission.)

Suppose a man, at rest in the chair, is started rotating, speeded up to some fixed speed and then kept rotating at that speed. What happens to the cristae? The nearly horizontal, lateral canals are most affected by such horizontal rotation. If this rotation is clockwise, the external canals, embedded in the skull, keep up with the head, but the lymph in them lags behind through its inertia, displacing each crista in a counterclockwise direction. (If you move a pan of water to the left, the water surges to the right of the pan.) This displacement stimulates the nerves and the perception of clockwise rotation ensues. Automatically the eyes tend to move in a counterclockwise direction as if to maintain fixation of external objects, snapping back in a quick clockwise movement when they can no longer move in the original direction. The sort of slow movement of the eyes in one direction, with quick readjustments in the other, is called *nystagmus.* So well coördinated are eyes and cristae, that watching a man's eye movements will tell almost as much about his perception of rotation as will his report of what he is experiencing.

If the rotation of the chair is continued at a uniform speed, the lymph presently gets speeded up with the canals. The cristae then resume their normal position and, if the man's eyes are closed or blindfolded, his perception of rotation disappears and his nystagmus stops. If his eyes are open, then he perceives the rotation visually (although his cristae now deny rotation), his nystagmus continues, and he is apt to feel confused and dizzy. The illusion of standing still during rapid rotation can be for a blindfolded person very striking. Suppose you start talking to such a man as he continues to rotate. He is convinced that he is standing still, and thus he hears your voice rotating about him. If you are twenty feet away from him, he will hear you—and see you in his imagery—flying around him at a tremendous speed, around a circle forty feet in diameter.

Now you stop this man suddenly. His canals stop, but the lymph in them coasts on, displacing his cristae in the opposite direction. That gives him the perception of rotation in the opposite direction. If he opens his eyes, his head will "swim"; that is to say, he will see objects spinning around him without getting anywhere. He will be dizzy, confused, and probably nauseated.

It is an interesting fact that these illusory rotations that are the aftereffects of real rotation move with the head. Let a blindfolded man put his head over to his left so that it is practically horizontal. Rotate him clockwise, as seen from above, until he is adapted to the clockwise rotation. Stop him. He will perceive himself rotating counterclockwise. Then let him straighten up his head. The illusory movement moves with his head and now he perceives himself rotating around a horizontal axis through his head, as if his feet were going up in front and on over the top. A man who has this illusion in a rotating chair feels as if he were falling over backwards, and, in an effort to right himself, will, unless strapped in, throw himself out of the chair on his head, as if he were thus maintaining an erect position.

Deaf mutes usually have degenerate cochleas. About half of them also have degenerate vestibular apparatuses. Those whose vestibular apparatus is defective do not exhibit these phenomena. They do not perceive rotation nor get nystagmic eye movements when spun around with their eyes shut. They do not get dizzy or nauseated on rotation. They do not lean in to adjust themselves against centrifugal force on merry-go-rounds. They have more difficulty in learning to walk, and a man who has lost his vestibular apparatus by accident has difficulty in maintaining erect posture in walking until he has learned to rely on visual clues.

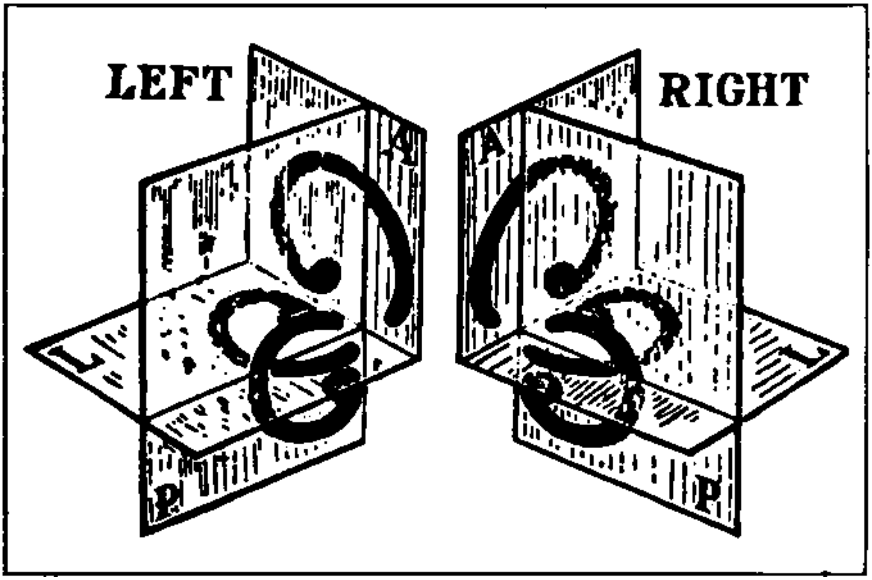

Fig. 55. Spatial Relations of the Six Semicircular Canals

The six canals lie in the skull in the relation shown. *AA:* Anterior canals. *PP:* Posterior canals. *LL:* Lateral canals. The left anterior canal is paired with the right posterior canal, the right anterior with the left posterior, the two lateral canals one with the other.

Even then he has difficulty in walking in blackouts when the visual clues are taken away from him.

The semicircular canals in the two ears form pairs which lie in parallel planes, as follows:

Left posterior canal—right anterior canal
Left anterior canal—right posterior canal
Left lateral canal—right lateral canal.

These pairs are symmetrical with each other: if the crista of one lies counterclockwise from its base, the crista of the other lies clockwise from its base, when the two are viewed from the same side (see Fig. 55). This fact has made some investigators think that one canal of a pair operates for clockwise rotation and the other for counterclockwise rotation.

In any case it is plain that every kind of rotation of the head will affect one or more pairs of canals. If the rotation is exactly in the plane of one pair, then only that pair will be affected. Other rotations will be resolved into the three components of motions in the planes of the three canals. Rotation head over heels would affect only the anterior and posterior canals, and not the lateral canals, because the anterior and posterior canals are placed obliquely in the skull, not front-back and left-right respectively.

Because it is change of speed—speeding up, slowing down, starting, stopping—that affects the canals, it has been said that the true stimulus to the perception of rotation and the adjustments that go with it is *acceleration*, both positive and negative, or acceleration and deceleration. It is not rotation that one actually perceives, but change in the speed of rotation. Continued rotation, after the speed has stopped changing, is accompanied by adaptation with no perception of rotation.

ADAPTATION AND HABITUATION

Adaptation is the rule for all the vestibular organs. When a given position, a given speed, a given rotation is continued without change, the perception of the position, speed or rotation fades out, and the perceiver comes to feel as if he were vertical and still. His cristae and otoliths have come back into their normal positions. The body always gives notice of an important change in conditions, but the notice, once given, is not continued when the conditions persist. The initial perception gives a man a chance to change the conditions if that is necessary. Thereafter, adaptation means that the man has himself adjusted to new conditions which he cannot, or at least does not, change.

The *aftereffects* of adaptation are a direct consequence of the adaptation. If a tilt to the left comes to be perceived as being vertical because the otoliths have readjusted themselves, then a change to the true vertical must be perceived as a tilt to the right. If clockwise rotation comes to be perceived as being still, because the cristae have readjusted themselves, then a change to being at rest must be perceived as counterclockwise rotation. If moving forward feels like not moving at all, then stopping must feel like moving backward.

Vision works, as might be expected, in a similar manner. If you look continuously at the moving water of a waterfall and then look away at the rocks beside the fall, the rocks appear to move upward. This negative aftereffect of seen movement is not due to eye-movement. If you look at a black spiral painted on a white slowly rotating disk, you will get, for one direction of rotation, the perception of a constantly expanding disk. It expands and expands, though it never gets larger. If then you look away at any other object, it will seem to contract—or else to recede, as if the contraction of the image of the object meant that it was moving away. If you drive a car for a long time along a highway watching the road and then stop, still looking at the road, you will see the road moving away from you as if your car were going backwards.

Vision also emphasizes the importance of the vertical, just as do the vestibular organs. If you wear spectacles with glass wedges in them pointing to the left, then all vertical lines will appear bowed to the left for several minutes. Presently, however, the lines straighten themselves out and look vertical again. You have adapted to the wedges and these important verticals are restored in perception. If then you take the glasses off, all the vertical lines at once appear bowed to the right, a reversed aftereffect of adaptation. In a few minutes they become vertical again.

All these phenomena of adaptation and its aftereffects point the moral that instrument flying in a plane is much safer than flying by a dependence on sensory clues. In a light plane at low altitudes, where vision can remain important, the pilot may depend on his eyes and inner ears, but for long flights at high altitudes he needs to learn to fly blind, even though he can see out of the plane. There are no verticals among the clouds to orient him; the ground is far away and often obscured. His dependence must be primarily upon his vestibular apparatus if he relies only on nature's instruments. Nature did not, however, make man for flight. A flying man is man's own achievement, and man's instruments are therefore best for a pilot's guidance.

Besides adaptation there is also *habituation* to the effects of much rotation and to violent changes of speed and direction. Whirling dervishes and ballet dancers do not show the aftereffects of rotation in the same degree that ordinary persons do. They do not get dizzy and nauseated when they rotate with their eyes open. They have less nystagmic eye-movements after they have stopped rotating, for they have become accustomed to rotation. The changes in habituation are learned changes. They occur in the brain. The vestibular apparatus works as it always did and the perception of rotation is not dulled, but the illusory aftereffects are diminished or abolished.

When the Bárány chair was used in the First World War to test the sensitivity of flyers to rotation, it was believed that the men most sensitive to vestibular changes would make the best flyers, would be most able to orient themselves in planes. That belief proved wrong. The most sensitive men have the greatest aftereffects and are, therefore, most subject to illusion as to their position in space. Experienced successful flyers are apt to show insensitivity in such tests, in part, presumably, because they have become habituated to rotation, like dancers and dervishes. Good pilots must depend on their instruments, not on their vestibular sensitivity.

It has been said that the *rail-walking test* is the best single test for selecting good pilots, because it tests the ability to coördinate vestibular, visual and tactual clues in the task of maintaining an erect posture by balancing. In this test the testee is required to walk barefoot along three wooden rails, each nine feet long, one of them four inches wide, another two inches wide, and the third one inch wide. He walks each rail three times, and his proficiency is measured by the distance he walks without falling off. Undoubtedly this is a good test since it includes the vestibular mechanism, but it should hardly be used alone. All the arguments against stressing the importance of vestibular sensitivity in flying apply to this test, and there are many other tests for prospective flyers which measure aptitude for the other visual-motor coördinations that are so important for pilots (see pp. 48-50).

MOTION SICKNESS

Motion sickness—airsickness and seasickness—is vestibular in origin. The deaf mutes who lack the vestibular organs do not get seasick—presumably do not get airsick. The blind do. Nevertheless vision may reenforce motion sickness. When the ship is in a rough sea or a plane is in bumpy air, the vestibular and visual clues put a constant demand on the body for readjustment to the vertical, and dizziness results. The eyes and inner ears, being closely linked with the stomach, together induce nausea and, if the disturbance is great, vomiting. If there has been vestibular adaptation to a new position, then the vestibular and visual clues may become contradictory. The consequence is confusion and enhancement of nausea.

To get rid of motion sickness it is obvious that it would be necessary either to get rid of the nerve impulses from the vestibular apparatus or to block their effects upon the stomach. Habituation has this latter effect. Experienced sailors and flyers do not easily get motion sick, although even they get into trouble when the sea or air is very rough indeed.

Nausea is, however, not only produced by vestibular and visual disturbance. Odors may be nauseating. Ideas may be nauseating. A stench can cause nausea or even vomiting. Some people get sick when they examine pictures of skin diseases or when they undertake to watch surgical operations. Some persons get ill from thinking or hearing about bodily injuries or diseases, and others get ill from wondering whether they are ill, from examining their own sensations too closely. All these factors enter in to reenforce the vestibular and visual causes of motion sickness, and must be controlled if sickness is to be avoided.

In brief the causes of seasickness and airsickness are as follows:

(1) Exceptionally violent *vestibular stimulation* is the primary cause. It may be irregular as in bumpy air, or it may be regular as in the rhythm of a long slow swell at sea. Habituation is the cure for it, since no one wants to have his inner ears removed.

(2) *Vision* contributes to motion sickness. Irregular movement of the visual field is bad. Eyestrain with exacting work is bad. Conflict between the visual and vestibular clues for orientation is bad. It is better to keep the eyes fixed upon some single simple object, like the horizon or a cloud, than to keep adjusting them to some complex object, like an instrument board or a book. It is still better, when practicable, to keep them closed and thus out of function.

(3) The *physical condition* of the sailor or flyer has much to do with his susceptibility to motion sickness. Fatigue, constipation, overeating and alcoholic hangovers all make a man more susceptible.

(4) *External factors* also make a difference. The effects of high altitude, of heat, of insufficient ventilation all are troublesome. Body odors, foul odors, food odors reenforce nausea. In fact, the class of foul odors used to be called *nauseating*. Ventilation lessens susceptibility to motion sickness because it removes these odors. Heat increases the body odors.

(5) *Suggestion* also plays its rôle. It is easier to be sick when other people are being sick, even though the odor of their vomiting is excluded. It is easier to be sick when you expect to be sick, when you think about it. It is also easier not to be sick when you do not expect to be sick, when you forget all about the possibility of sickness.

(6) Because suggestion works as it does, it is possible to *learn* to be sick and also to learn not to be sick. If you have learned to associate a ship or a plane with sickness, then you are more likely to have your learning bear fruit. The remedy is to learn to think about other things. Civilian air passengers are often distracted from thoughts of sickness by pretty hostesses, but this technique is not applicable to amphibious troops in landing barges or to air fighters in combat planes.

Habituation works to overcome motion sickness in experienced sailors and flyers, but this problem remains especially acute for the inexperienced troops who land in rough seas from barges to take a beachhead.

They may all arrive on the beach very seasick, just at the moment when the greatest efficiency is demanded of them.

In the Second World War there has been an attempt to use certain drugs, like hyoscine, sometimes in the form of pills, to diminish motion sickness. Such drugs have a depressing effect. They stop the secretion and movement of the stomach, although they do not directly inhibit vomiting. They do not affect the nerve from the inner ear. They do make the person who takes them less sensitive to all sensory impressions, and they make him drowsy, too. The claim has been made that they are successful in preventing seasickness in about half the possible cases, by no means in all. Thus this advantage is gained, when it is gained, at the expense of some alertness. When the pills are provided, it is well to use them but important to take no more of them than is prescribed.

The rules for avoiding motion sickness follow at once from the foregoing discussion.

(1) Become habituated to motion. Sailors and flyers do.

(2) Forget about the possibility of sickness. Think about things that do not excite sickness. Make such thinking a habit.

(3) Avoid associating sickness with ships and planes. It is best never to have been sick. The flying instructor should endeavor to get a student to the ground before he gets sick, and to continue his training at such a rate that his habituation keeps ahead of his motion sickness. Otherwise the student may tend always to be sick in planes, may acquire chronic motion sickness.

(4) Breathe fresh air. Keep foul odors, food odors, all odors of animal matter away. Avoid heat which produces body odors.

(5) Avoid fatigue, constipation, overeating and hangovers.

(6) Use the pills if they are provided, but do not take more than are prescribed; do not count on them too much; do not take so many next time, if the number prescribed makes you drowsy the first time.

If all these rules are observed, motion sickness can be greatly reduced. It always interferes with military efficiency, and its reduction is a great boon to sailors, flyers and amphibious troops.

REFERENCES

1. E. G. Boring, H. S. Langfeld and H. P. Weld, eds. *Psychology: a factual textbook*. New York: Wiley, 1935. Pp. 652.
   Pp. 176-184 give a clear, brief account of vestibular sensibility by K. M. Dallenbach.
2. C. R. Griffith. *An historical survey of vestibular equilibration*. Uni-

versity of Illinois Bulletin, Vol. 20, No. 5. Urbana: University of Illinois, 1922. Pp. 178.

A technical account of the subject with a bibliography of 1,701 titles.

3. C. T. MORGAN. *Physiological psychology.* New York: McGraw-Hill, 1943. Pp. 623.

A clear elementary discussion of reflexes and posture on pp. 308-329; also brief mention of the vestibular mechanisms, pp. 291-293.

4. C. MURCHISON, ED. *Handbook of General experimental psychology.* Worcester, Massachusetts: Clark University Press, 1934. Pp. 1,125.

Chapter 4, pp. 204-246, is a technical account of the vestibular and postural mechanisms by J. G. Dusser de Barenne.

5. WAR DEPARTMENT, ARMY AIR FORCES. *Your body in flight.* T.O. No. 00-25-13 (Restricted), 1943. Pp. 83.

A popular Army manual for flyers.

Chapter 8

Topographical Orientation

Orientation. A man needs always to know who he is, what time it is, where he is. A little child may not know. "Are you a little boy or a little girl?" "What day is today?" "Where do you live?" The child's ability to answer such questions shows how he is maturing psychologically, whether he has a mental age of three or four or more. The competent adult always knows who he is, what day and generally what hour it is, and where he is in the sense that he can tell what place he is in and how he can get from it to other places of importance for him. If he does not know what means would be required to get him home or to get him to the place where he must go next, he is lost.

Being lost, either as to what time it is or where you are, is a serious business, and everyone knows how uncomfortable it is. The discovery that you are lost at once makes you at least a little panicky, for the whole business of living for men and the higher animals depends on this capacity to move around intelligently from place to place and to be able at will to get back home. *Home* changes with the circumstances. You go home to your family, home to your hotel, home to your camp, home, even, to your foxhole. If you do not know how to go home, you are lost.

All animals with nests, lairs, regular places of abode or preferred haunts have, in this sense, homes. They know their way about. Birds, dogs, cats and many other animals often find their way "home" when they are supposedly lost, that is to say, when they are left in places where they have never been before. Thus psychologists have talked about a "homing instinct," asking the question whether some animals have a mysterious "sixth sense" that serves in a special way for their orientation, that helps them to find their way even though lost.

Psychologists understand homing in animals fairly well now, even though they cannot account for every anecdote of remarkable success in homing that comes to their attention. Animals have no special sixth sense. They are not sensitive to the magnetic field of the earth, are not their own magnetic compasses. To get around they use the senses that they use ordinarily and that man also has. If a dog leaves a new home, he keeps track of the way he goes and returns as he went. After a month of exploring, he begins to find familiar places by new routes, can go a new way and come back an old way. Pretty soon he knows the country for some miles about. If someone drops him from an automobile ten miles from home, he can scout around until he finds a path or road and follow it, and presently he may get into familiar territory. Luck plays a rôle in his success in homing. No one has tried "losing" a hundred dogs separately, each ten miles from his home, to see what percentage return. No one knows how many of those who do not return fail because they have soon been seduced to follow new masters and how many have simply stayed lost for a long time.

Birds are, of course, the most remarkable homers. Many birds, like the homing pigeons, can be taken a hundred miles away and get back to their nests. They migrate from their winter homes to their summer homes in the spring and back again in the fall. Why are they especially good at homing? Because they can fly high in the air and look at a map, the real map of the topography of the country. They see distant familiar landmarks and fly to them. If they see no familiar landmarks, they can follow rivers or coastlines until they find familiar objects. If human flyers lived in the air as much as birds do, if they could land whenever visibility is poor and wait for better conditions for observation, and if they always had enough gas, it would become almost impossible for a flyer to get lost anywhere within a thousand miles or so of his base.

In the experiments on the homing of birds, some investigators have thought that the birds remember the route by which they are taken away from home to be "lost," and simply reverse it in order to get back. That is not true. A bird can be kept in a cage with opaque walls so that he cannot see the route by which he is taken out to be "lost," and the cage be kept on the rotating disk of a phonograph so that he cannot keep track of the turns. Still he gets back. And, if you double the distance from home at which you "lose" him, then it takes him much more than twice as long to return. That means that he has had to explore, that the difficulty of getting home is proportional more nearly to an area of exploration than to the straight distance back.

Rats furnish an interesting illustration of how animals build up topographical maps of their environments and find their way around in relation to these mental maps. You can teach a rat to "run a maze"; that is to say, you can build a maze with many passages and turns, right turns and wrong turns, blind alleys and correct routes, take the rat from his nest, start him at the entrance of the maze, and have him learn to run directly and rapidly to a designated spot where he finds food (Fig. 56 *A*). If you have a rat that has learned such a maze and turn the maze about through 90 degrees, leaving the nest where it was, the rat is upset (Fig. 56 *B*). He is no longer so sure of his route. Why? Well,

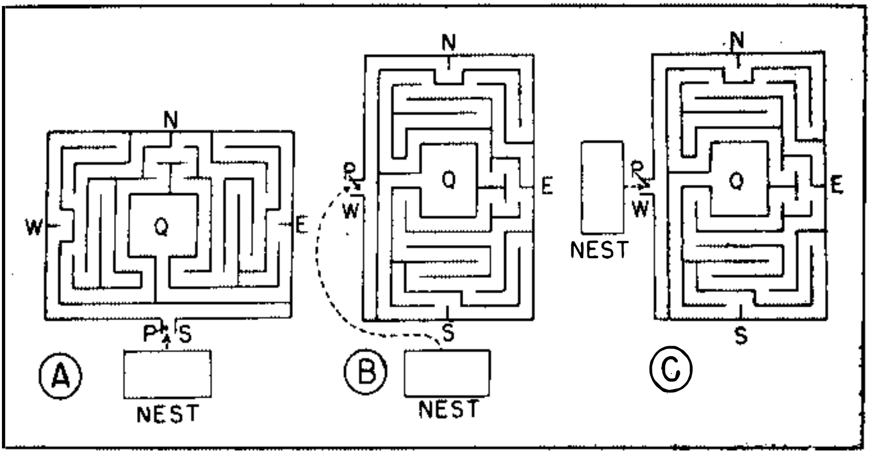

Fig. 56. ORIENTATION OF A RAT IN A MAZE IN RELATION TO THE POSITION OF THE NEST
A: position of maze and nest when maze is learned. *B:* maze is rotated without nest; the rat is confused. *C:* both maze and nest are rotated; the rat is not confused. *P:* starting point. *Q:* goal (food).

he may have been looking out of the tops of the alleys and using visible landmarks in the room to guide him; but you can cover the maze or put it in the dark and the rat still can learn it perfectly and will still have trouble when it is rotated. The only visible landmarks are now inside the maze and are rotated with it.

The reason for the rat's confusion seems to be that he is always aware of the position of his home nest. Rats, when abroad, are fearful, always ready on alarm to run back to their nests. They keep their lines of communication open in terms of a mental map. If, however, the rat's home nest is rotated with the maze (as in Fig. 56 *C*), if the maze is covered so that he cannot see outside, if all the landmarks perceivable by the rat, including the position of his nest, keep the same spatial relation to each other, then he will have no trouble with the rotated maze. His mental map is contracted to the maze and the nest, and he makes his run perfectly, even though he now goes east when he used to go north. Undoubtedly he knows at any moment which direction home is. He uses both his mental map and also the signs that he perceives at the crucial choice points.

Men are not so very different from rats in the means by which they find their way about.

There are two ways in which men get about, get where they want to go and then get "home" again.

One way consists in knowing always what to do next. It is the way most men drive cars, the way rats were supposed to run mazes until it was discovered that they have mental maps. You follow a road until you get to a choice point. Then either you know which way to go or a sign tells you. Automobilists have got accustomed to making these serial choices with signs or memory to decide for them—so accustomed that the sign outside of Boston which reads "Boston Either Way" comes to the driver as a distinct shock because it fails to make a decision for him. Most drivers tend to think of winding roads as straight, or at least as going in the same general direction, for that is what roads are for. The Boston driver, who, following the meandering Charles River, approaches the Harvard Stadium, passes it and then presently finds himself approaching it again, is astonished. He thinks he has not turned around, but actually the road and the river have turned him around without his knowing it and he is now going south instead of northwest. This is not the surest way to keep from getting lost, as every rat would seem to know.

The better way to keep from getting lost is to have a mental map and to keep charting a new one when you go into new territory. Some people always know which way north is, wherever they are. They feel lost if they do not know. If they make a turn, they still note vaguely that north is "over there." Such a person in the middle of a field in Kansas can point at once in the direction in which he thinks lies New York, Chicago, San Francisco or New Orleans. Other persons make up smaller mental maps of particular regions with less regard to the points of the compass. These maps work as well as the others, but they should have some special landmarks in them instead of the compass directions.

It is important to start building such a map of a new region correctly. A bad start may persist for years without satisfactory correction. Once a man arrived in Wilkinsburg, Pennsylvania, on the train. The trains going east toward Philadelphia run south through that town, so he thought south was east; but the trolleys going west toward Pittsburgh also go south through the town. When he first tried to take a trolley to Pittsburgh, he went in the wrong direction and never found out until he got to the end of the line, twice as far away from his goal as when he started. He never got his mental map of Wilkinsburg straightened out.

Men who grow up in checkerboard Philadelphia do not get lost easily—in Philadelphia. They think of streets as straight and at right angles.

Their maps are easily constructed. But a Philadelphian in topsyturvy Boston gets into trouble. He may base his new map, as he builds it up, on the Boston Common. That Common has five sides, each of which seems to him to make a right angle with the two sides that join with it. Tremont Street seems to be parallel to both Beacon and Charles Streets, and yet Beacon and Charles Streets make a right angle with each other. That is the way Boston looks to a Philadelphian who is prejudiced in favor of straight streets and right angles. The Bostonian with a correct mental map of the Common knows that the five angles are not exactly right angles (actually they range from 85 to 115 degrees) and that Tremont Street is curved so that it can be nearly parallel in different places to two other streets that are perpendicular to each other.

The capacity of men for forming correct mental maps is very great, although most persons do not use their capacities to the limit. Roads and streets and signs are enough to get them around in civilized familiar regions and they do not feel a constant need to put everything into precise spatial relation. If they had more need for constant orientation, they would practice more on the building of their mental maps, would more easily find new and better ways of getting to old familiar places, would learn more rapidly to find their way around in new regions.

Blindfold chess players have mental maps of the chess board, of the position of every piece and pawn on it. Some of them visualize the board with its successive changes. Others play just as skillfully without visual imagery, remembering the positions in muscular imagery. Each piece is in a certain place with "lines of force" reaching out from it to the territory which it controls. The queen covers eight radial lines in all directions, the bishop four diagonals, the knight short 2 x 1 and 1 x 2 spaces. Two such players can play by mail, each writing the other his next move, and each taking the problem of his next move to work with him, thinking it out on the train or the trolley. Not many chess players, however, develop that degree of skill in making and keeping mental maps of the changing board.

An Army officer, speaking of his own skill in finding the way in spite of detours required by the lay of the land, said that he could always "feel" just where the objective lay and could face toward it "as readily as a man with two good ears can face the source of a sound." He started out with a mental map and he kept it always by him, properly turned about, whatever changes he made in his course. He knew that his skill depended on experience, and, in fact, he lost his exceptional skill in a city with winding streets, like Boston. He could not even use it with very great success in much of New England, but he always knew where he was and where he was going in his familiar Virginia mountains. One of his clues may have come from the parallel mountain ranges there.

MENTAL MAP MAKING

The first prerequisite to mental map making is practice, and enough practice does not come without interest—constant interest. The man who would always know where he is, whence he has come and how, whither his objective lies, is he who is always interested in placing himself, in remembering how he has come, in planning where he is to go next, and next after next. The well oriented man has been well oriented for years. Noticing all the natural signs of topography, keeping track himself on his mental map and building that map up, all these activities are second nature to him and are carried on, for the most part, in the margin of his thinking, while he focuses his attention on other matters. You cannot make yourself into such a man overnight if you are not one already, but you can start. If you know how the expert does it, you can shortly get over being an amateur.

At first, the building of mental maps requires full attention. There is little thought left over for other matters. You get, if possible, at the start a preview of the country through which you are going to operate. You use a printed map and study it, if one is available. You may also be able to take it along and continue to work by it, but for practice it is better not to do that. It will not be often that you have time or even the map for study during real operations. You need, instead, a mental map for instant reference. If there is no actual printed map available, then you may be able to use the real map of the terrain itself, if you can get on a hill or the top of a tree and study the land over which you must go. Study the terrain—from the printed map or the earth's map—until you know it and remember the details. That takes practice, but the necessary skill comes with repetition.

After a man has started out for an objective in his practice scouting, he must keep checking his mental map against objects reached and landmarks seen—from the top of a hill or a break in the woods. He can learn always to "feel" the direction of his objective and also the direction of his base. He keeps adding new details to his map as his observation of the region increases. He corrects the map and twists it about when it proves to be wrongly oriented. He makes use of all the clues that a guide or a woodsman uses. If he has a compass he uses it too, and it may become a most important instrument in his success. He notes the position of the sun or the moon or the stars, the direction of the wind, the slope of the land, the nature of its covering. And he keeps checking on his mental map, because what he is acquiring is the habit of always having a correct guide of this kind. All these things he does elaborately and deliberately at first. Only after much practice can he let them happen and the map form itself automatically.

Eventually mental map making becomes automatic. The scout "feels" the important directions, though he may not know what clues gave him his correct information. In much the same way the blind may acquire "facial vision." They often know when they are passing or approaching objects, how far away the objects are, how large they are. They say that they feel the objects with their faces, just as the officer said he always felt the direction of his objective. They do not know how it is that they should be able to feel distant objects with their faces, and experiments show that they do not perceive in this manner. In general, they get their clues from hearing. The blind man taps with his cane or snaps his fingers, and he knows by the reflected sound where the objects are and how big they are. To know something is not, however, to know how you know it, and the blind learn this skill through practice without ever realizing just what it is that they do. In the same way the mental map making may become quite accurate for a well oriented man without his being fully aware of the clues which provide him with his map.

It is important for the scout or guide to have a mental map, for then he can take short-cuts or change his plans to meet emergencies. If he tries merely to learn a serial path with the right turns and choices in it, he is bound to that single path. He cannot change his route or venture with assurance on new territory.

Besides interest and practice, there are special practical aids that can be used in mental map making or in finding a particular objective with a poor mental map. There are compasses, as well as tricks for finding the points of the compass without a compass. There are printed maps to take along or to remember. There is the topography itself, which can sometimes be viewed from an elevation. There are other clues as to direction and spatial relationships. Let us consider these in order.

(1) **Points of the Compass.** Every soldier in basic training learns how to follow a compass course, but he must practice his instructions. He may, for instance, figure out in advance from a map how he is to get to an ultimate objective by way of successive intermediate objectives. Then he sets his compass and paces off the distance to the next inter-

mediate objective, and continues this procedure until he has reached his ultimate objective. If he fails, he has the problem of finding out what went wrong. If he succeeds within reasonable limits, he is ready to continue practice with another problem. As practice continues, he finds that he can follow a course quite rapidly by these means, that he has some attention left for thinking about things other than the compass and the counting of paces.

If a man has no compass, there are other ways of getting information about the points of the compass which may serve, although less accurately, to check the orientation of his mental map.

In the Northern Hemisphere, when the sun is visible, you point the hour hand of your watch at the sun. Then halfway between the hour hand and 12 is south—approximately. In the Northern temperate zone the sun is never in the north. In the Southern Hemisphere, the watch rule is less easily stated, but anyone can work it out. The watch must be on standard time. If you are using war time, daylight saving time, or zone time, the watch must be set back accordingly, or the rule must be changed. Halfway between the hour hand and 1 is south in the Northern Hemisphere with a watch set for war time, an hour ahead of standard time.

If the sun is casting shadows, then you can let the hour hand of your watch point with the shadows. Halfway between the hour hand and 6 is north—in the Northern Hemisphere.

If you have no watch and yet can guess the time, you can use this rule with an imaginary watch. Take two sticks, two matches, two straight anythings, and hold them so that the angle between them is what it ought to be for what you think the hour is. Then point the one that represents the hour hand at the sun, and halfway between the two is south —in the Northern Hemisphere.

Often the wind can give directions. In some parts of the world at certain times in the year the prevailing winds blow in the same general direction. Find out the facts about the winds. You may get your bearings by observing how the wind is blowing, or how the trees are bent, or in what direction most of the fallen trees lie.

The moss on trees may give some idea of which way is north, but it is not too reliable.

At night you can use the moon and the stars, provided you know about them—for the moon, its phase or the time of its rising or setting, and, for the stars, the time of year. It is well to learn the habits of certain constellations. In the Northern Hemisphere the Great Dipper

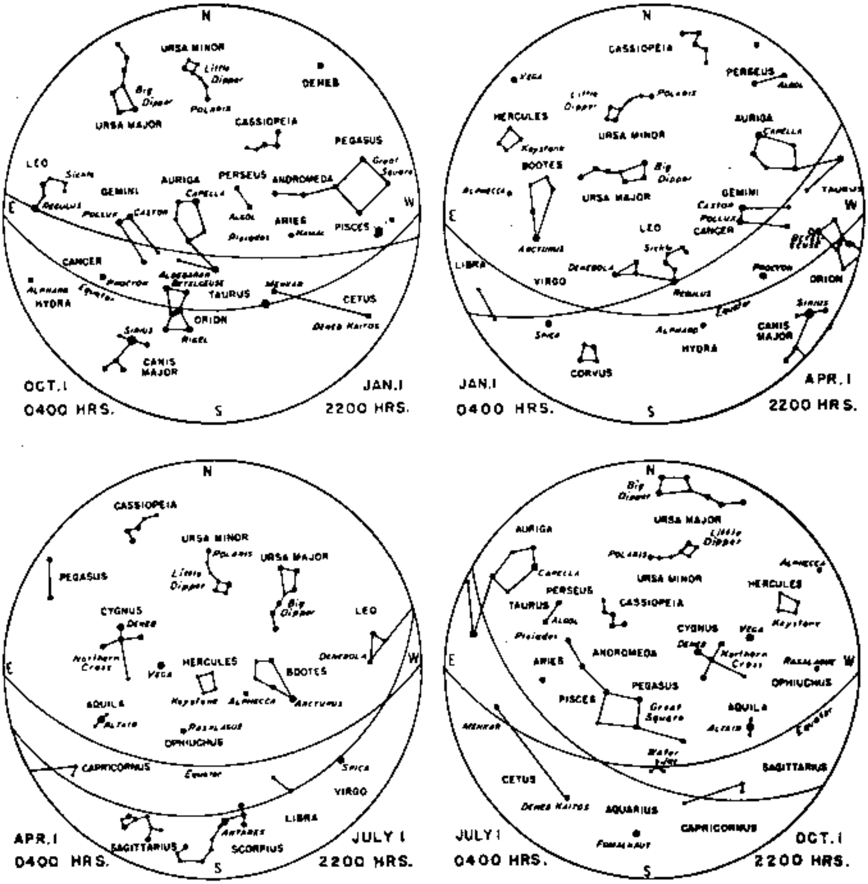

Fig. 57. Star Maps

The heavens at 2200 and 0400 hours at different times of the year at the latitude of 40° north. These maps are approximately correct from 30° to 50° north latitude, *i.e.,* for the United States, France, southern Germany, Italy, southern Russia and China. This is the way the sky will look to a man lying on his back and looking up at it, with north above his head and east at his left (the reverse of geographical maps which show the terrain as seen from above instead of from below). A man erect and facing south would see the stars above the southern horizon as in the lower halves of these maps. If you face north, hold north at the bottom, and similarly for facing east or west. (Courtesy of *Sky and Telescope.*)

and the North Star—the mariner's friend—are most important. The Dipper tells the time as it swings around the North Star. Two of its stars are the pointers for the North Star. In Fig. 57 the North Star is called Polaris.

The Dipper is not visible all night in the southern part of the Northern Hemisphere and not visible at all below the Equator. There are, however, other constellations which every soldier (and sailor) should know: in the Northern Hemisphere, Orion in winter, Cygnus in summer; in the Southern Hemisphere, always the Southern Cross. Orion can be seen as far south as the Solomon Islands (see Fig. 57).

If the line connecting any two stars runs north and south, it will always run north and south—provided the stars are high in the heavens. A couple of stellar compasses of that sort, chosen for the part of the earth and the time of year in which they are to be used, can often be extremely helpful.

(2) **Maps.** It is always best to have a printed map in your pocket. It is not a substitute for a mental map, because it cannot be unfolded so rapidly nor consulted so quickly, but it is more accurate. The fully equipped soldier needs both kinds of maps.

If there is no map to take along, then it is best to study one before starting off for the objective. It becomes the foundation of the mental map that you can take with you. Every soldier needs instruction and practice in reading maps and in remembering what he sees in them. He must pick out the essentials and put them on his mental map. He notices the location of villages and conspicuous buildings and roads, landmarks, and points of vantage. He answers to himself these questions. How do the streams, roads and trails generally run? Where are the hills with reference to the streams? Are there big ridges or valleys? In what direction do they run? What is the grade in various parts of the region? What kind of growth does the map show for different areas? Where are the swamps, the woods, the jungles, the cultivated areas?

He puts these items on his mental map if he can. He also remembers some of the topographical generalities that apply to the region. In general, practice in map reading becomes practice in the formation of mental maps, for you look at the printed map and try to translate it into the mind's-eye view.

(3) **Viewing the Terrain.** A bird's-eye view of the terrain helps the mind's-eye view. A tall tree, a tall building, a hill, a break in the woods on a hill—there are many ways of getting the bird's-eye view. Such a view has some advantages over the map, for it shows some objects and landmarks as they actually look. It also has disadvantages because some of the topography obscures other parts. Even a preview from an airplane lacks relief; you cannot see the grades, the hills, the valleys.

The bird's-eye view can often, however, be obtained again and again as your progress toward your objective continues. It pays to climb a tree to see where you are and where you are going. As you do that, your mental map gets more specific and detailed.

(4) **Clues.** Besides the clues for the points of the compass, there are the clues which landmarks furnish. The successful guide who is finding his way through new territory looks for the landmarks that he knows—bodies of water, distant towns, odd shaped trees. He notices constantly the slopes of the land, the direction of the streams, the moss on the trees, the changes in vegetation and in the soil. Being constantly interested in this matter of orientation, these items lead him persistently to correct his mental map.

He also avoids the common errors of amateur scouts. He knows that you seldom go straight on flat terrain in the woods, for almost everyone has a bias to the right or the left and the bias leads him to circle about. There are more ways of going circularly than of going straight. He knows that a diagonal path on a slope generally gets curved downwards. It is easier to go down than up. He knows that streams almost never flow along straight courses. He expects a tired mile in the late afternoon to be longer than a fresh one in the early morning. He tries to correct for these common errors.

Nor does the good scout forget that smell may help him. If he has a sensitive and well trained nose, he has use for it. The salt tang of the sea can be smelled a considerable distance away and leads him to water. Cattle have a distinctive odor which may tell of the direction of a farm or ranch.

The man who "knows his way around" in society, in any social group, is he who is constantly interested in knowing his way around. Every contact with a person tells him something about that person, influences his behavior with respect to people afterward. He may not have a conscious set of rules, he may not know how he finds his way, but his ambition to be successful with the people with whom he associates gives him in time a social orientation that prevents him from making many mistakes. And, when he has succeeded in one community, he can succeed with less effort in another. So it is with the understanding of a terrain and its topography. You seize on every clue to orient yourself a little better. It is, as a matter of fact, easier to make a mental topographical map than a mental social map, because topography is more easily remembered than nonspatial relations. How often one remembers certainly that a given passage in a book is at the top of a right-hand page when he nevertheless forgets the words that are printed there. Spatial relations are not hard to get into memory when there is enough interest in them.

HOMING

The man who is lost wants to get home, back to his base, back to his comrades, or perhaps on to his objective where his comrades will be. What is he to do? What is any man to do when he finds himself in strange country without being prepared for being there?

He does, as well as he can, what is done by the man who is seeking an objective with preparation. He uses his mental map, such as it is. He builds it up and makes it better by employing every clue. If he has a printed map and a compass, he is in luck. He hunts for landmarks, climbs trees, seeks lookout points. Home is now his objective and he uses the ordinary rules to find it.

If he is in the woods, he follows streams, provided he wants to go down hill or if he knows whither the streams lead, but he does not follow them if he wants to go straight. If he can retrace his path to a known place, he should do it, unless he is trying to get away from the enemy. Otherwise he may go ahead, blazing his trail so that he can later retrace his path if he wishes to, unless he is in enemy country. He will not want to leave a trail for the enemy. The best thing for him to do is, however, to get a look at the country from some high place and to fix up a mental map that will take him home.

A paratrooper may be half lost when he lands on the ground, but he will have had the advantage of preparation. He should, like any other scout, use this preparation to advance toward his first objective.

The best way to learn homing, however, is to practice it. Get yourself lost and then find yourself, taking on more and more difficult problems until success becomes habitual. It is not a pleasant experience to be lost, but practice reduces the unpleasantness. Leaders of trained soldiers who are about to go into combat may give their men this practice. The leaders take the men, at first by twos and threes, later alone, blindfolded and by a circuitous route, to strange places where there is no one to answer questions, and then they leave them there to find their way back home. Sometimes the men are allowed to study topographical maps before they are taken off to be lost, sometimes not. Such practice not only develops skill in homing when lost, but also in finding the way to other objectives.

The emotion connected with feeling lost, the fear and panic of it, is always a hindrance to getting home. It acts as a distraction and prevents the lost man from using his knowledge and skill efficiently and constantly. He thinks about his predicament with at least a mild irritation which is actually the beginning of alarm, when he should be thinking about his mental map and correcting it from the clues available to him. It tends to make him forget all the things he could do to find himself. Fatigue hinders him in the same way, and fatigue and panic reenforce each other. The tired, scared, lost man had better sit down and rest, forgetting his plight for a while, and then start in afresh to find himself. If night is coming on, he had better sleep and wait until morning, unless he thinks he is in enemy territory. Then he will be rested and have more visual clues to aid him. One disadvantage with fatigue and fear is that they warp judgment, preventing the lost man from making a wise decision as to whether to take time out to deal with his fatigue and emotion or whether to go on trying to find himself. The man who is practiced in being lost will, however, have less emotion. He will meet his unexpected problem with maximal efficiency and ordinarily with success.

REFERENCES

1. J. B. Watson and K. S. Lashley, *Homing and related activities of birds.* Washington: Carnegie Institution, 1915. No. 211. Pp. 9-60.

   An account of certain experiments on homing, a review of the theories, and a discussion of the status of the problem at the date of publication —a sound paper which dispenses with many of the mysteries that have surrounded this problem.

2. C. J. Warden, T. N. Jenkins, and L. H. Warner. *Comparative psychology: vertebrates.* New York: Ronald Press, 1936. Pp. 560.

   Brief discussions of homing in animals. See pp. 236-249 *et passim.* (Use the index.)

3. *Map reading for the soldier.* Washington: Infantry Journal, 1944. Pp. 101.

   Illustrated handbook which gives the elements of military orientation and includes samples of American, French, German, and Japanese military maps.

4. War Department. *Field Manual 21-25, Elementary map and aerial photograph reading* and *Field Manual 21-26, Advanced map and aerial photograph reading.* Washington: Government Printing Office.

   Exposition of factors and methods employed in map reading and the related field of aerial photograph reading.

There is no single book in English that discusses the psychology of topographical orientation, but many of the textbooks of comparative (animal) psychology carry short discussions of the problem, which resemble the present text except that they discuss the alternative theories and do not discuss homing in man. See, for instance, item 2 above.

Chapter 9

Efficiency and Fatigue

In modern mechanized war, which employs so many machines, there are no mechanisms so vital, so important, as the fighting men, the human machines upon whose efficiency success depends. Tanks, planes and guns must be designed—and constantly redesigned—so that they can perform most effectively the precise operations required of them. So the human machine must be trained to its operations—and constantly retrained to new operations—in order that it may work effectively in the tasks assigned to it. The design of a gun and the training of a man are not, however, alone sufficient to insure their best operation. The gun must be kept clean and lubricated, its parts adjusted; and the man must be kept healthy, strong and alert, his morale at top level. The efficiency of any machine, manufactured or human, depends on the maintenance of the best conditions for its operation, and this chapter and the next describe those conditions which assure maximal efficiency in human performance.

The soldier and the sailor have two kinds of work to do—routine and combat. In combat the soldier, at least, meets new situations and is required to act with originality, to adjust his capacities to novel conditions in order to make effective use of himself. He can make this adjustment efficiently only if he is in good working order and if he has a background of routine skills, acquired by training, to fit into the novel situation. The greater part of the life of both soldier and sailor is, however, routine. They have, with constant repetition, to learn to do many things extremely well and efficiently. They must be able to perform these tasks accurately, quickly and certainly. They must, therefore, possess both the training and the bodily vigor that make for efficiency. In other words, the human machine must be set for the precise operations that it is to perform, and it must also have plenty of oil with no loose bearings. Only then will its efficiency be maximal.

Some of the routine work which soldiers and sailors do is similar to routine work in civilian life. Driving trucks. Flying planes. Servicing both trucks and planes. Some of it is tedious and monotonous, not unlike the work on industrial assembly lines. More of it is novel but still subject to the same laws of efficiency as civilian work. Taking down and reassembling a rifle or a machine gun. Loading, aiming, and firing weapons. Camouflaging guns and other military objects. Digging foxholes, trenches and emplacements. Driving tanks. Serving big guns.

Many other operations combine initiative with routine. The man in the Signal Corps, who lays a line for a field telephone while combat is on, will have to decide how to take advantage of objects for the support or protection of the line as he finds them available. He may never before have done what he does in a new emergency; yet he makes his splices in a routine way and, the more habituated he is to the quickest way of making good splices, the more efficient he will be in combat.

The armed forces have therefore to study all developments in methods of efficiency and adapt many of them to Army or Navy uses. Especially from civilian industry is there much to learn about efficiency in getting work done. The principles are the same and many of the operations are the same. Soldiers and sailors are in fact workers and they know it.

EFFICIENCY

Efficiency is the ratio of output to input: O/I. You can measure the energy in coal. You can burn the coal under a boiler and then measure the energy in the steam that results. If the energy in the steam is 80 per cent of the energy in the coal, then the efficiency of the boiler is 80 per cent and the rest of the heat went up the chimney. The efficiency of a gasoline engine, the ratio of the energy delivered by the engine (output) to the energy in the gas (input), may be only 20 per cent. Efficiency is increased when you get the same output with less input or greater output with the same input. Such an improvement comes from the redesigning of a machine. Machines are always being redesigned in order to increase their efficiency.

Human efficiency is similarly the ratio of output to input. The input is man-hours, the total number of hours that all the workers work. The output is the product obtained—won victories, serviced airplanes, peeled potatoes. If a leader wishes to increase the efficiency of his men, what does he do? He wants to get more work out of the same men in the same number of hours, or the same work out of fewer men in the same number of hours, or the same work out of the same men in fewer hours—some combination of those relations. To get this result he may, perhaps, choose more efficient men. That is what personnel selection in the Army and Navy is for, a matter dealt with in Chapter 11. Usually, however, his men are already selected for him; he already has or should have the best available. Then all he can do is to redesign them if he is to make them more efficient. That is to say, he can instruct them, practice them, train them, motivate them, improve their morale.

The individual man has no way of changing his total input of man-hours. He is just one man with 24 hours a day to put into activities including sleep. That gives him 168 man-hours a week to use. He can, however, redesign himself by improving his morale or his physique or by altering his work habits. The work habits offer him a great opportunity. Under instruction and with the coöperation of his leaders he can change them to increase his efficiency. Contrariwise, by carelessness and without instruction his work habits may deteriorate and reduce his efficiency. Habits are, however, not the sole condition of efficiency. Physique and motivation also come in. Soldiers and sailors need to be tough and to have good morale.

The chief factors that affect human efficiency are as follows:

(1) *Work habits*—the distribution of work during the day, the changes of activities, the ways of doing a particular job, the exact motions used and the order in which items of work are performed.

(2) *Fatigue* and *rest*—in part as they are dependent upon work habits, in part as they depend upon physique, health and motivation, upon rest and sleep, even upon furloughs and leaves.

(3) *Boredom* and its opposite, *morale* (or *zest*). Monotonous work does not always produce boredom. Its effect depends on the personality of the worker. On the other hand, actual boredom always reduces efficiency.

(4) *Safety*—dependent in part on work habits, the quality of equipment, the use of safety devices to prevent accidents, the alertness of the worker, and the selection of the right man for the right job.

(5) *Physique,* health. Toughened troops and healthy workers do not get fatigued so soon. Diet, vitamins, sleep—many physical factors affect efficiency in this fashion.

(6) *Climate* and *weather.* Too much heat and too much cold diminish efficiency. There is an optimal temperature at which to work. Clothing is used to combat cold, ventilation to combat heat.

(7) *Oxygen,* altitude. Now that man has taken to the air, his oxygen supply varies and output in the form of precise accurate thought and action diminishes rapidly as oxygen gets less, as altitude gets higher.

(8) *Drugs* and *stimulants.* They may be bad for physique but help motivation. Alcohol is never good for physique nor is tobacco, yet both can affect morale favorably. The armed forces compromise. Alcohol is taboo for flyers when they are soon to fly. Tobacco is favored because it supports the morale of those who use it. Tea and coffee aid morale and in moderation increase efficiency. Stimulating drugs, like

benzedrine, may be issued by medical officers under exceptional circumstances.

The present chapter is concerned chiefly with the first five of these factors. The next chapter considers the last three.

All these conditions of efficiency apply to the individual soldier or sailor, but there are still other conditions that affect the *efficiency of a coöperating unit* when it is considered as a whole. You need to have the right man on the right job. That is a matter with which Chapter 11 is concerned. It is not enough to say that the efficient unit is one in which every man in it is maximally efficient. Efficiency depends on the relations among the men. Give a unit a poor leader and its efficiency is reduced; work is lost in friction (see Chapter 18). Put in a gun crew a man upon whom the others cannot depend, and you have in that social machine a partially stripped gear that will slip under stress and waste the work of the others. Efficiency in a group depends on proper selection and good morale (see Chapter 14), depends indirectly on methods of selection (Chapter 11), on adequate training (Chapters 12 and 13) and on leadership (Chapter 18). The old military maxim that every soldier should be trained to do everything so well that he can replace any comrade or superior who becomes a casualty simply does not work. It is an ideal goal, but you have to use specialization in jobs and in the relations among men, and never could you change all the men of a unit around and expect efficient action. A unit is a team. If it does not work as a team it is not efficient.

WORK HABITS

One important thing to do in a routine job—the aiming and firing of a weapon, the taking down and reassembling of a machine gun, the servicing of an airplane—is the elimination of useless movements, the planning of the job for the most efficient serial actions, and the determining of the minimal number of movements, their right order, and their right kind. The right movements are those that take the least time and produce the least fatigue. The motion study of workers in industry shows that such careful planning yields valuable returns in increased efficiency.

After the job is planned, it must be learned as planned. The planning should be done for the learner and the best technique taught him by an instructor. Otherwise the learner acquires wrong habits and has then to unlearn them. It is never efficient to learn a procedure incorrectly, for time is used up in learning the wrong way, more time in unlearning the wrong way, and then some time in learning the right way. Wrong habits may, moreover, persist in spite of persistent practice in unlearning them. Learn the right way the first time—that is the basic rule for efficiency. Let the planner do the work the wrong way in order to find out that it is the wrong way. Let him make all the mistakes for the worker, the soldier, the sailor, and let them then always be right with nothing to unlearn.

To discover the best way for any action, like loading a rifle or assembling a machine gun, the first thing to do is to *analyze the job.* That analysis is made, step by step, by expert riflemen and machine gunners who determine the best method of doing the job. Subsequently the military instructor finds their results in the official manual, and it then becomes his responsibility to teach the men to follow this best procedure and not to learn wrong habits which will later have to be unlearned.

The analysis of any new action or task can be worked out thus. If it has not already been done and printed in a manual, then an instructor or the learner himself must discover the best procedure. He breaks the job down into successive steps. He sees what simple actions make it up. A job that requires the fitting of a part into its place may, for example, start out with (1) searching for, (2) finding, (3) grasping, and (4) putting the part into its place.

After the first analysis has been made, the operation must be studied as a whole. In this study you see whether there are any waste motions that can be eliminated. You decide whether the work can be so placed that there is less searching, easier finding, quicker grasping, or moving over less distance. Such improvements will speed the operation and increase efficiency. The manner in which the work is laid out is extremely important. If a part must be turned around before it can be put in place, it takes longer to handle it and is more tiring than if it can be picked up in the position which is right for putting it where it is to go.

When you have settled all these points, you consider fatigue. Are all the motions being made in the way that will produce the least fatigue? Reaching up or bending your back to reach down is harder than reaching only with your arm and without much change of your body's position. If the handle of a tool is too large, too small, or so heavy that it tires your hand, you will be using up unnecessary energy. The handle should be changed. If the seat or support of a machine gunner on a ship or in a tank or plane, or the position of the weapon, causes him to strain, a change in the arrangement for the better will increase the accuracy of his fire.

When the gross movements for maximal efficiency have been determined, then it is time to consider the short quick motions. It may be necessary to take motion pictures of them, running the camera rapidly and studying the motions when they are projected slowly. Such slow-motion pictures not only show up the wrong motions, but they also enable the investigator to measure the time that each movement takes.

The following are some rules for determining the best method of work in any operation:

(1) Arrange the movements so that each ends in a position favorable for beginning the next. Then the successive movements will run along smoothly and but little attention will be required to pass from one to the next.

(2) Make the sequence of movements such as to encourage an easy rhythm, for such a pattern of motion readily changes itself into a single automatic act.

(3) Let the movements be smooth and steady without sudden changes of direction or sudden changes of speed.

(4) Keep the number of movements as few as possible.

(5) Arrange for the use of both hands as much as possible. Since a right-handed man has also a left hand, let him use it.

(6) When strength must be exerted, arrange, as far as possible, to have the force applied at a time when the momentum of the movement is optimal and at a place where the leverage is maximal.

(7) Arrange the workplace efficiently. See that seats, supports, work benches, are of the proper height to avoid a fatiguing posture, that weapons or tools can always be placed in the position best for the particular use or operation, that the more frequently used tools are in the more accessible places, that the tools and their handles are of a convenient size for the job, and that the work is laid out most conveniently.

Such analyses of jobs and studies of movement have proved worthwhile in industry. In one case it was found that a bricklayer used 18 movements in laying every brick. Analysis showed that 5 rhythmical movements were enough. When the man had learned these new work habits, his speed of laying bricks had increased from 120 to 350 bricks per hour. Even the simple expedient of placing the mortar and bricks on a raised platform, making it unnecessary for the bricklayer to bend over, made a considerable difference in efficiency because it reduced both time and fatigue. In the armed services similar studies and changes have resulted in more efficiency in the firing of weapons and many other special operations, though there is still much further analysis needed in a number of fields.

Special rules apply to carrying loads. The load should be evenly distributed. It should be placed so that the carrier can walk erect. For a long march the load should not weigh more than 40 per cent of the weight of the soldier, for short distances not more than 50 per cent.

Men in the services are often shown training films which are planned to teach them the best methods of doing any job that will have to be done repeatedly. They should watch these films carefully, noting the small details, observing how the demonstration troops hold their weapons or tools, how they use their hands and arms. The grip on a weapon or tool is just as important to the soldier or sailor as is the grip on a baseball bat or a tennis racket to a player. Combat and the preparation for it depend for success just as much on maximal skill and efficiency as does any sport.

On the other hand, it is not wise in the armed services to insist too rigidly on the precise standardization of movements. Men differ from one another. What is best for one is not always best for another. They differ in speed, in agility, in their capacity to unite a series of movements into a single rhythmical action. Battle situations often require that weapons be fired or work, like digging, be done with the body in awkward and therefore inefficient positions. Motion analysis gives only the average ideal. The details still have to be worked out separately by every man for him to achieve maximal efficiency under both good and bad conditions.

FATIGUE

Fatigue is efficiency's greatest enemy. Work increases fatigue, and fatigue decreases work. The more you work, the less work you can do—unless the excitement of an emergency such as battle enables you to tap new reservoirs of strength.

Physical and Mental Fatigue. Work may be either physical or mental. Physical work is any activity involving the use of muscles—lifting a shell, drilling, tapping out simple messages on a telegraph key, copying a muster roll. Mental work occurs in solving problems, arriving at conclusions, memorizing the orders of the day.

In physical fatigue a man's muscles ache. His body feels heavy because he is tired. His muscles are relaxed. His perception is dulled. He is not alert. It is an effort for him to think. Usually he is ready to relax and sleep, and he finds relaxation very pleasant. In mental fatigue, on the other hand, although his eyes, face and muscles are tired, he is apt to be restless. Lying down may not help him. He is annoyed by noises, is emotional and is generally irritable. He avoids more mental work and finds it difficult to make decisions, yet thoughts keep crowding into his mind. He wants to relax and sleep, but cannot. The physically fatigued man wants rest and should have it. The mentally fatigued man needs recreational diversion and outdoor exercise, or in extreme or chronic cases, psychiatric advice.

These are, however, representative extremes. More often mental and physical fatigue go together, and the recurrent need of the mind and the body for sleep finally stops both mental and physical work. If a man tries to study all night in a comfortable chair, he may indeed become so stirred up and restless over what he is studying or over other thoughts

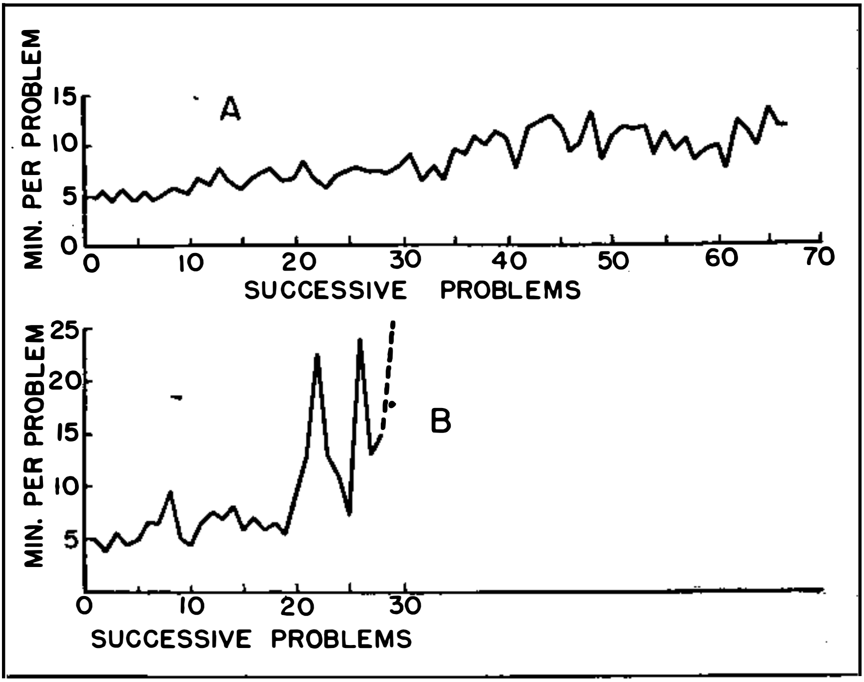

Fig. 58. MENTAL EFFICIENCY AS A FUNCTION OF MENTAL WORK AND FATIGUE

A: increase in mental inefficiency (minutes per problem) as a result of mental multiplication of 67 pairs of 4-place numbers in 12 hours during the day. *B:* the same for another person at night—30 problems in 3.5 hours. *A* stopped by prearrangement and could have continued. *B* was unable to continue.

that he needs to go out for a walk before he can sleep, but more often he just nods or goes to sleep in his chair.

Fig. 58 diagrams two quite different instances of mental fatigue. *A* and *B* are different persons. Their mental work consisted of arithmetical problems. Each had to multiply a pair of four-digit numbers in his head, record his answer, and then go on to another pair. *A* started work in the morning at 1100 hours and kept right on, with brief interruptions for tea and lunch, for twelve hours, stopping at 2300 hours that night. He completed 67 of these multiplications, beginning at a rate of about 5 minutes per problem and being slowed down at the end to 11 or 12 minutes per problem. As he got slower, he made more errors, became more variable in his work, but he was not exhausted by what would seem to have been a grueling performance. He could afterwards have done other kinds of mental work. He did not have to take a walk to cure his restlessness. He did not have to go to bed because of exhaustion. The only striking change was the great decrease in his efficiency—reduced work per minute.

B, on the other hand, started in at 2300 hours on a Friday night after a week of hard work, physically tired, perhaps mentally fatigued, and at an hour when the sleep rhythm is likely to overtake the worker. Like *A,* he began with a problem done in 5 minutes, and he did as well as *A* in the first 20 problems. Then suddenly, as Fig. 58 shows, he went to pieces. His times varied between 7 and 24 minutes per problem, until at 0235 hours, after only three and a half hours of work, he could no longer keep on. He even needed help in undressing for bed. He was, of course, physically tired and ready for sleep. He may have been more emotionally disturbed by the task than was *A,* for it is clear that *A* was anxious to perform the experiment and confident of doing well.

There are no sure rules as to when mental work produces fatigue and sleepiness, fatigue and restlessness, or simply loss of efficiency without much fatigue. It is more likely to produce sleepiness at night in a man who habitually sleeps at night. Fatigue is greater when there is emotional strain, frustration, effort and conflict, distaste for the task. *A* liked the task and experienced less effort than *B.* Habituated activities, which leave attention free for other thinking, may not constitute mental work at all. A man might call off the products of 2-digit numbers all day without fatigue, thinking mostly about other things, provided he was highly practiced in such multiplications. In other words, it is not mental work to be awake and thinking. It is mental work only when the answers do not come easily and there is some frustration before they arrive.

When fatigue is great, besides causing inefficiency and the unreliability that goes with variability of performance, it may lead to what are called *mental blocks.* Memory and association balk where they should run smoothly on. A familiar name, an important detail, suddenly is not there, although it seemed a moment ago to be available. These provoking and embarrassing blocks are often symptoms of mental fatigue, warnings that the man who has them is not at the time prepared for efficient thought and action.

Distractions, emotions and worries often produce results that resemble the results of fatigue though they are not fatigue. If the worker has his mind on something other than his task, or would like to have it there, he will be inefficient. slow. variable and unreliable, in proportion to the degree of his emotion or worry. His absent-mindedness may even appear to be a mental block, when suddenly he seems to forget the obvious. Fatigue is not the only cause of inefficiency.

In the armed services mental fatigue may be experienced by the highest commanders. They bear a particularly heavy load of responsibility for the success of operations, and it is therefore vitally important for such commanders to have at least the minimal amount of rest that will enable them to think, plan, and act to best advantage.

Consequences of Fatigue. There are three consequences of fatigue which are, of course, also its symptoms. They are physiological, psychological and behavioral. The body becomes less efficient. The worker feels tired. He produces less work in a given time.

(1) ***Physiological fatigue.*** As physical, muscular work continues, lactic acid accumulates in the blood as a result of the consumption of blood sugar by the muscle cells. More blood sugar is liberated by the liver and is consumed. Acute fatigue is, for this reason, reduced by eating sugar or candy. That is why soldiers on campaign are, when practicable, supplied with sugar in some convenient form like chocolate bars. A man with too much lactic acid and too little sugar in his blood feels tired and complains of fatigue.

Physiological fatigue does not, however, always result in a proportional loss of efficiency. Motivation works against it, and the emotion of an emergency may be enough to bring effective action from a man who has already reduced his sugar reserve and turned it into lactic acid. The fact is that a fatigued man is seldom near exhaustion but still has reserves of strength to use if the need is great enough. An athlete, pressed by another runner, may still break the record for the 100-yard dash

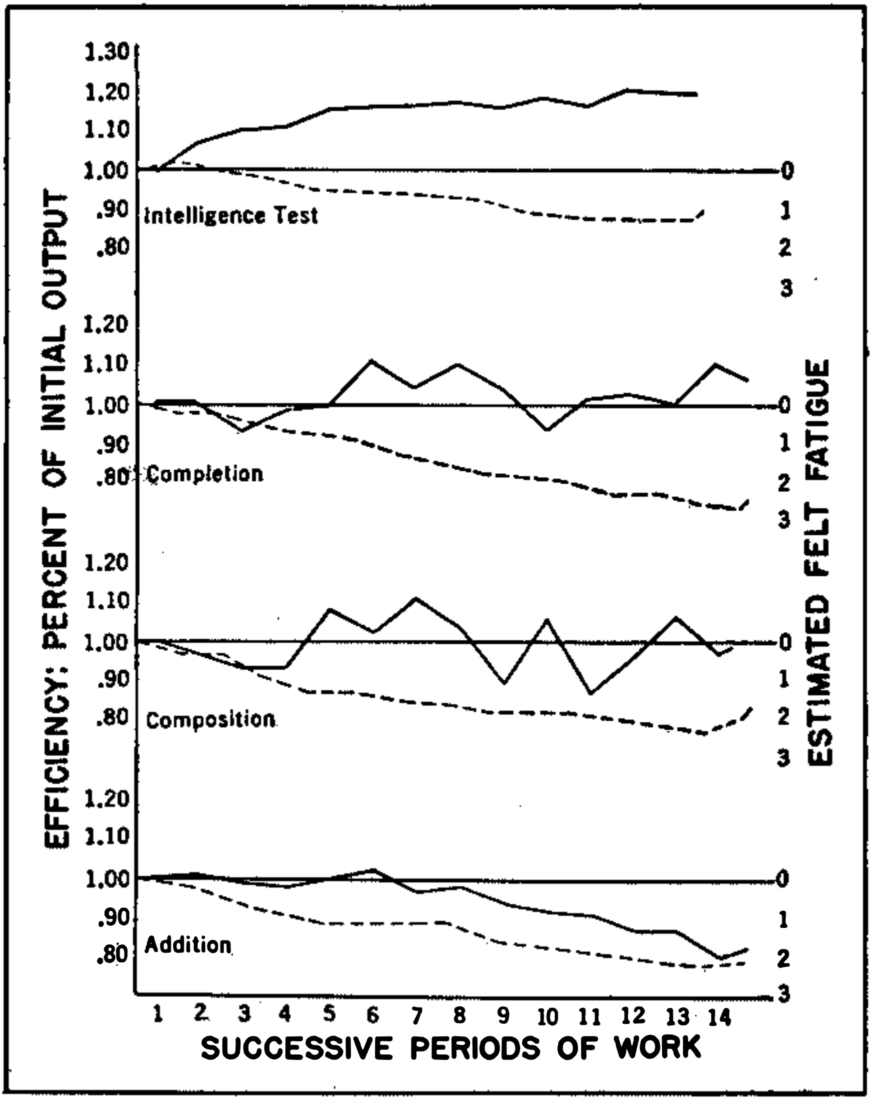

Fig. 59. CHANGES IN EFFICIENCY AND FELT FATIGUE AS WORK IS CONTINUED

Four kinds of work: Intelligence tests, completion of sentences with missing words, judgment of English compositions, adding of numbers. Efficiency (solid line) is diagrammed as per cent of initial rate of work (output). Felt fatigue (dotted line) is diagrammed downward as estimate of fatigue reported by worker, with *0* the degree of fatigue felt initially. The horizontal scale (1 to 14) shows the successive fractions of the total period of about five hours' work. (Adapted from A. T. Poffenberger, *Principles of Applied Psychology.* D. Appleton-Century Company, 1942, by permission.)

after using up sugar and accumulating lactic acid in the first two heats. An excited soldier may go successfully into combat after he has been marching all day or has been without sleep for twenty-four hours or more. A first-aid man may carry a wounded man hundreds of yards away from the enemy's fire, although a few moments before he might have felt that he could scarcely move one foot after the other.

Since it is not easy to measure lactic acid and sugar in the blood, and since physiological fatigue alone does not predict well how much a man can do, it is better to consider other consequences of work in estimating the military importance of fatigue.

(2) ***Felt fatigue.*** Feelings of fatigue are recognized by everyone, and a man can measure the growth of his felt fatigue by estimating its amount from time to time. He uses a ten-point scale, calls "1" *no fatigue at all* and "10" *too tired to move.* Curves of these estimates can be drawn, showing how felt fatigue increases as work continues. See Fig. 59, which shows (dotted line) how the feeling increases in different kinds of mental work. These curves are drawn upside down: the greater the felt fatigue the lower the curve. That is done so that they may be compared with the efficiency curves. They show that felt fatigue increases twice as much in about five hours of work on the adding of figures as it does in the same period of meeting the tasks of intelligence tests.

(3) ***Work decrement.*** The best measure of efficiency is the direct measure, the determination of the decrement in rate of work that occurs with continued work. This is behavioral fatigue, the fact that work reduces the capacity for more work. Fig. 58 showed how multiplying pairs of four-place numbers diminished the rate of multiplying by increasing the time per problem. Counting letters on a printed page for an hour can diminish the number of letters counted per minute by 6 per cent. Adding numbers for an hour can diminish the counting of letters by 15 per cent. Hence adding is more fatiguing, in respect of the work decrement, than counting. Fig. 59 (solid lines) shows gain and loss of efficiency in percentage of initial output for four kinds of tasks—intelligence tests, the completion of sentences with words omitted, the judgment of English compositions and the adding of figures.

Fig. 59 also shows that felt fatigue is not a good indicator of efficiency. In all of the four cases felt fatigue increased during the period of work. In the intelligence tests efficiency increased, in the adding tests it diminished, in the other two kinds of work it varied, tending to increase a little for the completion of sentences. Felt fatigue increased most with the completion of sentences, where efficiency changed little. In the adding, felt fatigue started to increase before efficiency began to diminish. Felt fatigue and efficiency increased together for the intelligence tests.

This discrepancy between the feeling of fatigue and the work decrement is doubtless due to differences in motivation. The intelligence tests are both tiring and interesting. They are not monotonous. Adding is tiring and dull. All mental work tends to produce the tired feeling. If it does not, you do not call it work. But even work—work that tires—can be fun. A scientist about to complete a discovery, an author about to finish writing a story, may find himself dead tired, though he started fresh, and yet working effectively at top speed. In the same way the sailor or soldier in combat may be dead tired, if he has time to think about it, and yet not at all inefficient.

The recovery of efficiency after its loss, as measured by the work decrement, shows great individual differences. Different men display different rates of recovery in the same job. The same man has different rates for different jobs. These variations may also be due to motivation, to the ease with which interest is recovered after it has been lost. Boredom—negative motivation—plays an important rôle in efficiency. It is discussed in a later section of this chapter.

Rest and Efficiency. The way in which work and rest affect efficiency is shown in the typical production curve of Fig. 60. The rested worker starts off fresh in the morning but it takes him a couple of hours to get going. Then he is at maximal efficiency. Thereafter fatigue begins to show and by lunch time he is slowed down. His rest in the lunch period leads, however, to his recovery, and he starts in the afternoon almost at maximal efficiency. Presently, however, fatigue returns and his production then diminishes very rapidly until he reaches his low point at the end of the afternoon. If he has to work overtime, he does not work efficiently.

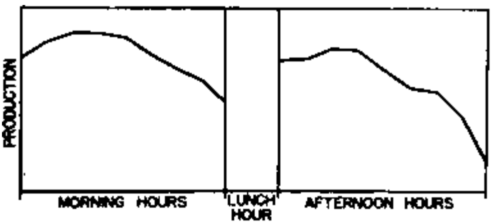

Fig. 60. Typical Daily Work Curve. (Adapted from H. E. Burtt, *Psychology and industrial efficiency.* D. Appleton-Century Company, 1929, by permission.)

It is well to have many rest periods. Students learn best if they do not do all their learning of one subject at once, do not try to cram up before an examination, but study a little and then stop for a while or for a day or two. Cramming is all right for review for an examination, for learning something that is to be used at once and then forgotten, but not for permanent acquisition. In industry efficiency is highest when rest-pauses are arranged at frequent intervals. Different occupations require different amounts, lengths and arrangements of these pauses. Soldiers and sailors doing heavy work, for example, need more rest than men on clerical jobs.

In arranging for rest periods the warming-up stage must be considered. Usually at the beginning of work there is a considerable improvement in production, an improvement that may last half an hour or more before maximal efficiency is reached. If the rest period has been too long, the worker has to get himself warmed up again after it. After a short rest, however, he can start in again not far below the greatest efficiency that he is going to achieve during the remainder of the day. Eventually, of course, the worker has to quit and sleep, and then get warmed up again the next day.

Another reason for having many short rest periods lies in the fact that recovery is more rapid when fatigue is not too great. You can fatigue your finger by having it lift a weight by a string over a pulley. In one such experiment it was found that the finger recovered in a half hour's rest after 15 liftings of the weight, whereas it needed two hours for recovery from 30 liftings. Doubling the work without resting meant quadrupling the time needed for recovery.

The best time for a rest period is at the moment when efficiency begins to drop noticeably. That is a way of avoiding large work decrements by resting before they occur. Such a rule is, however, a counsel of perfection, for there is bound to be some loss in efficiency before the day is done unless the worker does too little work altogether. It is hardly practicable to have four soldiers or sailors fight or work two hours a day instead of having one man fight or work eight hours or more—but it would be efficient if it were practicable.

In some jobs eight-minute rest periods, given every forty-five minutes, have been found to yield maximal production for the total time involved. One investigator says that 16 per cent of the work-day should be spent in rest.

It has long been customary for marching troops to rest the last ten minutes of every hour. Recent experiments, however, have indicated that this may be too long because muscles tend to become too stiff, and that five-minute rests in each hour are better, with more frequent rests of five minutes in severe conditions of heat and when the march is very long.

The week needs rest-periods as well as the day. One day off in seven is a pretty well established practice in industry—and even in military life when the exigencies of war permit. In industry there is apt to be a warming up from Monday to Wednesday, with sharp drop on Thursday and leveling off on Friday and Saturday. That fact suggests that it might be better to have a half-holiday on Thursday instead of Saturday, but such a conclusion does not fully consider motivation. The loss of the long weekend might increase boredom and thus cancel the effect of a better distribution of rests.

If workers are not given rest periods during the day, they will usually manage to take them. A British survey of industrial work showed that workers, left to themselves in this respect, usually "wasted" (rested) about ten minutes out of every hour. It is better, therefore, to prescribe the rest periods after discovering by experiment with a particular job how many and how long the periods should be. In one such study in Moscow production was increased 10 per cent by the introduction of regular rest pauses.

The sailor, and even more so the soldier, may have to catch his rest at irregular times during active periods of campaign and battle, and may often get less rest than he needs to keep up efficiency. In battle, commanders are often faced with the decision whether to continue to keep troops fighting after they have come close to exhaustion, or whether better immediate and over-all results are to be obtained by slowing up the battle long enough to bring up fresh units to take over the hardest fighting tasks. Such "reliefs" are extremely difficult to accomplish in the daytime since the enemy is likely to increase his fire on detecting the movement of troops and counterattack during the very hours the change is being made. Hence these reliefs must usually wait till after dark, with the result that the troops already in the fight must keep on fighting until that time.

In considering larger units of men who have been in and out of active battle for many days or even weeks without enough rest, the commander must often make his decision not only upon the availability of fresher forces but also upon the success he is obtaining as things are. One of the most exhausting operations in war is the pursuit of a beaten enemy. To achieve a complete victory, with the maximum of destruction of the enemy's forces, the commander may have to use his own troops to the point of complete exhaustion.

Thus, what would be inefficiency in almost any other type of human activity may, in a fighting army, give the highest efficiency in the end. At the same time, the Army and Navy will always reach a maximal overall efficiency through study and application, wherever possible, of such findings on efficiency as those discussed in this chapter and the next.

Complete rest does much more for recovery than does mere change of activity. One industrial plant introduced a 15-minute rest period in the middle of a two-hour stretch of work. Production was increased 9 per cent when the interval was filled with complete relaxation in a chair, but only 1½ per cent when it consisted of walking about. Here is a list of increases in efficiency for different kinds of rest in this experiment:

Complete relaxation in a chair	9.3%
Rest, the kind unspecified	8.3%
Listening to music	3.9%
Having tea	3.4%
Walking about	1.5%

In the Army, experienced leaders have long applied a similar rule on marches. They insist that their men spend all of the time of each hourly rest sitting or lying on the ground, rather than standing or leaning against trees or fences.

It would be efficient if one could work while resting, letting the rest period be used for the creation of some useful product. In a sense this arrangement can be made with nature when fatigue is specific and not general. General fatigue of the whole body results eventually in a decrement in any kind of work, but fatigue for one set of muscles may leave other muscles fairly fresh, and the mental fatigue for one kind of job may not completely carry over to a very different kind of task. Professional men, like physicians, may work fifteen hours a day, with time out for meals, if they keep changing what they are doing. A combination of studying, conferring, observing, listening, walking, driving may be a combination of useful activities and yet not so very different from mere staying awake and living. The varied activities of soldiers and sailors and their commanders enable them to work more efficiently than they could do were they confined to a single operation in an industrial plant. Industry might, indeed, take advantage of this fact and train workers for two jobs, a morning one and an afternoon one, each of which would be a partial rest for the other. For perfect efficiency there would have to be discovered some useful work that a man could do only by sleeping and eating.

When the kind of work is not varied, there arises the problem of overtime. How many hours per day and per week are most efficient when manpower is limited and it is not possible to get new men to work while the others rest? In a British munitions plant it was discovered that a reduction of the working week to 50 hours from 58 hours actually increased the hourly output by 39 per cent and thus the total weekly output by 21 per cent. In other words, by working 8 hours less a man did 12 hours' worth more work! That is a total gain of 20 hours saved—8 for the man and 12 for the plant. In this sense the men were working not only while they slept, but also while they went to the movies and talked to their families in the extra eight hours. They were storing up restedness for more efficient work when they came back to work the next morning and on Monday. If they could have spent these 8 hours on some useful production that was entirely different from the other job and as much fun as is leisure, they would have increased their over-all efficiency even more.

The usual amount of time given to active training duties in the Army and Navy is eight hours per day. This is usually divided into several different periods in which different work must be done. The eight hours do not include time spent in personal housekeeping chores such as making beds. Combat units, as they become more proficient, are given training over a much greater number of hours per day, and eventually go through maneuver periods in which, as in battle, there is but a little rest at irregular times, for several days. Such training is considered important especially because it shows the combat soldier that he can actually do with little rest and food for several days when he has to. The completion of such training successfully gives troops great confidence and increases their general morale accordingly.

Working Conditions and Efficiency. Working conditions affect efficiency. Bad illumination decreases visual acuity and also increases fatigue. Work suffers on both accounts. Noise may act as a distraction or it may spur effort, but increased effort increases fatigue. The effect of noise depends, therefore, on the kind of noise and its relation to the work. Music in moderation may increase efficiency, and bands certainly help marching. Heavy meals are bad for production if they produce sleepiness. Skin temperature, as it is dependent upon climate and weather and also on ventilation, is important and is discussed in the next chapter (pp. 199-207). Other working conditions are related to morale and motivation. We may consider here only the relation of illumination and noise to fatigue.

Illumination should be optimal. Too little light reduces visual acuity directly (see p. 29). Too much produces glare which in turn reduces acuity (p. 29). Poor acuity leads to the increased effort of accommodating the eyes to the work and thus to fatigue. Glare results in strain and fatigue. Uneven lighting means constant accommodation to the differences of brightness and thus fatigue. Illumination should be sufficient for the best acuity, insufficient for glare, and evenly distributed.

In certain investigations it was found that light from a daylight lamp (C2 Mazda) was better than from an ordinary Mazda, which was itself better than a mercury-vapor lamp. Eight foot-candles of light proved more efficient than eighteen for both work and reading. In one print shop type-setting errors were reduced by one quarter when the illumination was increased twelve-fold. In a factory the efficiency of roller-bearing inspectors was increased 12 per cent when the light was increased four-fold. In both cases further increase would eventually have reduced efficiency again. Since illumination costs money, workers get too little light more often than too much.

Fig. 61 shows how lighting affects visual acuity. Indirect lighting is best, direct lighting worst, semi-indirect intermediate. The more the lighting units show in the direct field of view, the more uneven the lighting of the field and the worse the acuity. Indirect lighting with the units out of the direct field is ideal. When direct lighting must be used, then eye shades are in order. They should be opaque with white or light linings. Shading the lamp itself is, however, better than shading the worker's eyes. In the armed services where work in the field may often have to be done in poor lighting conditions, efficiency can be increased and more and better work done by improvising measures, where possible, to improve the conditions—for example, using improvised lamp and eye shades.

Continuous noise may act as a distraction or a spur, and in either case it produces fatigue and eventually loss in efficiency (see pp. 118-120). The tension of muscles is increased by continuous noise, which also interferes with communication between workers, thus increasing confusion and fatigue. In a certain textile mill the weavers were made to wear ear plugs during thirteen alternate weeks so that the effect of the plugs on efficiency could be determined. The plugs decreased the noise

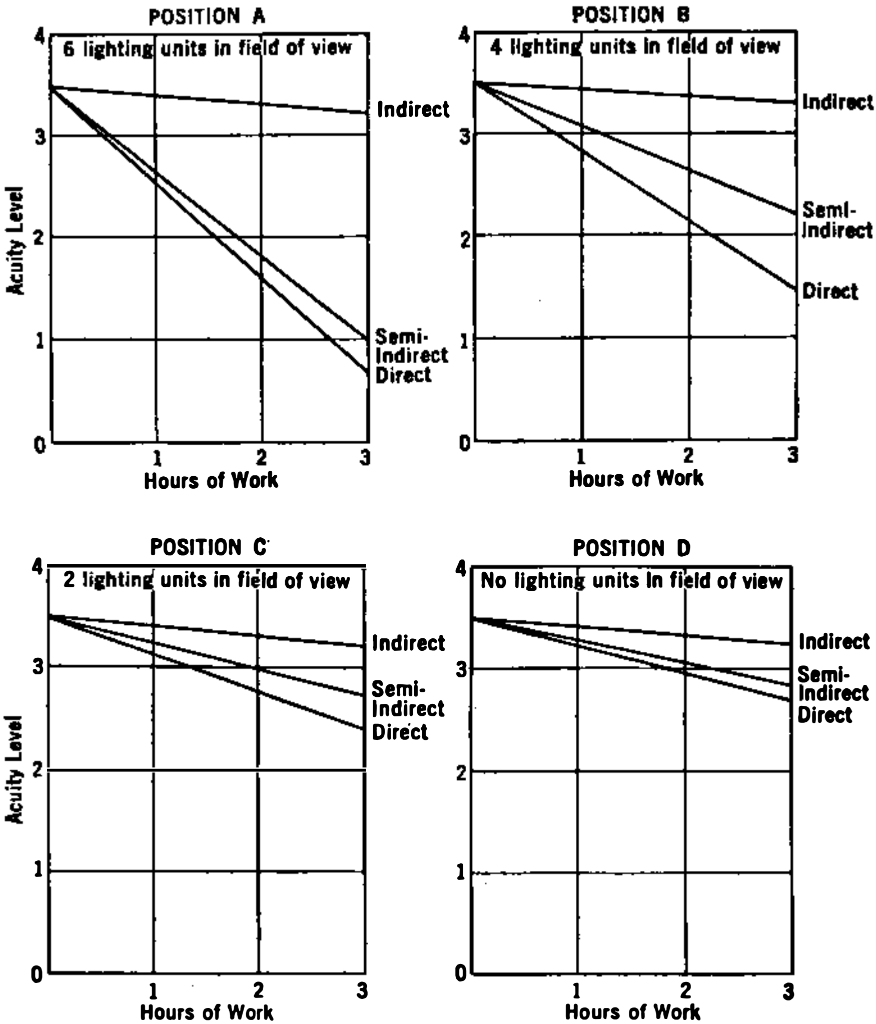

Fig. 61. Changes in Visual Efficiency during Three Hours with Different Kinds and Arrangements of Illumination. (From Ferree and Rand, *Proceedings of the American Philosophical Society,* vol. 57, p. 440, by permission.)

of the looms from 96 to 87 decibels and increased efficiency 12 per cent. In general, it is better to eliminate noise when possible, especially when communication is essential. Even some of the noises of war can be reduced by using ear plugs when this technique does not interfere with accurate communication (see p. 111).

BOREDOM

Motivation works against fatigue, but boredom—the lack of motivation—works with fatigue and is often confused with it. In boredom induced by monontonous work the muscles do not ache but there is nevertheless a work decrement, because the bored man's attention lags, his motivation goes down and his morale is, for the time being, low. It would be better if men never had to be bored, if their morale could always be high, their zest perpetually available for use.

Boredom may actually turn the normal work curve upside down (see Fig. 60). The worker may start fresh and do well, but his production, instead of increasing, diminishes because his work bores him. Later, when he sees the chance of release from monotony at lunch time or quitting time, he will speed up again, for the bored worker is the clock watcher. Fig. 62 shows clearly how boredom decreases efficiency, how the expectation of relief increases it.

The sure cure for boredom is interest in the work, nor is it always impossible to create interest. As a man becomes skilled, his pride in his pro-

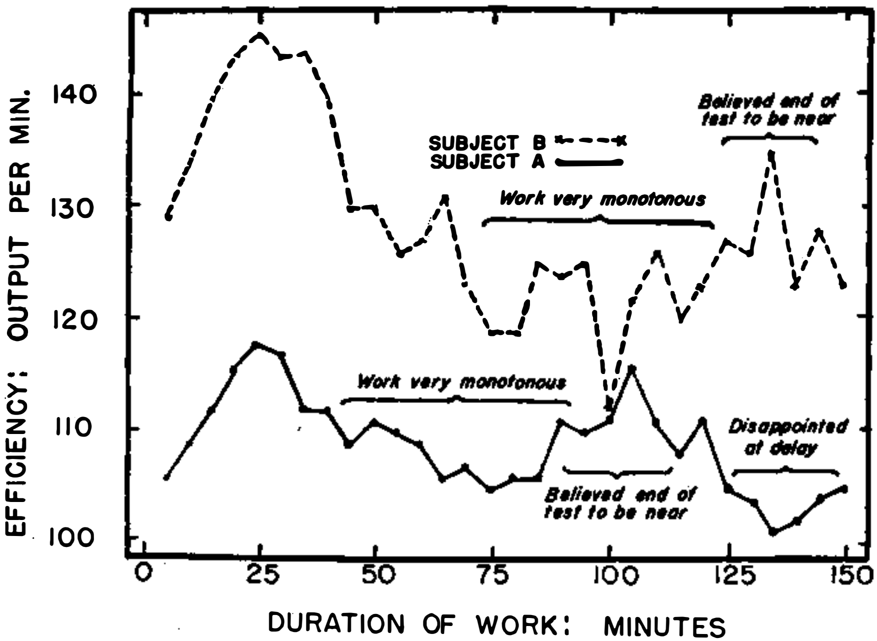

Fig. 62. Efficiency as a Function of Monotonous Work and of the Expectation of Relief from it. (Adapted from S. Wyatt, J. A. Fraser, and F. G. L. Stock, "The Effects of Monotony in Work," *Industrial Fatigue Research Board Report No. 56,* 1929.)

ficiency may reduce his boredom. Or his realization of the importance of what he is doing may increase his interest. In other words, all the factors which induce morale work against boredom (see pp. 325-342). The recruit in basic training is much more often bored than the soldier in an established unit which has good morale, the soldier who is convinced of the importance of what he is doing and how his comrades count on him for the unit's success. In the armed services, a full understanding of the immediate and eventual (combat) purpose of all training has been found to increase interest and speed of learning and therefore to obviate boredom or keep it low.

It is also true that motives get themselves established by repetition, that interest arises out of habituation. The man who complains about the monotony of his work and wishes release from it may not welcome relief when he gets it. That is the principle of the busman's holiday, and why the tired businessman does not after all want to retire.

Sometimes monotony can be reduced by a variety of jobs. The professional man is seldom bored because he does so many different things in the course of his day. The soldier and sailor also have variety, and that helps them greatly when they are not frustrated by their work, when they clearly understand the importance of what they have to do.

Not all men dislike monotonous work. There are great differences here. Some like to repeat the same acts over and over again, because they find such work easier and simpler. It frees them of responsibility and gives them time for day dreaming, for the company of their own thoughts. For them, variety of work would require constant attention and shut them off from thinking about themselves. Nor is it always the more intelligent men who want variety. Intelligence has actually little relation to susceptibility to boredom. The bright day dreamer welcomes the chance to lead his own thought life without interference from the reality that makes so many unwelcome demands upon him. Day dreaming is not, however, the sign of a healthy mind. Soldiers and sailors should not be encouraged in it. They should have a variety of work, whether they want it or not. The best morale is found among busy men, the men whose minds, as well as their hands, are full of their jobs all day long.

Nevertheless there are many monotonous repetitive jobs to do in the armed services. Not always is this kind of work assigned to the men who who will like it, who want to think about themselves. Then, as in similar conditions in civilian life, some become desperately bored, and some who are emotionally unstable get "bored to pieces" by their work, for they do almost go to pieces. First they get stale, developing one form of what is called *chronic fatigue.* Then they become anxious and fearful. They worry and are irritable. They cannot sleep. For such men a change is necessary. They may need more varied work, or they may require only a different kind of job, some other monotonous job in which they can feel interest. In Fig. 59 efficiency is shown to have increased with the intelligence tests in spite of fatigue because the work had variety in it. Efficiency declined with the adding because adding was monotonous. Nevertheless, a man who loved adding, as some of the mathematical prodigies do, might not show any decline in efficiency in summing numbers continuously. His pride in his skill might carry him along.

SLEEP

A man can stay up all night and keep awake provided he is active, provided he keeps using some muscles, at least his speaking muscles. He can march all night, play poker all night, talk all night. He will be likely to get extremely sleepy somewhere along between 0300 and 0600 hours in the morning, unless he is doing something intensely interesting, but he can come through the night awake if he is active.

That does not mean, however, that a man can read or study all night, using few muscles other than those of his eyes. If he has to study all night, he may have to read aloud or stand up to read. It would be easier to keep awake, if two men read aloud to each other back and forth, discussing the reading as they progressed. It is very hard for a man to fight sleep when he is quiet and by himself. For fighting sleep social stimuli like conversation are much better than good intentions, but activity in an emergency is best of all.

When a man has been awake all night, he will by breakfast time be getting less sleepy, and he can then get through the succeeding day pretty well. He may feel tired, especially if he has been marching or walking about to keep awake. He will be uncomfortable and a little dull. Other persons, however, will not notice anything wrong with him, unless he sits down and relaxes with nothing important or interesting to do. Then he will, most probably, doze off into sleep. If he has to do a job that requires accurate movements or accurate thinking, he is likely to make no more mistakes than usual, in spite of his sleepless night.

On the second night he will certainly not want to stay up, but he may have to. Another march may be necessary. The enemy may attack. The second night turns out to be like the first, except that it is more difficult. The man finds it harder to keep active under his own power, yet can manage to stay awake if the enemy or his leaders furnish the necessary motivation. He will not be able to keep his mind long on any one topic. When he tries, his thoughts and ideas will trail off into irrelevancies. If he can possibly get the chance to relax, he will; and then he will promptly go to sleep. Such a man ought not to be on sentry duty. If he is, he must keep walking to keep awake, and even then he may find himself going off into an inattentive daze while he continues walking. By this time he is almost certainly irritable—unreasonably irritable. Little things provoke him and he may also talk some nonsense. His anger never lasts long, however, for he would rather go to sleep than sustain an emotion.

The day after the second sleepless night goes better than the preceding night, but the sleepy man will be irritable, rambling and illogical in speech and thought, inattentive, more than usually sensitive to pain. His eyes will itch and he may begin to see double. He dare not sit down to read if he is to stay awake. His handwriting becomes poor and his pencil may drop from his hand as he writes. He may even begin to have hallucinations, imagining events that do not really happen, as if he had begun to dream while still awake. Yet he can still be spurred to his full mental powers and manual dexterity by a strong stimulus—by an alert, the near-miss of a shell, or even the sharp command of his leader. The effect of such a spur does not, however, last so long as it would normally. Pretty soon this man is back where he was, with the most important thing in the world his need to shut his eyes and go to sleep.

Sleep is deferred by excitement, social activity and muscular activity, because all these things demand or require attention. Motivation works against sleep. It is also possible to defer sleep by anything that reduces fatigue, since fatigue favors sleep. Food, especially sugar, can reduce fatigue. So does the Navy's frequent hot coffee. It is therefore best that men, who must stay awake all night, be fed. It is desirable that they have emergency rations, chocolate bars, hot chocolate, or snacks at frequent intervals. They need regular meals at the proper times, and should never be expected to go from supper to breakfast without any food—if they are to keep awake. In combat it may not be possible to provide food at night, but all leaders should know these facts. If it is dangerous for their men to sleep at night, it is dangerous not to feed them.

Sleep Deprivation. How long can a man go without sleep? He can manage a third night without sleep, and sometimes a fourth. All his symptoms get worse. It becomes harder and harder for him to command his attention. He needs more and more activity to keep him awake, A psychologist once kept himself awake for four whole days, spurred on only by the scientific motive of seeing what would happen. With doses of benzedrine to help him, he actually kept himself awake for eight days and seven nights.

There was once a man who believed that sleep is a bad habit which ought to be and could be overcome. He set out to cure himself. He was given a watchman's clock on which to record once every ten minutes the fact that he was still awake. He stayed awake almost continuously for nine and a half days, missing only 31 of the 1,380 recordings of the ten-minute intervals. Presumably he got some cat naps in between recordings. As time wore on he became dazed. He would keep his appointments at the wrong time or the wrong place or sometimes at both the wrong time and place. He got so that he was not always sure where he was. At the end of the sleepless period he was beginning to have hallucinations and delusions of persecution, and he had become so cantankerous that the experiment had to be stopped. He never got over his habit of needing to sleep.

Dogs have been kept awake for a week and seem to be normal again after a good sleep. They have constantly to be exercised or they will lie down and doze off. One dog was kept awake for 17 days and then died, presumably of overstimulation; but another dog recovered after 21 sleepless days.

Rabbits have been made to go for as long as 31 days without sleep. They were put inside a slowly revolving cylindrical cage which made them take a few steps forward several times in every minute.

Sleep soon restores the sleepy man or animal. Men who stay awake for two or three days are generally in pretty good shape after a twelve-hour sleep and show no effects at all after two or three days of normal living. Some changes can be found in the brains of animals who are deprived of sleep for several days, if they are killed immediately to have their brains examined. On the other hand, when the sleepy animal is allowed to recover before it is killed, its brain is found to have recovered too.

The combat soldier and marine, and less often the sailor, may have to go for long periods without regular sleep or sufficient sleep, but seldom do combat duties prevent them from having occasional snatches of rest and sleep. Even the hardest combat is seldom continuous for a given fighter, and he learns in campaign to get every possible moment of needed sleep, however brief—in his foxhole or the seat of his truck, or on the floor of a dugout where he may be waiting to carry a message.

He may at times also be able to obtain a number of short periods of relaxed rest without sleep, which is closer to sleep in value than is commonly believed. It is for these reasons that hardened and experienced combat forces are able to go on for days through periods of combat. The enemy, of course, does what he can to reduce the total of rest and sleep, and during lulls in battle may keep up a certain amount of artillery fire or bombing chiefly for this purpose. And what the enemy does can also be done to him.

Sleep Requirements. Since sleep abolishes fatigue, maximal efficiency requires enough of it. All soldiers and sailors need at all times sufficient sleep, sleep enough to be efficient, although they do not always get it.

There is, however, no precise rule for translating *enough* into hours. How much sleep do young adults need? Some become irritable when they get only seven hours a night; others do not. The unit with high morale can do with less sleep, since morale fights fatigue; but it is also true that loss of sleep fights morale. The normal adult seems to require from seven to nine hours in bed, with from six to eight hours of sleep—if he is to be maximally efficient.

The deepest sleep occurs in the first part of the period of sleeping, but there follow other periods of deep sleep interspersed with times of light sleep or wakefulness. The sleeper moves restlessly again and again—twenty to forty times—during the night. Because this initial deep sleep is the most restful, it has been suggested that distributed short naps would be more effective than one long sleep, just as distributed study is more effective than massed study. If a man slept for two hours out of every eight, would he avoid fatigue as well as by eight hours out of twenty-four? He would gain two hours by the distribution, but he would not fit into the routine of civilized social life. He would also have to break his normal daily rhythm of sleep and that rhythm is very hard to break.

There are no rules about the physical conditions for sleep that apply to all alike. Sleep is deepest and best under the conditions in which the sleeper is accustomed to sleep. Men can sleep well in the light. They do not all have to have spring mattresses. The Japanese sleep very well on hard ground. Sailors sleep with curved spines in hammocks, suffering no ill effects. Monotonous sounds tend to lull a man to sleep, but other kinds of noise need not keep him awake. Progressive relaxation of the muscles often helps one to go to sleep, as does also slow deep breathing. Some few people can go to sleep almost at will, as if it were a voluntary act. They can sleep under the most absurd conditions. Sleep itself is not a habit which can be broken, but going to sleep, when some fatigue makes sleeping a suitable thing to do, is partly a habit. You sleep most soundly with the conditions under which you have learned to sleep. Nevertheless you can learn to sleep well under new conditions, as many men who join the armed forces have to do.

In general, sleepiness and its opposite, alertness, follows a daily rhythm. Some men work best in the daytime, others at night. The day workers wake up early, accomplish a great deal of work before lunch, get sleepy after supper, and go to bed early if they can. Even if they cannot go to bed early, they wake early the next morning and start the next cycle of the rhythm, unless they have lost a great deal of their normal quota of sleep. The night workers get up late (if they may), work best after supper, go to bed late, and thus wish to sleep late again (if they may). Military and naval life are better adapted to the day workers, though in the Navy there are more regular night duties than in the Army or the Marines. Unfortunately, the night workers do not easily get their rhythms shifted over to the military routine, except, of course, when the day's work has been so hard that even a night worker is tired out and ready to go to bed when the day workers want to go.

Because these rhythms persist so firmly, it is better, when night work is to be done regularly, to pick the natural night workers for it rather than to distribute the night work equally among all. Among the staff of a military unit the night workers can be selected for the night shifts, the day workers for the day shifts. That would be the most efficient arrangement in any staff which must maintain maximal alertness during the twenty-four hours of the day. Rotation of night work among the men may seem fair, but it is not efficient.

ACCIDENTS

It is the military leader's responsibility to gain his objective in the length of time ordered with the least expenditure of men and matériel—especially of men, so that his unit will remain at high battle efficiency for the longest possible time. Efficient tactics keep casualties minimal. A great many casualties, however, do not occur in combat or even at the front. They are the casualties of accidents which happen everywhere, in the services of supply at home as well as in the fighting forces overseas, in training camp as well as in battle. If a careless soldier steps on a misplaced helmet as he tumbles out of his bunk, falls and breaks his leg, he is a casualty—fully as much a casualty as if the leg were broken by a fragment of an enemy shell. A man unable to work is a man lost, and the armed forces need to keep down the accidents fully as much as does an industrial plant.

The accident front at home is no safe place to be. In 1940 there were in the United States about 96,000 persons killed and 9,000,000 injured in accidents. These civilian deaths are more numerous than the American soldiers killed in the First World War. It is true that the Army in 1940—before it had gone to war—had about 30 per cent fewer accidents than the civilians, but then the Army was dealing with physically fit men between the ages of 22 and 44, whereas the civilian population included children and the aged. Accident casualties constitute a serious loss. The home front cannot well afford the cost that accidents entail in production, and the armed forces similarly, with manpower at a premium, need all the services of all men that they train. To train a soldier, to fit him into a special fighting job, perhaps as a noncommissioned officer, and then to have him lose, in some preventable way, his trigger finger, is as inefficient as it is regrettable. Accidents should be guarded against in every possible way.

Accidents can be classified as (a) mechanical, (b) circumstantial and (c) psychological. The *mechanical* accidents occur because of the failure or absence or presence of some man-made article. The steps were rotten and broke. The power-saw had no guard. He would not have fallen, if a shovel had not been left lying in the path. The *circumstantial* accidents happen because of the natural circumstances which surrounded their occurrence. The truck skidded because the road was icy. Blinded and deafened by the storm, he walked right in front of the engine. In the gathering dusk, he never saw the ditch before he fell into it. The *psychological* accidents depend on the mental state of the victim, most often his depression, distraction or emotion, sometimes on his more habitual absent-mindedness or impetuosity. He was too deeply depressed by his loss to notice what was coming. In his anger he forgot that the precipice was scarcely a yard away. Tired and without realizing what he was doing, he tried to lean against the revolving belt. Nor would he be deterred; what any other man could do he could do. Those are the ways in which accidents happen.

Mechanical accidents can be reduced if standards of quality are maintained and safety devices are used. If a tire on the truck is damaged, it should be replaced. The safety on the pistol should be kept in place. The manufacture and the subsequent care that make machines work efficiently also reduce the accidents that occur from their failure. Safety devices and automatic shutoffs eliminate a great deal of the danger inherent in machines. The Army and Navy are just as much interested in standards that prevent failure and devices that reduce accidents as is civilian industry. Standards must, however, be maintained with machines in use, and men must be trained to keep them up. The man who takes out a car with a poor tire, bad lights, a loose steering wheel, faulty brakes, and leaky bearings is, as likely as not, driving to an accident. Machines do not look after themselves. There is a human factor even in mechanical accidents, although in the purely military sense, the loss of matériel—wrecked trucks and tanks—may gravely affect the efficiency of a military unit even more than the loss of men when the battle situation is such that machines cannot be replaced and men can.

Since *falls* cause more accidents than any other single mishap, it is important to try to prevent them. Ropes, wires, boxes, and nails should not be left on walks where absentminded men or alert men in the dark may stumble over them. Weapons and tools should be put away and not left lying about. Oil puddles should be covered with dirt or sand. Most of the serious accidents in American shipyards have been due to this kind of "poor housekeeping," have occurred because the shipyards were not shipshape. Fences should be put up around holes (except foxholes). Railings should be provided—and also used—where they are needed. Man is an animal, walking, not too securely, on his hind legs. He is not any too steady and needs constant protection from falling.

Circumstantial accidents occur mostly because of poor light or extreme temperature. More automobile accidents happen at twilight than in daytime or at night, because drivers can see well in good light and become careful when they know they cannot, and the dangerous period is the time of change-over from day vision to night vision. Men walking on a road at dusk should walk on the side that makes them face the on-coming traffic and should if possible, both at dusk and at night, wear something light in color. Where and when it is safe and possible, artificial light should be provided to prevent accidents.

The fewest industrial accidents occur when the temperature is near 60 degrees Fahrenheit and accidents of all kinds are less frequent in the spring than in any other season. Except for the fact that ice is slippery, it is not certain why cold and heat increase the accident rate, but they do. Heat increases fatigue and makes men less reliable in their movements. That may be the reason why heat induces accidents. Cold also reduces agility if it numbs the body or the hands, or if it requires the wearing of heavy clothing which makes its wearer awkward. At any rate it is important indoors to keep the temperature optimal if accidents are to be minimal (see pp. 199-207).

Psychological accidents occur through the failure of the human machine. Poor vision increases accidents—one reason why men over 40 have more accidents than younger men (see pp. 30, 38f.). Men in poor health have more accidents than healthy men, old men more than young men. Tired men and men who have been drinking too much have many accidents, because they have poor muscular control. Depressed men suffer accidents more than happy men. Intelligence, as measured by the tests, does not seem to make any difference except that workers must be intelligent enough to learn how to use their machines and to form the habits which safety requires. That there are safety habits to learn is shown by the fact that men new at a job have more accidents than they do later on when they have learned how to look after themselves.

To some extent these psychological hazards can be reduced by education. Men must be taught the safety rules that apply to their work and must learn what situations are dangerous and thus to be avoided. That principle applies just as thoroughly to military activity as to industrial work. The common safety devices of factories, the use of signs and of colors for danger spots, the cross-hatching in contrasting colors of projecting objects, all such devices can be used on shipboard and in camp as well as in many other naval and military situations. Camouflage is one safety device which the soldier learns to use. So are trenches and foxholes. In fact, most of the practical rules that are given in this book for being successful in warfare—eating sugar when you are tired, talking to keep awake, putting your fingers in your ears to hear above a racket, staying in the dark or wearing red goggles when you want to see at night—all these rules are rules for avoiding accidents, for lessening casualties, ultimately for escaping the greatest accident of all, defeat.

When everything possible has been done to eliminate accidents, it still remains true that there will be accidents and that some persons will have more than others. These persons are accident repeaters, are *accident prone.* They seem to manage to get themselves into accidents even on fairly safe jobs and in spite of past experience. Undoubtedly such accidents are also psychological. They may be due to emotional distractions, worries, absentmindedness or day dreaming. They may be due to awkwardness or poor motor coördination. It has not so far been possible to detect these accident prone persons in advance of the accidents, yet there is no doubt of the existence of individual differences in liability to mishap. When the record convinces a leader that a man is accident prone, then, if the situation permits, he should give the man work where he cannot do himself much harm by inadvertent or awkward action. Two reportable driving accidents within a year, even though both are minor, are considered as indicating that the driver is probably accident prone.

It is obvious that many different factors can contribute jointly to a single accident. The road is icy. Twilight is coming on. The driver of the car is cold and tired and 55 years old. He is worried about his sick son. His tires are worn and his brakes are in bad shape. He has not yet learned to drive well anyhow. When another car suddenly slips out into the highway from a side road, what are his chances of an accident? And will the cause be mechanical, circumstantial or psychological?

Experience shows that it is well to be prepared for accidents. Men who anticipate the possibilities of accident, who rehearse imaginary calm cool action in idle moments of day dreaming or when going to sleep, may not avoid the accidents, but they may, nevertheless, find themselves prepared for deliberate intelligent behavior when the accident occurs. Men have tried impressing themselves with the maxim: "Relax, think fast, and do what is necessary." When the accident occurs, they remember the slogan, keep calm, think as fast as they can, and find that they then do what is necessary. Soldiers and sailors would do well to take this advice and to anticipate the various kinds of jams in which they might find themselves. The accident when it comes is not likely to be the anticipated one, but they will be prepared for calm and insured against panic. It is emotion and panic that oust wisdom in the presence of an accident, and the thought, at the right moment, that panic is bad can help to free the attention for intelligent thinking.

Some accidents are prepared for by drills. There are boat drills, fire drills, drills in the use of gas masks, drills with life preservers. They all serve to establish those habits and attitudes which make men more efficient when accident comes.

There is, of course, always the question as to whether drill works against originality. For instance, some instructors in infantry tactics believe that squad and platoon leaders should learn half a dozen battle actions as a basic repertoire for use when an attack must be rapidly made. Other instructors object that set methods destroy initiative. It is obvious that the Army should not abolish drill and discipline in the interests of initiative. What the soldier needs is a repertoire of useful habits and rules, plus one additional rule: Abandon the rules when you have responsibility for initiative and can see a better way. A man cannot be successfully instructed to be original and clever, but he can be told to give originality a chance and not suppress it when it comes to him. If he fails to find a novel, better solution of an emergency problem, then he can fall back on his standard repertoire. After all, inventive genius is really only the use of familiar ideas in novel situations (see pp. 272-275, 294f.).

In brief, then, the thing to do about accidents is to prevent them. Start out with equipment of high quality and maintain the standard with care. Use safety devices and invent new ones for new equipment. Put away objects that might cause accidents, especially falls. Have enough light when possible. Keep the temperature right when possible. Look to the psychological factors. Avoid distraction, fatigue, ill health, worry, emotion. Be young, if you can. Learn how to handle machines, tools, situations and emergencies. Then, if and when the accident comes, keep cool and use your head. In that manner accident casualties can be reduced and efficiency increased.

The special conditions of war necessarily increase the chance of accidents—mechanical, circumstantial, and psychological. Combat is essentially disorderly and emotional. Its effects can be offset only by continuous emphasis on the fact that even greater care is needed in war than in ordinary life. Such emphasis has been found necessary throughout the armed services.

REFERENCES

1. A. G. BILLS. *The psychology of efficiency.* New York: Harper, 1943. Pp. 361.
   An excellent handbook on mental work and fatigue, rest and recovery, sleep, work and incentives, the mental and physical conditions of efficiency in work and thinking.
2. H. E. BURTT. *Psychology and industrial efficiency.* New York: Appleton-Century, 1929. Pp. 395.
   Chapters 4 (fatigue), 5 (monotony), 6 (working environment), 7 (satisfaction and morale) and 8 (accidents), pp. 138-347, are clear interesting discussions of the matters in hand.
3. H. R. DE SILVA. *Why we have automobile accidents.* New York: Wiley, 1942. Pp. 394.
   A book on the psychological causes of highway accidents, containing numerous descriptions of driving tests and their results.
4. H. W. HEINRICH. *Industrial accident prevention.* New York: McGraw-Hill, 1941. Pp. 448.
   Chapter 6 gives many illustrations of safety devices on industrial machines; Chapter 8 presents case histories showing the importance of

psychological factors in accident prevention; Chapter 11 relates illumination to safety.

5. N. KLEITMAN. *Sleep and wakefulness.* Chicago: University of Chicago Press, 1939. Pp. 638.
   The best and most thorough book on sleep.
6. NATIONAL SAFETY COUNCIL. *Accident facts.* Chicago: National Safety Council, 1943. Pp. 96.
   Pp. 22-41 give statistics, presented in excellent graphic manner, of motor vehicle accidents; and pp. 42-43 the same for public aviation.
7. A. T. POFFENBERGER. *Principles of applied psychology.* New York: Appleton-Century, 1942. Pp. 655.
   Chapters 6 (work and rest), 7 (noise), 8 (illumination), 9 (climate, weather) and 10 (monotony), pp. 98-199, deal clearly and authoritatively with efficiency and work.
8. J. TIFFIN. *Industrial psychology.* New York: Prentice-Hall, 1942. Pp. 386.
   Chapters 4 (dexterity, manipulation, and achievement tests), 6 (visual problems of industry), 8 (work, fatigue and efficiency), 11 (accidents and safety) contain descriptions of tests and much valuable material relating to efficiency.
9. H. M. VERNON. *Accidents and their prevention.* New York: Macmillan, 1936. Pp. 336.
   Pp. 28-100 deal with accidents due to personality difficulties and environmental conditions; pp. 209-296 with accident prevention in home and factory. The subject of road accidents is more fully treated in item No. 3 above.
10. M. S. VITELES. *Industrial psychology.* New York: Norton, 1932. Pp. 652.
   An authoritative text on the subject in which Section 3, Maintaining Fitness at Work, pp. 325-628, is pertinent to the present subject.

Chapter 10

Physical Conditions of Efficiency

The conditions of efficiency are psychological, physiological and physical. Good morale is a psychological condition of efficiency. Boredom is a psychological condition of inefficiency—except for the man who likes repetitive work. Most of the basic conditions that produce fatigue are physical, and fatigue is the great enemy of efficiency. There are, however, other physical factors that affect efficiency—heat and cold, altitude and the diminished oxygen supply of high altitudes, alcohol, tobacco and other drugs and stimulants. This chapter deals with these physical determinants of inefficient action and the physiological means by which they operate.

TEMPERATURE

The human body is a remarkably precise self-regulating mechanism. For it to work efficiently certain of its properties have to be maintained in an exact equilibrium. Since the body must have the right amount of oxygen, it is equipped with mechanisms for getting more oxygen when the supply is too low and also for stopping the breathing when the supply is too great. The body must keep just the right amount of sugar in its blood, avoid too much and also too little. It must maintain the correct acidity of the blood, and it must also keep itself at the right temperature. Its capacity for maintaining these optimal states in respect of oxygen, sugar, water, acidity and temperature is called *homeostasis*. When bodily conditions depart widely from any of these optima, when homeostasis fails because regulation is inadequate, then efficiency falls off. A seemingly minor deviation from an optimum may cause a great loss in efficiency, and large deviations often result in unconsciousness or death.

To be efficient a man's body must, therefore, keep near its normal temperature. That is somewhere near 98.6°F, although there is more variability as to what temperature is natural and efficient than is generally supposed. The temperature of a perfectly normal person may vary from an average 97.3° at 0400 hours to an average 99.1° at 1600 hours. If, however, a man's body temperature gets, let us say, two degrees below normal, he begins to be sluggish and does not work effectively. If his temperature gets a couple of degrees too high, then he begins to have fever and becomes inefficient again—largely because the fever means that waste products are being rapidly formed and are accumulating in his blood, causing fatigue. The oxidation of these waste products makes the man sweat, and the sweating is both a disadvantage and an advantage for him. It is a disadvantage because it takes from his blood the water that is needed to dilute the waste products and salts. It is an advantage because the evaporation of sweat helps in the process of regulation by cooling off his too hot body. Evaporating water always takes up heat and carries it off. Porous water jugs and bags cool their contents in this fashion, especially if they stand in a not too humid breeze.

Actually the homeostatic regulation of body temperature is more complicated than this simple statement indicates. There is a "thermostat" in the brain which is set off by a rise in the temperature of the blood. It produces sweating and, in extreme fever, panting, which also helps to cool the blood by evaporating water from the lungs. Often, however, a fever has a purpose, the oxidation of bacterial waste products, so that cooling of the body by sweating is not desirable. The body, however, takes care of that too. It sets its brain "thermostat" higher and the result is a man with a high fever and a dry body. When this advantageous remedial oxidation has acted sufficiently, then the "thermostat" moves back to normal, the patient sweats, and his body temperature is in this way brought back to normal.

Ventilation—moving air, breeze—always works against heat in regulating body temperature. With enough ventilation, extreme heat may not cause inefficiency. With too little ventilation even mild heat may be disastrous. The story about the Black Hole of Calcutta, although questioned as to historical accuracy, is nevertheless accurate as to physiological fact. There the lack of ventilation was what made the heat fatal. The story is that 146 Englishmen were imprisoned, on a hot June evening in 1756, in a little room, 18 by 15 feet, which had only two tiny barred windows. They stood, crowded in with less than two square feet to a man. Their body heat increased the temperature. The resulting sweat increased the humidity. There was no cooling ventilation. By morning 123 of the 146 were dead.

Any soldier who has operated a tank in summer in a desert region knows what heat with insufficient ventilation can do to the efficiency of the human organism. The body may sweat a quart an hour, be sopping wet all over, yet still feel no cooling effect from the sweating.

Temperature Regulation. Body temperature and efficiency depend on *internal* physiological factors and *external* meteorological conditions. Here is the list.

Internal factors	*External conditions*
Oxidation	Temperature
Exercise	Humidity
Sweating	Ventilation
Adaptation	Radiation

Oxidation is the homeostatic mechanism by which body temperature is raised when it is too low. Oxidation is most easily increased by *exercise.* A cold man knows that voluntary exercise will warm him. He runs about or at least swings his arms to increase oxidation. If he does nothing, nature may provide exercise by making his body shiver.

Sweating is the homeostatic mechanism by which the body gets cool when it is too hot. The sweat pours out and its evaporation from the skin cools the blood. The evaporation of sweat depends, however, on external conditions. If the humidity is too high, the air will not absorb the sweat and there will be no cooling effect. If the air is still, then the layers of air near the body soon become saturated with moisture and will absorb no more. Ventilation is a means of providing fresh, less humid air for the absorption of more sweat.

There is also some *adaptation* of the body to cold and heat. A man can become accustomed to work efficiently at temperatures lower or higher than those that constituted his old optimum. It is not hard for young and middle aged persons to learn to be comfortable at 65° and even 60°, even when they have been previously accustomed to an indoor temperature of 72°F.

Men also differ from one another in their optima, either because of different adaptations they have made or because of differences in circulation. Their body weights also make a difference. A man who weighs 200 pounds suffers more from heat than a man who weighs only 150, because he has less skin surface in proportion to his weight and thus perspires relatively less. Because of these individual differences, exact rules for establishing the external conditions of the most efficient work cannot be laid down.

The most important external condition of body temperature is, of course, the *temperature* of the air in contact with the skin. The body cannot get too hot if the air next to it is enough colder than the body. It cannot get too cold with warm clothing because it heats up the air inside the clothing to its own temperature and then heats both itself and this air up further. On the other hand, the body can become too cold when the temperature of the air that touches it is above body temperature, because the evaporation of the sweat will cool it down. Skin temperature is controlled by evaporation and air temperature working together.

It is possible for the human body to operate efficiently for a short time in a dry heat as high as 250°F, provided ventilation secures sufficient evaporation of the sweat. It can also work well at very low external temperatures when exercise assures enough oxidation.

Thus the effect of air temperature upon body temperature depends on both *humidity* and *ventilation*—on humidity, because there cannot be evaporation from the skin, if the air is already saturated with moisture; on ventilation, because the air next to the skin soon gets saturated and there must be air currents to bring new, less humid air continually in contact with the skin.

Table III shows the maximal air temperatures at which homeostasis can keep body temperature constant under different conditions of humidity and ventilation. These data were obtained with nude men in a room whose walls were the same temperature as the air. The wall temperature makes a difference because of heat radiation from the walls.

TABLE III

MAXIMAL AIR TEMPERATURES AT WHICH HOMEOSTASIS CAN MAINTAIN CONSTANT BODY TEMPERATURE

	Air Velocity (Ventilation)	
Relative Humidity	*17 ft. per min.*	*500 ft. per min.*
0 per cent.	112°F	114°F
50 per cent.	97°	101°
100 per cent.	90°	93°

Radiation is important in temperature control because the body is constantly radiating heat to cooler surroundings or being warmed up by radiation from the warmer surroundings. This physical exchange of heat takes place independently of the conduction of heat to and from the air that touches the skin. It does not depend on the presence of air. Everyone knows that it is warmer in the sun than it is in the shade. Actually the air itself is not much warmer in the sunshine, but the warming radiation passes directly through the cool air.

Whenever surrounding objects are higher or lower in temperature than men's skins, radiation from these objects will affect the men's comfort and efficiency. In one experiment in a room where the walls were kept at a temperature of 45°F, the occupants did not begin to feel uncomfortable until their temperature had been raised to 79°F. They were radiating enough heat to the wall to keep their skin temperatures down. In another experiment in which the walls of the room were kept at the same temperature as the air, the occupants became uncomfortable when the air was at 70°. In fact, a man once found that he could work well in a small room in which the air was only a little above freezing temperature. He had lined the room with polished copper which reflected the heat from his body back to his body. He did not have to wait until his body had warmed up the air. He was comfortable as soon as he entered the room.

Windows do not make a room cold in winter merely because they leak. A room with many large windows would still be cold if there were no cracks. The glass, in contact with the cold air outside, becomes cold by conduction of its heat to the outside air, and then the human body radiates heat toward these large cool surfaces.

A crowded room becomes uncomfortably warm, as a rule, because it is filled with warm bodies. The heat that my body radiates to yours is cancelled by the heat that your body radiates to mine. The net result is that one body does not radiate heat to another body as warm as itself. A crowd in a room without ventilation can get too warm even when the air is so cooled that a person alone in the room would be uncomfortably cool.

In an engine room, in a submarine, in an enclosed cabin in high-altitude flight, the surrounding solid objects like walls and motors may have as much effect on efficiency as does the temperature of the air.

In general, then, the thermometer is not a very good guide as to efficient working conditions. Its indications have to be modified in accordance with other external conditions—humidity, ventilation and radiation.

Heat interferes with efficiency more often than does cold. Indoors, cold can be avoided by heating systems, whereas the cooling of air by air-conditioning systems is expensive, new and not generally used. Both indoors and outdoors, cold can be combated by putting on more clothes, but heat cannot always be abolished by taking them off. Muscular work makes cold more endurable. Walking at a rate of three miles per hour while carrying a 40-pound pack increases oxidation enough to increase the heat output of the body fourfold.

When temperature cannot be regulated homeostatically or by control of the external meteorological conditions, then resort must be had to *clothing.* Clothing can be used to keep the body cool as well as warm.

To keep cool in heat, do not let the direct sun beat upon your head. Wear a helmet, perhaps one made of plastic and certainly one that is well ventilated. Wear light-weight garments around the shoulders, trunk and hips—garments of open mesh with short or loose sleeves. The fibers of such garments quickly pick up the sweat from a large portion of the skin, more quickly than it would be directly evaporated under ordinary conditions. Since the total surface of all the fibers in the garment is much greater than the surface of the skin, the effective rate of evaporation is proportionately increased. A nude man standing in the sun may feel much hotter and more uncomfortable than his lightly clothed fellow. The fabrics for such clothing should be well chosen. Their fibers should be small and not hard twisted, for they must act like wicks. When practicable, they should be white or light in color in order to reflect the sun's rays. A dark fabric is warm because it absorbs radiation from the sun and from surrounding objects.

These are the general rules. Often, in the armed services other considerations, especially the measures necessary to protect the body from the bites of malarial and other dangerous insects, prevent the full application of these measures for keeping cool.

To keep warm in the cold, proper clothing is also needed, such as the Russians had in their first winter of war against the Germans, and as the Germans in general did not. Heavy clothing has, however, some drawbacks. It makes its wearer, especially the man who is unaccustomed to it, clumsy and diminishes his self-confidence. The problem here is to get the best heat insulation with the least weight.

Effective winter clothing is in reality an air-trap surrounding the body. Air is a poor conductor of heat, and air trapped in a fabric or in fur does not move about to cool the body by ventilation. The winter fabrics should be wind-tight, made of material that absorbs moisture from the skin and fashioned so as to contain or trap a great deal of air. The material can be made of fur or of multiple layers of fabric. Loose-fitting clothing is best, especially for socks and gloves. Tight clothing holds less air about the body, and may even restrict the flow of blood, thus increasing the danger of frostbite.

In general, the toes, fingers, ears and nose depend on the circulation of the warm blood to keep from freezing. The neck, arms, legs and trunk are warmed by circulation, muscular activity and by clothing.

Below 0°F clothing is likely to be insufficient to protect the body. Even the electrically heated suits of flyers may become inadequate. The hands and feet get cold first, then the body, then the legs. Continuous exposure to –20° usually begins to produce mental distress. At –30° there is apt to be a loss of morale: indifference begins to supplant distress. At –40° continued exposure produces lethargy, which may be followed by stupor and eventually by death.

Extreme cold is unpleasant only at first, when you shiver, feel cold (in part from the constriction of your blood vessels), and "huddle up" to try to get warm. Later your nervous system gives up the battle. Your blood vessels dilate and your muscles relax. You no longer feel cold intensely; in fact you may say that you "bask" in the cold. A physiologist who tried the experiment of exposing himself naked to extreme cold, wrote: "Up to the point at which shivering ceased, nature fought the situation; my instinct was to be up and about, an effort of the will was necessary to remain the subject of the experiment; after that I gladly acquiesced, initiative had gone. . . . Doubtless a second and more advanced stage would follow in which inertia would lapse into unconsciousness. For I suppose that, had the experiment not ended at that point, my temperature would have fallen rapidly and I was on the verge of the condition of travelers when they go to sleep in extreme cold never again to awake."

Optimal Temperatures. Even though the thermometer's reading, taken without regard to humidity and ventilation, is a poor predictor of human efficiency, there are certain gross climatic and seasonal differences which are indicated pretty well by temperature. In the northern United States it is certainly easier to work outdoors in the spring than

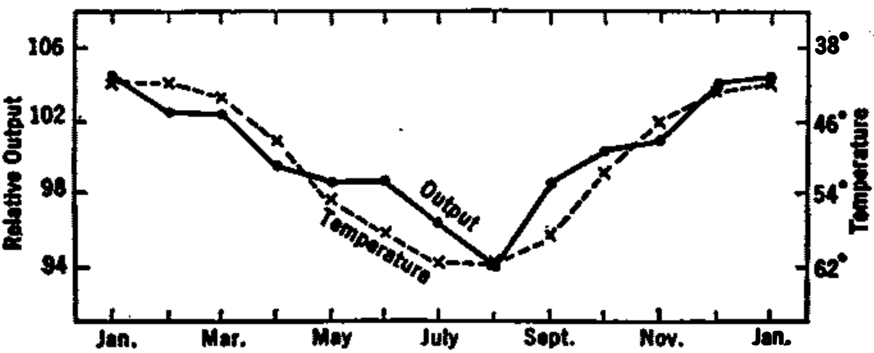

Fig. 63. Relation of Output in a British Tinplate Factory to Outdoor Temperature at Different Seasons of the Year. (Adapted from A. T. Poffenberger, *Principles of Applied Psychology.* D. Appleton-Century Company, 1942, by permission.)

in winter and summer. Winter is better than summer in Libya, summer better than winter in northern Alaska. The best work is done not too near the Equator or the poles.

Fig. 63 shows how the output of a British tinplate factory varied with the season of the year and also with the average outdoor temperature at the different seasons. The output was least in August with an average outdoor temperature of 62°F. Such work requires muscular exertion which produces oxidation and tends to keep body temperature up. Otherwise the optimal outdoor temperature would be higher.

It has been said that good mental work does not depend so much on temperature as does physical work. This statement must be accepted cautiously. It is true that there have been certain experiments in which simple mental operations were performed under different conditions of temperature, humidity and ventilation. The operations consisted of naming colors, stating the opposites of certain words, cancelling given letters in a printed page (a good test of clerical aptitude), adding figures, multiplying numbers in the head, and typewriting. There was practically no difference in performance on these tests under the "best" conditions (temperature 68°F, humidity 50 per cent, fresh air constantly circulated) and under the "worst" conditions (temperature 86°F, humidity 80 per cent, stale air recirculated). Production of test results under the "worst" conditions varied only from 98 to 105 per cent of the production under the "best" conditions. Production of mental multiplications even went up to 109 per cent when the "worst" conditions were improved by stirring up the air with high-speed fans. It is, moreover, well known that efficiency in such simple habitual operations is not *immediately* reduced by some discomfort. The discomfort may actually act for a time as a spur to attention, just as a noise may stimulate mental work instead of distract the worker.

On the other hand, thoroughly effective discomfort will, of course, reduce efficiency. A man who is so tired that he can only just keep awake will not continue to add and multiply at his best speed and accuracy indefinitely. In any case he will waste time resting, will start each successive item of his total task after a longer pause, will not continue at top speed. You can have a brilliant insight into possible tactics when you are in a tank in the desert in summer, but you are more likely to have it in a comfortable room in the spring. Mental efficiency eventually yields to bodily inefficiency.

In general, the best working temperature, except when bodily exertion is great, lies between 60° and 65°F, with the air not too humid and ventilation constant. The best climates for work lie between 25 and 55 degrees of latitude, the latitude of the United States, France, Italy, China, South Africa, southern Australia and the Argentine. Nearer the Equator lie Central America, Egypt, India, the East Indies and Brazil. There is little land south of 50 degrees, but north of 50 degrees are Canada, Siberia, Russia and Great Britain. The rule of latitude is obviously not absolute. The Gulf Stream, for instance, brings England the climate where civilization flourishes, but it is doubtful if northern Canada and Siberia will ever, with their present climates, lead the world in cultural progress.

On the other hand, it is true that Egypt in the torrid zone had a high civilization once, and some think that its climate must, therefore, have been more temperate in those days than it is now. The difference may, however, be due to social structure. When the ruling classes, the directing minds, keep fairly cool indoors, they may be able to have the bright ideas and the ambition to make the ideas effective, and then can perhaps compel the hot unambitious working classes to do the necessary work. In some social orders it takes energy and ambition to resist doing what you are told to do. The civilization of Greece developed through the active minds of relatively few men who were supported by the labor of slaves. Democratic civilization, on the other hand, would seem to belong to the temperate zone.

One has only to observe the conduct of men and the state of social progress in modern hot climates to see that homeostasis is not adequate to produce ambition and invention. The great masses of men in the torrid zones tend to be listless, uninventive, apathetic and improvident. They survive and are happy because nature offsets their improvidence by supplying easy food in the abundant production of the tropical plants, and by making elaborate shelter with heating systems unnecessary.

Frostbite. Exposure to extreme cold may result in frostbite. The part that is frostbitten first feels cold. Then it hurts. Later it becomes insensitive. Finally it turns white or bluish-white.

Every soldier or sailor on duty in the North or at high altitudes should know what to do about frostbite. The chief need is to keep the blood flowing through the exposed tissues in order that they may remain alive. Severe cold tends to produce spasms in the small arteries, spasms which reduce the flow of blood and give rise to pain. If the blood is very low in oxygen, as it may be at high altitudes, the walls of the blood vessels may be damaged, allowing the fluids of the blood to pass through. Then the tissues become blue and swollen, and blisters may form. At this stage sensation is lost. The exposed part becomes numb. Some remedial action is indicated, and it should be taken as soon as pain has given the warning.

Keep the frostbitten part at the level of the heart so that the return of the blood through the veins will be easy. If the fingers are frostbitten, put the arm at the heart level; if the nose or toes, lie down. Then arrange to thaw the part out very slowly. It is best to let the body do the warming. Cover the part with clothing. Put a hand against the body inside the clothing. Or wrap the part in cloths soaked in cool water and let it warm itself. Never put it near a hot stove, a radiator or a fire. Do not rub it with snow, for rubbing may injure and destroy the tender frozen tissues. If the tissues are damaged, gangrene results.

If a man has become unconscious from exposure to cold, he should, if possible, be placed in a cool room and covered with blankets. His arms and legs should be moved, but not violently. He should have warm drinks as soon as he is able to swallow them.

ALTITUDE AND ANOXIA

Men who ascend to high altitudes in airplanes or on mountains meet with reduced air pressure and this reduced pressure results in the absorption of less oxygen by their blood. They suffer from oxygen want or *anoxia,* as it is called. The effects of anoxia depend on the altitude reached, the rate of ascent, the time spent under low pressure, the amount of physical exertion of the man and his physical condition.

Effects of Anoxia. At low altitudes, below 8,000 feet or perhaps 12,000 feet, anoxia is not a serious problem. If you are physically fit, your body can make its adjustments automatically.

At higher altitudes, however, psychological changes begin. High altitude life, it has been said, begins at 10,000 feet. The first effects have some resemblance to the effects of a couple of cocktails taken on an empty stomach. You feel a warm glow of well-being. Nothing is wrong with the world. You begin to get clumsy in handling instruments or the controls, but you do not know that you are clumsy. In your own opinion you are somewhat more adequate than usual. You feel lazy, relaxed, confident. You do not want to be troubled about anything. Your judgment is deteriorating, but you do not know that either. If your wisdom is called in question, then it is inevitably the other fellow who is wrong. You may make some notes. If you do, you are likely to be surprised, when you read them later on the ground, at your poor handwriting, your poor phrasing and your bad grammar. Your daylight vision is still satisfactory, but your night vision is already affected adversely.

The rule is, therefore, to wear your oxygen mask above 10,000 feet, where air pressure is reduced to 10.1 lb. per sq. in. from the sea-level pressure of 14.7 lb., and where these deficiencies in judgment, motor control and night vision begin, accompanied by a gain in self-assurance that makes you unable to realize that you are ascending into danger. When your judgment is poor, you cannot safely judge the quality of your judgment.

At 14,000 feet muscular coördination gets worse. The oxygen-starved flyer without a mask could no more walk a chalk line or shoot accurately than can a man half drunk. Your handwriting has become quite bad. Your will power is failing. You may know what to do when an emergency arises but usually you are quite unable to do it. You begin to suffer from blocks in your thinking—the next idea refuses to come. You are emotional. You may laugh boisterously, or you may weep, or you may get pugnacious. Certainly you are not heading for victory or even safety. You need your oxygen mask badly.

After you have been for a time at 18,000 feet, if still without a mask, your muscular coördination becomes still worse. You may start to tremble. Your hearing is poor and your vision blurred. Noises seem to come from a great distance. Sights are dimmed. Both your field of vision and your field of attention are narrowed. If you are trying to watch a number of instruments, you will be unable to pay attention to any except the ones directly in front of you. You miss seeing anything off to the left or the right. Your attention has to be concentrated on one main task at a time. You are unlikely to notice an enemy plane that approaches from an unexpected direction. Your memory also goes back on you. Your judgment gets worse. Your mood changes even more. You lose your ability to know when you do things wrong. You still feel fine when you are not fine. You do not know your danger, for you think you can lick the world.

All these changes come on without your realization of them. You do not feel your bodily changes because your senses are dulled. You do not know that you are acting queerly, because your judgment is faulty and because you are in a breezy don't-care mood. It is a highly dangerous situation, and flyers have to be shown their own performances on tests at these altitudes in order to learn that they *must* put on their oxygen masks, making sure that the oxygen is turned on and flowing.

At 20,000 feet the effects of altitude for a flyer without a mask are profound. Hearing becomes very difficult, reaction time is slow, muscles twitch or even become paralyzed. Voluntary control of action is very weak indeed. The emotional moods of the flyer are so heightened that he is really delirious. He loses all sense of time.

Somewhere above 20,000 feet he passes out entirely. He does not know that he is about to become unconscious unless he is wise enough to read the signs from the altimeter on his instrument board. He is, however, not wise at 20,000 feet—unless he has his mask on.

All these effects are the symptoms of anoxia. They arise entirely because of the reduced air pressure—and oxygen pressure—at high altitudes. They are unrelated to height (except as height reduces air pressure), to cold or to any other incidents of high-altitude flying. They can be produced and studied in decompression chambers on the ground—chambers in which a man is placed and from which the air is pumped out in the amounts necessary to reproduce the low pressures of different altitudes. In such chambers he can be required to perform intellectual, sensory and motor tests, being shown afterwards how his abilities fail him when his oxygen supplies are reduced.

Physiology of Anoxia. Table IV shows how air pressure decreases with altitude. Air pressure can be measured in lbs. per sq. in. or in millimeters of mercury. The pressure at sea-level is about 14.7 lbs. per sq. in.,

TABLE IV

Relation of Altitude to Air Pressure

Altitude: *feet*	*Air pressure:* *lbs. per sq. in.*	*mm. of mercury*	*Altitude:* *feet*	*Air pressure:* *lbs. per sq. in.*	*mm. of mercury*
Sea Level	14.7	760	16,000	8.0	414
1,000	14.2	735	18,000	7.3	378
2,000	13.6	704	20,000	6.7	346
5,000	12.2	632	30,000	4.4	228
10,000	10.1	523	40,000	2.7	139
12,000	9.3	481	50,000	1.7	88
14,000	8.6	445	60,000	1.1	57

and that is pressure enough to support a column of mercury 760 mm. high. At 18,000 feet the sea-level pressure is halved, is about 7.3 lbs. per sq. in. or 378 mm. of mercury. At 10,000 feet, the critical altitude at which the oxygen mask should be put on, air pressure is about 70 per cent of what it is at sea level.

The blood absorbs oxygen in the lungs because of the pressure of the oxygen. The air consists of 21 per cent oxygen and 79 per cent nitrogen with small quantities of other gases. Thus it is correct to say that 21 per cent of the air pressure is oxygen pressure. At sea-level pressure is 760 mm. and thus oxygen pressure is 160 mm. (21/100 of 760 mm.). At 10,000 feet air pressure is down to 523 mm. and oxygen pressure down to 110 mm. That is the altitude to put on the oxygen mask. In other words it is desirable to keep oxygen pressure above 110 mm., as near 160 mm. as possible.

When the mask is used, the man breathes pure oxygen at whatever is the pressure of the air. The pressure inside the mask cannot be higher than the pressure outside or the oxygen would escape from the mask. Thus 100 per cent oxygen at a given pressure has about five times (100/21) the oxygen pressure that you get from 21 per cent oxygen in ordinary air, because the total pressure is the same as the pressure in the outside air but inside the mask all of it is oxygen pressure. The saturation of the blood with oxygen, the all-important physiological factor, depends upon the oxygen pressure. When the oxygen-saturation of your blood is low, you suffer from anoxia. The relationship between pressure and saturation is not exactly proportional but nearly so. Here are the figures for certain critical altitudes.

Oxygen saturation in blood .	85%	80%	70%
Altitude without mask	11,000 ft.	13,000 ft.	18,000 ft.
Altitude with mask	41,000 ft.	42,000 ft.	44,000 ft.

From these data it is apparent that 40,000 feet is a critical altitude with the mask, comparable to 10,000 feet without the mask. At 10,000 feet 21 per cent of the air pressure is enough to give the minimal oxygen-saturation of the blood and you can get along without a mask. At 40,000 feet the necessary oxygen-saturation requires 100 per cent of air pressure, and you can get that by using 100 per cent oxygen in a mask at the pressure of the outside air. You make up for decreased total pressure by using more oxygen. Remembering what happens above 10,000 feet without the mask, one realizes at once that a flyer should not stay long above 40,000 feet even with a mask. He should not, unless he is in a plane with a sealed cabin, where air pressure can be kept higher than the atmospheric pressure outside.

Rapid breathing will increase the saturation of oxygen in the blood as long as it is continued, but eventually it may work in such a way as actually to reduce saturation. Panting is caused, not by lack of oxygen in the blood, but by excess carbon dioxide, which stimulates the breathing center at the base of the brain. While voluntary rapid breathing keeps bringing more oxygen into the lungs, it also keeps getting the carbon dioxide out of the lungs. That means that carbon dioxide can be eliminated more rapidly from the blood, and the elimination of carbon dioxide in turn reduces the effect on the breathing center and tends to let breathing slow down. As soon as the man stops voluntary rapid breathing and lets nature take its course, he finds himself breathing abnormally slowly, because he has not enough carbon dioxide left in his blood to keep his breathing center at work. Panting with muscular exertion is an entirely different matter. Then the exertion increases blood pressure and supplies the carbon dioxide that makes the panter pant.

There are four principal ways in which anoxia may be produced.

(1) *High altitude* and the low oxygen pressure that results from it. This is the effect we have been considering.

(2) *Loss of oxygen-carrying capacity* by the red blood corpuscles. This loss occurs in anemia when the number of red cells is reduced, either by disease or more often in war by the loss of blood through injury. Each cell still carries as much oxygen as ever but the total oxygen traffic is reduced. It is also possible to reduce the carrying capacity of each cell by loading the cell with something else, like carbon monoxide or sulfanilamide. The red blood cells will absorb carbon monoxide (perhaps from an automobile exhaust) 200 times more easily than they absorb oxygen. When they have it, they hang on to it. That is what makes anoxia by carbon monoxide poisoning so easy and so dangerous.

(3) *Slow flow* of the blood stream. Fear, pain, injury, hemorrhage or shock may cause blood pressure to fall far below normal and slow down the rate of delivery of oxygen to the tissues.

(4) *Tissue poisoning* by drugs, gases or alcohol may cause a breakdown in oxygen logistics by blocking delivery at the tissue cells where the oxygen is used. The blood cannot get rid of its oxygen, which is then simply returned to the lungs for an attempted delivery on a second trip.

It is obvious that a flyer, suffering from any one of the three last defects, had better not add high altitude to his difficulties. For such a man the critical altitudes are much lower than 10,000 feet without the mask and 40,000 with the mask.

Parachute Jumping. Anoxia must be included among the many perils which beset the parachute jumper. A flyer bailing out at 40,000 feet has a long way to go under low oxygen pressure. If he pulls his rip cord at once, it will take him about 25 minutes to reach the ground. He will be unconscious in less than a minute. If he did not pull the cord at all, he would reach the ground in 3 minutes. The thing for him to do is to take as many deep breaths of oxygen as he can from his mask before he discards it and jumps. Then he holds his breath and his precious oxygen as long as possible, delaying the pulling of the cord as long as possible. With the parachute closed, he will fall from 40,000 to 30,000 feet in the first half minute, and it is possible for a man to hold his breath for that time, especially if he has avoided violent exertion before jumping. It is not likely that he can get down to 20,000 feet from 40,000 before breathing, but in any case he is likely to be all right. If he starts breathing at 30,000 feet, he may remain conscious until he improves enough at 20,000 feet to pull his rip cord at 10,000 and to complete his journey slowly in the warmer air where oxygen pressure is high enough. On the other hand, if he loses consciousness in the upper regions, that is not necessarily fatal. Experiments in decompression chambers show that the unconscious falling flyer will regain consciousness when oxygen pressure increases as he comes near the ground—regain it in plenty of time to pull the rip cord and float to safety.

If the man jumps from an altitude lower than 40,000 feet, even though it be as high as 30,000 feet, his problem is much simpler. He may get down to 20,000 feet or even less before he has to start breathing.

The cold of high altitudes constitutes another reason for delaying pulling the rip cord. The falling flyer may avoid frostbite if he can but fall rapidly enough through the upper cold regions.

ALCOHOL

Alcohol is not a stimulant. It is an intoxicant and must be generally considered as an enemy of efficiency. It has, it is true, its social and emotional uses, but it also has its dangers. It can play havoc with a man's effectiveness, especially with his efficiency in tasks requiring precise muscular control.

Effects of Alcohol The first effect of alcohol is *relaxation.* That may be all right when you are on furlough, when you are safely back at your base after a perilous mission, when you are not likely to be called back to duty soon. Then you can let down, lay aside responsibilities and find comfort—if you do—in a glass of beer or a cocktail. The medical officer may even, under some circumstances, prescribe alcohol for you as a medicine. Relaxation, however, is not what you need for efficient combat.

Alcohol *makes the heart beat faster* and *increases the heat loss* from the body. Because it dilates the blood vessels in the skin, it makes a man feel warmer and for a time more comfortable in the cold, but it does not warm his body. On the contrary, it makes him feel warm by losing from his body the heat which it needs, so that he is worse off in the long run, since he has lost some of the heat that would have enabled him to resist the cold. Alcohol is a poor overcoat. If it is taken for its warming effect, it should be drunk after the exposure to cold, not before or during the exposure. In this fact there lies one of the many reasons why flyers should not drink before flying: they become by drinking less able to combat the cold of high altitudes.

Alcohol *dulls the senses.* It makes it more difficult for you to see faint objects, especially objects in the dark—the enemy patrol in the dusk, the other plane against the night sky. It *reduces visual acuity,* making it harder to read fine print, harder to distinguish the kind of plane or tank that is seen in the distance. It *cuts down the range of vision,* preventing a driver from seeing easily other cars that approach from the side, reducing him to what is called "channel driving," where he drives only straight along into the middle of his field of vision. In this respect alcohol acts on the driver in much the same way that anoxia acts on the flyer.

Alcohol also *dulls hearing.* Not only does it interfere with a soldier's perception of the faint sounds that presage enemy action, but it also makes the drinker himself noisy. He is noisy partly because he feels relaxed and free, but also because he is so deafened that he does not know how noisy he is being. His own noise may prevent him from hearing the enemy and may aid the enemy to hear him.

In small amounts drinking may increase *physical strength* slightly, but in large quantities it makes a man much weaker. It also makes him *less steady, slows him up, reduces his dexterity* and skill in complex movements.

Like anoxia, alcohol *impairs both learning and memory.* It makes the acquisition of new skills and new information difficult. It interferes with the memory of recent events.

It also *disturbs the intellectual functions,* rendering discrimination less accurate and judgment less valid. All the tests of judgment and reasoning under the influence of alcohol show that drinking never aids and, in sufficient quantity, does hinder good thinking. Worst of all, it interferes with self-criticism. The man who is just a little tight does not know when he makes mistakes in action or judgment. He gains, not in courage, but in foolhardiness, because his judgment is weak. He is likely to undertake easily the difficult tasks for which he is at the moment least fitted. In general, he is less than normally alert, for good judgment depends on alertness, a sensitiveness to all the possible factors in a problem.

By and large, alcohol is the Great Uninhibitor, for it increases relaxation and self-confidence, and impairs sensitivity, alertness and good judgment. For this reason frustrated men use it for escape from the unpleasantness of life. With enough drinks they find themselves "channel driving" down the road of the immediate present, the immediate past suppressed as unimportant or entirely forgotten, the remote future entirely beyond the range of their reduced vision, and the straight-ahead present, which may at times be pleasant enough, the sole object of their restricted regard. Such men released from restraining inhibitions into the freedom of immediate impulse talk easily and loosely. If the enemy's spies are within hearing, the enemy may profit.

A great deal of experimental work has been done on the effect of alcohol on performance in mental tests. These experiments simply support these general conclusions. Alcohol never improves mental work. A little alcohol affects the test scores unfavorably, a greal deal affects them more unfavorably.

Tolerance to Alcohol. Every wise man who drinks at all wants to know his own limit, does perhaps know it. It is not, however, possible to write quantitative prescriptions for what will be "too much" and "not too much," for what will make a man drunk and what dead drunk. There are too many other factors that enter into the question of tolerance.

The man who weighs 200 pounds can stand about twice as much liquor as the man who weighs only 100 pounds. Like any other drug, alcohol is effective in proportion to what it has to affect—the entire body.

You get more kick out of a drink on an emtpy stomach than after you have had a square meal. Fats in the stomach—milk, cream, butter, cheese, olive oil—are especially helpful in keeping you sober.

The same amount of alcohol taken in tall drinks, well diluted with charged water or ginger ale, has less effect than it does when taken straight from the bottle or in a cocktail. It has less effect if it is sipped slowly than if it is swallowed in a gulp.

You get drunk sooner in a crowded, poorly ventilated room than you would in fresh air. You feel the effects sooner if you are sitting down than if you are standing up—and you are less aware of the effects when standing. If you want to stay sober, the best position is to stand on one foot and put the other up on the traditional brass rail, and the best activity is to walk briskly outdoors in the fresh air. If you want to get the greatest effect from the smallest drink, lie down.

Purely psychological factors also affect a drinker's behavior. A man who wants to get a little tight succeeds sooner in becoming gay and unsteady than one who is afraid of what the liquor will do to him. The man who drinks to feel free and to escape from social constraints is all ready to escape as soon as the drinking provides him with an excuse. He knows that his friends will not hold it against him if he sings or blusters or cries or talks about himself or makes easy love, provided they also know he has been drinking. Thus his low tolerance for alcohol becomes confused with their high tolerance for *his* alcohol. What starts as relaxation of the muscles ends as relaxation of decorum.

In fatigue and states of exhaustion, alcohol may have the effect of allaying the feelings of fatigue because it replenishes the depleted sugar in the blood. It may, therefore, at times have this merit. On the other hand, it is not always wise to treat fatigue with alcohol. The alcohol increases the blood sugar, thus reducing the fatigue, but the increase of the sugar sets up in the body the homeostatic countermechanism of increasing the secretion of insulin, which is the body's means of keeping the sugar in the blood within bounds. So far so good, but then an excess of insulin may have an undesirable effect. If too much of it is secreted, it produces nervous tension, trembling of the hands and face, excessive sweat and a feeling of anxiety. Even moderate amounts of alcohol taken on an empty stomach may produce these effects, which often interfere more with efficient action than does the fatigue which has been allayed. If one is going to fight fatigue with alcohol, he should know all these possible consequences.

It is not possible, then, to say how many grams of alcohol will produce this and that effect. Tolerance depends on all these other contributory factors. It is possible, however, to make a statement about time. With ordinary drinking the maximal impairment of efficiency comes about one and a half or two hours after the drinks. How long the effects last depends on how much the drinker has had and what he does to help the alcohol out of his system.

Use of Alcohol. The problem that the armed forces face in respect of the use of alcohol lies in the fact that alcohol helps the morale of those who are accustomed to use it and injures the efficiency of all who use it. Yet even that statement is too simple, since morale aids efficiency, and in the long run efficiency helps to build up confidence and morale.

The army is liberal in allowing men to drink at their own discretion as long as they do not disgrace themselves or the uniform. It does not teach men to drink, but also it does not attempt to get them to change long-standing habits when the change is not necessary for military efficiency. To the man who is accustomed to drinking in moderation, the occasional drink is a great comfort and pleasure. The man who is on combat duty earns whatever relief and pleasure he can find after the duty is over, or even before, provided he drinks too little to affect his needed skills very much. A considerable gain in morale is worth a small loss in efficiency, but the loss in efficiency ought always to be small. The soldier must be relied upon not to abuse his privilege.

On the other hand, the Navy, when at sea, has to insure maximal physiological efficiency. Sailors do not drink on shipboard because they can get no liquor. The modern navy is too dependent on the use of instruments of precision to permit drinking. What the men do on liberty may be a different matter.

In general, no man, soldier or sailor, ought to drink more than what is for him a very little when he is shortly to undertake a responsible job, a job requiring accurate coördination, keen perception and good judgment, and if there is any doubt in his mind as to how much is too much, he should not drink at all at such times. Especially is this rule correct if the responsibility is to be sustained for a long period of time. A man who has drunk too much may conceivably rally his maximal efficiency for a supreme moment, but he will not be able to sustain the level of effectiveness. Let him do his morale building afterward.

Flyers especially must beware of drinking before they go on duty. Pilots in the Air Forces do not touch liquor unless there is no chance of their being called upon to fly during the next twenty-four hours. They know better. Combat flying continuously taxes every sense to the utmost. No man in his right mind wants to take his chances with his senses befuddled by drink or a hangover—not against a sober skillful enemy. After returning from a difficult mission, then the pilot may have earned his drink. It may help him to get to sleep without going over his experience again in memory. The flight surgeon may even prescribe drink. Otherwise the combat flyer keeps away from alcohol.

It is not wise to use alcohol for escape from frustration. A weak man turns to this easy way out from frustration or from pain and fatigue. Eventually he will find that he has no practice in meeting these difficulties, that he is dependent upon alcohol as a means of escape from trouble, when actually he needs to know how to overcome trouble, not merely how to ignore it. He cannot always drink when things go wrong, for often one emergency quickly follows another, and his escape by alcohol from the effects of a first emergency leaves him wholly unfitted to cope with the second. The wise man avoids liquor altogether or keeps it as a luxury; he fears to make it a necessity.

Some men believe that alcohol makes them brave. They want a shot of liquor before they undertake a dangerous mission. They are not wise. Alcoholic bravery is merely the foolhardy recklessness that arises from insensitiveness and poor judgment. It is better for them to keep their fear, and the wisdom and caution that go with it. Fear has this military use and it should not be dulled by alcohol.

There is one unusual kind of person who must never drink at all. He is the man who cannot take the smallest amount of alcohol without immediately going to excess and getting stupidly drunk. He is quite unable to take "just one glass of beer" and has to leave the whole business alone. The first glass sets up a craving for a second, and so it goes. When these men have formed the habit of not drinking, they get along very well. It is moderation that is difficult for them.

TOBACCO

Smoking helps the morale of men who like to smoke. It decreases their muscular steadiness and thus may interfere with their efficiency in precision work. Whether it makes them short-winded is still an open question. Heavy smoking may reduce visual acuity and may help to induce peptic ulcers. It may be that tobacco aids the armed forces more than it harms them, but its effects ought to be thoroughly understood.

There seems to be no question about the fact that heavy smokers have less steady hands. It is not the nicotine in the tobacco that makes the trouble, for most of the nicotine gets burned up and but little of it enters the body. On the other hand, the products of burning tobacco and of the decomposition of nicotine—pyradine, carbon monoxide and other substances—are poisons which enter the blood and accomplish harm. It would be better for men not to smoke, if there were no reason for smoking, and the man who does not want to smoke is perhaps fortunate.

It is commonly believed that heavy smokers who inhale are short-winded—and every smoker inhales some of the smoke. These men are supposed to need more air to get the same amount of oxygen and to have to breathe more rapidly, especially in violent exertion. The experimental results on this matter are not, however, conclusive. It is hard to define short-windedness so that it can be measured. In some studies there has seemed to be no diminished respiratory efficiency among the heavy smokers. In others, men have been found after smoking to consume more oxygen—as much as fifteen per cent more after a few cigarettes. It would seem that the carbon monoxide in the smoke ought to put some of the red blood cells out of commission as oxygen carriers and thus to produce some anoxia.

The safe rule is: Do not smoke heavily immediately before expected violent exertion or ascent to high altitudes unless the emotional situation seems to require it. That depends on your smoking habits. Smoking, in the sense of inducing poise and self-confidence, may "quiet the nerves" even though it may also unsteady the hand.

Excessive smoking is believed to contribute to the development of peptic (stomach or duodenal) ulcers or to aggravate them when they already exist. These ulcers have been shown to be an important cause of medical disability in the Second World War, so the prescription for the man with an ulcer may be more strict than for the man with no ulcer. The case against tobacco is not, however, clear in the case of ulcers. Some authorities think that ulcers make men emotional, others that emotions give men ulcers. If men resort to smoking under emotional strain and also get ulcers because of emotional strain, then it might not be the tobacco that is producing the ulcers.

There is no doubt at all that very heavy smoking may produce patches of retinal blindness, and it would appear that somewhat less heavy smoking reduces visual acuity, blurs sight. Some physicians believe that acquired color blindness results from excessive use of tobacco. Flyers, lookouts, reconnaissance observers—all the soldiers and sailors who need the most accurate vision—had better keep smoking down to moderation. If they can do without it, so much the better.

The non-smoker who smokes finds that his mental work is less efficient. He may be distracted by the discomfort of nausea that the smoking produces in him. The habitual smoker, on the other hand, needs to smoke for his best mental work. He is distracted by not smoking. It feels queer to work without smoking when you always have smoked at work. To reach vainly for the pack of cigarettes that you have carefully left out of your pocket because you have "sworn off" is disconcerting and irritating. Smoking is not unlike studying with the radio turned on. The "radio-student" is bothered by the quiet. The not-smoking smoker keeps thinking about the absent cigarette.

Smoking has also a two-fold social function. In the first place, it is good to belong to the crowd, to do what others are doing, especially what is being done by others whom you admire. Not to smoke may seem to indicate a lack of manhood. The fact that smoking is said to be bad for you makes you a little proud of being able to smoke and still do your work. To refuse to smoke seems to be an admission of weakness or of lack of courage. In the second place, smoking aids poise because it gives you something to do. A man feels awkward unless he has something to do with his hands. Smoking gives him something to do with one of his troublesome hands, and doing something with one hand makes him forget that he has another awkward hand lying around idle. These two factors work together. Social poise comes when you have got over awkwardness with your hands and are using them so that you become one of the crowd. This is the way it seems to a great many men, though it is entirely possible to have relaxed hands and social poise without learning to smoke.

If you have to cut down on smoking—and it is a hard thing to do—the best immediate aid is to find something that you like to do that is incompatible with smoking. No swimmer wants to smoke while swimming under water. Similarly few gum-chewers want to smoke while chewing gum. Chewing gum is, therefore, a temporary expedient in this dilemma.

Smoking is, however, a habit which it is possible to break. If a man can stop smoking for a few weeks or months, he finds it easier to get along without smoking as long as the reasons for not smoking persist. On the other hand, inveterate smokers have been known to stop smoking for several years, have carried about with them all that time a vague desire to smoke again, and have then turned again to tobacco because the reasons for not smoking have changed—perhaps a peptic ulcer seems to have healed—only to find themselves inveterate smokers again in a few weeks, and perhaps with a new ulcer on the way. Habits can persist even when unused.

That a great deal of smoking is habit is shown by the fact that smoking depends on association. Some inveterate smokers never smoke in bed. They smoke incessantly during the day, light a fresh cigarette when undressing for bed, and then crush it out before getting into bed, where they rest placidly before going to sleep with never a thought of a smoke. If such a man goes to bed with a broken leg, he still does not want to smoke until he is able to get out of bed. Then at once he does.

The rule for smoking and efficiency is, therefore, this. Know all about the effects of smoking and find out for your own case what degree of not-smoking begins to make you more inefficient than smoking. Then stick to that degree. On the other hand, it is wise not to exaggerate this problem. Not many soldiers and sailors smoke enough to impair their efficiency seriously, and the cigarette in war is a magnificent morale builder.

COFFEE AND TEA

American soldiers and sailors depend on coffee, British on tea. Both, coffee and tea, because of the caffeine they contain and because they are usually taken hot, are actual stimulants. A large cup or two cups of either will wake you up, make you more alert, speed you up and improve your muscular coördination. Thus coffee and tea are not like alcohol and tobacco whose only good effects are social or emotional. It is a good thing to drink a cup of coffee before you go on night duty or when you

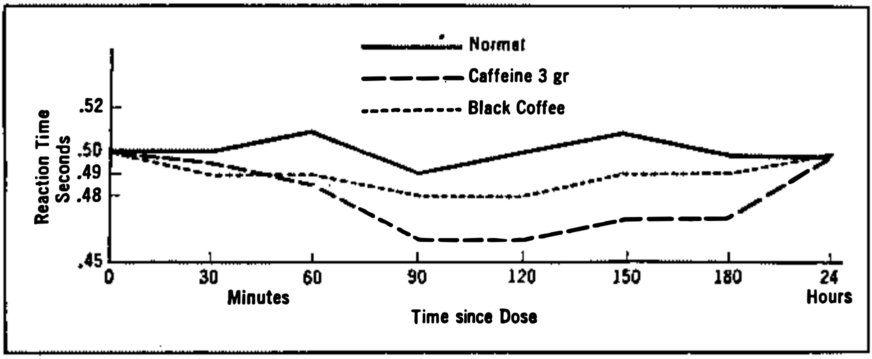

Fig. 64. EFFECT OF CAFFEINE ON CHOICE REACTION TIME
Normal: drinking water or swallowing starch in capsules. Black coffee: 3 grains of caffeine in coffee. Caffeine: 3 grains of caffeine in capsules. (From A. T. Poffenberger, *Principles of Applied Psychology.* D. Appleton-Century Company, 1942, by permission.)

are very tired and must still go on with the job. The ward-room coffee cup on shipboard may well have won battles.

Moderate amounts of caffeine speed reaction time. Fig. 64 shows how this effect occurs and also that it may last for as long as 3 hours. The solid line graphs the reaction times for making choices after drinking water or swallowing capsules with starch in them, the dotted line the reaction times after drinking black coffee, the dashed line the reaction times after taking capsules with caffeine in them. Caffeine capsules reduced these times almost ten per cent. Since caffeine probably does not change the rate of nerve conduction, the saving must have occurred only in the time of making the choices and thus would have been even more than ten per cent.

Drinking an excessive amount of coffee does not, however, increase the good effects still further. In fact, coffee in great excess will reverse the effects. You find yourself after too much coffee slowed down, unsteady, less well coördinated. The amount of coffee that is excessive is, however, dependent on the tolerance of the drinker for caffeine, a tolerance which increases to some extent with habituation.

Habitual coffee drinkers find, therefore, that after a time it takes two cups of coffee to do what one used to do. It may take four cups noticeably to decrease the efficiency of the habitual drinker, whereas three cups are bad for the man who seldom takes it.

An after-dinner cup of coffee never kept any man awake because of the caffeine in it. There is not enough. You are kept awake—*when* you are kept awake—by your belief that the coffee will keep you awake, or by the excitement of after-dinner conversation, or from some other emotional cause. If you drink the coffee to keep yourself awake, then you have something important to get done and you are likely to be excited by having got the job done or worried because you did not get it done after all. Emotion will keep you awake. On the other hand, three full-sized cups of coffee can easily keep a man awake, even without any excitement or worry to help out. Two cups may be enough, if he is not an habitual coffee drinker.

DRUGS

There are various drugs which can be given men to stimulate them or dope them. The action of most drugs is, however, complex. Seldom are they wholly beneficial, and their administration should be left to medical officers. Benzedrine sulfate is no exception to this rule.

Benzedrine sulfate is a drug which has been widely sold as "pep pills." In proper doses it will keep men awake, make them more alert, make their senses keener. It also has the apparent effect of improving their ability to think, reason and remember, but the findings are ambiguous in these respects and are probably attributable to the fact that the drug reduces felt fatigue and induces a happy mood which is favorable to good work. Benzedrine is much more effective than coffee in fighting fatigue and sleep. Its principal effect seems to be this diminution of felt fatigue, a change which does not always coincide with increased productive efficiency (pp. 176-179). It does not make a man much stronger at the moment, but it does enable him to persist longer in the exercise of strength—again presumably because he feels fatigue less.

Too little benzedrine has too little effect. Too much may reverse the advantageous effects. Constant use of benzedrine may have permanent harmful effects on the body. The drug acts differently on different parts of the nervous system, and that fact explains an unpredictability in its action. Sometimes a mild dose seems to decrease efficiency instead of increasing it. It is important, therefore, that the prescription of this unaccountable, paradoxical, sometimes harmful, generally fatigue-reducing drug be left to the medical officer. Self-doctoring with pep pills is not wise.

This caution about benzedrine sulfate applies with equal force to other drugs. If they are to be used, let the Medical Department prescribe them.

REFERENCES

1. H. G. ARMSTRONG. *Principles and practice of aviation medicine.* Baltimore: Williams & Wilkins, 1939. Pp. 496.

   The standard authority on the physiological effects of altitude. Chapters 16-19 deal with anoxia and altitude sickness.

2. ARMY AIR FORCES. *Your body in flight.* T. O. No. 00-25-13 (Restricted), 1943. Pp. 83.

   An excellent popular account of the effects of altitude on mind and body.

3. J. BARCROFT. *The brain and its environment.* New Haven: Yale University Press, 1938. Pp. 117.

   Chapter 3, pp. 83-111, is an interestingly written account of the effects of cold, heat, anoxia, too much oxygen, carbon dioxide, and sugar on mental states.

4. H. E. BURTT. *Psychology and industrial efficiency.* New York: Appleton-Century, 1929. Pp. 395.

   Chapter 6, pp. 222-272, deals with efficiency as dependent on illumination, ventilation, climate and noise.

5. E. BOGAN AND L. W. S. HISEY. *What about alcohol?* Los Angeles: Angelus, 1934. Pp. 112.

A primer on the effects of alcohol, very elementary but scientifically sound.

6. H. VON DIVINGSHOFEN. *A medical guide for flying personnel.* English translation. Toronto: University of Toronto Press, 1940. Pp. 102.

Discusses in compact form the important medical problems of the flying service which the flyer can apply to the maintenance of his own health and flying capability.

7. H. EMERSON, ED. *Alcohol and man.* New York: Macmillan, 1932. Pp. 451.

An excellent authoritative book on the whole problem of the effects of alcohol, with chapters written by 22 distinguished experts.

8. H. L. HOLLINGWORTH. "The influence of caffeine on mental and motor efficiency." New York: *Archives of Psychology.* No. 22, 1912. Pp. 166.

A technical account of experiments on the effect of caffeine on motor and intellectual tests, typewriting, discrimination and sleep.

9. C. L. HULL. "The influence of tobacco smoking on mental and motor efficiency." (*Psychological Monograph.* No. 150.) Evanston, Illinois: American Psychological Association, 1924. Pp. 161.

Representative of the best experimental work on the problem of the effects of smoking.

10. W. R. MILES. *Alcohol and human efficiency.* Washington: Carnegie Institute of Washington, 1924. No. 333. Pp. 298.

An excellent technical account of experiments on the effect of alcohol on motor reactions, sensory-motor coördinations, eye movements, typewriting and visual acuity, with a discussion of the other contributing factors.

11. M. V. O'SHEA. *Tobacco and mental efficiency.* New York: Macmillan, 1923. Pp. 258.

Part I is anecdotal; Part II is a sound popular digest of scientific findings and opinions.

12. A. T. POFFENBERGER. *Principles of applied psychology.* New York: Appleton-Century, 1942. Pp. 655.

Chapter 9 deals with the effects on efficiency of atmospheric conditions, and Chapter 11 with the effects of drugs and stimulants.

13. P. SCHRUMPF-PIERRON. *Tobacco and physical efficiency.* New York: Hoeber, 1927. Pp. 134.

A popular summary with a long annotated bibliography.

14. *Survival.* Washington: Infantry Journal, 1944. Pp. 376.

A manual for aircraft crews and other men forced down, adrift, or getting back to help in all parts of the world—including hints on living off the land, building shelters, travelling, protection against disease, saving life and limb.

There are many books on the effects of tobacco smoking and more on the effects of drinking alcohol, some of them scientific, others arguing for or against.

Chapter 11

Selection of Men

The abilities and skills of men to perform successfully hundreds of different kinds of jobs constitute the psychological matériel of the armed forces. The Army, Navy, and Marines need thousands of trucks, but a truck is of no use without a man with the ability to drive it, nor is it long of any use without a man with the ability to service or repair it. The Army and Navy need planes, but a plane must be equipped with a pilot or crew if it is to operate, and the plane and its pilot or crew need a ground crew to service it. The armed forces need beef, but much of a carcass of beef is wasted without a competent butcher. They need men to weld castings, repair watches and develop photographs. All sorts of abilities and skills are necessary, hundreds of skills in hundreds of thousands of men. How are they found?

In building armed forces largely from drafted civilians, many of these skills come ready-made among the recruits. It is the business of the classification officers to discover them and put them to work to the extent that the armed forces need them.

There is, however, seldom enough of the right kinds of skills available. Many civilian abilities have little direct use in the services, and the ratio of some types of civilian abilities to the whole population is higher than the armed services need. For instance, the Army gets among its recruits far too many lawyers but too few truck drivers. A number of lawyers can be used as lawyers if they are retrained in military and naval law. The others have to be made over into something else. Most of the surplus lawyers find their best usefulness either as clerical workers, or as drillmasters, instructors or combat leaders. The lawyer who can drive a car might even be made over into a truck driver. He has some aptitude—not much—for truck driving.

Aptitudes are potential abilities which can be made into actual abilities by training. The armed forces can provide the training. An ability in one skill often turns out to involve an aptitude for another skill, which is related to the first or includes it. A man who can drive a civilian truck under peacetime conditions inevitably has some aptitude for driving a military truck—but will need special training in driving across country and under blackout. A man who has an ability in mathematics has part of the aptitude for sea or air navigation but does not have the ability for navigation unless he has been specially trained in navigation. The Navy and Air Forces get many civilians with an ability for mathematics but few with an ability for navigation that is already built up in them.

Not every man who comes to the armed forces can be trained for any job for which he might be needed. Many abilities cannot be easily acquired after a man is eighteen or twenty years old unless he already has some aptitude for them. Others might be acquired were there more time for the training that would be necessary. Full advantage has to be taken of aptitudes as they are found, and efficiency requires that men be trained and placed so as to make the best use of their already acquired skills. It is, for example, not true that all leaders are born and not made. Leaders can be made, yet not every man can be made into a good leader. The weak bashful boy, grown up into a young man who feels so inferior and insecure that he cannot mix easily with other men, is not a good candidate for a combat officer. Usually he had better be trained for something else.

Often a man who has one much needed ability should, nevertheless, be trained for some other more needed ability. A top-notch automobile mechanic may seem to be wisely placed if he is repairing automobiles in the unit to which he is assigned. Yet it may be that he ought to be taken off the automobile job and trained as an ordnance repair man, if the need for such repair men is much greater. On the other hand, a commanding officer who has an experienced ordnance man working on his trucks and jeeps may not wish to lose him and may block his transfer to an ordnance unit where his ability can be more fully used. By holding onto that man, the officer would be contributing to an occupational casualty which prevents the Army from using an ability which actually it has available. To abandon the use of that skill is like abandoning an undamaged gun.

Abilities as they come to the armed forces are due partly to inherited natural capacities, partly to early training and influence which determine the habits and interests that make up the personalities of men, and partly to specific skills which the men have learned later in life. The next sections of this text inquire into these sources of abilities.

GENERAL ABILITY

Men who do well in one thing are very apt to do well in many other things. There are overlaps among human abilities. One can easily see why this is true.

Suppose one man is good at learning new skills or subjects, and another man is poor at learning. It is not possible to say why there should be such a difference, but such differences there certainly are among men and among animals, too. If there are good learners and inept learners, at least in respect of certain not too dissimilar tasks, then the men who learn easily in one task will be the ones more likely to learn easily in another task. Learning ability is thus a common factor in a whole set of abilities, and skill in one task creates the presumption of aptitude for another.

Various psychologists have suggested other factors that would be common to a great variety of different intellectual abilities—the ability to adjust easily to new problematic situations, the ability to recognize relationships, the ability to have insight into the relationships of seemingly unrelated things, the ability to make critical appraisals. Such capacities would help lawyers, doctors, ministers, business executives, statesmen, scholars, chemists, architects, novelists and engineers. A student would find them useful in the study of history, mathematics, science, philosophy and literature. It follows—since men really differ in general capacity for achievement—that a man who would make a good lawyer would also be more likely to make a good doctor than would the man who would certainly make a poor lawyer, and that the student who does well in economics has a better chance of doing well in biology than the student who is poor in economics. Not always, of course. There are special abilities and interests that are peculiar each to every profession, each to every study. If a man hates arguments and loves to help people by understanding how their bodies work, he might make a poor lawyer but a good doctor. The two abilities for medicine and the law are not even nearly identical, yet they overlap, have certain factors in common.

This fact is to be seen in the extreme in the genius and in the feeble-minded person.

The German poet Goethe was certainly a genius. He was precocious and showed great ability in many activities. At the age of eight he was successfully pursuing studies that are normally preparatory to entering a university. At ten he was writing clever Latin essays. At sixteen he could read Latin, Greek, Hebrew, French and English, and had read the classics in these languages as well as in his native tongue. He studied law, philosophy and literature, and published his first important work at the age of twenty-three. In adult life he excelled in writing poetry and literature, but he also made one important successful excursion into statesmanship and another into science. He had a forceful, active, restless mind. An egoist, he was forever undertaking the solution of new problems, generally with success. He was one of Germany's great men. Could he have kept to the law, he would almost certainly have been a brilliant lawyer. As it was, he influenced German thought profoundly through his writing.

Donald Noname, on the other hand, was a young man of twenty in an institution for the feeble-minded, the Training School at Vineland, New Jersey. Here Donald was being educated along the lines in which he could most easily advance. He was a handsome chap with a pleasant face, an alert manner, and but little awkwardness. He was an excellent farm hand and especially apt in handling farm machinery. One of his teachers called him "the finest industrial worker in the school." He had learned to play the bass horn well in the school band. His education in public school had progressed to the level of the first grade but there he stuck for four years. After five years of good instruction at Vineland with more personal attention than he would ever have got in public school, he was still at the first-grade level. At the age of fifteen he did not do quite so well on intelligence tests as the average ten-year-old, and, curiously enough in school work he was still back below the seven-year level. He could not put the words, *girl, river* and *ball* together into a single unitary sentence. He could not define words like *charity* or *justice.* Given money he could not make correct change. Conversation with Donald soon broke down the first impression of his intellectual competence. He had a poverty of ideas, a lack of originality, a very limited stock of general information, only a vague comprehension of abstract relationships. At the age of nineteen he wrote the following letter to Santa Claus:

> My dear Santa I wish you would please send me thease things a pair of russet button schoes size 8 and either a blue or reed norfalk sweater and about a dozen gellet safte razer blades I well be glade to get thease things yours truly Dondal Noname to frend Santa Cluas.

That is the picture of a moron, a high-grade feeble-minded person. All the evidence from other cases indicated that Donald Noname was never going to be more than a grown-up body with a child's mind. Now, twenty-five years later, he is a competent chauffeur for a family that looks after him, expects nothing brilliant of him, but finds him steady and dependable on his job. As a matter of fact, he probably serves them better in this capacity than Goethe would have done.

Heredity vs. Environment. Between the extremes of Goethe and Donald there is a wide range of abilities which tend, as a general rule, to stay put for a lifetime. There has been a great deal of discussion about the extent to which such differences are inherited and to what degree education can change them. Certainly the Training School could not make Donald into a Goethe. Would Goethe without an education have been a Donald? It is hard to believe it. Brought up without schooling in some savage tribe, he would still, it seems very likely, have had his indestructible verve, his insatiable curiosity, his indefatigable energy. He would have become a chief, or a warrior, or a great hunter or medicine man. On the other hand, education counts, too. Such a savage Goethe, introduced as an adult into European civilization, would not have made the same mark upon it. If he had been brought up a poor boy in Germany, prevented from going to school, having always to work hard for his living, he might have forged ahead to become great, or he might not. Environment and heredity both help to make the man.

Environment and heredity. Nurture and nature. It is hard to say which is more important, because both always operate together. The individual, after he is first formed by the union of two parent cells, is always being acted upon by his environment, being made into what he is to be. On the other hand, the environment has to have something to work upon, certain innate potentialities to develop or change. You never get a rabbit out of a hen's egg. That is heredity. Men and other vertebrates have two eyes, and it would seem that their two-eyedness is inherited. Yet some fish eggs, hatched in salt solution, developed into one-eyed fish; the salt was the eggs' environment.

That both heredity and experience, nature and nurture, have an effect on general ability as measured by intelligence tests is shown in studies of twins. Identical twins—twins formed from the union of the same sperm and ovum (the parent germ cells)—tend to be more alike, both in physical appearance and in general ability, than other children in the same family. They are most alike in performance on intelligence tests when reared together, having had, in general, the same environment, the same kinds of experience. Identical twins reared apart in the homes of different foster parents resemble each other in general ability less than identical twins reared together, especially if the environments of their respective foster homes have been very different. Fraternal twins—twins that are not identical—when reared together, resemble each other less than identical twins, but more than brothers and sisters who are not twins.

Identical twins may be regarded as having the same heredity. Fraternal twins, however, need not necessarily have quite the same heredity, since different pairs of sperm and ovum cells join to create them. Identical and fraternal twins reared together have approximately the same environment. It should be possible, then, to measure roughly at least the influence of heredity and environment on mental abilities by studies of twins. The results of such studies run something like this:

	Heredity	*Environment*	*Similarity*
Identical twins reared together	same	same	90%
Identical twins reared apart . .	same	different	65%
Fraternal twins reared together	different	same	60%

The exact degrees of similarity depend on just how different the heredity and the environment were. The similarity between brothers and sisters brought up in the same family under changing environmental conditions may be as low as 30 per cent.

Correlation of Abilities. Similarities of this sort are measured by a coefficient of correlation, which can vary between —1.00 through 0 to +1.00. One-hundred-per-cent agreement is indicated by the correlation of +1.00, no relationship, at all by 0, perfect opposition (like the relation of tallness to shortness) by —1.00. If you measured the heights of a thousand men, first in inches and then in centimeters, you would find that the two measures of height are perfectly correlated and that the correlation is +1.00. They would really be different measures of the same thing. If you take a certain amount of air in a cylinder with a movable piston in it and halve the volume of the air by pushing the piston in, then you double its pressure (provided the temperature does not change); or, if you double the volume by pulling the piston out, you halve the pressure. Volume and pressure are thus inversely correlated and the correlation is —1.00. The heights and intelligences of men are not related. There, the correlation is near zero. The heights and weights of college students are somewhat related —the correlation is about +.54. Not all tall men are heavy, nor short men light; yet the tall men are more often heavier than the short men.

The evidence for the existence of general ability lies in the fact that most of the tests of mental ability show positive correlations, show them because the two correlated abilities depend in part on the common factor of general ability, plus other common factors perhaps. Intelligence as measured by tests with a time-limit and intelligence as measured by tests in which correctness with all-the-time-you-want is the only requirement, show a correlation of +.79. Speed is not common to these two tests, even though intelligence is, and so the correlation is less than perfect. One intelligence test gives a correlation of +.48 with size of vocabulary; the more intelligent persons tend to acquire large vocabularies, but other factors certainly enter in too. A test of self-sufficiency showed a correlation of +.53 with a test of personality dominance; but dominance gave a correlation of only +.08 with an intelligence test, whereas dominance and vocabulary were correlated negatively, —.16. The last two correlations are not significantly different from a zero correlation.

In this way, by the determination of correlations, you can begin to work out the factors that are common to various abilities, and also to discover that there is something which you can call "general ability" and which is common to most intellectual capacities. For final analyses elaborate computations are needed, but it is enough here to see that the facts of correlation imply the existence of these common factors.

Growth of Intelligence. General ability, the capacity that is measured by intelligence tests, increases steadily during childhood, at first rapidly, then more slowly until it reaches its maximum on the average at about fifteen years of age. Some children develop more rapidly and go farther than the average, others advance more slowly and never get to the average. After fifteen there seems, under ordinarily constant educational conditions and on the average, to be very little if any increase, followed by slight decrease during the adult years to old age.

Army Tests of General Ability. In the First World War intelligence tests were used extensively as an aid in classifying many of the soldiers who came to the Army from the draft. The Army Alpha Examination was a group test given to men who could read, write and speak English. The men did not have to write words; they had only to write numbers or to underline printed words. Since the examination was planned to test general ability, it was divided into eight sub-tests in the hope that it would measure a factor common to them all and not a special aptitude for any one. The kinds of items ran like this for the eight sub-tests:

(1) "1 2 3 4 5 6 7 8 9. If 3 is more than 4 cross out the number 7, unless 6 is more than 5, in which case draw a line around the number 8."

(2) "If 24 men are divided into squads of 8, how many squads will there be?" and "A U-boat makes 8 miles an hour under water and 15 miles on the surface; how long will it take to cross a 100-mile channel, if it has to go two-fifths of the way under water?"

(3) "Freezing water bursts pipes because ( ) cold makes the pipes

weaker ( ), water expands when it freezes ( ), the ice stops the flow of water." The man is to put a cross before the best reason.

(4) "Wet and dry are ( ) the same ( ), opposite." "Encomium and eulogy are ( ) the same, ( ) opposite."

(5) Mixed-up sentences, like "houses people in live" and "envy bad malice traits are and" are to be marked true or false, according to their meaning when arranged properly.

(6) A series of numbers is to be completed by adding the proper next two numbers: "3 6 9 12 15 18 . . . ." and "3 6 8 16 18 36 . . . ."

(7) "Underline the one of the last four words that has to the third word the same relation as the second word has to the first:

"gun—shoots:: knife—run cuts hat bird"
"sand—glass:: earth—stone hay bricks dirt"

(8) "Underline the one of the last four words that makes the sentence correct:

"The tuna is a kind of—fish, bird, reptile, insect
"The ampere is used in measuring—wind power, electricity, water power, rainfall"

There was also in the First World War an Army Beta Examination for men who could not read English or who could not even understand it. The instructions were given by pantomine. Parts of the old Stanford-Binet scale and other similar tests were also given in individual interviews to the most inept men, when further intelligence testing seemed to be necessary.

In the Second World War both the Army and the Navy developed each its General Classification Test (GCT).

The Navy's GCT consists of one hundred items similar in many ways to the items of the old Army Alpha Test, except that they are put in terms of naval information and words.

The Army General Classification Test was developed in 1940 as an aid in classifying all enlisted men according to general ability, the ability of each man to learn the duties which every soldier must be able to perform. The test has proved useful in predicting how easily each inductee can learn his duties, and it has also been a help in selecting candidates for training in many of the military occupational specialties.

The original test, known as AGCT-1, was issued in four equivalent forms. It took about an hour to give. There were three kinds of items: verbal, arithmetical and spatial. They were arranged in order of difficulty from very easy to hard, so that the slowest learners could answer the earlier items and the aptitudes of the quickest and brightest could be tested by the harder items. Some questions were phrased in military language but they did not require any military knowledge. In fact, the AGCT requires no previous special knowledge or education other than ability to read the English language.

Every new arrival at a reception center who could read English was given one form of the AGCT. On the basis of his performance he was classified in one of five Army Grades, Grade I being the highest. His score was also recorded on his Qualification Card in terms of a standard scale. On this scale, 100 was selected to represent the average performance of adult males of military age, with about half of all the men tested scoring between 87 and 113. Measured with a good test standardized and scaled in this manner, the population examined would be distributed among the five Army grades as follows: Army Grade I, 7% of the population; Grade II, 24%; Grade III, 38%; Grade IV, 24%; Grade V, 7% (see Fig. 65, p. 241).

In spite of the relatively small sample of the total population on which this test was first standardized and scaled, and in spite of some fluctuations of minimum requirements and of Selective Service policies regarding deferments, the proportions actually classified in the several Army grades have roughly approximated the figures given above, as is seen in Fig. 65. The average score is actually a trifle higher, and the numbers in Army Grades II, IV and V are larger than were anticipated.

The three kinds of material used in AGCT-1 were selected after careful analysis and experiment in order to build a test of general ability that can be given in one hour. A still better test can be provided—and indeed has been—by allowing two hours of testing time instead of one. In this test, called the AGCT-3, it is possible to supply for every soldier four reliable part-scores in respect of (a) verbal ability, (b) spatial comprehension, (c) arithmetical computation, and (d) arithmetical skill.

Early in the war it was found wise to set a score of 110 on the AGCT as the minimum for recommendation to Officer Candidate School, although, of course, there are also many other matters that have to be considered in these recommendations.

The AGCT has been given to more than 7,000,000 men and the result for each man has been entered on his Qualification Card, along with other data.

SPECIAL ABILITIES

Besides general ability there are the special abilities. Suppose we were to consider five different jobs and the aptitudes for good performance in them. Suppose that these five aptitudes, taken pair by pair, all show positive correlations of different amounts. It is plain that some ability is general to all of them in different amounts, according to the correlations. What is left over is the special abilities, but there may be overlaps here too. Two of the jobs may be much alike, though not identical, in their requirements, and may thus have common special abilities, whereas two others may seem to have little in common besides general ability.

The situation becomes clearer if we examine the relationships of some particular jobs. There is an elaborate study in which 420 civilian jobs have been rated for the degree with which they employ five kinds of aptitudes: viz., (1) abstract intelligence, (2) social intelligence, (3) mechanical ability, (4) musical talent, and (5) artistic ability. The ratings of seven of these jobs are given in Table V.

TABLE V

RATINGS OF SEVEN OCCUPATIONS IN RESPECT OF FIVE APTITUDES
0 = Little aptitude required. 5 = Maximal requirements.

	Abstr. Intell.	*Soc. Intell.*	*Mech. Abil.*	*Mus. Abil.*	*Art. Abil.*
1. College president	5	4	0	1	0
2. Technical engineer with thorough knowledge of industrial processes	5	1	5	0	0
3. Mechanical engineer who designs and constructs machines	5	1	5	0	2
4. Pattern maker	2	1	4	0	1
5. Real estate agent	3	5	0	0	0
6. Concert artist	4	3	0	5	0
7. Portrait painter	4	3	3	0	5

In this study abstract intelligence is similar to "general ability." All these occupations need it—college presidents and engineers most, pattern makers least. A college president needs a great deal of "social intelligence," but the engineers need less. They deal with things more than with people. The real estate agent needs social intelligence most and little else besides general ability. The concert artist needs musical talent and the portrait painter artistic ability, and both need some social intelligence because they deal with people. The portrait painter needs some mechanical ability because he constructs his canvases and manages his paints, but the concert artist does not because he takes his musical instruments for granted, letting someone else fix them if they get out of order. The portrait painter does not need musical talent, nor does the concert artist have to be able to draw or paint.

That all looks very simple, but actually it is not. There is no evidence that social intelligence, mechanical ability, musical talent and artistic ability are completely independent special abilities that would show no correlation if general ability could be factored out of them. Certainly aptitudes like those for different kinds of engineering overlap one another in many ways, and it is likely that preachers and salesmen also have much in common. In the armed services it is best not to attempt any ultimate analysis into basic special abilities, but to deal with particular jobs and their relationships in job families.

The weight of the evidence, however, points toward considerable independence of mechanical, mathematical, musical and artistic abilities, if by artistic ability is meant the capacity to draw well rather than the skill to embody ideas in works of art. Verbal ability tends to be separate from these four, but is highly correlated with the capacity to do well in intelligence tests.

The Army is tending toward just this sort of analysis in its newest form of the General Classification Test, trying to find out how certain basic abilities (which may indeed be overlapping) contribute jointly in different degrees to different job-abilities. The Navy, too, is working in this fashion and at one time had worked out on the battleship *New Jersey* the ways in which the six tests of a basic battery are related to the qualifications of men for the different ratings.

Modern warfare of air, land, and sea is so highly mechanized that mechanical ability is at a premium. For this reason most of the men inducted into the Army during the Second World War have been given a test of mechanical ability, and later this practice became quite general in the Navy.

The way in which the Navy regards the special tests in its basic battery as related variously to its different rates is indicated in Table VI. The table shows what tests must be passed for ten of the three score rates which have had this analysis made for them. The Navy's GCT is given in all cases, and then various other tests in the battery of eight special tests. For instance, the torpedoman's mate can get along without the mechanical aptitude required by the gunner's mate, but needs electrical knowledge which the gunner's mate need not have. The radioman and the signalman have the same test requirements. The radio technician must have some skill with arithmetic and some electrical knowledge, but the radioman, who can do without these abilities, must meet certain qualifications in reading and spelling and be able to use radio code. These analyses are rough and, thanks to the work that has been done on them, also ready. The tests are basic but they are not ultimate, nor have they wide enough scope. In addition to them many other qualifications have to be met for each rate. They represent, nevertheless, a first attempt at a practical job analysis for a large number of naval jobs.

TABLE VI

TESTS WHICH MUST BE PASSED TO QUALIFY FOR EACH OF TEN NAVY JOBS

TEST	RATE: Gunner's mate (GM)	Torpedoman's mate (TM)	Rangefinder operator (FCR)	Radio technician (RT)	Radioman (RM)	Signalman (SM)	Machinist's mate (MM)	Carpenter's mate (CM)	Quartermaster (QM)	Photographer's mate (PhoM)
General Classification	X	X	X	X	X	X	X	X	X	X
Reading	X		X						X	X
Spelling					X	X				
Clerical Aptitude					X	X			X	
Arithmetical Reasoning				X			X	X	X	
Mechanical Aptitude	X		X				X			
Mechanical Knowledge	X	X					X	X		
Electrical Knowledge		X		X						
Radio Code					X	X				

A job is practically always complex. It calls for a variety of abilities or aptitudes. Since it is impossible to make out a complete list of wholly independent abilities which can be separately measured and related to the requirements of the different jobs, the practical procedure is always to analyze the job and to apply to its requirements the various means of discovering skills and aptitudes for it. The military problem is the selection of the men who most nearly know the job that has to be filled or who can be most readily trained for it.

A *job analysis* comes first. The job must be described. A competent analyst spends a day or two on the job with a soldier, noting down everything that has to be done on the job and preparing ultimately a description of the job. Practically all of the Army's jobs for both enlisted men and officers have now been analyzed, described and coded. The classification officers use these analyses, descriptions and code numbers in the selection of men to fill the jobs. Here is a description of one officer's job.

INFANTRY MORTAR PLATOON OFFICER

Directs discipline, training and tactical employment of the platoon; instructs men in mechanics, marksmanship, techniques and tactical use of the 81mm. mortar; performs essential administrative and supervisory duties for adequate care and supply of troops. In combat, receives from company commander development orders, special instructions and fire missions regarding employment of mortars; locates firing position areas and determines sectors of fire; takes appropriate measures to assure antiaircraft security, antimechanized defense and adequate supply of ammunition; observes rifle troops and coördinates movement and position of mortar squads; directs or executes as directed necessary reconnaissance; advises company commander as to best tactical employment of mortar squads.

Should know all types of infantry weapons. If an airborne battalion, must be able to train troops in additional techniques of loading and lashing planes.

At least six months military experience in line operations essential. Special training in Infantry School, or Reserve Officer Training Corps highly desirable.

The Navy has worked out specifications—job analyses—for more than fifty rates. Here are the qualifications of a rangefinder operator:

RANGEFINDER OPERATOR (FCR)

The Rangefinder stands a regular rangefinder watch, either high in the ship or in a gun turret, to spot enemy vessels, aircraft, or submarines. By the use of a binocular rangefinder, he finds the accurate range and bearing of the target. His observations are reported to the Talker who relays them to the plotting room. These observations, when combined with other data, will determine the angle at which the gun should be elevated and trained horizontally in order to reach the target.

When stationed in a gun turret, he may act as pointer or trainer. The pointer gets the sights of the gun on the target in a vertical direction, while the trainer moves the sights in a horizontal direction. He should be able to make an initial estimate of range by guess.

Rangefinder operators will be found on board almost all ships, except the smallest. In time of battle, he will be stationed at his rangefinding equipment, in a main or secondary battery director, or at an antiaircraft battery director.

A candidate for Rangefinder Operator must be under 31 years of age, and have 20/20 uncorrected vision, in addition to other special physical qualifications. It is important that he be emotionally stable, mentally alert, display calmness under stress, and have a clear speaking voice. Qualifying scores must be made on the Reading, Mechanical Aptitude and General Classification Tests.

A good deal is known too about civilian jobs. The *Dictionary of Occupational Titles* lists about 17,000 civilian jobs, classified under twelve major divisions. Some of these jobs are required in the military services, and others of them are related to military jobs in such a way that experience on the civilian job indicates an aptitude for the military job. There are several hundred military jobs, and about half of them are practically the same as civilian jobs. The other half employ civilian skills in various degrees. It is fortunate that America is motor-minded, for the modern army is also motor-minded and there are many military jobs which can use the skill of a man who knows how to keep his automobile in running order.

To make the best military use of civilian skills, classification officers not only have to know what skills a particular job requires but they also have to know about *job families.* Related jobs are classified into families. The most general job is put at the head of a family, and then the related jobs are named in order of their relatedness. For instance, there is the job family *baker—cook, oven fireman, steward.* If a baker is wanted and no baker is available, then perhaps a cook can be found to be trained as a baker. If there are no cooks available, then an oven fireman is the next best choice. A steward can be changed over into a baker more readily than can a man completely inexperienced in this job family, but he is not such good material as an oven fireman.

The Army needs many truck drivers and there are no military truck drivers in civilian life. A civilian truck driver will, however, be the best person to retrain for the military job. A chauffeur who has driven only passenger cars would be better than the jump boy on a delivery truck, but the jump boy would be better than a clerk who never drove a car and had no special aptitude for it. However, in time of peace many motor officers in the Army were of the opinion that the best military truck drivers were developed from young men who had aptitude for the work but had never previously driven any kind of motor vehicle. There is enough difference between civilian and military truck driving to require much unlearning of civilian driving habits. But in the wartime Army it was not possible to take the time to train nondrivers to be drivers, and there is, indeed, a question whether enough nondrivers with an aptitude for driving could have been found since most young men learn to drive a car so early.

To get the necessary information about civilian job experience the Army gives each new arrival at one of its Reception Centers a searching interview. The interviewer has been trained to draw out the complete story of the man's schooling and experience, to find out not only what jobs or occupations he has had, but also just what he did on the job, where and for whom he worked, for how long, his rate of pay, and—most important of all—how skilled he was at the job. If he says he was a pattern maker, is his knowledge about that trade pretty sketchy, or is he really well informed? To help the interviewer in finding out such facts he has at his elbow a book of trade test questions. He finally enters on the Soldier's Qualification Card the data about the man's best occupation and also his second best, if he has followed more than one. The Navy and the Marines also get such information by interview.

INDIVIDUAL DIFFERENCES

The men who enter the armed services differ from one another in hundreds of ways. They differ in height, weight, strength, and health, in lung capacity, size of feet, shape of head, darkness of skin, in acuteness of vision in daylight and at night, acuteness of hearing, smell sensitivity, in reaction time and manual dexterity, in educational background and knowledge of trade skills, in intellect and general ability, in personality, interests, opinions and attitudes.

In general, these human attributes vary in such a way that the average amount of each occurs in a population much more often than the extreme amounts. This fact is represented by drawing distribution curves which show the frequency with which each amount of a quality occurs. The so-called normal distribution curve is a bell-shaped curve. (Cf. the AGCT scores in Fig. 65.) This is the kind of curve you get if a quality depends upon a great many different factors in combination and these factors contribute or fail to contribute their quotas equally often. The normal curve is approximated in many cases.

Most distribution curves have only one peak and it is rare to get a curve with two peaks in it. Even the curve for color sensitivity, when sensitivity is carefully measured, has only one peak, though one might expect a peak for normal vision and another for color-blind vision with but few cases in between. That is not the case. Color blindness is simply very poor sensitivity, and there are more persons who are color weak than completely color blind.

All these differences represent what the armed forces have to work with—and also what they have not. It is the business of the classification services to inventory all the abilities and to get them put where they will be used. These services are the psychological Q.M.

Let us look more closely at some of these individual differences, especially at the differences that are important in the military services.

(1) **Intelligence.** Measures of general ability are very important in the classification of men. Tests of general ability must include more than one kind of task. The Army's General Classification Test (AGCT), as we have seen, measures the speed and accuracy with which men can solve problems in arithmetic, can show that they know the meanings of words of different degrees in difficulty, and can figure the number of cubes or boxes in a pile in which some of the necessary supporting cubes are invisible. These three abilities have been found in combination to give good initial indications of aptitudes for a great many different military jobs. You do not go far wrong if you say that Grades I and II of the AGCT will furnish the good learners in almost any job that has to be learned, although that statement is a little extreme, since motivation and interest also count so highly for easy learning.

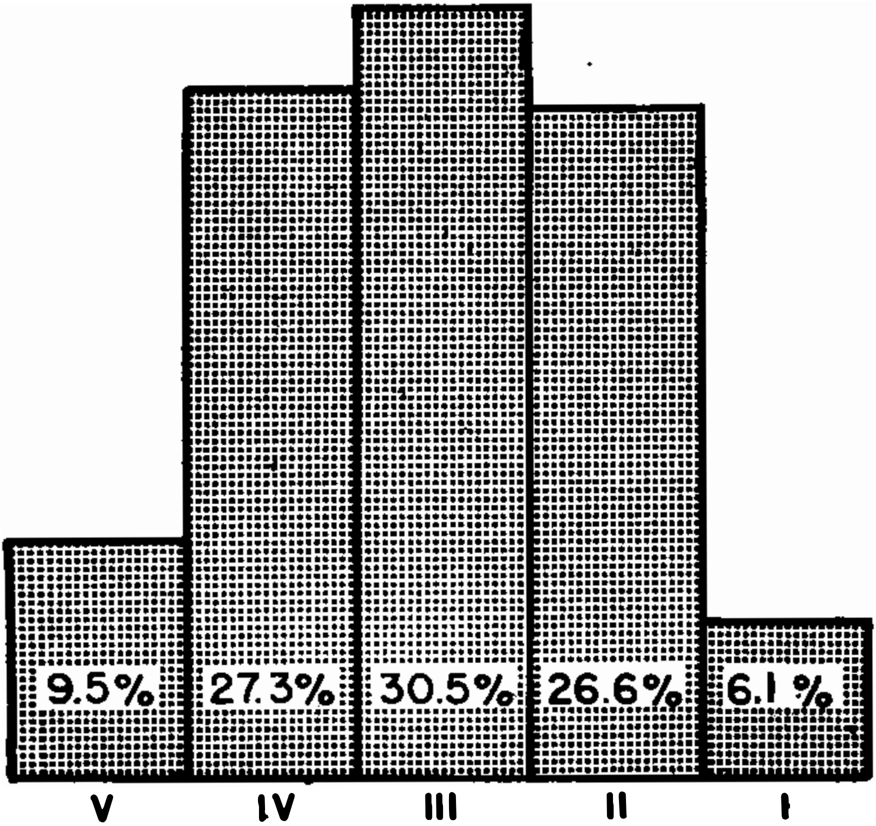

Fig. 65. Distribution of Army Grades in Army General Classification Test

Frequency of occurrence of Army Grades I to V in AGCT of all men processed through Reception Centers up to June 30, 1944. Some men in Army Grade V later earned a higher grade by taking a non-language examination. (From the records of the Adjutant General's Office, War Department.)

The AGCT has also been one of the bases for recommendation to Officer Candidate School (see Fig. 66).

As we have already seen (p. 233), the Army, aiming to furnish more information about the abilities of the man examined, is introducing a new test, the AGCT-3, which gives scores in several basic abilities as well as a general classification score. Similarly, the Navy uses a battery of tests for six basic abilities.

The pressure of time in the Army and the need for administering these tests to large numbers of men on a fixed schedule mean that these

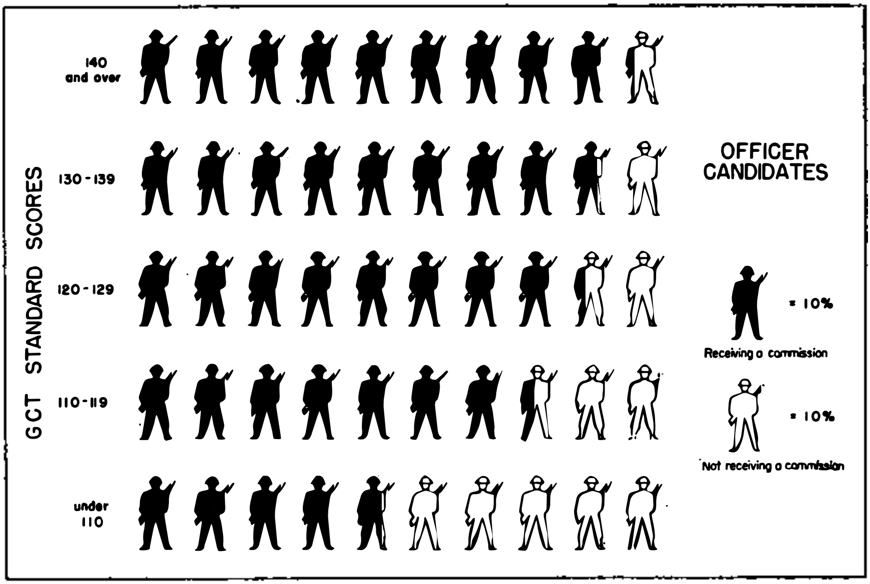

Fig. 66. PREDICTING SUCCESS OF OFFICER CANDIDATES FROM THEIR GRADES IN THE ARMY GENERAL CLASSIFICATION TEST

Shows the chances in 100 that a man, making a given Army grade on the AGCT, will as an officer candidate receive a commission. 14 schools, 5,520 men.

tests have generally to be taken with fixed time limits, and thus depend on both accuracy and speed. There are civilian tests of general ability, however, that depend only on accuracy, leaving the testee unlimited time to work out the answers to the problems. One such test, the CAVD, has many levels of difficulty within each of its sections. The test consists of the completion of uncompleted sentences (C), arithmetical problems (A), vocabulary (V), and the following of directions (D).

The Army and Navy do not use tests like the CAVD but they have numerous other classification tests besides their General Classification Tests. For example, in the Army, there is a non-language test for men who do not read or understand English, a higher examination in general ability, a test for women, a test for officer candidates and one for officers. Of special value whenever the results of a general group test are in doubt is the Army Individual Test (AIT-1). This test is in six parts. Three of the parts are performance tests for which a knowledge of spoken or written words is not necessary. The verbal tests are called "Story Memory," "Similarity-Difference," and "Digit Span." The weighted score on the total test shows a correlation of .84 with performance on the AGCT-1.

(2) **Reaction.** Men differ in both accuracy and speed of motor reaction to a signal, differing according to the particular task set them. Aviators, truck drivers and machine gunners may need to be tested for reaction time in the particular situations which they have to meet in their jobs. Men differ greatly, for instance, in the time they take to apply the brakes of a truck after a warning signal has been given.

A number of tests of reaction time have been used for selecting the men who will not "wash out" while training to be aviators. Fairly simple reaction times were used at first, but later the SAM Complex Coordination Test (also called the Mashburn Serial Reaction Test) proved to be better (see p. 49f.). The testee has to respond to a signal given by certain red lights by moving in appropriate ways a control stick with his hand and rudder pedals with his feet. A green light shows when he has made the correct adjustment, and then the red lights set him another problem. The measure of his skill is the time required for him to make a predetermined series of correct adjustments. Other tests require the continuous adjustment of an object or a spot of light. The testee must move the controls, for instance, so as to keep the spot of light at a given position or so as to move it along a given path. Both speed and accuracy count here in the score.

(3) **Perception.** The accuracy and speed of perceiving are important and men differ greatly in these respects.

Visual acuity in daylight illumination—the accuracy with which small details can be perceived—is useful in almost every activity, but especially important in the Navy which has minimal special requirements below which men are not accepted for regular duty. Visual acuity at night—the sensitivity of night vision—must be especially good in lookouts, patrols and aviators. Some men are night blind, can see scarcely at all in low illumination. There are tests for these capacities.

The speed at which night vision comes on after the testee has been in the light also varies and can be measured, as can also the speed at which accurate visual perception of objects at changing distances takes place. Both these measures give important information about aviators.

Auditory acuity varies among individuals and can be measured. Information can be obtained not only about the deafness and sensitivity of men for different frequencies of sound, but also about the differences

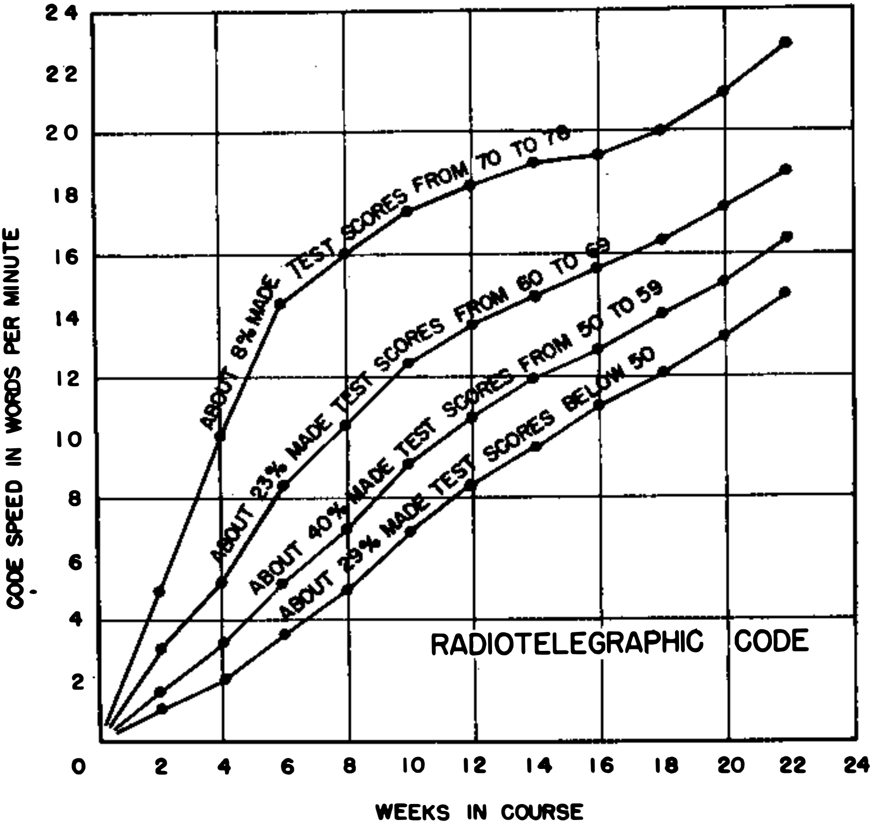

Fig. 67. Learning Radiotelegraphic Code

Learning curves for four groups selected in accordance with their aptitudes for learning code as indicated by an initial aptitude test. (From records of The Adjutant General's Office, War Department.)

in the success with which persons of equal sensitivity can interpret correctly words heard over a communication system.

(4) **Aptitudes.** The aptitudes in respect of which men differ and which the armed forces want are very many indeed. The Army regularly uses tests of mechanical aptitude, of dexterity, of clerical aptitude and of aptitudes for radiotelegraphic code-learning and operating. Mechanical ability is the most important of these tests. Over 7,000,000 Mechanical Aptitude tests have been given and the result entered on the Soldier's Qualification Card. Clerical aptitude does not generally have to be determined by tests because there are so many men in the armed forces

that have had experience as clerks. The Navy has similar sets of tests.

Fig. 67 shows how the curves for learning radiotelegraphic code are predicted in the Army by a test of aptitude for learning the code. The fastest learners of these four groups tended to have high scores in the test, the slowest learners low scores. All together, over 3,000,000 Radiotelegraphic Operator Aptitude Tests have been given.

(5) **Trade Knowledge.** The different knowledges and skills that belong to the various trades and occupations are, of course, of prime importance in the armed forces. Information concerning these assets is got at the reception center from (a) interviews, (b) oral trade tests, and, sometimes, (c) performance samples. The interviewer asks in much detail about the new arrival's work history, what occupation he has followed, just what he did in each job held, for whom he worked, for how long, and how much he was paid. In this way the interviewer finds out the amount and variety of the man's experience. Yet no interviewer can be certain about proficiencies in the great variety of skills in which the Army is interested. *Oral trade questions,* given in interview, are surer. The soldier may seem to claim more experience than he should, or he may claim more knowledge than his record of jobs would justify—perhaps because he has learned carpentry or electrical work on his father's farm and has never had a job outside his family.

The trade questions are technical questions which a workman experienced in that trade can answer. You ask a man who claims to be a good plumber: "What are the two most commonly used methods of testing a plumbing system?" He must then name two of the four right answers: *water, smoke, peppermint, air.* Or you ask a painter: "What is boxing?" He must know that *boxing* means the mixing of paint by pouring it back and forth from can to can. The interviewer has a list of such tried and proven questions for each of the more important trades. They enable him to classify the man he tests as W, S, or L. These abbreviations mean that the man is Well informed, or has Some information, or Little information about his trade.

Performance samples are sometimes obtained for such skills as truck-driving and typing. The driver drives a truck over a standard course, turning it around, parking it, taking it through mud and uphill and downhill. A typist, too, can be asked to show his skill on a sample of work. For the most part there is not, however, enough time at the occasion of first classification to give performance trade tests to those who claim the skills that the armed forces need.

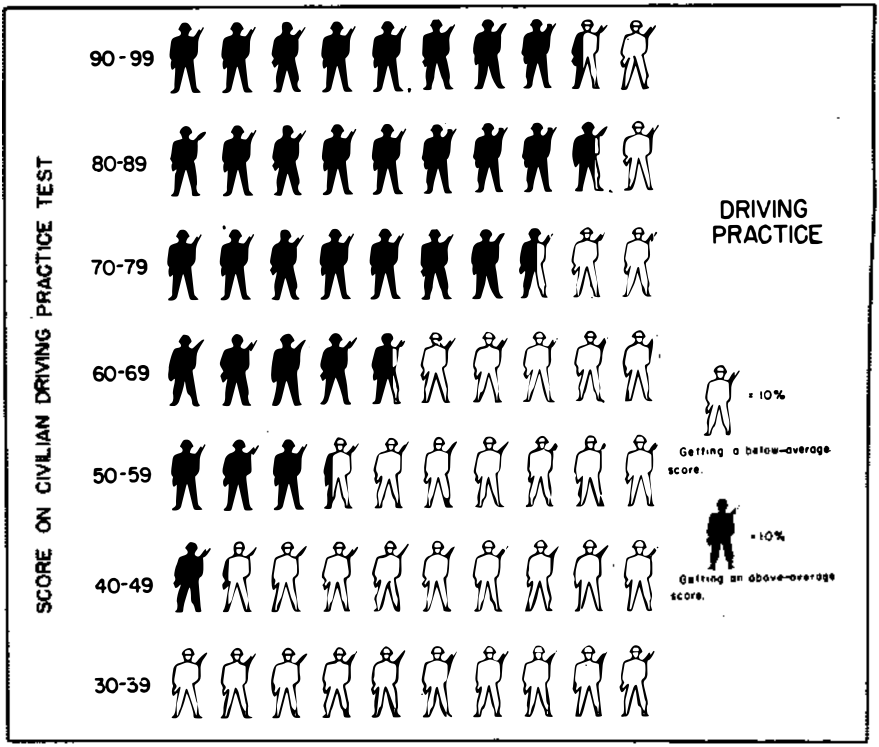

Fig. 68. PREDICTION OF ARMY DRIVING SKILL FROM TEST FOR CIVILIAN DRIVING
Shows chances in 100 that a man, making a given score on the civilian driving practice test, will obtain an average-or-better grade on the Army driving practice test. 270 men. (From the records of the Adjutant General's Office, War Department.)

Fig. 68 shows how a performance test of civilian skill in driving predicts success in driving Army trucks. It is not perfect in prediction because a few of the best civilian drivers failed in Army driving, although none of the worst civilian drivers succeeded.

The AGCT also helps in assessing a man's aptitudes for Army training in the mechanical and clerical trades and in other specialties. To let a soldier in Army Grade V go to a school for accountants would be to court failure, since nearly all professional accountants in the Army have scored in AGCT Grades I or II. Most, but not quite all, of the writers, lawyers, and teachers who have taken this test as enlisted men have also earned a place in Army Grades I or II. On the other hand, few teamsters scored in Grade I.

In Grades I, II and III are fully nine-tenths of the bookkeepers, ste-

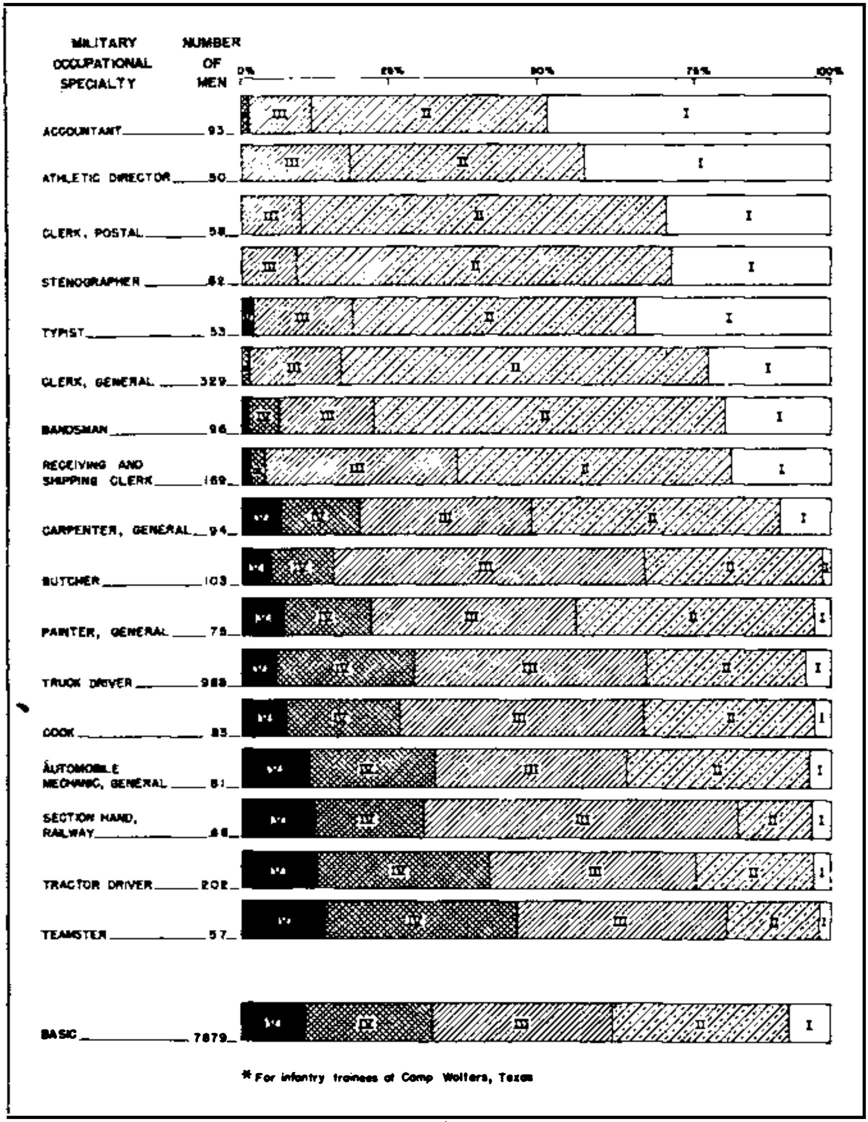

Fig. 69. Performance of Recruits from Different Occupations on the Army General Classification Test

Percentages of 2,649 recruits in grades V to I of the AGCT. The bottom line shows the proportions for 7,879 men in basic training. (From the 1942 records of The Adjutant General's Office, War Department. More recent data, not yet available for publication, change the frequencies somewhat.)

nographers, pharmacists, draftsmen, reporters, postal clerks, general clerks, radio repairmen, purchasing agents, instrument men, salesmen, athletic instructors, store managers, file clerks, embalmers, artists and tool makers.

In a number of trades, about as many men score below as above the dividing line which separates Army Grade II from Army Grade III; for instance, printer, shipping clerk, motion picture projectionist, dental laboratory technician, stock clerk, sign painter, machinist, aerial photographer, policeman, sales clerk and electrician.

There are many skilled trades and occupations in which about as many men score above as below the average for the whole Army. Among these are structural steel worker, welder, plumber, auto mechanic, carpenter, baker, and printer. Truck driver is a populous occupation in which somewhat less than half of the men score average or better.

In occupations like manual laborer, railway section head, teamster, farmhand and lumberjack, physical strength and endurance are indispensable, while ability to do computing or abstract thinking is optional. Here roughly half of the men score in Army Grades IV or V. But the range or spread of scores is enormous. It must not be overlooked that ten to fifteen per cent of the men in each of these labor occupations score in Army Grades I or II. Insofar as the AGCT measures the mental alertness and intellectual grasp required to learn what is taught in officer candidate school, these men have what it takes.

Fig. 69 is based on statistics in the Adjutant General's Office in 1942. The five paragraphs immediately preceding this one reflect recent data of 1945, data not yet available for more detailed publication.

(6) **Educational Achievement.** The ability to read even a little has military value, in recognizing labels, road signs and lists posted on bulletin boards. Training is speeded if the men can read well enough to get something from studying charts, posters and manuals of instruction. So the Army adopted the policy of teaching men to read if, at time of induction, they could not already read about as well as the average man who had four years of schooling. Special Training Units, so-called, were set up for this purpose, and it was astonishing how much progress the brighter illiterates were able to make in two or three months. Tests were constructed for use at the beginning and end of these special training courses and soldiers, who proved to be too dull to profit by this instruction and by the military training which accompanied it, were then classified as inapt and recommended for discharge.

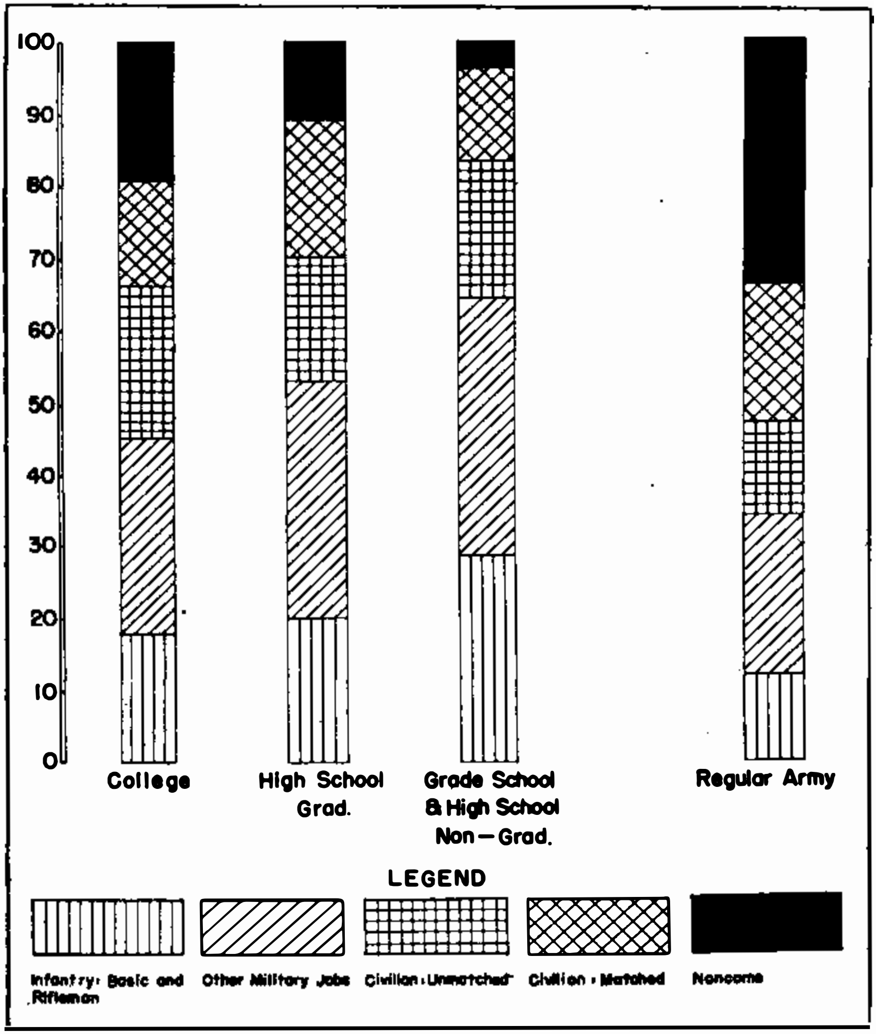

Fig. 70. RELATION OF MILITARY ATTAINMENT TO SCHOOLING. (From records of The Adjutant General's Office, War Department.)

At higher levels the Army has used at various times and for specific purposes a variety of educational achievement examinations: arithmetic, algebra, geometry, trigonometry, chemistry, physics, history, English grammar and composition, French, German, Spanish.

That education is related to military success is shown in Fig. 70. More college men get to be noncommissioned officers in the Army than do high-school graduates, more high-school graduates than men who do not graduate from high school. That means that fewer college men are left for duty as privates.

Success in the AGCT is related to schooling, but often the AGCT, that simple one-hour test, is a better predictor of success than is the number of years the man has been in school. Fig. 71 shows how the number of grades in school and the Army grade in the AGCT predict the success of tank mechanics. The AGCT is better. Men who went through junior high school have 61 chances in 100 of doing better-than-average as tank mechanics, whereas men who stopped at the sixth grade have only 28 chances—a difference of only 33 per cent. On the other hand, men who are classed in Grade I in the AGCT have 81 chances, and men in Grade V only 3 chances—a difference of 78 per cent. The AGCT gets at something more than amount of education.

(7) **Personality.** After account has been taken of general ability and special abilities, of the speed and accuracy of reaction and perceiving, of all the aptitudes and trade knowledges and educational achievements that are of military use, there remains personality. Men differ so much from one another in personality. They differ in emotional stability, in interests, in ease of social adjustments, and in a hundred other ways, some of them quite specific. These differences are important to the military and naval services, but it is not easy to test for them, to make out a personality inventory.

Emotional stability comes first in importance in the measurement of personality. At induction psychiatrists try to select for elimination those men who are almost sure to crack under the strain of war. The worst cases are rejected immediately. The doubtful cases may be put under observation and a decision about keeping them or about the kind of work to which they can be assigned made later. Subsequently officers have to be alert for signs of instability in soldiers and send for medical examination those who show signs of breakdown. The strain of campaigns is sure to break many men. It would be neither possible nor wise to eliminate them all in advance, because the "bomb happy" soldier—they called it "shell shock" in the First World War—usually gets over his anxiety and weeping and goes back to the front a cured soldier (see pp. 363-368).

It would be possible to know a great deal about the personalities of soldiers if there were time for thorough investigation and enough experts available to use the time. The Rorschach ink-blot test, in which

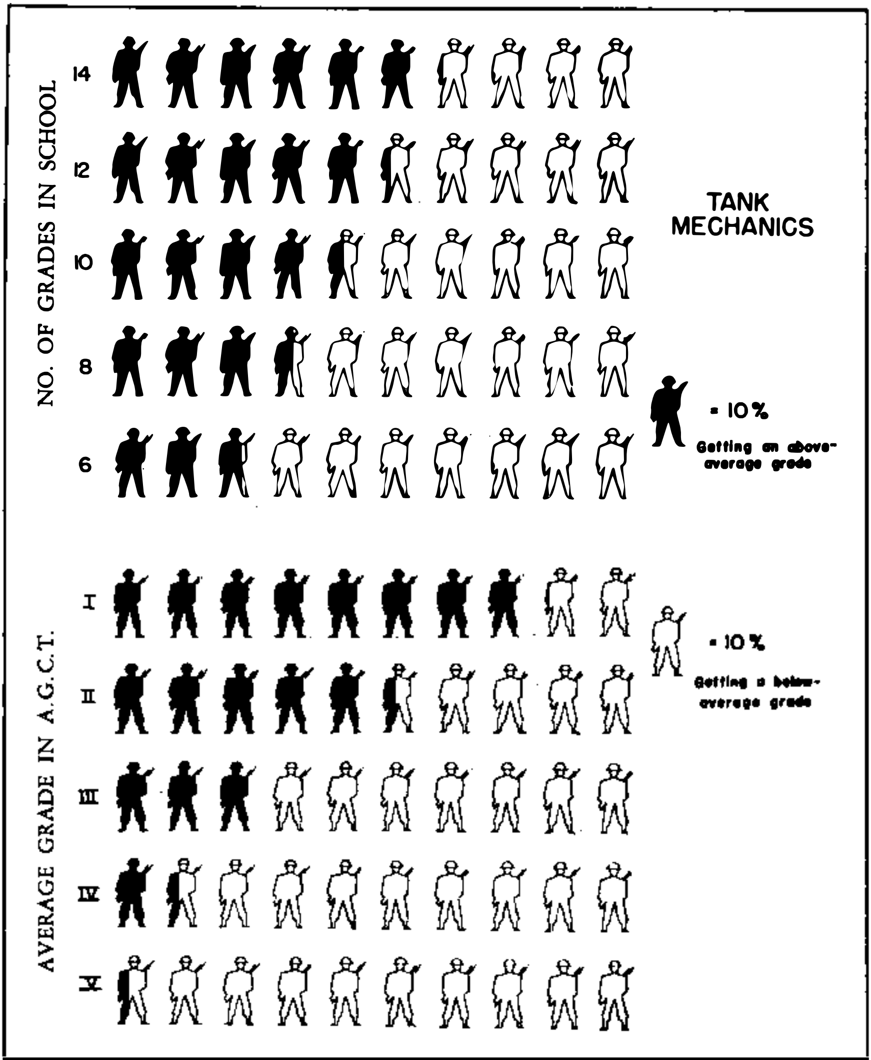

Fig. 71. Prediction of Success in a Tank Mechanics Course from the Schooling and from the Grades in the AGCT

The AGCT is a better predictor than amount of schooling. (From the records of the Adjutant General's Office, War Department.)

a man interprets what he sees or imagines in certain standardized ink-blots, yields a great deal of information in the hands of experts. So does the Thematic Apperception Test, where the testees are asked to tell stories about certain selected pictures. If you could use more hours than you have minutes available for such study and find a few thousand experts to do the examining, the military services would profit, except for the fact that the time would have to be taken from something else. The Army has been developing certain personality tests which promise some success under practical conditions, but the results are not as yet available for report.

Interests are important indices of personality and they may be determined by interview. A man does better work if he is doing what he wants to do. In the Army, men's preference is usually for the Air Forces, in spite of the hazards to those who fly in combat planes, or who service those planes at fields that are under frequent terrific bombardment from the enemy. At first it was believed that some of this preference was based on the glamor and excitement of adventure and heroic deeds, the glory of the successful fighter-pilot. It appears, however, that the preference persists even among men who know the dangers, who are aware of all the dull hard work and the grueling strains which the aviator must undergo, and who are aware that only a fraction of the men in the Air Forces become flyers or engage in regular flight.

The backbone of the Army, the infantry, is not so popular. That is unfortunate, because the infantry needs large numbers of able, sturdy, resourceful fighting men. The infantry seems less important because there is so much of it, but the failure to recognize its essential rôle has steadily been counteracted by propaganda—the kind of propaganda that tells the truth about the Infantryman's hardships and his importance. Men do not shrink from difficulties if they feel important in meeting them.

Aviators who do well in training for all three branches of flying are allowed to choose as to whether they will be pilots, navigators, or bombardiers. That is good policy. Use available interests when you find them. If you cannot find them, create them by training and by all the other builders of morale.

Educational achievement affects personality—of course. The college man who finds himself in routine work that makes no use of his training finds adjustment difficult. If he is then unhappy, Army officers who lack knowledge of how the Army uses classification to best advantage are apt to complain that he is soft and needs discipline. The fact is that the Army is likely to need his special training elsewhere. Even if his college work lay in a field that has no military use, he has—or should have—at least the ability to use his brains, and his interest in intellectual activity ought to be turned in a military direction. It is a much more efficient way to get morale and also to get certain work done. At the same time, it should be remembered that every combat arm of the services needs many men of a high order of intelligence and that such men can find plenty of problems to challenge them in any platoon or battery.

Leadership constitutes a persistent problem of selection for the armed services. There are never enough good leaders. Elsewhere this book points out that tests of leadership have not yet been successfully developed, that selection is best based on the history of successful leadership in the past, as it can be brought out in a skillful interview (see pp. 425-428). Some men who are not good leaders can learn to lead, but not all. Some who are good leaders in the earlier training of troops fail under the stress of combat. There is a set of capacities here in which the individual differences are large and which demand valid assessment if the abilities of men in the armed forces are to be best applied to the successful prosecution of war.

There are, of course, still other important differences of personality that have to be discovered on the job. One man can sit in the transparent cage of an airplane, feeling safe and confident. Another goes all to pieces under these conditions; he does not feel secure. Since you cannot take account of all the idiosyncrasies of human nature in advance, you must be ready to note them when they turn up, and often to admit that it is easier to find another man for the job in hand than to change the personality of the man already on the job.

CLASSIFICATION

Men are classified for assignment and reassignment to military jobs and training by classification and assignment officers. They review the facts about each man's experience and qualifications—facts that have been found from interviews, tests, medical examinations of strength and fitness, and observations of performance during periods of training. In the Army the methods are worked out by the Personnel Research Section of the Classification and Replacement Branch of the Adjutant General's Office. In the Navy this work lies with the Bureau of Naval Personnel. The techniques of classification are listed below.

(1) **Interviewing.** Every recruit gets a short interview of ten to fifteen minutes at the reception center when he enters the Army. The interviewer finds out about his age, schooling, job history, earnings, special skills, athletic activities, avocations, preferences for work, and evi-

dences of capacity for leadership. He avoids asking for any information that will be obtained otherwise by records or tests, for time is precious.

Not every bright man is a good interviewer. Interviewing is an art and interviewers have to be specially trained in personnel psychology. The good interviewer has learned to discount his own prejudices and to get at objective facts. He takes the point of view of the man being interviewed and knows how to put him at ease, how to gain his confidence and to make him feel that the interview is for his own benefit. He asks few direct questions but lets the man tell his own story under guidance. When he does ask questions, he is straightforward and frank, always making it appear that he is working to get the man well placed where he can be most effective. As the interview progresses, the interviewer is concerned not only with the man's responses but also with his mannerisms and peculiarities.

The information obtained is all recorded at once on the Soldier's Qualification Card. Only facts are put down there. Even the good interviewer is not trusted to form inferences. This card, with its data being continually supplemented, goes with the soldier through the Army. New facts are added to it, old errors corrected. The data about skills may be corrected later by tests and still later by actual performance on assigned jobs.

(2) **Testing.** Soldiers get the Army General Classification Test (AGCT). Sailors get the Navy's GCT. Some get trade tests. Most of them get aptitude tests.

(a) The AGCT is arranged to classify the men into five grades. Its scoring was arranged so that 100 would be the average score of men of military age, and so that about two-thirds of the population examined would score between 80 and 120. Actually the recruits and selectees have done a little better on the average than was anticipated, although the figures fluctuate as policies change with respect to deferments and and to minimum acceptable qualifications. At one stage of the war the distribution of grades was as shown in Fig. 65 (p. 241).

Grades I and II furnished the men who are most likely to make good commissioned and noncommissioned officers. Here also are many of the highly skilled specialists. It would not do, however, to have an Army made up entirely from these grades, for these men are not always well adapted for the more routine jobs.

Grade III furnishes many good noncommissioned officers and some specialists, and it provides good basic soldiers.

Grade IV gives good basic soldiers and men for routine work in which the soldiers in Grades I and II would be out of place, poorly adjusted and wasted. Here, too, are some of the excellent hospital orderlies, cook's assistants, truck drivers, maintenance men, airplane riggers, ammunition carriers without which an army would be easily defeated.

Grade V furnishes some dependable fighting men and many who are extremely useful doing unskilled manual labor and performing such indispensable duties as those of dock laborers loading and unloading cargoes, and helpers piling supplies on trucks. Engineer construction battalions absorb some of these men if they have sturdy physiques. But in general it may be said that Grade V yields few men who excel in combat or in technical specialties.

Individual differences on the AGCT are tremendous. Some men have scored as low as 42; others as high as 160. It would be nonsense to suppose that any man in the Army could learn to do any job. Human nature is not at all uniform.

(b) *The Oral Trade Questions* are used ordinarily when the interviewer has some doubt about the trade experience of the man, as to whether he is claiming more knowledge than he actually has or whether he may have more knowledge than his job experience shows. The United States Employment Service has published a volume of these tests for civilian jobs and a supplemental volume for Army jobs. Each test consists of fourteen to nineteen questions. A complete test can be given in five or six minutes.

The performance tests and work samples take so much time that they cannot ordinarily be administered at the reception center. The test of truck driving is no exception, although interview and oral trade tests do not bring out the versatility of the man's skill. Later on work samples become the usual means of indicating any skill, for performance on the job is the true measure of the man's proficiency.

(c) *Aptitude tests* are used for determining mechanical aptitude (the visualization of spatial relations and also mechanical inference), manual dexterity, motor coördination, radiotelegraphic operating ability, visual perception in stereoscopic range finding, and clerical ability. Mechanical aptitude is needed for motor mechanics, tank mechanics, airplane mechanics, radio mechanics. Bombardiers must have dexterity, pilots a high degree of motor coördination.

(3) **Personality Assessment.** The thorough assessment of personality with the tests that take much time and that can be used only by

experts has not been practicable. There are, however, many personality factors that are important in assignment of men and some of them can be taken into account when decisions are made.

Motivation is very important. The attitude of the new recruit toward the services and later his attitude toward his job can be noted. His interests may reveal the jobs in which he will be well placed, but in considering them it is necessary for the classification officer to distinguish between expressed interests and real interests. Many men think they want kinds of work in which they have had insufficient experience or none at all. They may not like their new jobs after they actually get them. It is better, therefore, to give special attention to the actual experience of the man in the past and not to rely entirely on his expressed interests in placing him in any given job.

Work habits are important. They have to be determined in job samples. And they may have to be corrected on the job.

Endurance is important. Physical training for all men is directed toward increasing physical endurance. The ability of flyers to stand deficiency of oxygen is something different, but these facts can be learned by trying the man out. Psychic endurance is still more important than physical endurance. Will the man be able to stand the gaff? The psychiatrist rejects at the start the men who are most likely to break. Officers under combat conditions take out men who show signs of breaking as soon as practicable and send them back for prompt treatment so that they can be shortly returned to duty.

The *efficiency reports* for officers have been used to record certain personality factors, but they are being used less than formerly. In them superior officers rate a junior officer on a rating scale, comparing him with various definitions or examples of concrete levels of performance. It is hard, however, to get these definitions clear, and the rating officers are often unable to avoid prejudice and favoritism. If they have got in the habit of thinking that a man is good, they are apt to rate him high on most qualities, whatever instructions the rating officers have been given in the interests of objectivity. Rating scales are always best applied by a number of raters, who will thus correct one another, but actually it has seldom been possible to multiply ratings in this important fashion.

It is better, therefore, in rating a soldier or sailor to stick to objective facts, actual records of performance, the items that can go on a Qualification Card or Service Record. All such records should be collected and regularly entered. Then eventually the total picture of the man will begin to stand out.

(4) **Qualification Cards.** There is in the Army a Soldier's Qualification Card and an Officer's Qualification Card. These cards follow a man all through his service. The data which indicate his proficiencies and deficiencies, his experience and learning, his successes and advancements are entered on the cards. Kept up to date, they are the Army's human inventory.

The Soldier's Qualification Card has places for the records of age, education, knowledge of languages, occupational history, earnings, special skills, avocations, sports, ability as a public entertainer, physical data, military experience, evidence of leadership, results of the AGCT, trade tests, aptitude tests and any other tests, recommended assignment, and a cumulative record of military service. Most important is the space for recording the man's military occupational specialty after he has finished a prescribed course of training in a specialist school or has shown on the job that he can do it as it has to be done in the Army. A civilian pay clerk, truck driver, baker or demolition man has a good deal to learn in an Army school before he can be trusted with the duties of his military occupational specialty—his MOS, as it is called.

The Officer's Qualification Card has comparable data for officers.

In the Navy similar data are placed on the Service Record of the sailor and the Fitness Report of the officer.

ASSIGNMENT

The data on the Soldier's Qualification Card or the Sailor's Service Record are used to assign him to training and to duty. They must be studied carefully if the best assignment is to be made. There is a difference between the best assignment and a correct assignment. A man may be correctly assigned in the sense that he has been given a job for which he is well suited or even best suited. It may be, however, that he has also some other skill or aptitude for which there is greater need in the military service, even though this skill or aptitude is only his second best, and that he ought therefore to be reassigned in order to fill the greater need.

Early in the Second World War the assignments in the Army Air Forces were inventoried with the discovery that 90 per cent of the men were correctly assigned in the sense that they had appropriate jobs which they could do well. Yet a further study showed that the Air Forces would benefit from the reclassification and reassignment of many of the men. As a result several thousand were reassigned to different jobs.

(1) **Air Crews.** The classification and assignment of air crews and of aviation technicians may be taken as examples of how these procedures work.

The Second World War created a tremendous demand for pilots, bombardiers and air navigators. There was no huge pool of civilian flyers to draw upon. In the early days of the war sometimes 60 per cent of the candidates in training would fail—"wash out." Seldom did less than 35 per cent fail. That was much too expensive. The failures tied up the training planes without producing results. The aviators were got ready for combat too slowly. The Air Forces turned to research in job analysis and the prediction of success in flying. The results have justified the effort, but, since research is still continuing, we can examine here only some of the more general bases for selection.

(a) *Physical fitness* is a prime requisite—fitness to endure strain at all times and especially at high altitudes. This capacity has to be determined by objective tests. Ordinarily examinations by medical men have not been satisfactory because successive examinations—as has been shown in the case of civilian pilots—do not agree with each other. Physicians need to check their judgments by specific tests.

(b) *General ability* is required—more than is needed, for example, in successful truck driving. The AGCT indicates what is needed here and also, because of its content, gives some indication of the candidate's ability to follow directions and to use simple mathematics.

(c) *Mathematical knowledge* is essential for navigators and navigating pilots.

(d) *Visual perception* must be keen. Night flyers must have good night vision. They must see well in low illumination and adapt rapidly to night vision. They must also have good acuity in daylight, and pilots must be able to shift back and forth between near vision (the instrument board) and far vision (the target and the enemy plane) with a minimal fatigue. These capacities are determined by eye tests.

(e) *Motor coördination* is just as important for pilots and bombardiers. There are various tests of this capacity.

(f) Pilots should have low *reaction times,* that is to say, they should be able to make a movement quickly in response to a signal. The SAM Complex Coördination Test is the best known of the tests used to determine these reaction times (see pp. 49, 243).

(g) *Dexterity* is required, especially of bombardiers, who have to manipulate the bombsight accurately and rapidly.

(h) *Personality* is important, but it has not been so easy to assess the necessary qualities accurately. It appears that emotionally stable, well-poised men make the best flyers, although the application of this rule to fighter-pilots has not yet been made. The aviator also seems to need some of the qualities of the good leader and the good mixer, for the men in a crew must be able to work well together as well as separately.

It must be remarked that research on the tests that predict all the necessary qualities for any given job has been handicapped by the difficulty of testing the tests. The tests for combat flyers, for example, ought to be validated by success in predicting good combat flyers, but until recently their correctness has had to be measured, for the most part, by their prediction of wash-outs in training, and the wash-outs depend, not on success in combat, but mostly on the judgment of instructors at the flying school. The judgment of instructors can be wrong. Even bombardiers, who can be tested by field target practice, do not show in training how their skills will stand up under actual combat conditions.

(2) **Aviation Technicians.** The Air Forces in the Army have schools which give specialized training for machinists, welders, metal workers, link trainer men, parachute riggers, teletype operators, weather ob-

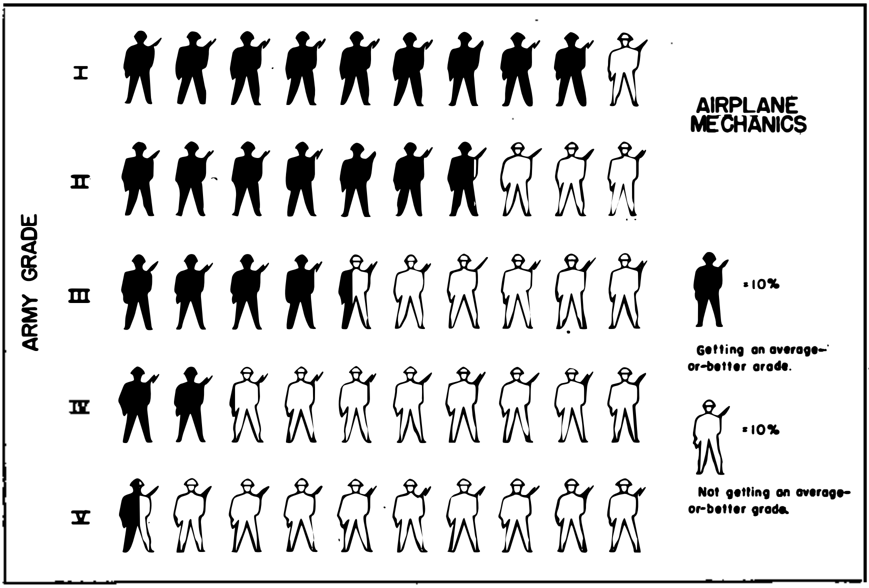

Fig. 72. Prediction of Success of Airplane Mechanics from Grades in the AGCT (From records of The Adjutant General's Office, War Department.)

servers, weather forecasters, general clerks, photographers, armorers, radio mechanics, radio operators and airplane mechanics. All these men have to be selected, trained and assigned by the use of tests and examinations.

The AGCT is not without value for mechanics. Fig. 72 shows that it is an excellent predictor of success for the airplane mechanics except, of course, for the fact that there are not nearly enough men in grades I and II to go around.

(3) **Truck Drivers.** The classification and assignment of truck drivers furnish another example of how these procedures work.

The effectiveness of an army is so dependent upon its mobility that any breakdown in transportation means disaster. One of the key elements in an efficient ground transportation system is the well qualified driver. The good driver can move men and cargo with speed and without accident. His accident-free driving and his care in the maintenance of his vehicle reduce repair costs and delays. It is therefore important that drivers be both selected and trained with the greatest care.

For every thousand men received into the Army, about 92 have had experience in driving light or heavy trucks. The Army actually needs about 83 truck drivers per 1,000 men. It would thus seem to have truck drivers to spare; yet it does not. It usually has a shortage of motor mechanics and of chauffeurs, so the truck drivers that are also good motor mechanics may be assigned as mechanics, and others may be used as chauffeurs. Such proper assignments create a shortage of truck drivers.

Selection of good drivers can be made by means of the following three indicators.

(a) A civilian experience record is obtained in an interview, or else a man fills out the Driver Experience Inventory. This inventory consists of fifty questions on the phases of driving experience which have been found to be most important.

(b) Knowledge of driving practices and regulations can be assessed by the Driver Information Test, which asks fifty questions about civilian experience.

(c) A performance road test under standardized conditions is also desirable, but it is only practicable under conditions where a hundred or more drivers must be tested daily.

Ordinarily the selection of drivers has to depend on the first two tests, but the road test may be added in the Quartermaster Corps, where as many as one man in five is needed as a heavy truck driver.

In selecting for the Q.M. other tests are sometimes added. (d) Visual acuity may be tested, and men who need glasses and have not got them may be given them. (e) Field of vision may be tested to discover how far and how well a man can see out of the corners of his eyes. (f) Ability to see in spite of glare may be determined. (g) The ability to see at night in blackout may be measured in the manner developed for infantry patrols and artillerymen.

(4) **Other Special Jobs.** There are many other fields in which the methods of selection and assignment in the Army have been developed because the military needs were so great.

Special techniques of selection and training exist for motor mechanics, tank mechanics, airplane mechanics, radio mechanics, and men skilled in electrical communications. General ability as well as mechanical aptitude are important in all these fields, and charts similar to the one of Fig. 72 for airplane mechanics have been constructed for each.

Radiotelegraphy is an extremely important means of military communication. There are schools for training the many operators needed, and a Radiotelegraph Operator Aptitude Test is used.

Observers for stereoscopic range finders have to be selected. They are given tests of stereoscopic vision as well as other measures of ability in range finding.

There is a good Clerical Aptitude Test.

As yet no comprehensive series of tests has been developed and applied in the selection of the infantry or marine fighting man. Such tests would have to include approximately the same types as those used in the selection of air crews, and would probably result in reducing the infantry losses that are due to lack of intelligence, sturdy physique, initiative and psychic endurance.

The selection and assignment of officers who are good leaders is dealt with elsewhere in this book (pp. 425-428).

Selection of men for specific jobs in the Armed Services, then, is not a simple matter. Some of the qualities that make for success in a given military job are known, others are not. Research in this field is going on as it is in the field of education and in industry, and some day we may have better predictive tests than those now available. In the meantime, although the tests will be wrong in certain individual cases, by and large they are of great value. In wartime millions of men must be assigned to training for specific jobs quickly. If the assignment is good, men find themselves with work that they can soon learn to do well and that they enjoy doing. These are basic conditions for efficient productivity and also for good morale.

REFERENCES

1. A. ANASTASI. *Differential psychology.* New York: Macmillan, 1937. Pp. 615.
   An excellent survey of the literature on the nature and extent of individual variation with stress upon cultural causes of such variation.
2. G. ARTHUR. *A point scale of performance tests.* New York: Commonwealth Fund, 1943. Pp. 64.
   A clinical manual describing the standardization and use of this nonverbal test of intelligence.
3. W. V. BINGHAM. *Aptitudes and aptitude testing.* New York: Harper, 1937. Pp. 390.
   A good presentation of the nature of aptitudes and of the tests which have been developed to measure a great variety of aptitudes such as aptitude for various professions, for clerical occupations and for skilled trades.
4. W. V. BINGHAM. "Personnel classification in the army." *Science,* Vol. 100. September 29, 1944. Pp. 275-280.
5. H. E. BURTT. *Principles of employment psychology.* New York: Harper, 1942. Pp. 568.
   An excellent text on the vocational selection of men, dealing with the testing and rating of aptitudes, trade tests and job analysis.
6. E. B. GREENE. *Measurements of human behavior.* New York: Odyssey Book House, 1941. Pp. 777.
   A clear presentation of the facts about testing instruments and their interpretation with an excellent treatment of the basic considerations in measurement.
7. G. C. SCHWESINGER. *Heredity and environment.* New York: Macmillan, 1933. Pp. 484.
   A fairly complete summary of the nature-nurture controversy, with good descriptions of mental tests and a summary of the evidence relative to theories of personality as of 1933.
8. M. S. VITELES. *Industrial psychology.* New York: Norton, 1942. Pp. 652.
   A systematic presentation of the genesis, problems, settings, findings and accomplishments of industrial psychology both in this country and abroad.
9. WAR DEPARTMENT. *Technical Manual 12-260, Personnel classification tests.* Washington: Government Printing Office, 1942. Pp. 71.
   An official, technical manual covering the principles of testing and a catalog of general ability and special aptitude tests as used in the selection of men for the U. S. Army.
10. WAR DEPARTMENT. *The personnel system of the United States Army.* Washington: Government Printing Office, 1919. See especially Vol. I, *History of the personnel system,* pp. 713.
   This volume includes "Man Analysis" (Sect. III), "Job Analysis"

(Sect. IV) and "Trade Tests" (Sect. VII), showing what happened in these respects in the First World War.

11. D. WECHSLER. *The measurement of adult intelligence.* Baltimore: Williams & Wilkins, 1941. Pp. 248.
    An excellent treatment of the nature of intelligence, along with a detailed description of the construction and use of the Bellevue intelligence scales.
12. R. M. YERKES, ED. "Psychological examining in the United States Army." *Memoirs of the National Academy of Sciences, Vol. 15.* Washington: Government Printing Office, 1921. Pp. 890.
    A complete account of the history, methods and results of psychological examining in the United States Army during the First World War.
13. C. S. YOAKUM AND R. M. YERKES. *Army mental tests.* New York: Henry Holt, 1920. Pp. 303.
    Popular description of the Army's 1918 tests and of their significance, brief and simple as compared with item 12.

See also the articles on recent work by the Staff of the Personnel Research Section, AGO, "Personnel Research in the Army," *Psychological Bulletin,* 1943, Vol. 40, pp. 129-135, 205-211, 271-278, 357-371, 429-435, 499-508, especially 205-211, 357-371; "The new Army individual test of general mental ability," *Psychological Bulletin,* 1944. Vol. 41, pp. 532-538.
In addition, see other references cited in Chapter 1, and, on leadership, references for Chapter 18 (especially Chapter 7 in item No. 5).

Chapter 12

Learning

After the personnel of the armed forces has been selected, it has to be trained. That would be true in peacetime when the forces are not being expanded, and it is especially true when a democracy has to build up large forces rapidly from men who have had no other preparation for military tasks than what is furnished by their civilian activities. The need is, moreover, greater in modern mechanized war, where the number of military jobs is so great and the demand for mechanical skills so large.

The first step in the creation of an expanded army or navy lies in the selection of men who have the requisite competence, whether it be based on natural abilities or learned skills. Since the available abilities and skills are not, for the most part, fully adjusted to military requirements, the men have to be trained. A civilian truck driver may know his job well, yet he will require much further training before he can drive Army trucks satisfactorily. A civilian of high intelligence with a record of leadership in his community may be excellent officer material, but he is not yet an officer. He too has to be trained. The forces take the best aptitudes they can find and adapt them by training. Training makes the soldier—and the sailor.

To acquire skill in their new jobs, to learn what to do, the men go to school. Most of the hard work of military life is schooling. Drill is school, both close-order and battle drill. The men learn their new jobs there. Some schooling is formal, with books, classes and practice sessions. Military life itself is also school, where habits are set and discipline acquired. Battle is school—the last course of training. In it green troops learn to be seasoned troops, the tough hardened troops that can take punishment and defeat and can exploit victory.

The learning that training is designed to produce depends on three things: (1) *practice,* (2) *motivation* and (3) *understanding.*

The men must know how to do what they have to do. They must *understand* the reasons for what they do. Only when learning includes thorough understanding are men able to apply their wisdom to the new situations that war is forever producing.

They cannot learn unless they are *motivated* to learn, unless they learn to want to learn. Learning is in this way tied up with morale. When a man wants to do what he has to do, when he has zest and good morale, then he is ready to learn how to do it. He must have motives for learning, incentives to learn. When he wants to learn, then success in learning becomes a sufficient reward to make the learning rapid and to make it stick afterwards.

Besides motivation and understanding, there needs to be *practice* too. Most feats of skill, whether the skill be figuring out the range of a target or the mechanical operation of a machine gun, are not automatic when first understood. The mental or physical acts have to be repeated again and again, have to be practiced, before they become so permanently set that a man can perform them without error under all conditions of distraction and emotion—combine several skills, mental and physical, mechanical and tactical, in combat.

Practice, motivation, understanding—these are the basic principles of learning of all acts, intellectual and mechanical, military and civilian.

PRACTICE

It is common experience that one learns by practice and that enough practice of the right kind and of the right things makes perfect. Practice means *repetition.* Children repeat the multiplication tables again and again until they know them. The man with a speech to make may say it over many times in advance so that he shall not falter when the occasion for it comes. The rifles all come up together at port arms because of practice. Practice is drill.

For this reason soldiers drill, going through the same movement repeatedly until a habit is formed and stamped in. They practice with all their special operations—the use of the rifle, crawling on the belly, digging a foxhole, driving a truck in convoy, landing an airplane—until the various physical movements follow one another automatically with little or even no thought. Discipline is largely practice, the formation of certain habits of reaction that occur without effort on their proper occasions.

While repetition is not es-

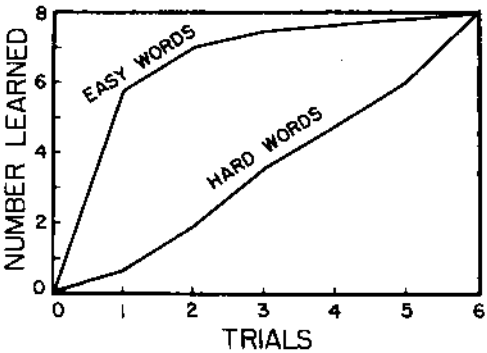

Fig. 73. LEARNING CURVES: MEMORIZATION
Learning curves for lists of 8 hard and 8 easy words. Averages of 11 records of 5 men who learned these lists perfectly in 6 trials. (Data from G. M. Peterson, *Journal of Experimental Psychology,* Vol. 11, pp. 40-44, by permission.)

sential to learning—you can learn to throw yourself on the ground at the sound of a falling bomb in a single experience—repetition is nevertheless the usual way in which learning is made perfect. Obviously, if you do not learn the first time and still must learn, there is nothing to do but to have a second trial, and a third, and so on, until the fact or act has been learned. For this reason ability to learn is often measured by counting the repetitions required to make the learning perfect, or to make it good enough for whatever purpose the learning has.

Fig. 73 shows two memorization curves. The men whose learning was being studied when these curves were made were undertaking to learn lists of words. Each list had in it eight easy words and eight hard words, and the figure shows averages for all those cases where learning the lists took exactly six trials. The easy words were learned more rapidly than the hard ones—71 per cent of the easy words were learned in the first trial but only 7 per cent of the hard words. The curve for the easy words is the common form for such curves, for learning is usually rapid at first, and then advances to perfection more and more slowly. Yet learning *can* go on at a uniform speed all the way to perfection, as it did for the hard words.

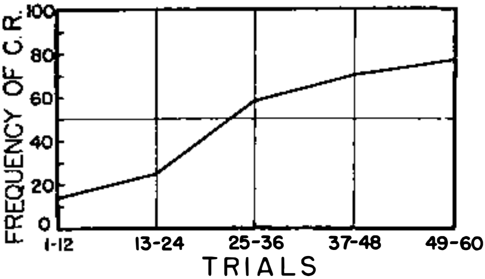

Fig. 74. Learning Curve: Conditioned Response

Learning curve for the eye-blink (caused by a puff of air on the eyeball) conditioned to a light shone in the eye. Each point is the average of 12 trials for 10 men. (Adapted from E. R. Hilgard, R. K. Campbell, and W. N. Sears, *American Journal of Psychology,* vol. 51, p. 501, by permission.)

Learning curves have no one single shape. They may be straight or curved, curved upwards or downwards.

Fig. 74 is a learning curve for what is called the *conditioned response.* A response is said to be conditioned when some unusual stimulus, one which will not ordinarily bring about the response, begins to elicit the response because it has frequently accompanied the usual stimulus. When the saliva flows in a dog's mouth because food in his mouth stimulates the sense-organs of touch, taste and smell, that is an unconditioned response—a response to stimulation that is born in the dog. The dog, however, usually sees his food before he eats, and early in his life he gets so that his mouth waters as soon as he sees food. The sight and the taste have so often accompanied each other that now the sight produces the response that belongs properly to the taste—a conditioned response. And you can go further. If a bell is always sounded just before the food appears, the dog will get so that his mouth waters at the sound of the bell. He has learned that the bell is his dinner bell, for the secretion of saliva has now become conditioned upon the sound of the bell. The flow of the saliva, the conditioned response, can be measured.

In the experiment diagramed in Fig. 74, the response was a blink of a human eyelid. The experimenter directed a quick puff of air at a man's eye, and the man's lid blinked. Then the experimenter tried shining a light at the man's eye just before the blink to see if he could get the eye to blink when the light was flashed and the puff of air omitted. He could, and the curve of Fig. 74 shows the result. In the first twelve trials the eye blinked for the light without the air-puff about 14 per cent of the time. By the 60th trial it was blinking 77 per cent of the time. The curve looks as if the conditioning were never going to be perfect, never going to reach 100 per cent. This too is a learning curve where repetition seems to be the important condition of learning.

Conditioning (Fig. 74) differs from memorization (Fig. 73) in that conditioning seems to be more automatic and less conscious than memorization, but it is not clear that there is any fundamental difference.

In memorizing words, the learner first thinks the word and then acts—by speaking it or writing it down. In the conditioned response, he acts first, by blinking, and then thinks, by realizing that he has acted. Learning, however, follows the same general laws in both cases.

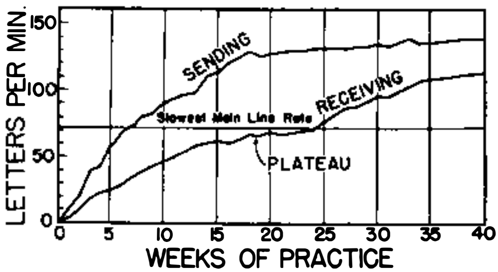

Fig. 75. Learning Curves: Acquisition of a Skill

Learning curves for receiving and sending telegraphic code for a single man during 40 weeks of practice. (Adapted from W. L. Bryan and N. Harter, *Psychological Review,* vol. 4, p. 49, by permission.)

Fig. 75 shows a learning curve for the acquisition of two skills—sending and receiving telegraphic code. The curve shows how skill kept improving during forty weeks of practice. Sending is easier than receiving, so the curve for sending lies always above the curve for receiving. These acts are much more complicated than speaking lists of words or blinking eyelids. The curve for receiving has a flat portion in it, a *plateau,* as it is called, which represents the period from the 15th to the 28th week when the telegrapher improved hardly at all in receiving. This seeming lack of improvement may have been due to discouragement or to boredom. Or it may have been due to the learner's need to discard certain unsatisfactory habits and to form some new and more proficient habits. The fact is, however, that learning curves do not always have plateaus in them.

The flat portion at the top of the sending curve is not called a plateau because there the sender is reaching his maximal skill, his so-called physiological limit, and is not expected to improve even with further practice. Very few people actually reach their levels of maximal skill. A man who has worked out a reasonably efficient way to assemble a machine rarely feels the need for working out an even more efficient method. The final flat portion in his learning curve, then, is not the final level he could attain, but without further motivation for improving he is likely to stay at the pseudo "final" level.

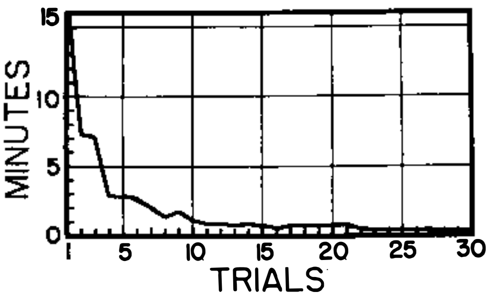

Fig. 76. LEARNING CURVE: PROBLEM SOLVING
Learning curve for rats finding their way through a maze to food at the end of the route. Averages for 19 rats. (Adapted from J. B. Watson, *Psychological Monographs*, vol. 8, no. 2, p. 100, by permission.)

Fig. 76 is a learning curve for solving a problem. It is drawn to show the average performance of 21 rats who had to learn to find their way through a maze to get food in a food box at the end of the maze. (For a figure of a rat maze, see Fig. 56, p. 156.) This curve drops with practice because proficiency is measured in time. At first the rats go slowly, investigating as they go, running into blind alleys, making mistakes and repeating them. As they learn the true path, they speed up by making fewer mistakes and by actually running faster. On the average it took these rats 16 minutes to get to the food on the first trial. By the second trial they had got down almost to 7 minutes. By the 18th trial they were making the run in about 10 seconds.

It is ordinarily supposed that learning takes place by the formation of new special connections in the nervous system, by *association,* as this formation is called. Many persons think of the nervous system as acting in a manner similar to a telephone system, where certain connections are set up all ready to be used when plugged in, or are left plugged in when the habits are so well established that they always happen when a given stimulus occurs. Such an analogy is far too simple to describe the facts; yet learning consists of forming complex nervous connections which are effective whenever the conditions are just right.

To learn any act or set of ideas requires many connections. Such connections can, when motivation is strong and the connections are not too elaborate, be established on a single occasion, but ordinarily the job is not completely done the first time. The event has to be repeated again, and perhaps again and again, until all the connections are formed. That is why repetition is ordinarily necessary for solid learning. Each trial brings the set of necessary connections nearer to completion and permanence. When an association or complex act has first been brought to perfection by many repetitions, it is still not completely learned. It is likely to be soon forgotten, unless it is repeated still other times. Not always is that the case. The child may try to grasp the candle flame but once, and then, forever after, shun fire. His experience of being burned was so intense that the association of fire—avoid is fixed permanently in his nervous system.

Most learning is, however, temporary, unless it is further impressed after it has first reached perfection. That is why drill and practice must be continued. Drill counteracts forgetting and also renders the habit more permanent, so that forgetting affects it less. The object of drill and of discipline is to fix certain habits so firmly upon men that they will never forget them, nor fail to execute them even when emotional distraction is at its maximum.

MOTIVATION

The evidence seems to show that no man ever learns without wanting to learn, or at least without perceiving that two things that are to be associated belong to each other somehow or other. If a man repeats words without any thought that he will ever need to know again what he has been repeating, he does not learn. In the same way, if a man is introduced to someone but never expects to see him again, and there is no reason why he should remember the man's name, a few minutes after the introduction he is not likely to remember it. Everyone has had the experience of reading all the words on a page with his thoughts on something else, and then finding that he knows not at all what he has been reading.

Attention and interest are basic in learning. It is doubtful if repetition alone would ever be enough; and, since learning can occur after but a single occurrence of an event, it seems that motivation and interest are really quite as important conditions of learning as is practice. Even the dog, who learns to salivate to the sound of a bell, has in a sense to get interested in the bell in relation to his food. He might thus be said to know that the bell is his dinner bell. And the man who learns to blink when the light is shone into his eyes almost inevitably comes to appreciate the relation of the light to the puff of air—for the light is a clue that the puff which makes him blink will soon come. He blinks, as it were, in anticipation of the puff.

In learning it is important, therefore, first to secure *interest.* It is easier to learn interesting things than uninteresting, because to be interested is to be attentive. When the act or material to be learned is uninteresting, then it is difficult to secure even ordinary attention.

Interest, and therefore attention, can be secured for learning by providing *motives* for learning. The primitive motives come from rewards and punishments. Animals and children are taught by rewards and punishments. Although punishment is the common method for training children, reward really works better. Reward makes the learner like his task so that his interest comes automatically. Punishment makes him dislike the task and wish to avoid attention to it altogether. For this reason a reward, like approval, is more effective in promoting learning than is a punishment, like a bawling-out. The successful leader knows this fact. He may have to resort to reprimand when other methods fail, but in general he is much more likely to achieve results by his approbation of successful accomplishment.

Success and failure act like reward and punishment. Indeed, it is not too much to say that success in achieving a goal is a reward and that the frustration of failure is a punishment. At any rate, it is a fact that success gives rise to a satisfaction which has the effect of stamping into the memory those thoughts and actions that lead to success. In learning, nothing succeeds like success, for success means that you have been correct and also that you will be more likely to be correct the next time. Failure, on the other hand, tends to remove the motive for learning, and may lead to the establishment of incorrect learning which has later to be unlearned, before habitual success can be established.

Since success and failure are in this way so intimately related to learning, it is important for the learner to know when he succeeds and when he fails. He needs always to be kept informed of his progress in learning, both in order that his motivation may be kept up and that he may correct his errors at the time he is making them. On the target range he must know both when he makes a hit and how badly he misses, as well as why he is missing.

It is also a great aid to motivation, and thus to learning, to have the learner *participate* in the process of learning, to make the activity of learning his own personal possession. That is why practice drill combined with lectures is so much more effective than lectures alone. An officer can learn a great deal about tactics on a blackboard, but he needs maneuvers to make his learning stick. You may watch the sergeant go through the manual of arms repeatedly, but *you* will not know it until you have made the movement repeatedly yourself. Understanding how a thing is done is not always knowing how to do it. Complex actions have to get their connections worked into the nervous system. Complex mental acts, like figuring a range, also have to be practiced. Lectures are necessary in training, but they are inadequate until they have been stamped in by actual practice.

It is for this reason that troops are never seasoned until they have been through battle, that an air fighter is never trained until he has been through fighting or bombing. Do the tests for air fighters really pick out the best men? No one knew for sure until the men selected by the tests had a record of success at the front.

Sometimes learning is aided by letting a man pick out his own methods of study. The best methods ought to be suggested to him, yet occasionally the most effective method for him is the one that he has thought up himself. A student in botany once learned to recognize correctly several plants which looked very much alike by differentiating them in terms of their different tastes. This was not the best method for everyone else, but it was for him; it was his own method; it commanded his pride and secured his interest and motivation. Not for everyone is the poorly written textbook a disadvantage. The man who gets angry at a poor textbook, reads it correcting it and deciding how it should have been written, is likely to get more from his angry attention than he would from an easy text that might even lull him into inattention.

It is plain that learning is thus somewhat dependent on *morale.* When morale is good, learning is easier. The unit with good morale is a unit that likes to do what it has to do, likes to learn what it has to learn because it is determined to get ahead. Perhaps the men in the unit realize that learning is what will lead to success, and success often means not getting killed. Keeping alive is as strong a motive as could very well be found, and, when it is attached to learning, the learning is likely to get on well.

It is obvious that motivation for learning, as for any other activity, is favored when the learner or actor feels free and not coerced, when his effort seems to him to spring from within himself and not to be imposed from without. The history of men's fight for freedom follows along with the history of civilization. Similarly the history of every person contains this strong element of resistance to authority. The child begins to fight for freedom, even when he is still being dependent on his parents. He wants them to serve him and seeks to escape from serving them, wishes to have them help him because of his need, not because of theirs. Later in adolescence he fights for his freedom in the outside world, lessening his dependence on parents. These needs persist in every man throughout his life, unconsciously for the most part, but consciously whenever their satisfaction is seriously threatened. For this reason motivation in learning is greatest when the learner believes that he himself is deciding what he shall learn and how he shall learn it. The successful teacher avoids the use of authority like the plague. He undertakes always to interest the learner. He does not tell him that he must learn but tries to cajole him into wanting to learn. After that he provides the best conditions for what the learner thinks is his own self-initiated learning.

Does the use of this principle seem incompatible with military discipline? It is not necessarily impossible in the services. In the armed forces everyone, learner and teacher alike, takes certain necessities for granted. It is necessary for every man to become proficient in his tasks for his own good, and no one objects to aiming at success. The instructor, when this point is established, can assume the rôle of helping the learner to succeed without loss of discipline.

UNDERSTANDING

Next to interest or motivation, the understanding of the relationships to be learned is the most important aid to learning. This may be because understanding assures interest, although, of course, interest in learning and the desire to learn can exist without understanding.

Here is an example. Men who learn to extract square roots on a calculating machine learn the rule upon which the method is based —that the sum of a number of odd numbers, starting with 1, is equal to the square of the number of numbers summed. That sounds like arbitrary nonsense, yet it is true and anyone can learn the rule. $1+3=4$;

1 and 3 are the first two odd numbers, and the square of 2 is 4. $1+3+5=9$; that is three odd numbers, and the square of 3 is 9. $1+3+5+7+9+11=36$; 6 odd numbers, and the square of 6 is 36. And so on. Yet when one has learned the rule, it is hard to remember it because it seems to have no reason in it.

On the other hand, it is easy to remember if one understands why it is true. Look at Fig. 77. Start with the square *A*. That is a single square. If you want to make it larger, you add the 3 *Bs,* and then you have 4 little squares, which is the square formed on the side 2. If you want the square formed on 3 small squares, you have to add the 5 *Cs,* which gives you 9 small squares altogether, the square of 3. And so on. In other words, each time you make the square bigger you increase it to the right and below by one column and one row of squares. That is the same thing as adding the next odd number, for there are *1 A, 3 Bs, 5 Cs, 7 Ds, 9 Es, 11 Fs,* etc. That puts sense into the rule, and, once you see its meaning, you can never forget it. You can, of course, learn to get square roots on a calculating machine without knowing the rule; but, once you know the rule, it is unlikely that you will ever forget how to use the machine for extracting square roots.

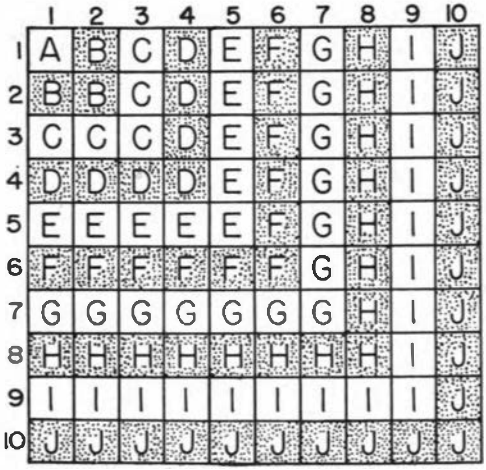

Fig. 77. UNDERSTANDING AND INSIGHT

Diagram to show how the rule that the sum of a number of odd numbers is equal to the square of the number of numbers summed can be made intelligible.

Since understanding is so important for learning, good teaching nearly always needs both oral instruction and actual practice. There need to be textbooks, lectures and explanations to make clear an understanding of the material to be learned, and then there needs to be the actual use of the learning to make the understanding complete, to reenforce it by the participation of the learner in the business of learning, and to stamp the learning permanently into the learner. The final stages of understanding thus come with the actual practice. To learn to swim you must first be told what to do, and then you must practice until you fully understand what it is that you were told. You can do a little toward learning to drive a car in bed by thinking about how to manipulate the gearshift, the clutch and the brake, but you cannot then get out of bed and drive right through traffic. You need more practice to get the complete understanding and to establish the connections that every skilled driver has firmly fixed in his nervous system. It is the same with studying chemistry. You have to know from lectures or the book what is supposed to be going on, but you need laboratory practice before you understand thoroughly about chemical reactions.

Sometimes understanding comes only slowly and laboriously as learning progresses. Sometimes it comes in a flash of *insight,* and then learning is often instantaneous. A man wonders why his girl is cold to him, wonders until he sees another fellow kissing her. Then in a flash he knows. He does not require constant repetition of that experience before he catches on, before he can remember what is the matter. He learns as quickly as the child learns not to grab the candle flame.

Learning by sudden insight produces, of course, abrupt changes in the learning curve, and conversely abrupt changes in learning are usually considered to be evidence of insight and understanding. Look at Fig. 78. That is a learning curve for an orang-utan who was given the problem of finding out the rule which would tell him which box in a row of boxes had food in it. He was given at different times different numbers of boxes, from three boxes up to five, and the food was always placed in the box at the extreme left of the row. A very simple rule, yet a difficult one for an ape to learn. The curve shows that this ape began by making four or five errors in every ten trials and kept on without getting the hang of the thing until his 220th trial. Then the experimenter changed the situation to give him a greater motivation, with the result that the ape got worse and made seven or eight errors in every ten trials. Then

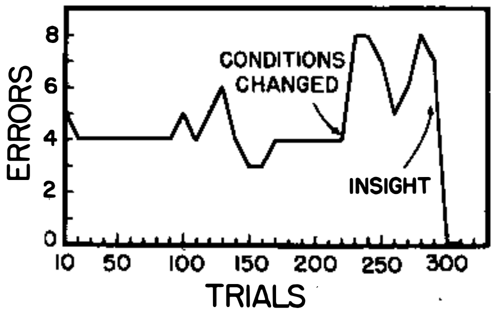

Fig. 78. LEARNING CURVE: PROBLEM SOLVING AND INSIGHT

Learning curve for an ape who, to get food, had to choose the lefthand box from a row of boxes which varied from three boxes to five. The ape did not learn at all until after the 290th trial; then he suddenly performed perfectly. (Adapted from R. M. Yerkes, *Behavior Monographs,* vol. 3, no. 1, p. 27, by permission.)

suddenly after the 290th trial his errors dropped to zero. For twenty consecutive trials he went at once to the left-hand box and got the food. He had learned. Is it too much to say that he had got the hang of the situation, had had a sudden insight into the rule of the left-hand box?

In the same way the child who avoids the candle flame has presumably had insight into the relation. He knows now that fire hurts. But in such a simple case understanding is little more than an association. The resourceful sergeant who maintained his communication lines after running out of field wire by connecting to a barbed wire fence had more than an association. He understood the problem enough to have insight.

It is, of course, possible to learn relationships that do not seem to make sense, although considerable repetition may be required unless they are learned under the great attention aroused by emotion—like the child and the flame. The multiplication tables are learned in this fashion. There is sense to them, but the sense cannot be perceived by immediate insight. One can see in Fig. 77 that $2 \times 2 = 4$, because the larger square with two small squares on each side has four small squares in it altogether. But one cannot see that $10 \times 10 = 100$, because one cannot perceive 100 squares as differing from 99 or 101. Because we have mastered the tables so thoroughly, it seems quite certain that $6 \times 7 = 42$ and $4 \times 5 = 20$. These equations hold, however, only for the decimal system. If we changed over to the octile system, with only eight digits instead of ten, omitting the digits 8 and 9, then we should find that $6 \times 7 = 52$ and $4 \times 5 = 24$. We could learn that system just as well as the familiar one which we use without understanding it, but it is always much harder to learn when understanding is impossible.

Learning the names of people is much like learning the multiplication tables. There is no sense to the association. You cannot figure out a general principle for what names people have. In such cases, when true understanding is impossible, it helps to employ a false understanding, to make puns about relationships or to establish crazy associations. You meet an insignificant little man named King, and you remember his name by remembering that he does not look like a king. You meet a tall lean man named Gardiner, and you think that he looks like a bean pole which a gardener would use. Memory systems make use of bizarre associations of this sort. They should only be used when better sense is lacking. There is, for example, the story of the man who tried to remember names by rhyming a given name with a meaningful word. Thus, he associated the name Rummick with the word "stomach;" but invariably thereafter he addressed the man as Mr. Kelly.

NATURE OF LEARNING

Learning is a process of integration and selection. Integration and selection are different aspects of the same thing, like the head and tail of a coin. When you join two items together in an integration, you leave all the others out. Learning how to hit a target with a rifle or to drive a truck in the dark is a matter of connecting up many complex movements with certain perceptions to the exclusion of all the wrong movements which you might make and should not make. It has been said that you always know how to do a thing before you learn it, and that learning is simply acquiring the capacity for not doing the wrong things. Learning how to tell North from the stars similarly depends on an integration of ideas and perceptions, the right ideas with the right perceptions to the exclusion of other ideas and other perceptions. Learning how to navigate a plane or a ship is ever so much more complicated. Then connections must be made between the right ideas, the right perceptions and the right movements. Learning to crawl on your belly over rough ground is largely a matter of selecting and integrating the right coordinating movements.

These connections are all made in the nervous system, in the brain. *The events*—the movements and ideas and perceptions—*have actually to occur together* in the brain for them to become associated, so that they will form a pattern of thought or action in the future. The thought of Napoleon does not bring up the thought of Caesar, unless you have been accustomed to think of Napoleon and Caesar together, or are thinking of them both as great generals.

Happening together at the same time is usually, however, not enough to form an association between two nervous events. It is best to *think of the two things as being related,* as belonging together, to be interested in them and their relatedness. Not only is attention necessary to learning, but this particular kind of interest is also important. The rule appears to hold for a conditioned response as well as for any other kind of learning. Merely ringing a bell when the dog sees food would not seem to make the dog's mouth water at the sight of food, until he "gets the idea" that the bell means food. The evidence as to what ideas the dog is having is indirect, yet the flow of saliva is in some way an anticipation of the food, for the flow decreases or stops when the experimenter stops giving the dog food after the bell is sounded.

Understanding a relationship to be learned is of very great importance, especially when the relation is complex. Understanding promotes interest. And, conversely, interest begets the desire for understanding. The practical rule for learning is, therefore: Get sense into the relationships to be learned, as much sense as possible. Even the artificial sense of puns is better than none at all. But simple relationships that have no apparent sense, like the linking of numbers in the multiplication tables or the names of the months in their order, can nevertheless be learned if the learner is interested without understanding. Everyone knows: Thirty days hath September, April, June and November. There is little sense in that, for almost no one knows about Emperor Augustus' adding the 31st day to his month, August, so that it would have as many days as Julius Caesar's month, July. On the other hand, the man who knows that fact is never going to forget that August has thirty-one days. And everyone knows that it takes much longer to memorize a long sentence in an unfamiliar foreign language than to memorize an equally long sentence in one's native tongue.

What about *repetition?* Do you have to repeat to learn? No, not necessarily. If you can get up enough interest on a single occasion, you can know the new relationship forever afterward. Perhaps the story about the Emperor Augustus and August is interesting enough to some readers of this book for it to stick in their memories from now on. At any rate a strong emotional experience fixes itself in association at once. A man can learn in one experience to throw himself flat on the ground when he hears an approaching shell. Ordinarily, however, interest is not great enough to produce permanent associations at once. Then the events have to be repeated to make learning stronger, and repeated again, and perhaps again and again, until learning has occurred. Repetition is useful, and often necessary, to provide the occasion for interest and understanding. If there is not enough interest at the start, enough may accumulate eventually with enough repetitions. If there is no understanding at the start, nevertheless understanding may come in gradually with repetition, or arrive suddenly at some point in the series of repetitions by a sudden insight—as it must have done with the orang-utan whose learning curve is shown in Fig. 78. That ape had to try 290 times before he suddenly realized the nature of the rule by which he could always get food from boxes on his first try.

Repetition alone, then, without unusual motivation, understanding or insight cannot be counted on to bring about learning. The student who is made to copy the word *principle* 1,000 times because he confuses it with *principal* will not necessarily learn to spell the word correctly. More likely he will continue to misspell both words. Yet the simple realization that *principle* meaning *rule* is spelled with the *le* of *rule* provides the necessary insight to make for perfect learning after one understanding of the memory device. The more insights a learner can be given in acquiring any skill, the fewer repetitions he will need in acquiring that skill.

REENFORCEMENT AND INHIBITION

Different learnings can help each other or interfere with each other. They can reenforce each other or inhibit each other.

Reenforcement occurs when the two learnings are related and each increases the understanding of the other. A camoufleur learns that an object becomes invisible when it matches its background exactly in color and pattern. He also learns that an object is especially visible, stands out from its background, when its surrounding contours are obvious, because they are straight lines or smooth circles, or because they are made prominent by the shadow which the object casts. He can learn these principles separately, but the two principles support each other, as the student-camoufleur is likely to realize by insight or to be told by his instructor. Matching the background means that the contours disappear. There is only one principle, not two. If the prospective camoufleur knows both instances of this law of perception, he is less likely to forget the principle or either of the rules. That is reenforcement.

All learned facts which are related to each other and consistent with each other reenforce each other, because they increase understanding.

Reenforcement also occurs when one thing to be learned involves part of something else that has already been learned. A man who has always tinkered with his automobile can learn to be an airplane mechanic more easily than an artist who has had no mechanical skills or interests.

Inhibition occurs when the related things to be learned contradict each other, when one of them has to be unlearned in order to learn the other. That is why cars have standard gear-shifts. In the old days, when the gear-shifts followed different patterns on different cars, a man with a new make of car had great difficulty because he had to unlearn his old habits in order to acquire the new. The movement for a reformed calendar meets opposition, not because we cannot think up a better arrangement for the numbers of days in months and their relation to the days of the week, but because the new calendar would mean unlearning the old system and the dates that are fixed according to it.

Here then is a practical rule of learning: *never make a mistake.* If you make a mistake you are likely to learn it. Then, to learn the fact or movement correctly, you have not only the trouble of learning, but you have also to unlearn the mistake. Men who work with machines often acquire awkward or laborious or fatiguing ways of performing an operation. They ought to be protected against such mistakes when they are first learning, so that they will not have to unlearn their errors later.

There are altogether four ways in which two learnings can affect each other, two of them helpful, two harmful.

(1) **Facilitation of Learning.** When two sets of ideas or complex actions are related or have in them common knowledge or movements, then learning the first facilitates the learning of the second. Naturally, because the second is already partly learned in learning the first, or at least some of the understanding that helps the learning of the second is already available from learning the first.

(2) **Reenforcement of Memory.** Similarly the learning of the second reenforces the memory of the first. You can improve a memory by learning something else that is related to it.

(3) **Inhibition of Learning.** When two sets of ideas or complex movements contradict each other so that they cannot both represent perfect connections in the nervous system at the same time, then the learning of the first makes the learning of the second more difficult, because learning the second means unlearning the first. That is why it is so difficult to learn two foreign languages at the same time, since two different words must be learned for the same English word. You can, however, start a second foreign language after you have got far along in a first, because then, since you no longer have to translate every word of the first into its English equivalent, there is no longer any interference.

(4) **Inhibition of Memory.** If, however, the second of two contradictory things gets itself learned, then its learning interferes with or weakens the memory of the first. That is natural, since learning the second means unlearning the first.

It is almost impossible in the individual case to tell in advance when two learnings will help each other and when they will interfere. That is because one never knows all the factors that are involved in each learning. A student may be helped in learning history because he has already learned a good deal of mathematics, and the reason may turn out to be merely that, in learning his mathematics, he also learned how to study, how to keep his attention on a book, where to find a quiet place without distractions or how to study without noticing the distractions.

Another student may find that his knowledge of mathematics interferes with his studying of history because in the mathematics he has got so fond of the precise formulation of laws that he has come to resent the vague statements of cause and effect with which history has to deal.

Nevertheless the general rules are clear. *Get things related. Make understanding as broad as possible. Build on old learning as far as possible in undertaking new. Find out what is true or best or right early, so as to avoid mistakes which have to be unlearned later.*

EFFICIENT LEARNING

Learning in the armed forces—at least in time of war—must be rapid and efficient. There is no such time for the leisurely acquisition of attitudes and interests as there is in school and college under the ordinary procedures for obtaining an education. The soldier and the sailor must concentrate upon the tasks in hand, must make use of all available short cuts, must eliminate the nonessentials. While there is some evidence that rapid learning does not stick so well as slow and deliberate learning, it is doubtful whether this principle applies when the knowledge and skills acquired are to be continually practiced in actual use. Speed is necessary and learning never stops when war is on.

Learning and teaching go together. A man can learn, however, without a teacher, whereas no teacher can teach without a learner. Learning is more important than teaching. It is what teaching is for. Teaching merely sets the best conditions for learning, makes information and techniques available, arranges situations in which the learner is more apt to acquire the necessary interest and motivation which are essential for his success.

The following paragraphs translate the principles of the preceding sections into practical rules for efficient learning. They regard the learning process, as far as possible, from the point of view of the learner. The next chapter will have something to say about what the teacher can do to help the learner. Nevertheless the two processes—teaching and learning—are never wholly separated. The teacher keeps always in mind what the learner should do so that he can help the learner—by arranging good conditions for learning or by teaching the learner how efficient learning can be managed.

Here are the rules for efficient learning.

(1) **Be apt.** That may seem to be a strange instruction to the soldier or sailor who is about to be given training. Either he is apt or he is not. How can he choose?

The fact is that everyone can do some things better than others. Efficiency in training, therefore, begins with the selection of aptitude, and aptitude depends partly on native ability and partly on previous training. In the armed forces aptitude is indicated by score on the General Classification Test (which depends both on native ability and on general training), by previous experience, and by performance in special tests, like the test of mechanical ability. Selection of men for training, of men with the requisite aptitude, is, of course, primarily the task of personnel officers; yet the man himself, the potential learner, can sometimes choose or help in the selection. He often has the chance to apply for special training, and then he had better take counsel with himself as to whether he really has the aptitude for this special training and whether he is likely to be a success, a success in the face of the heavy competition which he will meet. He ought not to forget to assess his aptitudes in advance so that he can head into success.

(2) **Be interested.** That too may seem like a difficult order. Can a man decide to be interested in what he has to do in training, or is interest something involuntary that either happens to a man or does not? It is not wholly involuntary, although the requirements for good teaching assume that much of the learner's interest is furnished him from outside. Here are some of the ways in which a man can increase his own interest.

(a) *Choose for interest.* There is not always the possibility of choosing, but sometimes there is. In the Second World War, if a man passed the Army's basic flying test, he was asked whether he would like to be trained as a pilot, a bombardier or a navigator. If he was adequate in the tests for the subject of his choice, he was when possible given his choice. That is one of the ways of securing interest in order to help learning. A man rarely finds it difficult to concentrate on something if he is interested in it.

(b) *Tie up learning with morale.* A poor leader can always spoil morale, but a good leader gains it by securing the coöperation of his unit. To that extent good morale is voluntary. The learner of a special skill must remember that his learning is his way to success in the military life and that he can help himself in attaining that success if he is determined to learn.

(c) *Tie up learning with success and failure.* Success itself is a reward, failure a punishment. The learner can reward himself by his success. Let him remember this. It will not be hard, for the armed services help the soldier and sailor by recognizing success, often with promotion.

(d) *Compete.* Competition is a splendid incentive, and the learner can often decide to compete, to check his progress against the progress of others. If he cannot be at the top of his group, he can at least choose men at his own level with whom he may compete. And there is always one man exactly at his own level who makes an excellent competitor—himself. Self-competition, the effort to beat one's own record, may prove as effective a motive for learning as any other.

Competition between groups is usually more effective than competition within the group itself. The trouble with competition within the group is that the men of low ability in a particular skill are likely to get discouraged and the competition may hinder rather than help their performances. Doing a job well gives a man self-confidence and stimulates him to further achievement. Doing a job much more poorly than others in the group destroys a man's self-confidence and causes him to lose interest in the job.

(e) *Work with others when possible.* It is easier for most men to be interested and effective when working coöperatively in a group than when working alone, even when every man is working at a different part of the same job. So learning goes better when the social stimulus is added to the work of learning.

(f) *Participate.* Learning is most effective when the learner makes the process his own, when he does things about it, when he thinks up his own personal ways of remembering facts or acquiring skills. Let the learner not follow routines in his learning, doing mechanically what he has been told. Let him decide for himself those details of learning in which he is left free. His interest will grow as he makes the learning his own undertaking.

All the other items listed below also contribute to interest because they contribute to success. Interest creates success, but success also creates interest.

(3) **Know the rules.** This admonition means that the learner should know all the rules that aid good learning, the principles mentioned elsewhere in this section and this chapter. The construction of a memory or a skill is a concrete job of human engineering, and the learner should plan his learning along psychological principles just as carefully as the engineer uses mechanics for constructing a bridge or kinematics for designing a machine or electronics for building a radio set. There are, in addition, some special rules.

(a) *Be attentive.* Learning requires attention. Assure good attention to the task in hand. Interest secures attention, and attenion to study also can become habitual. For book study, it is a good plan to have, when possible, a special place which is never used for loafing or idle conversation. Attention then may become a habit which is put into action when the learner settles down in his special place. Of course, such special arrangements are not always possible in barracks. The man who has acquired the habit of paying attention to a book when he has a book in hand to read is fortunate. He may be able to study anywhere.

(b) *Avoid distractions.* The ideal way is to have a secluded place for study, yet seclusion is rare in military life. The better rule is to learn not to be distracted by distractions. It is quite possible to get the habit of studying in noise or in spite of the conversation and activities of others—and the habit, once begun, gets stronger with repetition, so that peace and quiet themselves may become distractions and the learner needs some vague disturbance in the background of his consciousness in order to do his best studying. This is what has happened with the man who, having always studied with the radio on, now needs to have it on while he studies. The fact that he probably wastes a certain amount of energy in overcoming the distraction is partly offset by the fact that such is his pattern for studying. This is the way in which he has learned to concentrate.

Not all potential distractors distract. A mild disturbance may act as a motivator, keeping the learner on the alert for maximal effort. Too comfortable a chair may let the attention down. A century ago authors sometimes wrote books at tall desks at which they had to stand up. The radio sound, when it stimulates work, acts in the same fashion. The distractors to avoid are only those that really distract. Disturbances that keep up the learner's effort are desirable.

(c) *Do not be tense in acquiring mechanical skills.* The learner of skills should not be tense and over-anxious. He will learn better and acquire fewer wrong motions if he takes his time and goes at his task easily. To be aware of effort while you are working is to be aware of something that is not the task in hand, to be distracted by your own effort.

(d) *Check progress.* The learner should know how he is progressing. When he makes a mistake he should know it—at once, if possible. Not only does such knowledge keep him from learning to be wrong. Knowledge of errors and of speed of performance keeps up interest and helps the learner to seek out the means for improvement. So checking often prevents wrong learning, sustains motivation and interest, enables the learner to participate in the process of his learning.

(4) **Avoid errors.** Avoid doing anything that is either wrong or even only unnecessary. In other words, avoid doing anything that will have to be unlearned later, for doing the incorrect or unnecessary thing is learning it, and that learning will have to be cancelled later before perfection can be achieved.

(a) *Avoid making mistakes.* Take time to be right on the first occasion. Do not jump to conclusions, because jumping to a wrong conclusion may impress it as firmly on the mind as if it had been right. In the acquisition of skills, figure out the best method first, or let the instructor demonstrate it. Then adhere to it carefully.

(b) *Avoid unnecessary motions.* Plan work so as to require the fewest movements, and work consistently in that manner from the start. If the nature of the task permits it, group the motions into larger units so that a single movement can accomplish the purpose of two or three separate moves.

(c) *Avoid unnecessary steps in mental operations.* A child in adding learns to think: "Eight and seven are fifteen; put down five and carry one." He is likely to say all these words to himself as he does the operation, and he will still be adding in this fashion as an adult unless he has unlearned his childish method. The thing to do is to learn simply to see a 15 in imagery after seeing an 8 and a 7 without thinking the extra words. An expert accountant can run his eye down a column of figures and see the successive sums as his eyes meet each new figure, all without talking to himself.

Reading that is done for sense, and not for the effect of the sound (as in poetry), should be done visually, especially if the reader has good visual imagery. Pronouncing the words to one's self is an unnecessary movement, an extra task which it is very hard to unlearn once it has been learned; yet most people can, with conscious effort, unlearn it. Try to read so fast that there is no time for pronouncing the words. Ultimately the pronouncing will drop out and the reader will find he can get the meaning visually and much more rapidly. A man can help himself to read in this way by trying to read phrases rather than single words (see pp. 289-292).

(d) *Keep conditions the same.* Making unnecessary changes in the operation to be learned means unnecessary learning. In assembling a machine, lay out the parts in the same relation to each other and put the machine together in the same order. Even if there is no one best order, select an order and stick to it. Learning is hindered if the arrangement or the order is varied. For example, in making calculations, it is helpful always to arrange the data and the computations in the same way on the paper, so that the pattern on the page will suggest the necessary operations.

(e) *Aim at perfection.* Aim at perfection from the start. To aim at less than perfection is to be content to allow some wrong habits to creep into the process and become fixed. This rule may slow up learning at the start but it pays for itself in the long run. If the learner knows about the rule, then he will not be discouraged if he is slow at first. He may lag for a time behind the others who do not accept the rule, but ultimately he will be rewarded since he will have no wrong habits to unlearn.

(5) **Understand.** Understanding helps learning immeasurably, even though it is not absolutely essential to learning. Not everything can be understood thoroughly. A mathematical formula or an electrical connection may have to be taken for granted by the man untutored in mathematics or electronics. He is then at a disadvantage as against the expert who does understand. But let him understand the whys and wherefores of what he does as much as is possible. Let him take some time for understanding. Understanding helps learning both directly and indirectly—indirectly because it increases interest which is so important in learning.

In learning how to use or to put a machine together, the learner should, as far as possible, learn how it works, what each part is for, why the user does what he does. In learning how to care for a machine, he should similarly know the reason for everything he does.

The same rule applies to calculations—range-finding, navigation.

In learning from books, the broader the understanding, the easier the learning. It is well if the book connects a specific technique with general principles, provided time permits the learning of general principles. There is seldom time in military training to learn the interesting side lights that go with practical knowledge, the impractical applications, the non-military uses of principles, the history of a problem—yet these additional items do help learning if there is time for them and if the learner finds them interesting. On the other hand, the learner is often just as anxious as his teacher for rapid progress, and extra illustrations of a principle may bore him when they seem to slow up the learning process.

Artificial sense is better than none. If the learner has to make associations that he does not understand, which have no meaning for him, then he had better create nonsensical meanings, by way of puns or bizarre associations, to help him. Memory systems are built on this principle (see p. 292f.).

(6) **Learn wholes, not parts.** Learning by wholes adds sense and understanding to the sort of material that has sense to it. In a book the learner should preview a chapter before he studies its details, so that he can comprehend the purpose of each chapter and understand the relation of the parts to each other. In acquiring an act of skill he should go all through the performance again and again, not take each part-action separately. Learning by wholes gets all the parts related to the whole and to each other. It makes a more solid learning. Sometimes it also means that the learner gets less bored with a given part because in learning the whole he does not come back to each part soon again.

This rule has, however, to be used with judgment. If someone wanted to learn the Constitution of the United States by heart, he would not read the whole document through again and again until he knew it. He would get bored by his slow progress and boredom is the enemy of learning. Nevertheless, it would be a good idea for him to study the structure of the document first, so that he would know the relation of every part to the whole.

(7) **Practice.** Repeat. The learner who stops at the first, or even the fifth, perfect performance of a newly acquired skill is not working the habit into his nervous system in such stable form that it will become part of his permanent repertoire. The same rule holds for book learning. What you just barely know today you will ordinarily not quite know tomorrow. Forgetting sets in as soon as there is any learning at all, and the learner must *overlearn* if permanence is what he is after.

In practicing for the purpose of acquiring permanence in a skill or a knowledge, it is well to space the repetitions further and further apart in time as overlearning progresses. The learner who has just achieved mastery had better impress his learning at once with a little more practice. Then let him put the matter out of his mind until the next day, when he should practice again. He will find that he is less skillful than when he left the problem the day before, but he will soon be back where he was and can further impress his knowledge or skill a little more readily. If possible, he should keep this up indefinitely. If he has acquired a skill that he does not use for months, he should then seize the first opportunity to practice it again or to use it for some practical purpose, so that he can fight his forgetting and get his skill better and better impressed.

When skills are acquired in this way they do finally become lifetime acquisitions, even without further practice. A man who has learned to swim can still swim though he has not swum all winter or even for years. A man who rode a bicycle as a youth can ride as an adult. Two men meeting after twenty years' separation, during which they have thought little about each other, will find that they can revive a host of common memories. On the other hand, the man who knew how to extract cube roots with pencil and paper ten years ago is likely to find that he has forgotten how to perform the process, but that is because he did not perform the operation often enough ten years ago to make it permanent. Permanence depends on overlearning.

STUDY

There are other special rules that apply to the study of books and manuals. There are no new principles, but there are special ways of applying those principles which have already been under discussion.

Interest is basic. If the learner lacks interest in the subject, he should try thinking about the subject matter as he studies the general nature of the book in hand. Often interest will appear in this fashion. The learner appeals also to all the other principles for arousing interest—studying with others if the social stimulus increases the motivation for learning, competition with others or with himself, betting on how quickly he can get the job done, participation by working out his own methods of study or undertaking to apply what he reads to some special problem of his own devising.

The study of texts and manuals requires understanding. There is not often much in them that has merely to be learned by rote. Most things make sense or have sense back of them, and the learner can be expected in such study to aim at understanding, and thus to promote his learning.

He must learn to study under what would ordinarily be distraction. It will take effort at first, and effort means fatigue, but repeated success will eventually form a habit such that he may actually study better in the hurly-burly of military life than he could in a quiet library. Having a fixed time and place for study may be possible for the soldier and that helps. The place and time become a stimulus for study and tend to shut out other thoughts. Some habitual smokers never smoke in bed. As soon as they get into bed all thoughts of smoking disappear. Similarly, an habitual student may get himself trained so that a textbook or manual in hand, at the right time and place, banishes from his mind all thoughts of everything but the content of the book.

There is also a best way in which to tackle a book. Here are the rules.

(1) Get a bird's-eye view of the whole book first. Turn at once to the table of contents to see what the chapters are about, whether there are main divisions and what they are. See what the book is about and how the author expects you to go about learning it.

(2) Leaf through the book. Sample the different chapters. Read the topic sentences—usually the first sentence in each paragraph or section—to get an idea of what the book is about. See whether there are tables, figures, problems to be worked out, summaries to the chapters, how long the different parts really are.

(3) Next try to get a better idea of the purpose and scope of the volume. There may be an introductory section devoted to that purpose. If there is, read it.

(4) Then turn to the summary or conclusions of the book as a whole. They are apt to be at the end. Find out, if possible, what you are supposed to have learned by studying the book. That will put in mind the goal at which study aims. You ought to read for a purpose.

All this preliminary work helps to provide the learner with a view of the book as a whole, to increase his interest, to augment his understanding, to make the text more meaningful by bringing every part into relation with all the other parts.

(5) With this total impression of the text in mind, start in on the first assignment or the first chapter. Read it through rapidly, skimming. When there is something that is not clear, let it go until later. If such superficiality hurts your conscience, get another conscience. This is still the preview. Thorough understanding comes later.

(6) If your reading is slowed by the tendency to pronounce all the words, then start at once to learn to read visually by phrases. This is the time to acquire that skill. Read too fast to leave time for pronunciation. Ultimately you can learn to read without pronouncing if you practice it on every proper occasion, and, when you have learned, you will be better off for life.

(7) Next read through the assignment slowly. This time you must understand everything. Repeat a section or paragraph when you do not. If the text refers back to something that has gone before and you do not recognize the reference, turn back to make sure about it. The author is trying to help you to connect up the different parts of the book. Accept his help.

(8) This is also the period when your own participation in the learning should be brought in. If the material is very important and you find learning difficult, it is best to take notes on what you read. That uses up

time, and there may not be enough time for note-taking. Still it is best if learning does not come otherwise.

One method of note-taking—a method that takes much time but makes participation maximal—is to paraphrase the text in notes of your own. You may even change the text into a catechism, turning each paragraph into a question and its answer. By changing the form of the writing, you have to take thought and to know just what is being said. You also see just what the author was driving at when you formulate the question that he was trying to answer. This method may be too slow when there is a war on, but it is an ideal method if there is enough time for it.

Another method of participating in the learning of difficult material is to explain the text to someone else. If you cannot explain it, that is because you do not thoroughly understand it yourself. Go back over it and try to clarify it in your own mind. The coach-and-pupil method applied in this way is chiefly of value to the coach, but two can take turns. If you do not like the way your coach puts things, you can rephrase them for him and thus make it clear and definite for both of you.

(9) If you come to items that do not make sense, then you may have to stop and memorize them. Numerical values, lists of items, names of things, arbitrary orders of procedure—such things must sometimes be memorized. Put sense or nonsense into them if you can. Otherwise repeat them and review them until you know them.

(10) Then review the whole assignment rapidly. This time, as you skim, the details, now learned, should crowd into the mind. If they do not, if you cannot tell the content of a paragraph at a glance, slow up and repair your faulty memory. If there are many failures in this first review, review again.

(11) Then put the book aside, but review it again later if there is opportunity. Frequent reviews at longer and longer intervals are the way to make the content into permanent memories.

RAPID READING

Most men who read slowly can learn to read more rapidly by practicing the correct techniques. Of course the reasons for a slow reading rate are not necessarily the same for all readers but usually the slowness is due to one of three factors, or to a combination of the three. First, a man may be a slow reader because he stops to read every word as a separate word instead of trying to read words in phrases. Secondly, a man will read slowly if he pronounces each word to himself as he reads it. This "inner speech" is not necessary to reading and slows the reader down. Thirdly, a slow reader is apt to be an overconscientious reader. He not only reads every word as a separate word but he also feels that he *must* read every word, every *and, so* and *but.* He does not realize that he can get the complete sense out of reading matter without apprehending every printed word.

Of course, all reading material cannot be read in the same way. Charts, diagrams and maps have to be read slowly and often word for word. Technical instructions also should be read slowly, though this rule does not mean that a man should not read them by phrases, trying to get the sense of the whole thing. The difficulty of the material and its importance to the man must determine both the way in which he reads and the speed at which he reads.

One way to teach yourself to read by phrases is to practice moving your eyes in the right way and at the right speed. In reading the eyes do not move continuously along a line of print. Instead they move by a series of successive jumps. When the eyes are moving, you do not see clearly enough to read; you read only when your eyes stop moving, *only between the jumps.* When the eyes come to rest, you can see not only the word you are looking at directly but also the words on each side of it. This means that at a single glance you are seeing two or three words clearly enough to read them all at once. Most people do not take advantage of this fact. They stop to read every word as a separate word, and that is what makes slow readers of them. That is also why so many of the slow readers pronounce each word as they read it—they read so slowly that they have plenty of time to use this childhood habit.

The habit of pronouncing words silently while reading may sometimes be the basic cause of a slow reading rate. Such "inner speech" is more often, however, merely an accompaniment of slow reading, not its cause.

A man can break himself of word-for-word reading habits, as well as of inner speech while reading, by practicing the proper eye-movement rhythm with the aid of the chart shown in Fig. 79. This is what you should do. If you can get a metronome, set it so that it will click about 80 times a minute. Now let your eyes rest on each successive cross in the chart for the duration between clicks. Then move them on to the next cross, and so on down the entire page. After you have been over the chart about ten times and have the "feel" of the rhythm, stop the metronome and repeat these same rhythmic eye-movements on the chart ten times more without the metronome. Now turn to a printed page and,

X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X
X	X	X

Fig. 79. EYE-MOVEMENT CHART FOR PRACTICE IN READING

To be used for practicing the proper eye-movement rhythm in order to speed up rate of reading.

still maintaining the same rhythm, let your eyes make three and only three stops on each line. With ten minutes of such practice every day over a period of three or four weeks, you will find that you can read phrases by this technique and that you will have unlearned the habit of reading each word as a separate word. The chances are you will also have unlearned the habit of pronouncing each word to yourself as you read.

A metronome is best to use because you can listen to its clicks while looking at the chart. If a metronome is not to be had, it is possible to use a pendulum. Any weight suspended on a string 22 inches long will swing from left to right and back again about 40 times a minute, which means that it passes the center position 80 times a minute. Use a large weight that contrasts with its background so that you can be aware of its swinging without looking at it, can give nearly all of your attention to the chart.

MEMORIZING

The rules for memorizing material that does not make sense have already been given. There are only two of them.

(1) **Repeat.** Attentive repetition can eventually impress on the mind even the most bizarre relationship.

(2) **Put sense into what seems senseless.** Sometimes you can find really valid meaning for what seems arbitrary, but in other cases you may be able to make up only bizarre or amusing meanings.

These rules apply to memorizing men's names—a most important kind of learning for the successful leader. When a leader has been told a man's name, he should speak the name aloud, then and whenever he sees the man, providing he sees him again before he has forgotten the name. By repetition of this sort, he can make the memory permanent.

A few people with exceptional visual imagery can write a man's name in imagery on his forehead when they first learn the name, and see it there afterwards. This kind of imagery cannot, however, be easily developed with practice.

A simple example of sensible nonsense is the WORM formula for gunners. Worms have nothing much to do with guns, yet it is easier to remember the word WORM than the arbitrary letters M, R and W. Having learned the word, you learn further that W-O-R-M means "W over RM" or $\frac{W}{RM}$, where W is the width of the target in yards, M the width in mils, and R the range in thousands of yards. If you know two of the values and want to find the third, you just cover up (in your mind's eye) the letter you do not know and figure out what the other two letters would give you. If W is 10 yards and R is 5,000 yards, then M is 10 over 5 or 2 mils. It sounds complicated but it works well because it depends on remembering a simple word, WORM.

One of the best known *memory systems* is based on what is little more than punning, yet it is easy to learn. It consists in associating every consonant with a number, like this:

1 is *t,* because *t* is a thin tall letter like 1.
2 is *n,* because *n* when written has two loops.
3 is *m,* because *m* when written has three loops.
4 is *r,* because *r* is the fourth letter of the word *four.*
5 is *l,* because *L* in roman numbers means 50.
6 is *j,* because 6 is something like a capital *J* reversed.
7 is *k,* because 7 is something like a *k* upside down.
8 is *f,* because *f* when written has two loops like 8.
9 is *p,* because 9 is something like a *p* reversed.
0 is *z,* because *z* is the first letter of the word *zero;* and also *c,* because *c* is the first letter of the word *cipher.*

Then the other consonants are worked in by relation to these eleven. *b* is 9 because it sounds like *p.* *d* is 1 because it sounds like *t.* *g* is 6 because it is like *j.* *q* counts as if it were *kw.* *s* is 0 because it is like *c* in cipher. *v* is 8, being like *f* (loaf, loaves). *x* counts as *ks.* The vowels are omitted.

That still leaves out *w, h,* and *y.* Why? Why, *w, h,* and *y* are why. That's why.

That system is easy to remember. You can almost learn it by reading it through carefully once—all because it puts sense or nonsense into the otherwise meaningless relationships.

The system makes every word into a number, and, with cleverness, every number into a word or phrase. *Army* is -43-. *Navy* is 2-8-, 43 and 28. *Maneuvers* is 32840. If the number of a man's not-too-new automobile were 394,192 and he wanted to remember it, he could change the numbers into letters—*mprdbn*—and perhaps be bright enough to change the letters into *my poor Dobbin.* He'd always be able to remember that little joke.

Memory systems are, however, make-shifts. It is much better to use real sense. Science is the ideal memory system, for its theories about nature are convenient ways of remembering a great unrememberable complex mass of facts. But science makes use of real sense.

PROBLEM SOLVING

When a problem has to be solved and the correct method for solving it is known, then there is no real problem. The solver, knowing the method, applies it and comes out with the answer.

When the method is unknown, on the other hand, then there is truly a problem, and the soldier-student has to find the correct method as well as apply it. Such problems, "originals," occur in textbooks, in combat, and in life. The general meets them in the large and the recruit in the small. Solution of them comes by knowledge and insight—insight as to what will be useful in the solution. It is hardly practical advice to admonish the soldier to be wise and bright so that he may readily solve his problems. Yet that is what he needs—wisdom and ready insight.

The rat solves the problem of the maze by *trial and error.* He blunders around until he gets to the food. He does it again. Soon he remembers the paths that lead to the food, and later the correct paths farther away from his goal. Trial and error remain the last resort of all men with problems to solve, but trial and error are expensive of time—and, in actual combat, of lives.

The advice to him who would increase his efficiency in solving problems is that he be clear and explicit and give all his relevant knowledge a chance to work. The problem-solver should first take a bird's-eye view of the problem, understand it, see it clearly. He should formulate it explicitly, putting it into his own words, perhaps writing it down. He should review and list all the methods that seem to him in any way applicable. If new methods keep popping up into mind, he had better write them all down. Then he tries to see which method will work. This becomes a sort of mental trial and error, but it is more efficient than the actual starting out to do something which may turn out to lead into a blind alley.

On the other hand, it is not always possible to be sure that a method will work until it has been tried out. There may be too many contingencies. A chess player can see the consequences of one move several moves ahead, but not twenty moves ahead. He works by a combination of trial and error with immediate insight. The more experienced he is, the farther ahead his insight stretches.

So the more knowledge of the subject the problem-solver has, the more his insight has to work with.

Do men differ in their capacities for insight? It seems that they do, that one man is more clever or original than another; yet it is hard to say in what originality consists. Perhaps the difference lies in alertness, in the readiness to try new methods when old ones fail, in the self-confidence which leads to the abandonment of an unsuccessful method. A man has lost a letter. He cannot remember where he put it. He looks this place and that, in every place he can think of. Does he look twice, or three times, in the same place, merely because he must do something and can think of no new place to look? Then he is wasting time by not looking thoroughly once and ruling each place out of consideration finally. This may be what difference in originality, when knowledge is equal, boils down to: exhausting one method thoroughly and then abandoning it completely. That at least is the way Sherlock Holmes was supposed to think.

PLATEAUS

Sometimes learning, after progressing satisfactorily, seems to stop. Further improvement seems impossible. The learning curve stays at a dead level, a *plateau.* Such a plateau appears in the learning curve for radio-telegraphic receiving in Fig. 75 (p. 267). It is a discouraging time for the learner. When the reasons for plateaus in learning are understood, some of them can be avoided and the others will be less discouraging when they occur.

There are a good many different reasons for the occurrence of plateaus in learning. Here are the more important ones.

(1) The learning may actually consist of the acquisition of two skills, one of which can be learned only after the first is acquired; or, even if the two skills could be learned together, the learner or his instructor may arrange them to come successively. The learner starts out with skill No. 1, giving it full attention and using all the devices of understanding and participation to help him. As he learns, the task gets easier. Then skill No. 2 is introduced and he forgets that he must go back to full effortful attention, so he remains on a plateau, until repetition gets him off of it or until he realizes that the plateau is the result of his attitude toward the learning. Such a plateau is not necessary. It results from laziness.

(2) Another kind of plateau, one which is unavoidable, occurs when the operations of skill No. 1 have to take time to become automatic before the learner has enough attention left to add skill No. 2. There often has to be a plateau for overlearning skill No. 1, before skill No. 2 can be added, or else there will be a set-back in skill No. 1.

A driver who learns to drive a car on peaceful country roads may have to pass through a plateau before he learns to drive in traffic. He can drive well enough if he gives the driving his full attention, but he has not enough attention left for traffic. Of course, he can avoid the plateau by learning to drive in traffic from the start, but that may be too hazardous.

The pilot in training may strike a similar plateau when he has learned to take his plane up and bring it down again. He thinks he can fly, but his actions are not yet automatic. When he is given new problems in navigation, he finds he cannot master them, because—and only because—he has not yet overlearned the primary skills so that he has enough attention left over for new problems.

(3) Plateaus occur when something has been learned wrong and has to be unlearned before the learner can proceed further. The rule of "never make a mistake" is also a rule for avoiding some plateaus.

Sometimes a plateau occurs because a man has had a false insight, yet he finds it difficult to give it up and to try something else. That is inefficient because it is likely to prevent new insights. When you are stumped, the best thing to do is to put the problem aside, if you can, and to come back to it fresh a few hours later. In the meantime you will have been doing other things and are not as likely to be as bound by your previous false insights, when you return to the problem, as you would have been had you kept working at it continuously.

(4) Sometimes the plateau is a consequence of the fact that the learning gets harder as it progresses, either because the more difficult skills come later in the process or because the instructor increases the requirements more rapidly. This is not a true plateau but an artificial consequence of the problem.

(5) Fatigue can start a plateau, and rest can take a learner off of it. If learning is continuous, the fatigue may be merely the consequence of keeping on too long at the task.

(6) Distractions are great producers of plateaus. A plateau may be a sign of worry. Falling in love, the great distractor, may have the same effect. If an unaccountable plateau in learning persists, the learner or his instructor had better look into the learner's emotional life to see whether he has got all his attention in hand for his main job.

(7) Success creates interest and failure dulls it. Thus a plateau, by discouraging the learner, tends to perpetuate itself. Failing to improve, the learner gives up and does not try so hard.

The best thing to do about plateaus is to understand them. Most of them can be remedied. None of them is necessarily permanent. The realization that they are of usual occurrence and that they are temporary will do much to keep up the learner's interest and to carry him on to renewed improvement.

RECOGNITION

Recognition is of great military importance, especially the recognition of standard military objects, like airplanes, tanks and ships. Soldiers and sailors can learn, slowly in general experience, more rapidly with training, to recognize the various types of planes and tanks, the various kinds of warships. Recognition of such objects means that the observer knows at once with what he has to deal, whether it belongs to the enemy or his own forces, what are its firepower and other capabilities. He needs that knowledge at once and he needs to have it with certainty. An error may cost him his life and may even contribute to defeat.

Recognition is learned like everything else—by insight, understanding, and the repetition of practice. The Army conducts *recognition schools* for learning to recognize both planes and tanks. In these schools the learner is shown moving pictures of the selected planes or tanks, each under all sorts of conditions and at all sorts of angles. He begins, for instance, with a pair of planes that look very different and is practiced until he can tell instantly which plane is in sight, no matter how it appears—from above, from below, from the side, from in front, from the tail, at other angles—against a bright sky, at night in a searchlight beam, against the ground in daytime. Then he practices upon more similar planes, and then upon still more similar ones, and then all the planes that he has learned to know are introduced into the picture at random and often only briefly, and he has to learn to discriminate accurately among many possibilities.

The *tachistoscope* is also used. A tachistoscope is an instrument for giving a very brief exposure of a picture or some other visual object. For instance, you can expose a meaningless string of consonants for a tenth of a second only and observers, who are waiting with attention focused on the field, can recognize correctly four or five of the letters on the average, seven or eight of them in exceptional instances. They can recognize twenty or more letters if they form the words of a simple sentence. (Of course, the recognition takes more than a tenth of a second. The memory of what is seen persists quite accurately for a couple of seconds or more after the object has disappeared.) So the tachistoscope becomes the tool of the recognition school. Men learn to recognize tanks, planes and ships in tachistoscopic exhibition as readily as they can learn to recognize printed sentences.

As learning of this sort progresses, the learner is required to identify military objects that he sees but briefly out of the corner of his eye without the benefit of deliberate foveal vision. That process is kept up until he knows *planes*—or *ships* or *tanks*.

In the early stages of recognition-learning, understanding is used. The structural differences between the types of objects are demonstrated and explained. The learner is told what to look for. His recognitions are at first conscious and deliberate. After his learning is well advanced, this analytical understanding of what is going on drops out of his mind. The object—plane, ship or tank—identifies itself to him at once for what it is, without his being able to say how he recognized it. Similarly many civilians can at a glance distinguish one make of automobile from another and are hard put to it to tell how it is they know the difference.

Such recognition is, in fact, one of the commonest and most important types of learning. We think of a given object as having always the same color, shape and size, yet it is hardly ever presented to the observer in the same way. Snow looks white, even in shadow. Grass is green and the sky is blue. The first colored moving pictures lacked a good blue; yet audiences saw the greenish blue skies as a true blue. A square object always looks like a square object, though, if it is lying on a table and the observer stands to one side, the image of it on his retina is a rectangle or a diamond. A six-foot man looks like a six-foot man at twenty feet away and at forty feet away. He does not at forty feet look like a three-foot dwarf, although the retinal image that the observer has of him is only half as tall at forty feet as it was at twenty feet.

In other words, perceptual learning in men is directed at the recognition of the identity of constant objects, not at the perception of the ways in which their impressions vary under different conditions. That fact is very important in the business of living, where it is necessary for a living organism, man or animal, to survive by recognizing the identity of the objects that he comes across, especially of food and enemies. He cannot afford the useless luxury of being interested in the nature of the sensory impressions which convey this information to him. He has merely to know what the impressions mean, what objects they signify.

The soldier and sailor have the same problem. They need to identify objects immediately and with certainty. Their success and survival depend upon their ability in recognition. War merely accentuates the importance of success and the danger of failure, and habits for the recognition of military objects can be formed with practice just as readily as they are normally acquired for everyday living.

REFERENCES

1. C. BIRD. *Effective study habits.* New York: Appleton-Century, 1931. Pp. 247.
   An excellent book on how to study.
2. H. B. HENRY, ED. *The psychology of learning.* 41st Yearbook, National Society for Study of Education, Part II. Chicago: University of Chicago Press, 1942. Pp. 502.
   An excellent but advanced and technical survey of three theories of human learning, conditioning, associationism and field theory.
3. E. R. HILGARD AND D. B. MARQUIS. *Conditioning and learning.* New York: Appleton-Century, 1940. Pp. 429.
   A technical but clear treatment of learning from the point of view of the conditioned-response theory.
4. W. KÖHLER. *The mentality of apes.* New York: Harcourt Brace, 1927. Pp. 342.
   An interpretation of the behavior and learning of chimpanzees, with especial emphasis on the rôle of insight in learning.
5. J. A. MCGEOCH. *The psychology of human learning.* New York: Longmans, Green, 1942. Pp. 633.
   An excellent comprehensive presentation of the major theories and experimental data in the field of human learning.
6. L. C. PRESSEY. *A manual of reading exercises for freshmen.* Columbus: Ohio State University Press, 1936. Pp. 112.
   A practical manual for increasing speed of reading.

See also Chapter 2, item No. 1 (especially Chapters 9 and 10) and item No. 5 (Chapter 18). References in Chapter 13 are also relevant, especially items Nos. 2 and 4.

Chapter 13

Army Teaching

The purpose of teaching is to supply the conditions under which learning will take place most efficiently. One hears talk about good and bad teaching, and, of course, there are good and bad teachers. Yet it must not be forgotten that the ultimate teacher of the learner is the learner himself. He himself must be interested and participate in the learning if he is to learn. Teaching merely puts him in a situation in which he can learn.

Thus it is the teacher's business to know all about the psychology of learning and to get the learner to work according to these well understood principles. Since the teacher assumes the rôle of leader in the mission of learning, he can supply, as does every good leader, some of the outside stimulus—the conditions that make for interest. He can also impart the necessary information, both the information to be learned and the information about the best technique of learning. Because his position gives him prestige, he can do more than any one other person—always excepting the learner himself—to provide motivation through social contact. The teacher and his methods are thus very important indeed.

In military training the methods of teaching are particularly important, because accomplished teachers are not generally available—especially when forces are being rapidly built up for war. Moreover, every leader, from the sergeant squad leader up, must give instruction. Hundreds of thousands in the armed forces must teach. Hence military teaching in an emergency must be standardized, and procedures must be provided for teaching the teacher.

The Army chooses for teachers men who are "energetic." That means men with initiative, enthusiasm, interest, desire for action, self-reliance and the personality of a good leader. Usually they have had no experience in teaching, but such men command the respect of the soldier, convince him that he is being taught efficiently and rapidly, and infect him with their enthusiasm. If these men—officers, commissioned and noncommissioned—also have sufficient general ability and are provided with good instructions as to what they should do, their teaching may become very effective indeed. The soldier wants to learn and to learn rapidly, for both his personal safety and his chances of advancement depend on his success in improving himself. The Army's instructors have pupils with good motivation.

Actually the instructor is a special kind of leader, and all leaders are instructors. The qualities of leadership are, however, discussed elsewhere in this book (pp. 417-423).

RAPID TRAINING

When an army is being built up rapidly for war, training must be fast. The recruit usually gets twelve weeks of basic training, and then he may go to a specialist's school for six weeks. After this he may need and receive more special training. His military learning does not stop there, but goes on until he is a veteran. Nevertheless speed in training is necessary. When a new army is to be built up, millions of men have to be trained. It is not possible to go slowly or waste time.

For that reason the best available men must be selected for the more special training—men whose score on the General Classification Test indicates that they can learn rapidly, men who already have some ability in the skill required or at least some demonstrated aptitude for it. Personnel officers must select the proper men for the proper training.

The fact that a man does not rate high in ability to learn quickly or that he has no special aptitude for military jobs does not mean that he can be left without training. Every soldier has to be trained. The less apt receive the simpler basic training; the others are trained as specialists. Men who stand at different levels of ability and aptitude need to be trained for different jobs. Those who are lowest in aptitude for learning, who cannot speak English, or who are illiterate must go into the special training units provided for men with these deficiencies.

Especially important is it to have the soldier-learner *participate* in the learning process. Lectures and textbooks and explanations are necessary at the start along with some actual practice in the particular skill. The soldier must perform the act of skill again and again. He must be drilled far beyond the first perfect performance, until he reaches the stage of automatic action.

Interest in learning is enhanced by the personality of the instructor and by the individual nature of the instruction—for, as much as possible, the individual soldier gets immediate contact with an instructor or an assistant. The Army has solved quite well the problem of giving instruction to masses of men and yet getting personal comment and criticism for each man.

The instruction is kept lively by being made immediately *practical.* It is necessary that the learner understand basic principles if he is to be most efficient, but instruction in basic principles must be kept near

Fig. 80. Visual Aids in Teaching
(Photo from U. S. Marine Corps.)

enough to practice for the application to be apparent. General theory that seems to the learner remote from use counts for him as irrelevant and is omitted from the instruction. Everything else that seems irrelevant is likewise omitted. Much information that might help learning by stimulating interest and broadening understanding is also omitted under pressure for speed--if an army is being rapidly trained for war.

The instructors must always keep to the fore the purpose of the learning and its relation to combat. Since learning is more efficient when its purpose is clear, soldiers who are preparing for combat ultimately and for maneuvers first will be more interested when they are not allowed to forget that success in learning will be immediately, as well as finally, to their advantage.

The method of Army instruction is sometimes referred to as the all-around attack. Every possible way of reaching the soldier's mind is used. Lectures and other forms of oral instruction, such as recitations and discussions, are used for the exposition of general principles and to introduce a new topic. They are accompanied, whenever possible, by demonstrations and by other visual aids—charts, diagrams, enlarged pictures, films, sand-table demonstrations, working models, actual machines. Machines with parts cut away to expose hidden mechanisms are sometimes used. Mechanical principles can often be shown with models whose parts are made large and of wood.

Instruction is put to immediate use by *action on the job.* Men learn by doing. They manipulate the weapons, the machines, take them apart, assemble them, use them. Thus the student-soldier learns to see why he has to do what he has to do, while he hears why he does it. And all the while that the whole weapon, machine or instrument is becoming something familiar to him, his habits for its use are becoming so automatic that eventually he will have become competent to work with it even under emotional excitement, and to work both rapidly and correctly. The paratrooper who has just landed near his machine gun needs to know how to set it up and operate it as readily and as unhesitatingly as he can write his name.

In all-around instruction all the *senses* are used—some for one thing, some for another; some for one man, some for another. Lectures are auditory, demonstrations are mainly visual. Manipulation uses the muscle sense. The well trained mechanic must also know how a machine sounds when it is working correctly. Some men can distinguish among airplanes by the sounds of their motors. Smell also comes into training. War gases are learned by smelling weak dilutions of them and several smells may be a warning that enemy troops are near. The closer the student-soldier or student-sailor gets to his actual task, the more he will employ every means of information for his guidance. And his instructor, if he is himself well trained as a military or naval instructor, will see to it that the soldier or sailor misses no aid to learning and no clue for the successful performance of his task.

Monotony is the enemy of learning, but sometimes instructors can relieve it by introducing enough variety to speed up learning. The Navy has in this way managed to increase the speed of code learning by variation of the dull, endlessly repetitious task. What did they do? They varied the style of sending, using different operators in addition to the perforated tape. They introduced special practice drills in which particular difficulties were emphasized. At times they required copying against interference. At other times they forbade any copying until an entire word had been received or until a signal had been given. They had the instructor read back the correct text after the messages had been copied. They used a code which the receiver could translate so as to reveal its hidden message. They introduced misspelled words and required the misspelling to be reproduced as received. They kept varying the pitch and loudness of the signals. All this variation created interest and made competition keener. The men liked the work better, and the instructor, although his work was increased by the new procedure, also felt relieved of monotony.

METHODS OF INSTRUCTION

Instruction in the Army, as in its other procedures, is standardized. The courses and lessons are carefully worked out in advance. The instructions to the soldier-students and to the soldier-teachers are much the same wherever and whenever a course is given. The period of basic instruction is twelve weeks, although some specialized courses are arranged for shorter or longer terms.

This uniformity results in interchangeability, as indeed it is intended to do. If an instructor is transferred in the middle of a course, another can take his place. If a soldier gets ill or is given a leave or a furlough because of an emergency at home, he has at the worst to lose twelve weeks. Some courses are, however, given simultaneously but started at different times. Then the man who loses two weeks can be transferred to another course that started two weeks later, and the man who finds progress too slow for his knowledge or ability can be put in a course that is further along in its practice.

Although uniformity has these advantages, it tends also to make the slow men work too fast and the fast men too slow. Yet it may be that the relatively slow man is trying to learn too difficult a skill. The fast man, on the other hand, can often be used by the instructor to help give instruction to the others, and giving instruction is a form of participation that makes his own learning stick.

A great deal of the instruction is given out of doors—partly because there is in the Army more outdoors than indoors to use for classrooms, but more because the skills being learned are chiefly those to be used outdoors and therefore had better be learned under natural conditions. All of battle except house-to-house fighting is outdoors, and in actual combat conditions it is more likely that a man will have to set up a machine in a field than in a machine shop.

The normal procedure for instruction is as follows. The instructor, before he meets his class—and often a new instructor is just keeping ahead of his class—studies what he has to teach, plans the demonstrations, sees to it that everything he needs for instruction—every aid to instruction—is ready at the right place. He begins actual instruction by explaining to the group what the instruction is about, what

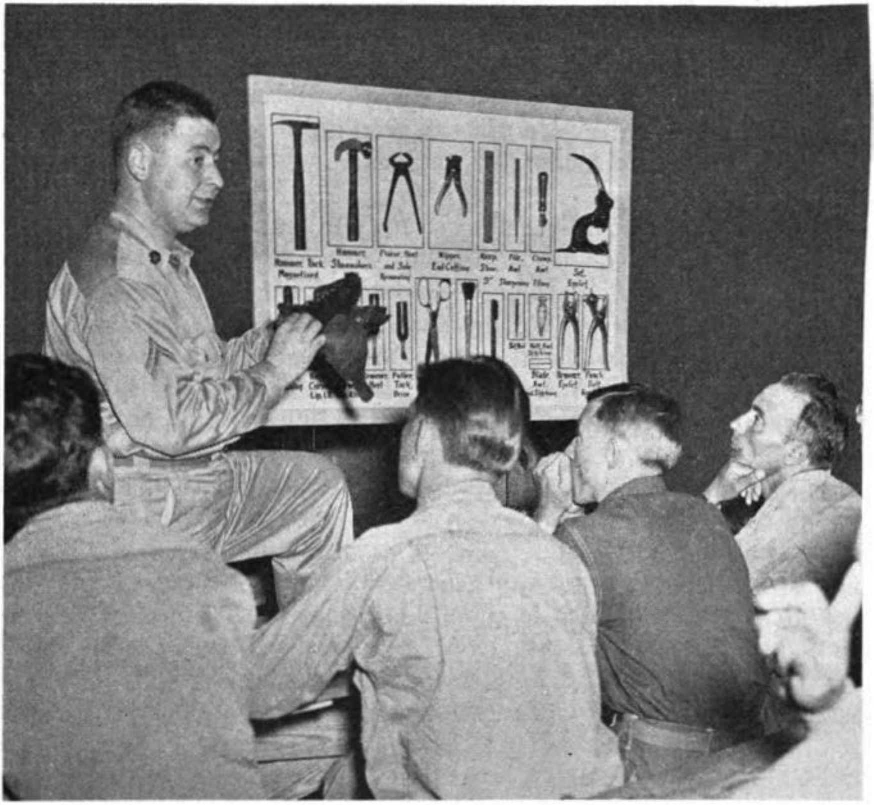

Fig. 81. VISUAL AIDS IN TEACHING
(Photo from U. S. Army Signal Corps.)

the objectives are, and why the course is a wartime must. Then he or his assistant demonstrates part or all of the things being taught, when the instruction is about the use of things. The soldiers are next given practice, as much as is possible in the available time but not enough to tire them. Then the instructor with his assistants assembles the group and examines each man to determine how well he has learned. The day's session should end with discussion. The instructor answers questions that puzzle any of the men, he repeats some of the main points to be remembered, he indicates what work will follow next, and he says again why the work of that day is important in war.

When the instruction cannot be practiced at the time, then the session turns into explanation and becomes more like a lecture.

Although the lessons, the methods of instruction and the demonstrational aids are prescribed for the instructor, he still has good opportunity to make his personality and originality count. He can use any device of which he is capable for securing interest and attention. He is like any other leader. He has certain prescribed things to teach by certain prescribed means, yet his ingenuity and personality are still very important.

Not e ery soldier is a good instructor or leader, but every soldier who would be a good instructor must remember certain basic things which make for good teaching. He must, first of all, know his material well so that he can present it clearly to his students. He should be interested in his subject and enthusiastic about it, if he is to get and retain the attention of his students. Illustrations, anecdotes, and jokes enliven a lecture and often help to clarify a given point. In addition to knowing his material and how to present it, the good instructor must also know his men. He must be willing to take the trouble as far as possible to know them by name and to learn about their individual capacities.

Individual instruction is, in general, most effective, yet a new army has great masses of men to train. There may be 200 men in a single class, meeting out of doors. How can a single instructor teach them?

For the explanation of general principles and uses, a single instructor with a good voice may be enough, especially if he supplements his voice with good visual aids. Mobile public address systems are often available also. For practice in acquiring skills, there are ways of making the instruction individual.

Sometimes assistants to the instructor—noncommissioned officers or members of the class who have "caught on" more rapidly than the others—walk continually through the group while its members are at work learning something new. The assistants stop and give help wherever it is needed, showing one man how to hold his rifle or tool, explaining to another some point about which he is puzzled, correcting the mistakes of still another.

At other times the class or company is divided into squads. Assistants start each squad out on the practical skills which they are to acquire. The instructor moves about from one squad to another. He lets the men sit down by their work and tells them the why and how of what they are doing, explains its importance or describes what they are to do next. This method works well for some parts of machine gunnery, for shop work, for first-aid instruction.

Still another method is to divide the class into teams. In a machine shop, for example, two men may work on each machine. These men are carefully matched, so that each new man or each man who is slow at learning is paired with another who is a little farther advanced or a little better at the particular job. The instructor and his assistants watch to be sure that the better man does only his share of the work. The less skilled man learns by watching the other and by his suggestions, and the more skilled man also learns because his pride in his skill makes him want to keep ahead of his team-mate. A similar method is used in the instruction of units equipped with weapons operated by a crew, such as machine guns and mortars. The several squads (crews) of a company or platoon may all undergo instruction at the same time, with the squad leaders acting as assistants to the head instructor.

There is also the *coach-and-pupil* method, where the men are paired but neither of the pair is better than the other. A platoon, for instance, is lined up in double row for instruction in rifle marksmanship. The front rank men take the positions from which they must learn to fire a rifle, going through the motions of loading, aiming, and squeezing the trigger and firing, using dummy ammunition or none at all. The rear rank coaches. The coach may be no more skilled than his pupil,.

Fig. 82. Coach and Pupil Method in Learning the Rifle
(Photo from U. S. Army Signal Corps.)

but you can see when another man is wrong, even when you lack the skill to be right yourself. The instructor walks along the line, coaching the coaches, telling them what faults to look for, just how the rifle should be held. Presently the men change places. The coach becomes the pupil and the pupil the coach, and the instruction goes on as before.

These methods are not perfect. They are practical ways of making massed instruction into individual instruction in an emergency when time is at a premium. They work well. A modern army can be trained rapidly by them. It could be trained better in the same time if there were time to train the teachers or if there were better methods available for picking the kind of leader that makes a good teacher. In a sense the teacher problem is just a special part of the leader problem—it is hard to find or train enough men who are good in dealing with other men.

SPECIAL TRAINING

Besides the huge numbers of men that the Army gets from Selective Service and sends directly to basic training, there are large numbers of other Selective Service men who are not ready for basic training at the start. Some of these men are illiterate and need to be taught, at a simple level, reading, writing and arithmetic before they are ready for the regular training. Others cannot speak English and have to learn enough of that language to understand commands and simple instructions. Some who cannot speak English are also illiterate, whereas others are literate in their native tongues. Then there are still other men who are low in their capacities to learn, low in intelligence and in their scores on the General Classification Test. Unless this defect is great, these men are not untrainable for certain military jobs, but they need special attention at the start. And finally there are those with physical handicaps, who may have to be trained for special jobs where the handicap will not interfere, who need at any rate special attention, since their adjustment to military life is more difficult than is the adjustment of the normal recruit.

For these men the Army in the Second World War established five kinds of instruction in Special Training Units as follows:

(1) **Illiterate or partly literate men who speak English.** This group includes the Americans who have failed to receive a formal education, either because of lack of opportunity or, in many cases, because they lacked the ability to continue in school. They are given instruction in the three R's and returned to regular basic training as soon as they

are ready to continue with it—nearly all of them after twelve weeks' training, many after six weeks.

(2) **Men who do not speak English, but who are literate in their native languages.** These men need instruction in English only—in speaking, reading, and writing simple English. They must acquire a usable vocabulary of about 3,000 common words which include the most usable military terms. They must be taught more than the meanings of words; they must understand sentences and paragraphs.

(3) **Men who do not speak English and who are illiterate in every language.** This group combines the deficiencies of the first two groups. The necessary training is greater and takes longer.

(4) **Literate men whose capacity for learning is less than required in regular training.** These men, being literate, are not necessarily at the lowest level of intelligence, but they are too slow for the pace of regular basic training. If they receive basic instruction more slowly, they may be made into good soldiers. The Army cannot afford to do without them, and thus must alter its instruction to suit them.

(5) **Physically handicapped men,** who are nevertheless acceptable for military duty. Many men with physical handicaps have made successful adjustments to civilian life. They need, however, special training, especially where the defect is a deficiency in stamina. To put these men at once into the regular units, while they are being toughened, would slow up the work of the regular units, decrease the morale of the regular units, discourage the men themselves and decrease their morale. They need special training with other men who are like them, until they have caught up and are ready to stand the regular pace.

Great care is exercised in the selection of men for the Special Training Units, because in war the Army cannot afford the time for special instruction when the regular instruction can be made to serve. Minor deficiencies do not constitute a reason for assigning a man to a special unit. He is so assigned only when the probability of his success in regular training is extremely doubtful.

Literacy is determined quickly and readily by the Picture Literacy Test, in which the men are required to print out the names of pictures and also to show that they understand the use of the object shown.

Low scores on the General Classification Test mean that the man must have an individual examination to determine his general mental and social competency. Although the Army does not always have available the skilled examiners that it would like for this work, the test procedures that have been devised work fairly well with a minimum of errors. When a man gets into a Special Training Unit for this reason, he is under constant observation and can often be returned to regular service after a few weeks. Everything depends on the degree of his deficiency.

The Special Training Units are organized under the separate commands and not at special schools. This arrangement has the advantage of making the transfer of a man to regular training easy whenever he has advanced to the stage which justifies the transfer. On the other hand, it means a very large number of competent teachers has to be found for the special units and instructed in the special methods which the units employ.

The War Department teaches these teachers by special courses of instruction, by issuing guides, handbooks, reading lists and films having to do with these special methods of teaching, by directives on methods and policies, by inspections and reports. The teachers are, in the first place, selected with great care. A survey in 1943 showed that 75 per cent of them had been engaged as civilians either in elementary education or in teaching the mentally dull and retarded.

Special textbooks have been written by experts for these classes. Special materials and visual aids are made available for them. Graphic presentation is used as much as possible. In other words, these special kinds of instruction follow the same principles as the regular instruction—they are tied in directly with the military life and the military training of the men. The material these men learn to read is not the same as that given to children or adults in Americanization or other civilian classes. They read instead about such things as the rifle, their officers, and about activities in camp. They learn to write first with the goal of getting letters off to their families telling them where and how they are. In arithmetic they learn first how to count their pay, how to make purchases at the post exchange, to buy postage stamps, to send money home.

Not many of these men require more than a dozen weeks to be prepared for regular training. Many are returned sooner. Some few, on the other hand, are judged to be incapable of learning enough to make them into good soldiers. Such men are recommended for honorable discharge from the Army and returned to civil life, where they may engage in useful activities under circumstances better adapted to their capacities. It is right that the discharge is honorable, for the psychologically deficient are not subject to blame for their ineptitudes.

REFERENCES

1. H. C. McKown and A. B. Roberts. *Audio-visual aids to instruction.* New York: McGraw-Hill, 1940. Pp. 385.
   A practical textbook written primarily to instruct elementary and high school teachers in the use of a large variety of auditory and visual classroom aids but profitable reading even beyond these levels.
2. N. Mosely. *Teacher's manual.* New York: Cornell Maritime Press, 1943. Pp. 208.
   An important and practical book for military, marine, vocational and industrial teachers.
3. E. L. Munson. *The management of men.* New York: Henry Holt, 1921. Pp. 801.
   A readable textbook presentation of the science of handling men and of developing morale, written from the military standpoint. Chapters 13, 18 and 19 are especially relevant.
4. War Department. *Technical Manual 21-250, Army instruction.* Washington: Government Printing Office, 1943. Pp. 227.
   An official War Department manual designed to assist Army instructors to carry out their teaching objectives efficiently.
5. War Department. *Instruction in special training units.* Pamphlet No. 20-8. Washington: Government Printing Office, 1944. Pp. 83.
   A brief manual covering the techniques of instruction for men falling into the category of slow learners and non-English speaking group.
6. War Department. *Teaching devices for special training units.* Pamphlet No. 20-2. Washington: Government Printing Office, 1943. Pp. 42.
   An excellent guide to special teaching techniques adapted for use with men who are linguistically handicapped or poor learners.
7. War Department. *Field Manual 21-6, List of publications for training.* Washington: Government Printing Office, 1944. Pp. 348.
   An official list of publications used in the training of Army personnel. Very useful as a guide in preparing military training materials. Revised frequently.

See also references in Chapter 18, especially items Nos. 4 and 5.

Chapter 14

Motivation and Morale

Of all the complicated machines that mechanized war employs, the most complicated are the men who operate the other machines—the tanks, the planes, the guns. These other machines, however, do not start themselves or aim themselves; it always takes a man to do it. What starts the man and aims him?

While men are energized by the food they eat, they are steered by their *needs.* They want things—oxygen, water and food, love, freedom and power, clothes, houses and amusement. Some of these needs are primitive, like the new born baby's need for oxygen; some are acquired and depend on the society in which a man lives. All together, however, determine his motivation, the springs of his action. If you could control a man's needs, you could control his actions. By understanding his needs, you may be able to guide his action and to steer him in the direction you would like to see him go.

When a man cannot satisfy a need, then he is *frustrated.* Frustration of a strong dominant need may lead to anger or to depression, anxiety and inefficiency. Such a need should be satisfied or a substitute found. Fortunately it is often possible to find substitutes or to escape from the dominance of one need by the satisfaction of another. For instance, a man may forget his homesickness when he finally gets interested in the work of his military or naval unit. Or he may substitute, even though inadequately, a sense of comradeship within his unit for what was for a time a dominating longing for his wife or sweetheart at home. Frustration is often a man's worst foe, but it need not be. It may stimulate him to attempt to remove or change the source of the frustration.

Unfortunately needs often create their own frustrations because they *conflict.* A man may want approbation very much, yet he may also want to save his skin. Shall he undertake a dangerous mission alone with only one chance in two of coming back for the approbation of his commander, his fellows and his conscience, or shall he manage to evade it with some good excuse and thus keep safe? Can he continue to carry out orders to maintain an enfilading fire when he finds himself under direct frontal attack by the enemy? Which of his needs will win out there, his desire for approbation or his desire for self-protection? One of the two needs must suffer frustration; he cannot have both satisfactions. In this way frustration is promoted by man's own complexity. He is forever wanting incompatibles.

When a man's needs are so adjusted that the strongest and most compelling ones are satisfied by success in the job which he has to do, then his *morale* is good. The problem of military morale—or any morale for that matter—is to tie up a man's needs with the activities of his job. Then he wants to do what he has to do, and his morale is excellent.

Needs, wishes and motives—frustration and conflict—morale, which means using the needs effectively—these represent the dynamics of man who is the basic military machine. No leader can control his unit well in combat who does not understand the mechanisms of his men, the human, highly variable machines that are the prime movers in war. Nor can a man do justice even to himself unless he has some insight into the basic principles of his own action.

NEEDS

You cannot understand men's needs by listing all the things they want and try to get. They want too many different things. Men want food, love and activity, but more specifically they want beefsteak, kissing and baseball. The second lieutenant longs for promotion. The sergeant hopes to have his new girl friend all to himself this evening. The clerk in the headquarters company is praying that he may get away from paperwork and into action. Almost any thing, act or event can become an object of desire. We should, nevertheless, like to know the general classes of needs which apply to most people most of the time. Such knowledge could be used to understand and control men and thus to create morale.

Primary Needs. Certain needs are primitive, dependent on physiological necessities and conditions—primary needs, as they are sometimes called. These include the needs for oxygen, water and food. A man has to have every one of these three things to live. We know, moreover, something about the physiological mechanisms that get these needs satisfied under ordinary circumstances.

When a man gets out of breath he pants. He has been exerting himself in some way, using his muscles violently and destroying muscle cells. The *oxygen* previously in his blood has been used to burn up these dead cells, thus creating an excess of carbon dioxide. This excess—it takes only the tiniest increase to have an effect—stimulates the respiratory center at the base of the brain to make him breathe deeper and faster, to make him pant. Panting increases the circulation of air through his lungs, removing the excess of carbon dioxide, and substituting needed oxygen for it. A baby is cut off at birth from the oxygen supply of its mother's blood. It starts breathing as soon as enough carbon dioxide accumulates in its blood to stimulate the breathing center in its brain. If you pant voluntarily for a few minutes, so as to get an excess of oxygen in your blood, then you just naturally stop breathing for a minute or two, until the accumulation of carbon dioxide starts you breathing again. That is the way this need is supplied.

The human body also cannot live without *water,* and its water supply is kept up by thirst. Ordinarily when the concentration of the blood gets too high, when there is too little water in it, secretion of saliva is diminished and the mouth and throat get dry. This perceived dryness appears to act as a warning to a man to get a drink. Actually, however, the effect of a bodily shortage is automatic. The thirsty man is distressed, whether there is water around for a drink or not. He keeps thinking about water, will do anything he can to get water. A drink quenches his thirst, not because it wets his mouth but because it dilutes his blood down to the proper concentration. Water injected into one of his veins will stop his thirst just as quickly as a drink.

Besides oxygen and water, the human body must also have *food* and the food has to get into the blood—a good deal of it in the form of sugar for burning up waste products, some of it in other forms for replacing the burned up cells. When the blood lacks sufficient nutriment, then a man always tries to get food. Often a diminished sugar content in the blood sets up slow rhythmical contractions of the stomach, contractions that are felt as the gnawing aches of hunger. These aches, not necessarily severe, constitute a conscious warning that the body needs food, just as a dry throat and mouth warn a man that his water supply is low. But he will still try to get food without the hunger pangs when his blood needs nutriment. The pangs disappear as soon as food is eaten, no matter how little; yet appetite, his desire for food in the absence of the pangs, keeps him eating through the meal. A man with his stomach removed still keeps wanting food every so often. It seems that the chemical constitution of his blood has some direct effect in his brain, an effect which causes him to seek food, and to eat it when he finds it.

Still another primitive need is *sexual desire.* This need is satisfied by the completion of the sexual relation between a man and a woman. Like drinking and eating, this act is a definite kind of human behavior which accomplishes a definite purpose. When the need is frustrated, all sorts of elaborate devices of courtship enter into a man's conduct—or a woman's. That is not surprising. The same thing happens when a man is deprived of water or food; he bends all his energy and intelligence to get what he lacks. The reason that courtship seems to be more complicated than eating and drinking is merely that it runs into more difficulties. Religion and society place more restraints upon the sexual relation because promiscuity can have more disastrous effects than overeating or drinking too much water.

The physiological basis of sexual desire seems to be the presence of internal sexual secretions in the blood. At least they sensitize a man or woman to pay attention to persons of the opposite sex and to situations that have in them sexual possibilities. In a man this condition is likely to mean that there is also an accumulation of sexual secretions in the internal genitals so that he has a feeling of tension and a need for its relief. He can relieve this tension by masturbation and, indeed, relief is sometimes better secured in that way than in another; but masturbation does not often solve a man's problem of sexual desire, for the sexual need is much broader than a need for mere physical relief. It is tied up with inherited patterns of behavior which

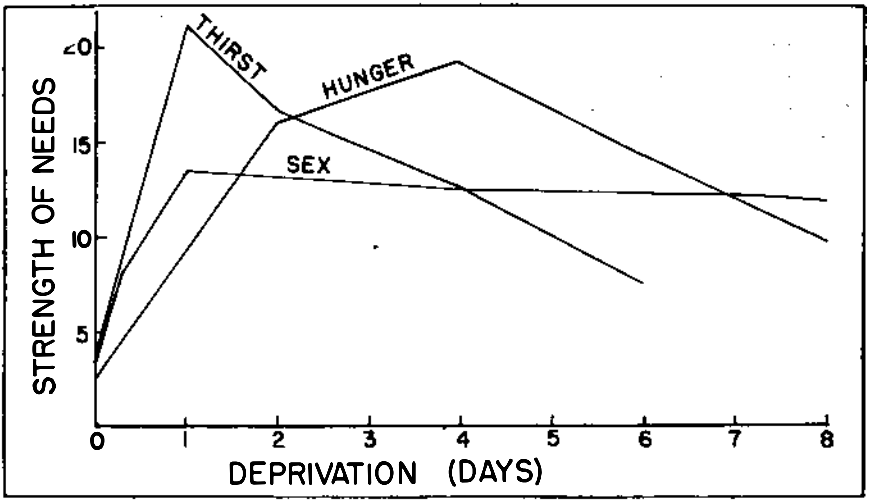

Fig. 83. RELATIVE STRENGTHS OF PRIMARY NEEDS IN THE MALE WHITE RAT

Strength of hunger, thirst and the sex need are shown by the number of times the rat will accept an electric shock on crossing a grill to reach food, water, or his mate. The need becomes stronger with continued deprivation, then gets weaker. (Reproduced from Warden, *Animal Motivation Studies*, by permission of Columbia University Press.)

have their seat in the nervous system, patterns which are set off in the presence of internal secretions in the blood under a great variety of situations.

The needs for oxygen, water and food are *vital.* A man cannot live without them. He can live for minutes without oxygen, but not for hours; for days without water, but not for weeks; for weeks without food, but not for months. Sexual need is not vital. Perhaps it should not even be called primary. At any rate, failure of sexual satisfaction does not cause death, though in some persons it does cause psychological maladjustments.

The question has often been raised as to the relative strength of the three primitive needs discussed above—food, water, sex. At least a partial answer to this question comes from the studies of animal behavior. The strength of a need can be measured by counting the number of times an animal will cross a grill which gives him an electric shock in order to reach food, water or his mate. When he is denied the satisfaction of any one of these needs, his motivation at first gets stronger, that is to say, he will cross the grill oftener to satisfy that need; but this is true only up to a certain time of deprivation, when a maximal strength of motivation is reached. Thereafter the motive becomes weaker again (see Fig. 83).

With continued deprivation, the male white rat shows the maximal need for water and for a mate on the first day, and for food on the fourth day. Thirst is at first the strongest of these three needs (Fig. 83), but after the second day hunger becomes stronger than thirst—the hungry rat will cross the grill more often to reach food than the thirsty rat will to reach water. Sex need, after the first day, remains fairly constant, so that ultimately, as the desires for water and food diminish, it becomes the strongest. Of course, that is not to say that a rat which has been deprived of water for eight days will seek a mate when water is available, for the rat which has had no water for a week is likely to be dead. The figure shows, nevertheless, that needs can be measured and compared, and that they vary in strength with deprivation, passing through a maximum and then diminishing.

There are other primitive psychological needs, like the need for sleep and the need for activity. The need for *sleep* is vital. Man cannot live for many days without sleep, nor can most animals. Changes occur in the brain tissue if an animal is kept too long awake, changes which are, however, soon restored by sleep. The need for *activity* is not vital, but it is very important in a normal man or animal. Men and other animals are essentially doers, trying always to change something, to get where they are not, to achieve.

Is there a need for self-preservation? There probably is. But it might better be regarded as the general goal which many needs have in common rather than as a separate primitive need. Hunger, thirst, sleep—all contribute to the preservation of the individual.

All of these elementary needs are complicated by habit, suggestion and social relations. Sleep and hunger follow rhythmical patterns which can, nevertheless, be changed to match new patterns of living. People get thirsty from seeing cold water, from hearing about water and thirst, from being told there is no water to drink if they were to want some. They yawn when others start yawning. The eating of meals may become a social ritual, and even a hen who has satisfied her hunger will start eating again if a hungry hen is brought in to start pecking at the grain. And sex—how that biological need to perpetuate the race has become complicated and socialized into all the unprocreative activities of love and courtship! Men do not often deliberately destroy themselves, yet it may happen that a parent, a friend or even a stranger will sacrifice himself to rescue an endangered fellow-being. The men of a military unit may sacrifice themselves for patriotism or pride in group accomplishment. The Spartans at Thermopylae made such a sacrifice. Modern examples are the so-called "suicide squads" of the First and Second World Wars. In spite of the biological nature of the primary needs, any of them may be overlaid by, and within certain limits controlled or altered by, other needs as they appear in the demands of socialized living.

Secondary Needs. Most of the needs that determine the conduct of men are secondary needs. They are not dependent on physiological necessities and are, at least for the most part, learned. They are social in nature. There is little to say about them except that they are established by learning, often with difficulty, and, when long established, are hard to change.

Sometimes the rule is laid down that a long established habit becomes a need. A recruit has no physiological need to drill for the sake of drilling, but he drills because of his need for approbation, or his fear of disapprobation and punishment, or for some other extraneous motive perhaps. So he drills and drills, and, though he thinks he hates it, presently he stops complaining or complains because it is the fashion to complain. If then he is transferred to a special service where there is no more drill, he may miss the drill, even though he would be most unlikely to admit that fact. Ordinarily, practice establishes new special needs. Men like to exercise their skills, no matter how painfully and reluctantly they may have been acquired.

In this principle of the autonomy of well established habits lies an important rule whereby discipline contributes to morale. The leader must remember that, however reluctant his group for routine and discipline, practice and skill tend to instigate secondary needs. They are working for him.

No one has ever made a successful list of the secondary needs. There have been attempts to classify them, to relate them to a few primitive needs, but human activities are so complex, human habits are so specific, that it is generally better to recognize the particular needs in particular cases and to let classification go. Only a few secondary needs, by way of example, can be mentioned here.

Is there a need for *aggression?* Certainly, sometimes. But you cannot say just when or how aggression will be the need that requires satisfaction. Frustration usually leads to some aggressive impulse, but not always. It may lead, for instance, to despondency. Attack may create an opposing anger, or it may induce fear and escape.

Is there a *gregarious* need? Pretty surely. Most men do not want to be alone for long. Especially in danger should men be grouped in twos or threes for emotional support. But the conditions are complex. A man does not always want to be with other men, and he may want to choose what other men he shall be with. And some men manage to hide themselves in their own thoughts even when they are working in a crowd.

In general, men do better work in groups. If they are all doing the same thing, competition may develop among them and act as a spur to better performance. But even without competition men accomplish more when working together on complementary jobs or even on entirely independent jobs, as is so often the case in the work of a military unit. It is easier for a man to keep busy when everybody else within range is also busy, hard for a man to concentrate in a crowd of loafers. Nor is it difficult to see what importance these facts have for military morale. Any human force that increases the efficiency of a group when it acts as a whole is helping morale.

Self-assertion, apart from aggression, is often regarded as an important human need. The desire to assert oneself would include the desire to obtain standing and position in one's group or community, the desire for prestige or superiority. There is no known physiological basis for self-assertive behavior, yet it may function in the service of primary needs. That is to say, part of the soldier's desire for a rating or a commission in the armed services may be based on desire for more pay so that he will feel able to marry the girl he loves. Self-assertion would thus be a means to an end rather than an end in itself. In any case, in our culture self-assertion is often regarded, within limits, as a desirable need. It plays an important rôle in leadership and as such is discussed further in a later chapter (pp. 412f., 419-421, 424f.).

Sometimes *religion* is pointed to as a basic need of man. Certainly religion satisfies needs for dependence and love and presumably other needs, too. Religion is, however, so highly social in its forms that it is hard to tell whether there is a general need for it. One man, who never goes to church, is sure that his belief in a wise order of nature, or his faith in the wisdom of human kindness, is religion. When, however, one comes to comparing the religious needs of a Voodooist, a Moslem and a Baptist, one sees how great is the rôle of habit in settling just what constitutes religious satisfaction. Neither the Voodooist nor the Baptist feels any need to prostrate himself toward the east and pray several times a day, nor does the Moslem believe in baptism.

FRUSTRATION

A man is frustrated when he has a strong need that cannot be satisfied. There are various ways in which the satisfaction of a need may be thwarted.

There may be an external obstacle. His commander refuses him a leave when he wants very much to go. His rival runs off with his girl. He has lost his knife and cannot get into a can of rations and he is hungry. Whether his frustrations are great or small depends entirely on the strength of his need for freedom, femininity, or food.

Or the obstacle may be internal. It may be another conflicting need. You cannot always have both honor and safety together, though you may need them both. The recruit's ambition to succeed in the Army may conflict with ever so many other needs, the habits and desires which fix his natural way of living in civilian life. Love and duty often create strong conflicts, for love has a way of being irresponsible. Can the soldier do his job well in the Army when he is consumed with longing for his wife or sweetheart?

Sometimes the obstacle is not clear or specific. Nevertheless a man may feel frustrated and may do his best to find some person or thing to blame, to serve as a scapegoat. What is the obstacle when a man tries hard in vain to solve a puzzle and then throws it in anger across the room? He puts the blame on the puzzle, but the obstacle may really be his own stupidity or inability to apply his intelligence at the time. If other people have been solving the puzzle, he may get especially angry at it. What is the obstacle when a company cannot take an objective? The enemy, of course, and a good thing it is to get angry at the enemy. But the real obstacle may be the essential difficulty of the position attacked or the commander's failure to use his men and weapons efficiently against the position. What is the obstacle when men get too tired to keep up the march or the fight? Themselves, of course, their fatigue. But they will often blame something else than themselves.

In the armed forces the sources of frustration often cannot be removed and are not clearly understood. When the sources are not known or when they are recognized as being due to a man's own limitations, the frustrated man usually blames—becomes aggressive toward—something or someone other than himself. He finds a *scapegoat* to carry the blame, just as the Children of Israel were taught to place their sins on a goat—a scapegoat—and drive it away into the wilderness. The motivation behind such "scapegoating," the blaming of a guiltless or a partially guiltless object or person, is an attempt to reduce frustration, to find something active to do about a situation when the normal action is prevented. In the Second World War administrators in Washington sometimes felt forced to resign under the pressure of public opinion, although they had performed their tasks as well as might be expected. The public had to find a scapegoat to relieve its frustrations caused by the deprivations of war. It is easy to make minority groups into scapegoats—the fear of spies and saboteurs can lead to unjust suspicions of all foreigners and of innocent groups —of the Jews, of the Negroes, of all American-born Germans and Japanese. Hitler, recognizing the frustrations of the German people, sought relief for them by making the Jews into scapegoats. Scapegoating relieves emotional tension, unjust and stupid as it is.

Living, so it seems, consists of almost nothing other than frustration and conflict, of decisions between needs, but mostly these decisions are easily made. Either one need is so much stronger that the other subsides without frustration, or the needs are unimportant and so equally balanced that their owner flips a mental coin, as it were, forgets the one and becomes absorbed in the other. Few men will stand for hours on the street corner because they find themselves placed between two equally desirable movies. They simply choose. But a man may wait for weeks or years, living and working ineffectively, because he faces a choice between two careers, or perhaps between two women, or even between a particular career and a particular woman—two incompatibles which do not fit each other. Then he does not choose easily. He may alternate between the two desires, trying first one, then the other. He may seek some compromise between them or he may cease *all* activity, become apathetic or even appear to be paralyzed. In an extreme case, he has a "nervous breakdown," and may have to go to a hospital.

Frustration, due to the thwarting of the satisfaction of a strong need by an external or internal obstacle or by a conflict, occurs more easily in some persons than in others. One man has a high degree of *frustration tolerance,* as it is called, accepts the inevitable fairly easily, recognizes incompatibles when he meets them, chooses between them and acts on his choice without regret. That is the healthy mind at work. Another man continues to batter his head against a stone wall or to try to eat his cake and have it too. To attempt the impossible persistently is to live inefficiently. That is the unhealthy mind, the man with low frustration tolerance. Both the healthy and the unhealthy mind may occasionally need psychological help.

PSYCHOLOGICAL MECHANISMS AND FRUSTRATION

The immediate consequences of frustration may be varied, but in general the frustrated man tries to overcome the frustration, escape from it, substitute some other goal for the original one, or, when he is frustrated by his own conflicts, find a way in which he can partially combine his incompatible needs in relation to some new goal. These mental devices by which he avoids frustration have been called the *psychological mechanisms.*

After National Socialism came to power in Germany there were many frustrated Germans, men who were opposed to the Nazis and who were thwarted or persecuted by them. An analysis of the autobiographies of ninety of these men revealed many different reactions to frustration. Open resistance, aggression against the aggressor, was first tried by a number of them. Many, however, soon assumed a defeated attitude and submissively resigned themselves to their fate. Others temporarily found security in preoccupation with routine tasks, with religious activities, with anything that provided distraction or hope. Some sought security by strengthening their ties with already established social groups. A man would turn to his family, his church, or his club. Others simply lowered their aspirations, ambitions and hopes—let themselves pass into the beginnings of apathy. Still others tried to conform to the Nazi regime in an attempt to please their oppressors. Some continued realistically to plan escape from Germany, while others resorted to unrealistic daydreams of freedom from persecution. The most common reactions were intensified planning, increased shrewdness of calculation, persistent effort to solve the insoluble problem. The mechanisms of defense against frustration and of escape from it are, however, very numerous indeed, and it is never possible to predict what will happen in a particular case.

When a man cannot actually escape from the source of his frustration, he becomes depressed or aggressive, or else escapes into some other activity or into daydreaming. He is worried, tired and ineffectual, or angry and aggressive, or apathetic and dreamy. He is more likely to become angry if he can pin the blame for his being thwarted on some external person or thing, for then he knows what to be angry with. That is the reason for lovers' quarrels, the reason why a man can even murder his sweetheart. On the other hand, if the frustrated man recognizes that the trouble lies within himself, is due to his own lack of ability or to the fact that he is being dominated by two incompatible needs, then there is more chance that he will become despondent and depressed rather than angry, unless indeed he is able, by himself, or with help, to gain a clear helpful insight into his problems. Sometimes his depression becomes an aggression directed against himself; he blames himself, heaps abuse on his own head. In an extreme case he may even commit suicide.

Depression is never useful. It is better to have anger, which is the frequent response of the healthy mind and often the motive for good action. Anger against the enemy, anger against a shirker or a thief is useful and desirable. It is an honest kind of anger. A great deal of anger that comes from frustration is, however, not straightforward, but the shifting of blame from one's own self to someone else, to someone who is really not at fault. The soldier who always has an excuse for his own mistakes and puts the blame on the sergeant is not indulging healthy anger. On the contrary, he is acting immaturely; he is reverting to a level of childish irresponsibility.

So much for immediate reactions to frustration. A long continued frustration, however, brings out more complicated modes of reaction, the psychological mechanisms. The recruit who never learns to like life in the Army or Navy, in spite of the fact that habits tend in time to get themselves liked, may become habitually tired and depressed or habitually irritable and aggressive. Or he may repress the need which he cannot satisfy, substituting something else for it.

In a thorough-going *repression* a man forgets about his frustrated need, does not admit its existence even to himself. Quite sincerely he seeks a substitute for its own sake—or at least he thinks he does. Not all repressions, however, are so thorough. Sometimes a man may know that he is concentrating on a substitute and even encourage himself voluntarily when it works well for him.

One common substitute for a repressed need is *fantasy* or wishful thinking. A man cannot have what he wants, so he takes it out in daydreaming. Perhaps he is not being very successful as a soldier, so he builds up stories to himself about great feats of prowess in which he is the hero and his critics are put to shame. Or he wants love but has no girl—perhaps because he is too shy, or perhaps because there simply are no girls around; so he daydreams of himself in a successful love life, and perhaps emphasizes his dreaming by masturbation. Such a man may be happy doing repetitive monotonous work, since it gives him the leisure to live his imaginary successful life. A certain amount of fantasy is normal and healthy, but too much shuts a man off from normal friendly coöperative relations with his comrades and is bad for morale.

A different result of frustration is *identification.* In it, a man unable to satisfy a need for himself, ties himself emotionally to someone else and feels and behaves as though he were that person. A man tends to identify himself with someone who is obtaining an objective satisfaction of needs which he himself has been unable to satisfy. In a mild form this is what happens when a father gets pleasure out of his son's success, or a son out of his father's. A movie may give pleasure because the members of the audience identify themselves with the hero who achieves what they could never hope to achieve. Or the hero of a novel may give the reader an *ersatz* success. Stories of the sexual exploits of others and some kinds of jokes about sex matters hold the attention of men almost in proportion to the degree with which their own sexual needs are frustrated. In general, identification is a good and healthy solution of the problem of frustration. It is bad when it leads a man to neglect his own efforts toward success, and to depend principally for gratification upon the success of another person or on the success of fictitious heroes.

It is common in the Army for the soldier to identify himself with his commander or with his unit as a whole. He is full of pride when any of *his* officers are successful. He may be miserable and humiliated if one of his officers should demean himself by unworthy behavior. Often he will make excuses for his leader, if he has had other reasons to admire him. Such identification is powerful in insuring group morale. It puts a heavy responsibility on the officer, especially on the junior officer, since it is with him that the young soldiers most readily identify themselves.

Then there are *compensations* through which a man attempts to make up for some defect or lack in his personality. Compensations are of two kinds.

The *defense compensation* occurs when a man is ashamed of one of his needs, represses it and behaves in a manner directly opposed to the repressed need. He would like to be strong and athletic but he is weak and awkward. So he builds up a life of being interested in art and literature, becoming violent in his scorn of men who like baseball and boxing. Or he is frustrated in his sexual life, turns against sex and is strong in his denunciations of moral laxity in others. When he is old, perhaps such a man joins a committee for the suppression of vice—not really because he knows how much harm vice does, but because he is against anything that belongs in the class of what he wanted and never had.

The *deficiency compensation* is sometimes good because it is an attempt to fight against and overcome a deficiency. Theodore Roosevelt, a sickly child, became physically strong through exercise and tough living. His antipathy to his weakness made him willing to do something constructive about it. Franklin D. Roosevelt surely owed some of his health and strength of will to the fact that he had the effects of infantile paralysis to overcome. The psychoanalyst, Alfred Adler, who had rickets as a child, developed the theory that escape from inferiority is the most important need in man's mental life. Deficiency compensation is, however, bad when it leads to foolishness, when it makes the weakling excessively profane or obscene, when it makes the fearful man, not merely brave, but foolhardy. The soldier who risks his life unnecessarily for no better reason than his own pride is not serving his country. Bravery ought to have a useful purpose.

Finally there is *projection,* the mechanism whereby a man projects his own suppressed wishes into others. The reformed drunkard sometimes becomes a prohibitionist. He sees his own suppressed desire for alcohol in others. The frustrated old maid who has repressed her own sex desires thinks men are always trying to seduce her. The coward sees cowards everywhere. Projection warps judgment, often accounts for an intensity of feeling about other people's action that is out of all proportion to common sense.

It is thus plain that men are controlled by their needs but that they do not always know what their needs are, that they cannot always understand their own motives. A man will, nevertheless, nearly always assign a motive to his action because he is expected to know what it is, and when he makes up a wrong motive—often unknowingly because the real one is repressed—he is said to be rationalizing. *Rationalization* is the assignment of plausible and acceptable motives to one's own actions without relation to the real causes, to the actual needs that are operating. The safe rule is: never trust fully your own opinion of your motives. If a friendly critic suggests a reason other than your own, weigh his opinion carefully, for he may be right. Or you may both be wrong. The real motive may be too thoroughly repressed for either of you to get at it.

These mechanisms of motivation come up again in connection with the personal adjustment of the soldier to military life and to combat (pp. 350-363). They are, however, also at the basis of morale. That is why they have to be considered here at the beginning of these chapters on the soldier's conduct.

DETERMINERS OF MORALE

What is morale? It comes pretty close to defining the morale which soldiers and sailors need if we put it in these simple words: *Morale is wanting to do what you have to do.* And that, moreover, includes *wanting to want to do what you have to do,* for a reluctant morale is not good morale.

After the fall of France in the summer of 1940, *morale* suddenly became a very important word in America. Its vagueness did not prevent its popularity. Everyone seemed sure that "morale" was badly needed by civilians as well as soldiers and sailors; yet no one was able to give a precise definition. Morale, like health, was obviously something desirable and something that everyone thought he understood, yet what was it?

One aspect of morale is indicated by the Pfc's definition: "Morale is what makes your legs do what your head knows isn't possible." An officer said: "Morale is the assurance you have while walking down the street that, when you wink at a girl, she will wink back at you." One psychologist said: "Morale is your confidence in your ability to cope with whatever the future may bring"; and another gave the definition cited above: "It is wanting to want to do what you have to do anyway."

Still another psychologist has stressed the intellectual, emotional and social aspects of good morale. Intellectually morale is a man's conviction that what he is doing now is helping to get him eventually something that he wants. Emotionally morale is the zest that goes with health and competence, enabling a man to perform effectively the job that lies immediately before him. Socially morale is a man's fundamental feeling of agreement with his superior officers and with the others with whom he coöperates, a feeling that there are no fatal cross-purposes working within his unit.

The War Department's Division of Information and Education has fixed upon four attributes of good morale as follows:

(a) *Zeal*—the voluntary "plus" which a man gives to his task, over and beyond perfunctory obedience to regulations.

(b) *Discipline*—in General Marshall's words, "cheerful and understanding subordination of the individual to the good of the team."

(c) *Self-confidence*—basic sense of personal worth, founded on a realistic appraisal of what the job is like and on confidence in past training and present leadership.

(d) *Satisfaction*—freedom from discontent and worry (not the mere absence of griping); fundamental satisfaction with one's day-to-day part in the war effort:

AWOLs rate poorly in respect of every one of these attributes.

How can a man be made to want to do what he has to do? How can he make himself want to do what he has to do? The establishment of morale is obviously a problem of using the needs which the man already has and of tying some of them into his job, by training and by the arrangement of external conditions, so that he finds himself doing in his job the sort of things that he likes to do or attaining through his job the sort of satisfactions that are important to him. It is really the secret of successful living—to like to do what is most useful.

Morale is not a general trait of personality, which some men have in large degree and others not. Morale is simply the man's relation to a particular job or the particular requirements of his life. His morale is high if he knows what his objectives are and if he believes that they are attainable and worthwhile. His morale is high if he has confidence that others consider his objectives important and especially if he is confident that his leaders believe in them and will continue to work toward them even when the going is hardest.

A man could have high morale for one job and low for another. If his morale is high for two different jobs or undertakings and the two activities come into conflict with each other, then he is in trouble in a very special way, for he has two specialized needs in conflict. Not always can a man do well and at the same time two useful things that he likes to do. Mostly, however, military service does not present such conflicts.

It is not too much to say that bad morale always arises from frustration. If good morale is wanting to do what you have to do, then, when you do not want to do what you have to do, you are frustrated. How can you get rid of such frustration? Sometimes by removing the obstacles that cause it or by having them removed—getting warm when you are cold, getting letters when you are lonely, being important when you feel inferior. Sometimes by getting hold of another need and substituting it for the frustrated one, like letting pride overcome fatigue, or identifying yourself with your leader or your unit in the achievements of either.

It has been objected that wanting to do what you have to do is too narrow a definition of military morale, that morale is better defined as *zest,* the spirit of readiness for new experiences and activities, the opposite of apathy and yet something different from aggression and anger. That may be true, but men in the Army and Navy have a job to do, a duty to perform, and the nature of the duty generally comes down to them from higher command. They have always a mission to accomplish, and, if they have zest for it, then they will be found to be wanting to do what they have to do, wanting to do what comes to them from higher command because of the action of the enemy and the purposes of the war.

There are a dozen conditions, both physical and psychological, that aid military morale, that help to add zest to the performance of duty. Let us see what they are.

(1) **Water and Food.** If the needs of troops for water and food are not satisfied, if they are thirsty and hungry, then morale goes down. Men tend to become irritable and jittery; they are likely to be aggressive and quarrelsome, projecting their troubles on others, finding fault where no fault lies.

When the Children of Israel found themselves in the wilderness without food and water, they forgot their sufferings in Egypt and turned against their leader, Moses, who had been successful thus far, blaming him. Hungry, thirsty, tired troops also become ripe for fantastic rumor and even panic, especially if they are unseasoned troops. Judgment yields before frustration—and sometimes discipline too, if great fear is added to the frustration.

Well trained and experienced troops, however, are not seriously affected by hunger and thirst that do not reach a severe stage. They have had practice in endurance. They know that hunger and thirst are often among the hardships of war. And pride in ability to keep going on little, plus realization of the military necessity for so doing, offsets in considerable degree the tendency to a lowering of morale. At the same time, the fact that morale is generally lowered by hunger and thirst, at least enough to be raised by hot, cooked food when it is needed, is fully recognized in the Army and Navy. Every effort is made to get such food to men in battle. Subsistence on cold food and emergency rations is not considered normal, though at times it may be unavoidable for as long as several days.

Vitamins in the food are also morale builders. Essential to health, they provide buoyancy and lessen fatigue. The Army and Navy see to it that the diet supplies proper vitamins or issue them separately when the right foods become unavailable.

(2) **Cleanliness.** Being clean builds morale. Healthy civilized men do not like to be dirty, but when they first learn the discipline of standing inspection they are likely to resent its rigid requirements, to become frustrated by them. Discipline may require them to keep cleaner than they have before or to clean up more often or more regularly. After they understand the reasons for these requirements and the habits of neatness become autonomous, so firmly fixed that the men always clean the mud off their uniforms and shoes at the first opportunity, then they are also fortified against the depression and the greater risk of illness that so often go with dirt and slovenliness. Dirty troops and dirty ships have high sick rates.

(3) **Warmth.** A reasonable amount of warmth also helps morale. A vigorous man may be braced and stimulated by cold for a while, but not by unremitting cold. If he can have warmth for his rest and relaxation, he will be cheered by it. Mild warmth is almost never unpleasant;

cold often is. No one ever likes to feel cold all over for long. The cold shower bath is pleasant because it is brief and leaves a man with a warm glow.

Men in dangerous situations always prefer warmth to coolness and will put up with the poorest ventilation to secure it. If they cannot find warmth, they are likely to become fearful and anxious. Perhaps warmth carries with it from childhood the sense of protection of the warm body of the mother, or the sense of being loved. Love is always thought of as warm, never cold—and so is protection. "He shall cover thee with his feathers, and under his wings shalt thou trust."

Warm clothing is, therefore, an important condition of morale, and so is a warm place to sleep and eat. Men can fight well when cold, but they fight better if they are warm.

(4) **Fatigue and Sleepiness.** The tired soldier and the sleepy soldier are irritable men, readily exasperated, quick to anger, easily frightened. Their morale is low. They lose sight of the larger issues. They cannot plan well nor anticipate action clearly. The one needs rest, the other sleep. They should have both as soon as it becomes possible. Fatigue and sleepiness hit officers as well as men. When an officer tells a private that he is "yellow-bellied," perhaps the officer is tired, too.

These needs do not, however, have to dominate. The fatigued man is still spurred to new levels of exertion by fear or anger—by any emotion in fact. Emotion puts the body in a state of readiness for action, helps it get rid of the fatiguing substances in muscle and blood. Other needs can fight fatigue—pride, loyalty, any of the components of good morale. Fatigue works against morale, but morale also works against fatigue. What the man finally does is the resultant of all the forces acting on him.

It is the same with sleepiness. Not many men can stay awake all night reading a dull book; but most men can manage to keep awake from midnight to morning with the stimulation of conversation or of marching. A man can manage two sleepless nights in succession if he has a need for doing so and the need is reinforced by activity or social contact. And on the second night, when he is perhaps just dozing off, a command from his leader may suddenly galvanize him into action. It is all a matter of fighting one need with others.

Water, food, warmth, rest and sleep are external goals upon which the needs of a man are directed. They are basic, but most of the conditions for good morale are internal. They lie in a man's *attitudes* toward his job as a soldier. How can he like doing what he has to do as a soldier?

(5) **Realistic News.** The soldier needs news. He needs good news most, but bad news is better for him than uncertainty.

He should always know how the war is going on all fronts. The victories should be played up for him but the defeats should be honestly told him. A defeat can improve morale as the morale in the United States suddenly rose on the report of disaster from Pearl Harbor. A British psychologist declared that in his opinion the chief factor in the high morale of Britain following Dunkirk and the blitz was that the inhabitants of the British Isles felt that they knew the worst, that nothing was kept from them. Churchill's promise of "blood, sweat and tears" actually raised morale. On the other hand, the bombing of the Germans in Tunisia helped greatly to break an already crumbling German morale. Uncertainty—lack of definite news or lack of confidence in it because of previous false information—is never good for morale.

For the same reason troops should be told as much as possible about the military situation in which they find themselves. They ought, when possible, to know at least where the enemy nearest to them probably is and his general strength and condition. They ought to know what kind of weapons the enemy has. Ignorance of such facts sometimes makes troops panic-ripe.

Men need letters from home. In training camp they need the frequent passes and furloughs that they get. Not only do they want reassurance of love and affection from their loved ones at home, but they want also to know that everything is going all right. One man hopes to hear that the roof has at last been mended, another that the mortgage has been looked after. They are glad enough to hear about rationing and food shortages, because that means to them that the home folks are supporting the war effort, but they are not helped by hearing frequent complaints. Men in combat zones are apt to think that they are earning the right to do the complaining themselves. They do like to know all that is going on, and the V-mail is an excellent morale builder for men overseas.

Men at the front need also general news about the country at home. They want to hear that their country is back of their effort, that the Government intends to help them find jobs after the war. Brave men, who are not afraid to face death from the machine guns of the enemy, may, nevertheless, be troubled or even torn with fear about what is going on at home or what may happen to them when the war is over.

(6) **Recreation.** Boredom is an enemy of morale and variety its friend. The different activities of the soldier's and sailor's job provide a great deal of variety, but unfortunately for morale they are all alike in one respect—they are all prescribed duties. A man needs some time when he is free to choose activities for himself, activities that express some need or interest of his own. So there should be leisure in the soldier's life and a wide variety of means for employing it according to his own inclinations.

The Army by carefully planned questionnaires has determined what soldiers like to do in their leisure time, what sports they prefer as participants, as spectators, in the tropics, in temperate climates. For instance, in the tropics swimming ranks first, but American baseball is still a good third.

A camp can provide a reading room—books, magazines, newspapers. It can provide radios and a chance for the men to listen to their favorite programs. It can provide movies, shows, entertainments. It can see to it that each man has time, place and facilities for writing letters home. On shipboard the same things can be done in more limited degree. For a unit stationed in unfamiliar territory, or a ship's crew reaching a far-off friendly port, the Army and Navy can provide historical tours to visit points of interest in the vicinity and to study the terrain from a military point of view.

Recreations that increase the serviceman's proficiency at his own job serve a double purpose in morale. They provide fun plus the sense of advancement toward the main goal of winning the war. Skeet-shooting, hunting, athletic contests may be counted among these recreations.

Passes and furloughs are invaluable. The man on pass feels free of most of the constraints of discipline. What he actually finds to do—shows, dances, sight-seeing—depends on what the neighboring community affords, but for most men any pass anywhere is better for morale than none. It is mostly on passes or furloughs that the feminine contacts are made, that the sex needs, partly suppressed in camp, get full or partial expression.

A furlough is a long pass with a chance to go home and a chance to do something for the great wealth of needs which the soldier already had before he went into the Army.

These needs which Army life restrains or directs upon imperfect substitutes can be restrained again if given, as often as possible, opportunity for normal expression.

Too frequent passes, however, may be damaging to morale. Legend has it that Hannibal's army, after a string of victories, spent an idle winter at Capua and lost its morale for the spring offensive against Rome. One officer reports that one month of near vacation at the seashore in 1941 destroyed the morale of his men for months. A reasonable period of total relaxation after a gruelling period of combat is a different matter.

These are all matters that the Army and Navy have done much about in the Second World War, realizing their importance and taking steps to impress all commanders with the need for constant attention to them.

(7) **Self-importance.** Every man needs to feel important. This need is basic. A man who loses respect for himself is lost as a useful member of society. A man who feels that he has lost the respect of all other men is pretty nearly as badly off. A man readily accepts a subordinate status provided he still thinks he measures up to some self-established aspiration. But he must measure up to something, be successful in some regard, feel essential in whatever it is he is doing.

The morale of a great many recruits in training camp suffers especially because they feel unimportant. The recruit is landed in an entirely new life, is faced with a set of requirements which seem to him confused, arbitrary and often useless. For instance, the men of a company may have been lying around in the barracks after lunch for a half-hour of "bunk fatigue," when the order comes for them to fall in within two minutes in fatigues, leggings and light packs. "Why didn't somebody tells us half an hour ago?" they complain, not realizing that the skill to meet similar orders rapidly is indispensable under battle conditions and requires practice. When they have fallen in they may have to wait around doing nothing for half an hour. "Hurry and wait" becomes the cynical complaint of the recruit about the Army. Campaign and battle, however, are principally "hurry and wait," but there is no good reason for military leaders to overdo them from carelessness, as often happens.

Morale can surely be broken by enlisting the interest of men in a job, letting them find out later that their work was unnecessary and useless, and then keeping them on other jobs which seem purposeless to them and are, for all they know, equally useless. When prisoners are made to move by arduous labor a pile of stones from one place to another, and then to move them back the next day to the same position, and such useless labor is continued, their spirits break.

In the Army morale can be kept up, in spite of necessary confusion and the giving of "orders and counterorders," by explaining the reasons to the men, all the reasons they can know without endangering military security. Men who have been given reasons during the training period are more likely to obey willingly and without reservation at the front. At training camp let the commander explain the reasons for seemingly arbitrary action to his men, or let him see that the noncoms do. And, if the commander delegates this task to the noncoms, let him be sure that they do it. This principle applies to combat, too.

As training goes on, this enemy of morale, lack of self-importance, gets weaker. The men learn about the Army. For many of them there are promotions. They begin to feel important. Even the private first class has achieved something and can now feel above those who have not. Honors and citations are a great aid to the morale of those who receive them, but for all there is the honor of becoming a veteran. The men who have come through combat are veterans to those who have not, and there are also lesser veterans. The men who have come through inoculations and the gas chamber seem like veterans to the men who have not. It is good for morale to feel yourself a veteran.

One officer gives a special reason why it is good for the men of a unit that has suffered severe losses in combat to have replacements sent immediately to the unit. Why? Because the veterans then tell the replacements all about what has happened, building up their stories and establishing their own bravery, banishing their emotion over recent horror by their assumption of self-importance.

In general, a unit with a good leader improves in morale as its training and experience increase. The men learn to work together and to depend on one another. Each feels that he has become important, has become essential to the successful operation of the group as a whole.

(8) **Jobs.** The finding of the right man for the right job is necessary for the efficient working of the Army and the Navy. The finding of the right job for the right man is equally necessary for morale. A soldier or sailor is more likely to be content if he has something he can do well, a job that uses his abilities as effectively as ever they could be used in the armed forces even though the job he is now doing has no counterpart in civilian life. Even in such a job, if he is rightly placed, he may experience success and thus learn to want to do what he has to do.

The Army and Navy jobs also provide opportunities for technical training in specialities. A man who learns photography, or radio repair, or who acquires expertness as an automobile mechanic when he was only a tinkerer before, realizes that he is increasing his practical skills and so worries less about what he will find to do for a living when the war is over. To his sense of success is added his feeling of increased security about the future.

A good morale builder is to allow men, whenever possible, to choose the speciality to which they would like to be assigned. It has been found that the soldier or sailor who is permitted to choose is happier in his job, even when military necessity interferes with his being placed exactly where he would like to be, than is the man whose vocational wishes were never consulted. Often, however, in both the Army and Navy there can be little choice allowed because of the need for large numbers of one class of soldiers or sailors. Then other morale builders have to be emphasized, chiefly the reasons why the choice must be limited to satisfy the urgent need.

Sometimes a job needs to be "sold" to the soldier or sailor. The possible jobs are described to the men in booklets and by movies, their characteristics made clear, and the men are invited to express preferences based on their newly acquired knowledge of the different kinds of work.

Occasionally a job may need to be "resold." There was a time in the Second World War when the rumor got around that radar operators were likely to have their eyes injured by their prolonged observation of oscilloscopes. That rumor was combated by performing an experiment in which the vision of a group of men who made the prolonged observations was compared with the vision of another group who rarely worked more than half an hour at this task. The results, which showed that the vision of neither group was affected adversely by their work, were then brought to the attention of the operators. The rumor was scotched.

Some soldiers and sailors read books or professional journals in their leisure time and thus increase their proficiency in fields that will not be useful until after the war. Some eagerly try to improve their capabilities for their military jobs. Many men are sent back to college by both the Army and the Navy for further study on subjects of technical military importance. To get even highly specialized college training out of military service is a privilege for the men who want it and can profit by it and have the good fortune to get it. That too is a morale builder.

Besides these ways in which the morale of the individual soldier is favored by external conditions and events, there are also the relations of each man to other men, the *social relations.*

(9) **Group Solidarity.** The new recruit has left all his friends, men and women, at home. He is lonely. He needs companionship and, in different degrees according to his social capacities, he finds it among other lonely recruits. He substitutes new friends for old. Even his need of feminine companionship may be lessened in some degree by the constant talk of soldiers about sex, although it may also be increased in this way. But his loneliness gets less because he has companions. In the early days of training he has little more than these personal friendships to depend upon. Transfers are frequent. Leaders change often. He is not yet part of a unit that is being built into a unitary fighting or working team.

But when he does become part of a particular unit, then a new kind of companionship begins to be built up—provided morale is increasing as it should, provided the group has a good leader. Shifts of personnel have become less frequent. Good morale requires that they should be infrequent, although sometimes they are necessary. For instance, no leader should try to hold on to an expert airplane mechanic for looking after the jeeps of his unit, not even for the sake of keeping his unit intact. The man should have gone to the Air Forces in the first place unless, of course, the Army's need for jeep mechanics happens to be greater than the need for airplane mechanics. In general, however, with the group held together and with good leadership, group loyalty forms. The men find that they are all essential to one another. They come to depend on one another, to feel that they belong together and can trust each other. In such a social atmosphere the self-importance of the individual grows. So does his sense of security. In all kinds of drill and in field problems the men learn mutual dependence.

Some officers stress close-order drill as a morale builder. The men learn to act in unison. The drill, they say, should be held on level ground to prevent inequalities of movement among the men, if possible on a wooden floor so that the sound of marching feet will impress the men with their unitary character. There is something emotionally pleasant in the single thud when all the feet strike the floor at once. Only a fraction of the soldier's or sailor's training time, however, is given to this type of drill, for there are too many other things to be learned, some of greater importance, and all of value in building morale. For the knowledge that he is *fully* trained is always an important element of morale for soldiers and sailors alike.

All commanders stress field exercises. There the individual fighting soldier has more responsibility and often finds himself playing a unique rôle in the total movement. Though fighting as part of a team he may often be practically alone, and feel alone; and only through combat training can he gain the self-reliance that will sustain his morale at such times in combat. The coördinated perfectly timed work of a football team in action welds men into a unit of action for battle, and this too must come from combat training, from field exercises and maneuvers. The same sort of perfectly coördinated effort is required of men who set up a machine gun or other crew-served weapon and keep it in action. Each does his part, different from the others, but fits it into the action of his mates so that all move smoothly as a single unit. When a man rarely fails in his part, never misses his cue, the others come to trust him. Such teamwork is learned through drill first and then combat practice in the field. And when perfection is approached the achievement always adds to morale.

Showing off, especially credit duly acknowledged by higher authority, is a good thing for morale. Distinctive hat pipings, battle patches, service stripes, medals, marching through town with a band—all such things help to make the unit conscious of itself as a unit. All help to develop pride in one's unit.

On the other hand, the leader must never take his unit to task as a whole before other units or before superior officers. There are always some men in the unit who have done their utmost, who are not to blame for a fault involving unit performance. Group censure or punishment lowers morale. A leader may berate his men in private, as long as he stands up for them in public. They need to know that every man in the unit, especially the leader, is working for all the others.

For this same reason it is better not to put too much stress on competition within a unit. Success may temporarily boost the morale of the men who win, but it fosters an every-man-for-himself spirit that is fatal to group morale. It also lowers the morale of men who lose much more often than they win. Ruthless competition can in this way disrupt the morale of a unit. Competition of one unit with another, within limits, is a good morale builder, but this, too, can easily be overdone. The attainment of a high—but attainable—standard is of much more importance to military and naval morale and efficiency than the selection of champion units. The object of every unit should be to defeat the enemy, not to outdo some other group of Americans.

When a military unit approaches combat, morale usually gets better. Then the men realize how important it is for them to stand together.

Their need to trust one another becomes plainer, and if properly trained for combat they have had time and opportunity to acquire this trust. Every man should be working toward the common objective—the success and safety of the unit—for all are likely to meet or escape disaster together in the dangerous life-and-death business that is now close at hand. In training camp, morale depended on a hundred different needs. None of them seems important in comparison with avoiding death while overcoming the enemy, the great need of troops in combat.

Showing off also reaches its climax after battle. There is no pride so great as the pride of victorious veterans, and no unit is so tightly knit together as one of seasoned troops who know they can win because they already have won.

(10) **Leadership.** Because of his unique and dominant position, the leader of a unit can make or break its morale. That is because he has power as well as the responsibility that goes with power. His men can be hungry, cold, tired, worried and without much chance for recreation, and can still have good morale, if they have been trained to think of hardships as "normal" on campaigns and if they know that their leader shares these difficulties with them and is constantly working for them. They can do without letters from home if the leader makes it clear that he is trying to get their mail for them. They can face death at his command if they are sure that death is necessary to victory—if they know that he is competent and willing to lead the way into the danger.

The rôle of the leader, which is discussed elsewhere in this book (pp. 410-425), is that of commanding servant. He accepts conditions as they come to his unit from the outside, as right or necessary. Mud and cold, heat and wetness, and enemy fire are necessary evils of war. Commands of superior officers are necessary and right. The good leader never criticizes his superiors to his men. He does his utmost to protect them against incompetence or injustice, explaining to them the reasons behind such orders from higher authority as may seem unreasonable.

All these external conditions simply fix the nature of the problems which the unit has to solve. When they are known, it is the leader's task to let his men realize that he is working with them to solve the common problems in the ways that will most successfully satisfy the men's own needs—their needs for safety, comfort, self-importance, companionship, and so on through the list. When things go badly the men will project their frustrations upon him, unless they know that he is for them. Then they may even identify themselves with him, feeling that his successes are their successes.

A capricious, selfish leader, who commands without serving, who treats his men as machines for executing orders, can never have good morale. Even if the men could conceivably form a group loyalty to one another in such a unit, they would direct a common resentment against the leader. They could not be wanting to do what they have to do out of strong loyalty to the immediate leader who tells them what it is they have to do, although men under such a leader will often have a strong sense of loyalty to commanders higher up. They would be likely to blame the immediate leader because he is not one of them and also to place some blame on higher commanders for giving them a unit leader who does not measure up to their standards.

So the leader must think about his men and their needs, identifying himself with them. He must show that he knows their dominant needs, recognize each man and use his name, make it clear that he notes every good performance. Then he can command them, dress them down in the privacy of the unit, and administer justice. Morale is not hurt by justice administered without favoritism or caprice.

It is easy to show how the good leader can keep up the morale of his men, but who is to keep up the morale of the leader? Who are his companions? On whom can the leader rely to get him out of a tight place? Into whose ear can he pour out his own complaints? He can ask advice of his subordinates, but he must make the decisions himself and not hold his advisors responsible. He cannot complain to his subordinates or his men. He may rely on them for support and to some extent for judgment, though he must make the decisions. He cannot complain freely to his superiors though he can always give them the facts about any circumstances that seem to work an undue hardship on his unit. His men can well look to him for approval, but he had better not look for approval from them. The leader who is seeking the approval of his men rather than the success of his unit is not likely to gain success, or for long to hold his men's approval either. In fact, the leader is isolated by his position of power and responsibility. He is likely to be lonely.

There is no simple external remedy for the leader's isolation. He must be friendly with his men but not familiar. He must keep his distance from them and they their deference for him. If he succeeds in welding his unit into one reasonably cheerful, loyal family, still he cannot expect to get from his men the same sense of security that they feel in trusting him. He must therefore be emotionally tough. He must be strong and responsible, self-assured and without need for immediate approval. His rôle as a leader requires that he have the capacity to act pretty much alone. Men who have this strength of character, which often comes largely through experience in leadership, are not common. Presumably that is why good leaders are so scarce, why the highest morale is so seldom found, especially in military forces that are rapidly expanding, in which it is at once necessary to have large numbers of leaders who are themselves limited in training and experience.

In addition to the external material and social conditions of morale, there are some internal conditions, *personal attitudes,* that count. They cannot so easily be controlled, but it is important to know about them.

(11) **Ideology.** A man's belief about the war, its causes and its rightness, may effect his morale, especially when he has first been drafted and is facing personal obscurity in the big arbitrary confusion of his initial training. Beliefs and convictions are the most important determiners of civilian morale. To many men about to be drafted, questions like these come up. Is this really a war for democracy? Is democracy really better than other kinds of government, democracy with all its inefficiencies? Will victory provide security, fair treatment and honorable status for me? for most men? Are our leaders to be trusted?

One careful analysis of civilian democratic morale showed that it broke down into (1) a reasoned determination to achieve victory, (2) confidence in leaders, and (3) satisfaction with the traditional values of the government.

For the more thoughtful and intelligent men in the armed services, ideological convictions may continue to support or hinder morale. These men never lose sight of what their world would be like if the enemy won the war. They return to the military job with renewed determination after reading about some new enemy cruelty or injustice or after hearing of an enemy victory. They are the men with time-perspective. They are accustomed to think in long terms, about next year and even years hence. They have always planned their lives ahead.

They plan their lives ahead, but even they are thinking less about the future of democracy than about what is back of the next hill when they are to attack at dawn, or what will be in the skies the next time their plane delivers a bomb load.

For a great many men, however, ideology is not a very important element in the morale of training camp or later in combat. They know what the war is about. The Army sees to that with its excellent indoctrination films and other orientation measures. But the important things are work and recognition, and the sergeant, and furloughs, and sex. These men think about work and recognition, and the sergeant, and furloughs, and sex. They lack the larger perspective. Tomorrow and next week concern them most. They think much about combat, for the topic is continually forced upon them. Overseas and at the front, they also think about food, mud, warmth, recognition, the men they dislike, and, of course, sex. Before combat they think about danger and what to do to keep safe themselves and, in a unit with good morale, to make the unit safe, to insure its security—tomorrow or next week, not next year. Their pride lies in achievement—their own and their unit's. They get to hate the enemy when they have contact with him, but they hate him more for the way they see him behaving than for any philosophy which they know he represents.

The most able men—the good leaders at all the levels of rank—are the men who have their ideological orientation so firmly fixed that they think little about it and enter easily, wholly and enthusiastically, into the demands of the immediate present. Today's problem looms large, whether it be trivial or great. Able military men are not mere dreamers. They live intensely in the present, but can discuss the future with you if you ask them.

(12) **Religion.** All reports from men who have seen troops facing danger at the front show that a trust in God and a belief in some kind of immortality is a great supporter of morale. Men who have faith in the power of prayer find that it works for them, gives them assurance, lessens fear. For this reason the armed services support religious faith, provide chaplains to minister to the spiritual needs of the men and opportunities for religious observances.

Effective religious belief is not, however, something that is cultivated as the morale of a unit increases. It has grown—when it exists—out of long established habits of thinking which were, in most cases, built up by the parents of the soldier or sailor when he was a child. Some men lose faith as they grow up, others gain it. When it exists, it has high military value, but for the most part the armed services have to accept it when they find it and do without it when it is missing.

If the leader understands and appreciates all these determiners of morale, he is in a position to control morale, to build it up in his unit —especially if he has some help from higher authority, like the provision of reading matter, entertainment, athletic equipment, and other means of recreation. Civilian agencies in adjacent communities may help him.

The leader needs also, however, to be able to assess morale. He needs to know the indicators of good and bad morale and to give special attention to them, lest he be misled in judging his unit by his own wishful thinking. He should find out, at first hand, if possible, what his men need to build their morale. The men should be able to talk with their leaders, to tell them what is on their minds. They may be worried about things at home. They may feel that the training pace is too rapid, or more likely that it is too slow. They may want more quiet periods for study or opportunities for special training in map reading and other military subjects they may feel uncertain about.

Then the leader must see that his men get what they need or, if that is not possible, that they get an explanation of why they must do without. If the pants do not fit, he sees that they are altered. If the mail is not coming through, he does something about it. If his men wish they had a radio, he should get one for them even if he has to make it with his own hands or buy it out of his own pay. If his men get little out of a lecture or training films, he may be able to get an instructor who can interest the men and keep them awake, or he may see about better ventilation in the hall. If his men have the discouraged feeling that all the glory is going to some more glamorous outfit, he may have to prove to them that that is not so. He must see that they get news of the men in combat who are distinguishing themselves, must see that they hear what their own division or branch of the service is contributing and how it is winning respect and honor. It is not necessary for him to exaggerate or boost pride artificially with forced pep talks. He needs only to tell his men what is going on in the combat areas, and to see, when possible, that they get a chance to meet and talk with men who have been in the thick of things and come back with decorations and stories to tell, when his unit has not yet had the chance to earn some decorations of its own.

A good leader has no difficulty in listing the indicators of good morale. They include low rates of desertion and AWOL, of faked illness (malingering), or of illness that appears to have a mental rather than a physical cause, of venereal disease, of courts-martial and civil arrests, of careless loss of equipment or injury to it, of slackness in dress and saluting, of misunderstanding of orders and slackness in carrying them out, of requests for transfer. A leader will also have regard to the frequency of the use of recreational facilities, to the speed with which men learn to do their jobs well, to their coöperativeness in solving group problems.

At the front and in combat there are still other indicators of morale: the fewness of stragglers, the infrequency of unnecessary abandonment of equipment or of wasteful use of ammunition and supplies. And if insubordination, desertion, willful surrender, sabotage for the purpose of avoiding combat duty, or self-inflicted wounds begin to appear with any frequency, then a seriously poor state of morale is indicated.

In the armed services, all commanders keep accurate statistics on these morale indicators in order to detect early any change in morale so that conditions can be improved. Such records make it possible to compare one period of time with another, and one unit with another, and to set standards. Have the AWOLs fallen off or increased in the months since the hardest period of training began? Has the number of men using the reading room increased? Is the sick rate up for no external reason? The use of such statistics checks any leader's wishful thinking about morale. It should not, however, take his attention away from other important items that cannot be counted and ought not to be forgotten. It is hardly possible to enumerate coöperation or even neatness, although they depend to some extent on the unit's rate of punishment for minor military offenses.

The Army has an Information and Education Division to help all commanders build and sustain morale in their units. An officer selected by his commanding officer and trained by the Special Services Division studies levels of morale in the command and among the units. This officer makes suggestions to the leaders, to the commanding officer, and to the highest authorities. All commanders do well to make the fullest use of these officers, to seek their advice and give it serious thought. Morale is vital in every military unit.

REFERENCES

1. G. W. Allport. *Personality: a psychological interpretation.* New York: Henry Holt, 1937. Pp. 588.
   A systematic, comprehensive and technical treatment of the basic psychological issues involved in the understanding of human personality. Chapters 4, 6, and 8 are especially relevant.
2. C. Bird. *Social psychology.* New York: Appleton-Century, 1940. Pp. 564.
   A standard text covering the traditional topics in social psychology.

3. COLONEL G. B. CHISHOLM. *Morale: a platoon commander's responsibility for his men.* Toronto: Canadian National Committee for Mental Hygiene. Pp. 15.

Brief but excellent; considers group formation, coöperation, attitudes, drill, warmth, showing off, sex, religion, fear and self-discipline.

4. H. COPELAND. *Psychology and the soldier.* Harrisburg: Military Service Publishing Company, 1942. Pp. 136.

A guide to military morale which emphasizes the importance of morale, discipline, leadership and ideals in the British Army as even greater than military weapons.

5. R. INGERSOLL. *The battle is the pay-off.* New York: Harcourt, Brace, 1943. Pp. 217.

An excellently told story of the experiences of the former editor of *PM* as an American soldier in the battle of Tunisia in the Second World War.

6. J. T. MACCURDY. *The structure of morale.* New York: Macmillan, 1943. Pp. 224.

Applies psychology and the experiences of the Second World War to the study of fear, leadership, national differences, loyalty, totalitarianism and democracy.

7. F. J. ROETHLISBERGER. *Management and morale.* Cambridge: Harvard University Press, 1941. Pp. 194.

An analysis of problems of morale in industry.

8. G. WATSON, ED. *Civilian morale.* Yearbook for Society for Psychological Study of Social Issues. Boston: Houghton Mifflin, 1942. Pp. 463.

A series of chapters written by eminent social psychologists on such topics as the theory of morale, how morale develops, the state of American morale and morale in industry.

See also references in Chapter 18, especially item No. 3 (Chapters 6, 7, 8), item No. 4 (Chapters 8, 9, 10, 11), and item No. 5 (Chapter 10).

Chapter 15

Personal Adjustment

Half of living is changing things or people—making something in a factory, growing something on a farm, getting a customer to like your product, getting a girl to like you, taking the family somewhere in the car, hitting a home run at a picnic. The other half of life is changing *yourself,* adjusting yourself to the inevitable, the unalterable and the necessary.

Personal adjustment is the psychological side of growing up, of becoming mature. The new-born infant is adjusting to a new world when he has to start breathing to keep alive. It is doubtful whether he likes the change from the ease and comfort when his mother did his breathing for him, but he adjusts. He adjusts again when he gives up his bottle and learns to drink from a cup. He does not like that at first. And, when he becomes a boy, he keeps on adjusting—learning to play with other children, learning to go by himself to school, learning later what to do about that strange change in himself when girls begin to be interesting instead of ridiculous. Earning his living means continual adjustments for the youth and the man, as do his affairs of love, marriage and parenthood. So that half of life is personal adjustment, learning to adapt to new conditions which cannot themselves be changed easily.

In a democratic nation like America most men have not had to make the adjustments which must be made to military life. They have been meeting successively, with greater or less success, the requirements of maturity as civilians, and then war breaks out and they have—some millions of them—suddenly to adjust to an entirely new kind of life, a controlled life of coöperation under discipline, a life of taking orders and learning to do new and unexpected things, a life without privacy or women in it, a life which brings success only by leading most men into danger and some to death. That is a large order for adjustment, one not easily made, one fraught with potential psychological casualties.

Young men adjust most easily. They are still at the age when they expect great changes in their lives. Their habits and preferences are not yet solidly set. A youth of eighteen can make these adjustments fairly easily, and a man of twenty-five; but a man of forty-five has great difficulty, especially since he is apt not to have the physical stamina necessary in the rigors of training and combat. These adjustments are somewhat easier in totalitarian countries, where the boys look forward to military training and all receive it. The fanatical German youth in the Second World War, who were *Hitler Jugend,* were better prepared psychologically for war than the American youth of the same age. Some psychological casualties are the price of sudden precipitation into military life.

When one comes to consider the adjustment of the soldier or sailor to the many new requirements which military service lays upon him, it is convenient to keep in mind the distinction between his *social needs* and his needs as an individual. These latter are sometimes called his *ego needs.* Man is fundamentally egoistic. The preservation of his life, his body and his self-respect are utterly vital to him, and it is hard to say which of them is most important—for a man will sometimes accept bodily injury and even death to preserve his self-respect. In fact, it is a question as to whether self-respect, being a matter of a man's own attitude toward himself, is ever lost, whether the man who reviles himself in abject humility is not really holding on to self-respect by experiencing pride in his humility, whether the suicide does not still believe in himself when he escapes from the world which no longer believes in him. In such fashion the social needs get all mixed up with the ego needs. Men want both friends and honor.

In the Army there are two successive problems of adjustment and some men go to pieces trying to meet one or the other of these sets of requirements. The first set appears in the adjustment of the recruit to training camp when he is required to change from civilian to military life. The second set comes with the adjustment to the greatest rigors of life at the front and to the danger of combat. Only seasoned Army men have made both of these adjustments, and even some of them may break under continued defeat and increased hardship.

THE RECRUIT'S ADJUSTMENT

When the recruit gets to training camp he finds many of his ego needs threatened. He finds himself in a confusion of rules and discipline. He is asked to make his behavior conform to all sorts of activities for which he does not understand the reasons. Often it seems to him that no one of importance is interested in him as a person. He is made to dress and act like everyone else. He is likely, therefore, to be troubled by a fear of the loss of his identity. He is told that he must think now, not as a clerk or a salesman or a machinist or a student or a lawyer, but as a soldier. Yet everyone else is also a soldier and it seems to him at first that there is no expectation that he should be anything other than just one more among all the others, although later he will find that his training emphasizes the importance of his individual initiative.

Simultaneously he discovers that he has much less freedom of choice left to him. His life largely is ordered for him—when he shall get up, how fast he shall dress, when he shall eat, what he shall do next, and so on through the day until taps when, of course, he must be in bed whatever his previous retiring habits may have been. He still has choices to make, but they are new choices.

Added to these new requirements there is a loss of privacy. His life has suddenly become public. If he looks much at his girl's picture, his comrades know it. If the corporal has to dump him out of his bunk in the morning, they all know that too. It is not easy for most American men who have had privacy to give it up.

The things the recruit does during the day, moreover, do not, for the most part, make sense to him. It is important that he be told the whys for discipline and for this and that requirement, and generally military authorities agree that he should be told. In the rush of military life this need of the recruit's is sometimes forgotten, or military security may make it impossible to meet it. Nevertheless, there are few things worse for morale than having to keep on exerting yourself at seemingly useless tasks.

Finally, the recruit may become painfully aware that all of his own friends and his family are not just around the corner and that there are no girls or women folk in camp. He may find this a strange and restricting life, and he is likely to be pretty homesick.

In fact, homesickness is so likely, can interfere so much with the recruit's success, that some of the Navy's psychiatrists have given a name to one severe form that it takes—*cryptic nostalgia.* Such a recruit is preoccupied with thoughts of home. He seems stupid and inefficient, unreliable, only moderately obedient, slow to learn, awkward in drill, often remiss at inspection. So he is put down as stupid and inept, when he is merely homesick and inattentive. Often, when he is unaware of the nature of his difficulties and they are explained to him, when he is told by an understanding officer that his homesickness is spoiling his chance of success in his new life, he is surprised, recognizes the correctness of the diagnosis and improves at once. Not always though. The requirements for adjustments in the Army or Navy may be too much for the weak personality.

Most recruits make the necessary adjustment to military service. It is interesting to note some of the factors that are working for them.

There is, first, the send-off at home. A man may even have feared the draft, may have sought in every way to get deferment, may have gone around saying that his draft board was prejudiced against him, and then, being drafted, he may for a moment become a hero among his neighbors, be given a rousing send-off by the community. Very often that event changes him. If there develops a chance of his being rejected at the induction center, he will fight to be allowed to stay in the service rather than welcome a release. He does not want to be sent home ingloriously to live as an incompetent among the persons who cheered him when he left. He will not suffer from cryptic nostalgia during his training period. When he thinks about home, he will be thinking about those who expect him to be a success.

Some new recruits actually find luxuries in the Army and Navy—the men who have never had the use of a flush toilet or a shower bath, who have seldom had a well cooked square meal, who have indeed worried as to where their next meals were coming from. They find greater comforts and more spending money than they ever had before, and better than all those things they find security. The Army and Navy look after you. They give you good food with plenty of vitamins. They require healthy living of you and, when you eventually find yourself tough and in the best of health, you inevitably worry less. Worry and chronic fatigue go together.

If the recruit resents the compulsion that is put upon him in training camp, he can find natural relief in griping and in humor. Griping is a relatively harmless form of aggression in the face of frustration and relieves tension. It is not to be condemned. Leaders should understand its usefulness, while combating the recruit's resentment by explaining the reasons for what seems so senseless to him. Humor is also often aggressive, a partially concealed aggression in which the recruit restores his wounded pride by taking a superior rôle, making fun of what he hates, laughing it off. It is an important means of relief which helps morale greatly.

Loneliness in the recruit can be helped by occasional passes and furloughs, and the armed forces know well that they must combat nostalgia by such means. A recruit who gets a chance to see his family every few months is greatly helped in spirit. Later, as his morale develops in a unit, the formation of friendships between comrades and of the sense of solidarity within the unit makes the need for contact with his home less, but furloughs still remain important to him. They furnish occasions when he is relieved of many of the constraints of discipline.

In general the growth of morale is nothing other than this process of adjustment. As training proceeds the recruit begins to get interested and to experience successes. He learns this and he learns that. When he finally gets to be a seaman first class or a private first class, he has reached the first stage of being a veteran. As the new habits become more and more familiar, they become more and more autonomous, are pleasant to perform and do not require external motivation. Adjustment, though difficult, is also normal, and it may be made easier by a skillful leader who knows how to establish morale in his unit.

ADJUSTMENT TO COMBAT

As a unit gets nearer to combat new worries develop. Actual battle is likely to increase them.

There is first the fear of death. It is best met by accepting the possibility of death as a natural part of every soldier's and sailor's job, and by being careful not to lose a sense of proportion about it. There are a great many men in an army or a navy and only a small number of them get wounded and a still smaller number killed. The soldier or sailor remembers these statistics, knows that his chances of coming through unharmed are good and that he will then get relief from the strain of combat. If he is wounded, there will be for him a purple heart decoration and usually some glory. Men who have been through the worst of warfare often say that only a fool wants to live forever, adding the warning: "But if you must die, make your death count for something. Don't throw your life away by taking needless chances." Others develop a belief in fatalism: "That shell won't hit me unless it has my number on it, and, if it has, why then I can't help it." Religion, belief in immortality, faith in the effectiveness of prayer, help too. They are strong supporters of morale in combat.

Most men have to adjust to the unaccustomed sight and smell of death and blood as well as to the fear of death. A major in the first AEF, one of the greatly loved officers of that great adventure, helped his men to overcome this repugnance by teaching them that consideration for their friends must go on after death. He taught them to make certain that the body of a friend always got thoughtful care and a decent burial. The men of this battalion—a battalion with splendid morale derived from a splendid leader—would crawl out into no-man's land to bring in the body of a comrade who had fallen, even if they had to gather it up in a basket. That sort of affection makes death seem less of a complete cutting off. Every man comes to think of his own death with less horror because he knows that the tie of comradeship would carry on even then.

Some men also worry or feel guilty over killing enemy soldiers. American boys are taught that it is wrong—the greatest wrong—to kill. This principle is learned so early in childhood that it becomes a basic attitude, a part of conscience. If men had acquired this attitude after they were grown, it would be fairly easy to change it; but conscience is set in childhood by parents and teachers and is hard to change. A soldier or sailor may know that criminals must be executed and that enemies must be killed, yet his emotions may rebel. If duty forces him to kill—and in war it must—then afterward he may feel guilty, become anxious. He may not know why, but his conscience will be the cause.

The first treatment for an unadjusted conscience is reason. The fighting man must understand the reasons for a just war, how civilization, as he sees it, requires that its enemies be killed, lest they kill it. After he has got the ethics of the matter straight in his mind, he will be helped by finding that his comrades, many of them, feel no repugnance at killing. It is not necessarily true that the good fighter hates the enemy that he kills; nevertheless he is probably better off if he feels righteous anger toward the enemy, for such anger makes him more effective and obliterates his useless sense of guilt.

Another thing to which the soldier must adjust in combat is the shortened time perspective which war necessitates. The soldier or sailor cannot plan ahead; he has no certain future beyond today. Thus, if the waits between combat engagements are long, he becomes restless and uneasy. There is a futility about long waits which is frustrating, especially when there is nothing he can do about terminating them. Under these conditions he may find that he is living mostly for food, games, sex, drink, and detective thrillers. This may be a pleasant state of affairs for some men but many, and especially the more sophisticated, find it unsatisfactory, even intolerable.

The Armed Forces Institute of the Second World War developed a correspondence school which offers courses in a wide variety of subjects. Such work has the immediate purpose of making idle time really count for something and the remote purpose of preparing the soldier for improved status when he is demobilized.

THE PSYCHOLOGICAL MECHANISMS

Not all men adjust to military life. Some are rejected at induction as too great psychological risks. Others break in training and have to have special treatment or be discharged. Others go to pieces when they get into combat. Only then do they become psychopathological cases, requiring special treatment, needing anything from a short furlough to a short stay at a medical station close to the battle front or a prolonged stay at a base hospital. Fortunately good soldiers are, in the large majority, men who can manage their own needs and emotions under the normal difficulties of combat; but the maladjustments of the minority require special understanding by comrades and leaders.

To understand these breakdowns, it is necessary, therefore, to learn how the mind works, to get a bird's-eye view of the dynamic mechanisms by which it meets frustration and conflict.

The simplest psychological adjustment is satisfying a need, getting what you want. A small child is apt to feel lonely when he is hungry, especially if no one comes to relieve his hunger. Loneliness and hunger experienced together become associated and later on loneliness alone may produce hunger. The lonely soldier is apt to feel hungry. He knows that he can get candy at the PX and he has money in his pocket. So he goes to the PX, buys a candy bar, eats it, feels less hungry and less lonely, is satisfied, and is all ready for another need to do something for.

But suppose he has no money? That lack creates an obstacle to the satisfaction of his need and he is—mildly—frustrated. So he casts about for some way of getting candy without money. Perhaps he tries a loan from another soldier, and then another. Failing there, he may start talking about candy to a hungry looking comrade, until the other man offers to buy for both. This typical procedure is called *trial and error.* When the means of solution are not clearly known, the dissatisfied person tries this and then that until he succeeds or is distracted by some other more important need.

If he does not understand the nature of his need, his trials are likely to be more random, less intelligent. Perhaps he feels depressed but does not know why. He wants the company of a girl but he may not know that he does. So he wanders about and finally with a pass turns up in town. If he meets a friendly girl there, he finds his depression gone. His trials and errors have at last ended in a success.

Most of mental life goes on in that way. Needs come up and are satisfied in the light of knowledge and available means. When a man does not understand his need or the means are not available to him, then he hunts about at random until he hits on a possible solution. The trials and errors may not occur in his actual behavior; they may go on only in his thought. He thinks about his problem, tries out this possibility and then that in imagination, until a workable solution suddenly occurs to him. Such a solution in imagination or in behavior is called *insight.*

The man who invented the sewing machine was baffled by the fact that he could not get a machine to hold a needle, with a point on one end and the eye in the other, and have the needle go all the way through the cloth to pull the thread through. Then he dreamed that he was being chased by men with swords that had holes in their pointed ends, and at once on waking he had his needed insight. Put the needle's hole in its point and fix it so that it can go back and forth. That is the way inventive genius depends on insight.

Unfortunately frustration is not always so easily relieved. Often wisdom suggests no remedy. Insight does not always come to the rescue. The frustration remains, trial and error continue. Various partial satisfactions may be found, even though the individual does not fully understand what the frustrated need is. The less he understands his needs, the less satisfactorily can he satisfy them.

The ways by which the mind adjusts itself to frustration appear to be of two sorts: *defense mechanisms* and *escape mechanisms.* Both are attempts at adjustment, yet each may lead to absurd exaggerated adjustments which, in resolving a frustration, create other social difficulties, leave the man ill-fitted to perform his military work well, make him, therefore, maladjusted in his duties. If these maladjustments are extreme and persistent, the man may be said to be *neurotic,* to have a *neurosis.*

Many of these troubles begin with a *feeling of inferiority,* which is itself a result of frustration. If a man cannot get what he wants, he is likely to feel inferior. If a child feels inferior, because his parents do not love him, or because he thinks they do not love him, or because he is in competition with a brother or sister who seems always to be more successful than he, or because he is weak or lame or awkward and so at a disadvantage in competition with other children—if a sense of inferiority gets established in a child for any such reason, it may stay with him for life, no matter how successful he may become as an adult, no matter how little his casual acquaintances, seeing only his achievements, may suspect it. Out of such fixed feelings of inferiority the defense and escape mechanisms arise in a man, usually without awareness on his part of his constant use of them.

Such a person, feeling himself to be inferior no matter whether the facts justify his feeling or not, shows many well known characteristics. He may be very sensitive to criticism, and perceive criticism of himself where it was never intended. He is apt to be seclusive, to avoid society, even to cross the street to keep from meeting an acquaintance. He wants compliments, even flattery, and will go to surprising extremes to secure approval. He makes a poor competitor, for he is a poor loser. He is likely to find satisfaction in speaking unfavorably of others, for in running them down he seems to himself to be raising his own prestige. These are some of the symptoms of a feeling of inferiority. Some of them are defenses, some of them escapes.

During the last forty years, under the original stimulus furnished by Sigmund Freud and psychoanalysis, these mechanisms have been studied, understood and given names. It is not always possible to distinguish defense from escape, and the different defense mechanisms get themselves mixed up in any personality, as do also the escape mechanisms. The names are worth learning, nevertheless, because knowing the list serves to keep one in mind of the complexity and variety of human motivation and to prevent one from too ready an acceptance of the first explanation that suggests itself when the puzzling behavior of another person—or indeed of one's own self—has to be accounted for.

An interesting thing about these mental mechanisms is that the man who has them is almost certain to be unaware of them. In extreme forms they may constitute mental disabilities, like neurosis, but the "patient" does not "suffer" from them as he does from a physical disease. He may experience unpleasant feelings, like depression, but no physical pain. Men seldom seek out doctors to find relief from these maladjustments. They have often to be persuaded into accepting psychiatric or psychological aid.

Can a man recognize the fact that his motives are defensive or escapist? Not easily. Psychiatrists and psychologists often fail to be aware of these special motives in themselves. Yet knowing about the symptoms does create a possibility of self-diagnosis, and does also provide an opportunity for one person to interpret wisely the motivation of another.

The more obvious symptoms of poor adjustment are feelings of anxiety and inferiority, vague bodily discomfort, loss of appetite, mild stomachic disturbances, headaches, lassitude, fatigue, fatigability, heart flutters. None of these symptoms is a sure diagnostic sign, for every one may come from a nonpsychological cause. Anxiety before battle is not a sign of mental difficulty. Sugar and affection will both reduce fatigue. Stomachic disturbances may be due to an ulcer, although it is true that the ulcer may be due to worry, and the worry may result either from a normal fear of combat or an irrational fear of what other people are thinking about you.

These symptoms need to be watched. If they recur again and again when there is no discoverable nonpsychological cause for them, then they would seem to be mental. The lieutenant who always had a headache when things went wrong in the company was having an emotionally caused headache. An increase in his self-confidence would have helped him more than aspirin.

For a discussion of the relation of the psychological mechanisms to frustration, see pp. 321-325; and for a further discussion of symptoms, see pp. 353-363 below.

DEFENSE MECHANISMS

The defense mechanisms are the means whereby a man adjusts—usually imperfectly—to frustration or to his feeling of inferiority by some psychological change of attitude, thought or conduct which is more constructive than escape. These mechanisms are compensation, identification, exhibitionism and projection.

(1) **Compensation.** The most direct defense against inferiority or deficiency is to compensate for it, to combat it in some way. There are several kinds of compensation.

Direct action, or *compensation in kind,* attempts to get at the source of an actual inferiority and to remove the source. Thus compensation for a physical defect may lead to an extremely valuable contrary behavior, as when a puny boy by practice makes himself into an excellent swimmer. Demosthenes is said to have worked so persistently to overcome his stammering that he not only learned to speak normally but actually to declaim skillfully in public.

Sometimes the source of the frustration cannot be removed by direct action. The plain girl cannot change her face but she can change herself into a woman of charm whose plain face is no longer a handicap. This is compensation by *substitution* and like direct action is a desirable form of compensation.

Compensation is a mechanism of defense usually undesirable when it is used to deceive others, when a man puts on "a false front," though it is often unknowingly used in this manner. A timid man may put on a great show of boldness or be arrogant in manner or boastful or obscene in language. Other common signs of compensatory defensiveness are the conspicuous clothing of self-conscious adolescents, the loud voice of the bully and the obsequiousness of Uriah Heep.

Maladjustment due to compensation for inferiority is most striking when it leads a man to the repeated assertion of his superiority over other men. They do not like his arrogance and snub him. Since snubbing makes him all the more inferior, he may redouble his effort to appear superior. Thus a vicious circle is set up. Or he may, insecure in his relation to other men, alternate between acts of superiority and inferiority, a course of conduct which does not get him liked because it leaves his acquaintances uncertain about him or else leads them to suspect his sincerity when he is being modest.

A great deal of the prejudice of Gentiles against Jews functions in this way. The able and competent Jew find himself unfairly discriminated against by many of the Gentiles with whom he comes in contact. He feels inferior because he does not command their respect, yet, assessing his own qualities, perhaps correctly, he feels competent and not inferior. At first he may try to compensate for his handicap by aggression. But the Gentiles turn out to resent the aggression, partly because it fortifies the prejudice they may already feel toward Jews, partly because it is apt to get mixed up with the Jew's deference (an escape mechanism) which is a logical mechanism to try next by way of appeasement for the prejudice. Deference and aggression are, however, contradictory and the Jew then appears to the Gentile as inconsistant, insincere, a pattern which any majority group can readily force on a minority group. Hence the Jew's attempt to adjust to the prejudice has eventually the effect of strengthening the prejudice. That tends to make the Jew try ultimately to escape from the Gentiles, to associate primarily with other Jews where he finds no prejudice, but the prejudiced Gentiles do not like this any better. They become disturbed because they see the Jew helping to form a strong coöperative group of persons toward whom they are already ill-disposed.

This illustration shows not only how defense and escape adjustments work in together, but also how very difficult it is to get the perfect adjustment in complex social situations where the true sources of frustration are either not faced or not known. The psychological pattern holds not only for Jew and Gentile, but for any minority group in relation to a majority, and indeed for almost any person who suffers from social frustration.

A form of compensation which may be used unwittingly to fool oneself as well as to fool others is known as *self-justification* or *rationalization*. Failure needs a scapegoat. Or it must be made to appear as a success, or at least as not a failure. Passing the buck, putting the blame on the dog—these are ways in which men rid themselves of responsibility in order to avoid shame.

A rationalization is plausible and often convincing—except to the psychologically wise. Often it consists in blaming an incidental cause instead of the primary one, in blaming the rain or the mud or the carelessness of a comrade when the most important fault is the soldier's own lack of skill. "Sour grapes" is rationalization, a depreciation of what you cannot get. "Beautiful but dumb" is a rationalization when beauty does not look upon you with kindness. So is the "sweet lemon" a rationalization, the argument that what you have is better than what you really want but cannot get. In small matters rationalization is an excellent means of adjustment to failure and frustration, but it is not a strictly honest means. The man who is wise enough to see unpleasant truth and strong enough to "take it" is much better off in the long run.

(2) **Identification.** Another defense mechanism is identification. It is an indirect kind of compensation. Everyone knows how parents identify themselves with their children, hope to see for their children successes which they have not had for themselves. Not so clearly understood is the way in which young men identify themselves with their fathers, or transfer this identification to other leaders under whom they serve. A son, who feels inferior, may experience real pride in his father's achievement. A soldier or sailor may get genuine satisfaction out of the success of his leader—the "old man," as he often calls him—who, quite likely, has come, without the soldier's knowing it, to play the rôle of father to him.

Identification does not so often lead to serious maladjustment, but it is never a good thing to let down your own ambition entirely, to be content with the successes of someone else. Still it is better to have this satisfaction than to remain frustrated and inferior, perhaps developing some neurotic symptom by way of defense or escape. This is discussed in more detail on pages 359-362.

(3) **Exhibitionism.** This is an attention-getting mechanism. The child or man who feels inferior may resort to various means for getting attention. Ordinarily a baby cries for attention, a child asks questions. Children also get attention for themselves by obstinacy or disobedience. A child balks at eating, makes his mother coax him to eat. Or he disobeys, taking whatever punishment is given him, because it seems better to him to be punished and important than to remain unpunished and unimportant. Children often lie and steal in order to gain attention, or accuse themselves falsely of misdeeds which they never committed.

In the armed services the need for attention expresses itself in various ways. There is the good way, where the soldier, for example, tries to compensate for inferiority by trying to excel in his job—nor is the Army (or the Navy) so standardized that he cannot stand out from the others as a good soldier after his responsibilities have become somewhat specialized. There is also the poor way, in which the soldier expresses his need for importance by blustering and boasting, by lying about his exploits, by playing tricks on other men, by being in general a bully or a conceited ass. And there is the very bad way, where prominence in the guardhouse or the brig seems preferable to being a nonentity in the ranks. A leader should always have in mind the possibility that breaking regulations may be due to the fact that a man can no longer stand being ignored, must find some way in which he can stand out from everyone else. In child, soldier, or sailor, distinction by disobedience is an achievement in which success is easy.

(4) **Projection.** This is the defense mechanism which makes a man see his own faults in others and not in himself. It is closely allied to rationalization. The awkward recruit criticizes awkwardness in others, thereby making himself feel less awkward because he assumes the superior position of the critic. The dishonest man may be constantly suspecting dishonesty in others. He does not know he is being insincere. He has extenuating rationalizations for his own lies, but only suspicion for the truth-telling of other men.

Sometimes projection, when it is linked with compensation, is not so insincere. The puny weakling has at last by exercise and practice made himself strong and skillful in at least some activities, yet he still feels inferior, is not quite certain of himself. So he tends to reassure himself by noting how inadequate are other men in the skill in which he at last excels.

There are extreme forms of defensive rationalization and projection which may require special treatment or even a psychiatrist's care in a hospital. They are the *delusions.* The most common kind is suspicion, especially the belief that other persons are in conspiracy against you. Then you not only try to put your blame on your careless comrade or on the unreasonable sergeant, but you may find yourself convinced that you have become an object of hatred to your commanding officer, your sergeant and many others, all of whom are conspiring, you think, to do you out of a fair deal. In an extreme case of this sort, a man develops delusions of persecution, suspects the persons around him of being "out to get him." He finds always a new conspiracy when he changes from one unit to another, from one hospital to another. Extreme cases of delusions occur in certain psychoses (insanities) and yield to treatment only with difficulty or not at all, but in the mild case the suspicion may be got rid of simply by arranging for some success by the man who feels inferior. All the principles for building good morale work against such maladjustments.

These are the defense mechanisms. They are not always distinct from the escape mechanisms, for escape is a kind of defense, although it is not aggressive. In defense the frustrated man tries to do something positive about his inferiority. In escape he tries to get away from it.

ESCAPE MECHANISMS

A man escapes from a situation in which he feels inferior or frustrated by becoming seclusive, by refusing to coöperate with others, or by building up a world of fantasy which he makes much more pleasant than the real world in which he finds himself. Or sometimes he escapes by refusing to accept mature responsibility and reverting to childish attitudes. Another form of escape is to forget unpleasant or humiliating experiences or ideas. These mechanisms are called respectively *seclusiveness, negativism, fantasy, regression,* and *repression.* The extreme case of psychological escape from the real world of living is known as *schizophrenia.*

(1) **Seclusiveness.** The simplest form of escape in the presence of inferiority is seclusiveness or timidity. A man is shy and bashful. He stays by himself, does not make friends easily. He never risks making a suggestion, never volunteers for a difficult mission. He is perpetually afraid of failing. The origin of his timidity may lie in excessive capricious discipline that he received as a child, or in a childhood illness that

made him weak and unable to compete with other children, or in a solitary boyhood in which he had no chance to learn how to get along with other boys. Nevertheless success may bring him out, if success can be arranged for him, restore his confidence, reduce his timidity. Success will, however, hardly abolish timidity completely in such a man. He will still be very, very cautious never to undertake anything that he cannot carry through with satisfaction to everyone.

Sometimes this timidity leads to a degree of seclusiveness that gets mistaken for stupidity or even for feeble-mindedness. A soldier may be able to score 120 or 130 on the General Classification Test (where 100 is about average) and still seem to his leader to be stupid, merely because he is so shy and unresponsive. A leader who thinks he has a stupid man to deal with had better look up the AGCT score on the man's Qualification Card to make sure that the man is neither consciously feigning stupidity nor is merely very bashful.

(2) **Negativism.** The negativistic man resists suggestion. He may not be actually disobedient, but he never volunteers; he resists coöperation even when compelled. That makes, of course, for bad morale. Unless the soldier is too deeply fixed in this attitude, all he may need is reassurance and encouragement. Still negativism can make serious trouble, for a leader cannot sacrifice discipline by coaxing.

(3) **Fantasy.** This is a more common form of escape. The soldier likes to daydream. Everyone daydreams a little. You dream of a display of prowess, of saving someone else from danger, or of being in a position of great power, of the death of someone who has caused you frustration, of the destruction of other obstacles to your success, or even of your own death as a martyr with honor and glory coming to you after you have died. Almost any timid person who has been frustrated in love knows how these themes run through his imagination. The girl is sorry she rejected him because he has now saved her life, or because he has now acquired power over her and can force her to his will, or because he has died for love of her and she now recognizes his worth. The soldier who suffers from the harshness of a top sergeant may in fantasy reverse the rôles and subject the sergeant to biting criticism, to endless marches, to cleaning latrines.

Some daydreaming is normal and not harmful—in leisure time or when going to sleep—just as ordinary dreaming is normal in sleep; but too much daydreaming interferes with the real business of learning to be a better soldier or sailor. It takes the man's mind off his job, it hinders his getting along with other men. If there is enough of it to make him so seclusive that his leader thinks him stupid, when he is not, then daydreaming is a serious business, a definite loss of the soldier's most valuable piece of equipment, his alert attention. The lookout and the sentry have no time for daydreaming.

(4) **Regression.** In this form of escape a frustrated man, unable to meet a difficult adjustment in a mature manner, resorts to an immature method. He acts—if his regression is great enough—like a child. Showing temper and sulking are childish reactions to frustration. Surrendering initiative and letting other people decide things for you is also an immature reaction. That, of course, does not make so much trouble in the armed forces, although going on sick call may be a way of getting out of mature responsibility. Yet the services provide hundreds of ways for substituting childish reactions for more mature ones, and it is well for leaders and men to remember that immaturity may be an escape for the unhappy inferior man. Help him to be successful and he may become mature, if his habits are not too well established.

(5) **Repression.** This is a form of escape by which a man actually puts out and keeps out of mind the memory of a painful, perhaps a shaming experience, or the thought of some strong frustrated wish of his, a thought that would make him feel guilty or would be painful because his inability to realize the wish is humiliating to him. A man with a repression is not willfully refusing to recall or to think about something unpleasant. He cannot, if the repression is strong, voluntarily bring the memory back, no matter how much he wishes to do so, no matter how fully convinced he is that remembering could be to his advantage. When repression is so strong, the psychiatrist can sometimes recover such lost thoughts by encouraging the person to talk fully and at great length about his needs and wishes, and by removing, both by friendliness and logic, his feeling of humiliation or pain about them. Sometimes the psychiatrist will use hypnotism or certain drugs to help a person recall these lost memories.

Repression can vary in degree all the way from the relatively simple forgetting that causes social errors to pathological, neurotic amnesias. The *neurotic* patient often unconsciously adopts psychic invalidism (usually in neurasthenia or hysteria) as an excuse for, and protection from, failure to meet the requirement of the environment or of his own conscience.

Two examples may make this clearer. A soldier is talking to his girl and another soldier comes up. The first soldier begins, with every feeling of friendliness, to introduce the second, whom he knows quite well, and finds to his embarrassment that he cannot remember the name of the newcomer. He has to ask him his name. Now that is a repression if under other circumstances he has found that he always did remember the name, and if it is also true (whether he realizes it clearly or not) that he does not like the man or is jealous of him in relation to the girl. Any unreasonable failure of memory has a good chance of being a repression. But such little lapses ordinarily do not make much trouble.

Severe repressions may occur when shame is very great. A man has, let us say, hated his mother, who is no longer living. He would be ashamed of himself for such unfilial thoughts, but actually he does not think the thoughts. He may even speak with affection of his mother; yet deep down underneath he hated her, though he does not know it, cannot tell anyone or even himself that he hated her. Then he gets engaged, and one day his girl does or says something that is just what his mother would have done or said. At once he unconsciously identifies her with his mother and immediately experiences a revulsion of feeling against her, a revulsion that lasts. The engagement has to be broken off. He is ashamed of his inconstancy, does not understand it. He may never understand what happened, unless he gets some help from a psychiatrist who can reveal to him the real nature of his relation to his mother and thus to his fiancée.

One consequence of severe repression of fear or anxiety is a phenomenon that the psychiatrists call *conversion-hysteria.* A man develops a physical symptom which has no organic basis but which incapacitates him in much the same way that the organic disability would.

The Nazis, it is reported, forced some Jews to stand by and watch while their friends or sons or fathers were tortured and mutilated and finally killed by slow degrees. That was an unbearable experience for the watchers, and some of them solved the problem—their mental mechanisms solved it for them—by going "blind." What was too horrible to see was repressed while it was still going on—a good adjustment to horror. The "blindness," however, continued afterward. These men remained "blind." They could no longer see most things. Their eyes were all right, but their brains blocked most visual impressions, refused to do anything about visual stimuli. Having seen one sight too horrible to see, they protected themselves thereafter by seeing little or nothing.

Men who have not been prepared for the horror of battle sometimes come out "blind." Men whose legs have failed them through fear in combat may come out psychologicaly unable to walk. A man who lies for hours in the brush with an enemy twenty feet away and lies terrified on his arm until it goes to sleep, may find afterwards that his arm seems to be permanently anesthetic. He can prick it until he draws blood, still there is no sensation. Such conversions of repressed anxiety into physical symptoms need medical care. They may be remedied quickly with wise firm advice by a medical officer at a field station close to the front lines, or the men may have to go to a base hospital for a long treatment.

There are other ways in which illness furnishes escape for the troubled or frustrated mind. The man who goes on sick call because he cannot quite stand the thought of another day of drill and discipline may be a conscious malingerer. It is easy to claim that you are sick and to believe that you are sick when sickness will get you out of something unpleasant.

That is not to say, however, that all such wish-warped illnesses are consciously faked. Neurotic wishes to escape are repressed. The soldier does not know that he wants to escape; he has not admitted it to himself. He would find such a wish in himself shameful and degrading. But the wish may be so strong that it operates in spite of his conscious desires. The soldier has no control over such neurotic illness.

Take the case of the nostalgic soldier who developed "indigestion" and could not eat what the mess provided. When he forced himself to eat, he vomited his meal. Yet vomiting did not lie within his normal voluntary repertoire of skills. Afterwards, he was found in barracks devouring candy and chocolate cake which his mother had sent him, much less wholesome stuff than what he could not stomach at the mess. That soldier got a bawling out by his captain, but he did not really deserve it. Harsh treatment was likely to make his stomach even more undisciplined. It would have been better had the facts been reported to a medical officer, who could then undertake to help the recruit's repressed nostalgia, a nostalgia that let him eat his mother's indigestibles when his stomach was revolting at good Army ham and eggs.

There is no use in commanding such men who are mentally ill to act sensibly, no use in bawling them out. Such treatment merely makes them worse. Nor is it helpful to humor them. They need firm and friendly treatment, sympathetic understanding and encouragement to take on as much responsibility as possible. It was found in the Spanish

Civil War that men with neurotic paralysis of the legs could sometimes be persuaded to engage in crawling races, and that some of them, in their eagerness to win, actually got up and ran. The psychologists in that war also hit on the plan of assigning men with neurotic blindness to night watches in posts where their failure to see would not be dangerous. They were told that, as they could not see anyway, they could work in the dark. But, of course, in the dark some did try to see, and some of them got their vision back in this manner.

(6) **Schizophrenia.** This is a name given to a most important form of mental illness. It is an extreme form of mental escape from the real world. All the escape mechanisms might be considered mildly schizoid, but in extreme form this difficulty may require that the man have hospital treatment for months, for years, or even permanently. The schizophrenic person has delusions, often of persecution, sometimes of grandeur. He may be negativistic, even to the extent of maintaining, in a stupor, the same bodily position for hours or all day. Delusions and auditory hallucinations are generally the first indications that escape has gone so far. The soldier or the sailor begins to hear voices, and will tell you about them if you approach him sympathetically. When such things occur, the aid of a medical officer must be sought. The trouble may be quite serious, or, on the other hand, the difficulty may be something that can be treated successfully within a few weeks or months.

Schizophrenia used to be known only in its extreme form of hospital cases and was then called *dementia precox.* It was thought to be an incurable psychosis. Now it is known that the schizoid state of mind varies all the way from normal daydreaming to the case of the man with constant hallucinations, fixed delusions of persecution, so negative and seclusive that he leads, at least for most of his day, a life entirely apart from other people. The word *schizophrenia* means splitting of the personality, a splitting of an imaginary mental life off from the real world of living. It is, in other words, an escape from an intolerable world of reality into a world of fantasy.

Everybody escapes from reality now and then. It is only when the condition is constant and results in serious maladjustment that medical advice or care is required. Ordinarily, advice or treatment brings such a patient back to the reality of his responsibilities, although there are, of course, others who continue to live out their lives in their own imaginary worlds and never return to reality.

Schizophrenia can sometimes be helped by giving the patient severe shocks of various kinds—electric shocks or shocks induced by the injection of insulin or metrazol. This method is not a certain cure, yet it goes to show that schizophrenia is not necessarily incurable. That is as might be expected, since schizophrenia seems to be only an extreme form of escape.

MENTAL HEALTH AND MENTAL BREAKDOWN

To be at his best, a soldier's mind must be fit as well as his body. He must be alert and accurately aware of his surroundings. He must shoulder responsibility willingly and accept the dictates of superior officers without resentment. He must be able to get along with other men without undue friction and ordinarily with mutual pleasure.

The symptoms of a healthy mind—and also, it may be said, of good morale—are these:

(1) The soldier or sailor uses his abilities with enthusiasm and satisfaction, although not necessarily with happiness.

(2) He wants to do something worth while, to pull his load and not to be carried by others.

(3) He gets along well with other persons, including his superiors and those with whom he has a difference of opinion.

(4) When he is disappointed or meets with deprivation or strain, he faces the situation with a sense of humor, with constructive ideas and a fighting spirit, not with fear, rage, hopelessness or suspicion.

(5) He perseveres in the effort to solve a problem or to complete a task in spite of difficulty or disappointment.

(6) He likes to give as well as to take.

That is the ideal picture, the picture of perfect morale, perfect adjustment. You cannot, however, post the list on a bulletin board and admonish men to mold themselves according to the stated pattern. Morale, as the previous chapter shows, has to be built up by indirect means. Some men will, moreover, break down under strain and difficulty, no matter how good are the conditions for morale. They break because they were not strong before they entered the armed services and because their difficulties of adjustment are very great. In a sense war is not responsible for many of the breaks it causes. So many of the psychological casualties would have occurred eventually under civilian stresses.

There are, therefore, just two things to do about these potential breakdowns. Some of the weaker personalities can be detected and their owners weeded out of the services at the beginning, either at induction centers or in the early days of training. If the initial screening is well done when the military units are formed, then there are not likely to be so many breakdowns until the going gets much tougher, until combat is approached and entered into. At these times the leaders must watch their men for evidence of breaking, trying to forestall it by getting some kind of relief for men who seem likely to break because of fatigue, or special treatment or advice by medical officers for those who show marked changes in their behavior.

On induction, recruits receive a brief interview by a psychiatrist who is on the lookout for signs of feeble-mindedness, mental disease, alcoholism and emotional instability. Many men who would later become psychological casualties can be spotted in this way by a skilled examiner, but the examining physician does not have much time. If he has to interview seventy men in the course of a day, he can spend only a few minutes on each, especially if he has to spend many minutes on the suspected cases. Yet some examiners acquire remarkable skill. They know just the right questions to ask, just what kind of reply or what kind of behavior has significance. And, once they become doubtful of the recruit's fitness, they can take more time for him.

The examiner considers the manner in which the recruit enters the examining room and his general appearance. Has he any abnormalities of gait, significant physical defects, unusual movements, revealing facial expressions, evidence of being confused or stupid or negativistic or anxious or tense?

Then the examiner asks questions. Here is a set of significant questions that has been worked out at the Newport Naval Training Station:

(1) How old are you?
(2) How far did you go in school?
(3) What have you done since you left school?
(4) When last did you have a weak spell, a fainting spell, or a nervous spell?
(5) Does your vision ever get blurred? Do your eyes sometimes blank up for a second?
(6) How often do you have headaches?
(7) Were you ever knocked out by a blow on the head?
(8) Did you ever have a fit, a convulsion, or a seizure?
(9) When was the last time you walked in your sleep?
(10) Do you have any trouble with your kidneys?
(11) Have you wet your bed since you were a child?
(12) Have you ever had any kind of nervousness?

(13) Now tell me, what was the worst jam you were ever in?

(14) Have you ever been arrested for anything?

With an expert examiner, that does for a first weeding out of suspects for further examination or observation. The best evidence, however, comes from watching the recruit's adaptation to training in his first weeks of military life. How well does he adjust to all the new requirements? What is his attitude toward his new job and how does he act on it? Does *he* think that he is likely to break down? One wise medical officer at Fort Bragg, a man who has to assess the psychological promise of new recruits, has drawn up the following list of symptoms of emotional instability, of prognosticators of emotional casualties:

(1) Inability to get along with other men, as shown by seclusiveness or combativeness.

(2) Insecurity, as shown by a furtive appearance, a persistent feeling of being picked upon, complaining or even crying, lying and boasting, frequency of drunkenness, lack of persistence on the job and frequency of unfinished work, frequency of physical complaints and of going on sick call.

(3) Anxiety, as shown by a harassed, frightened, tense, scared look or behavior.

(4) Depression, as shown by a worried or sad look or behavior.

(5) Lack of personal pride, as shown by untidiness or dirtiness.

(6) Lack of interest, as shown by indifference, a dull blank expression, wooden movements, slow talking and moving, poor attention.

(7) Unusual energy output, as shown either by sluggishness or by energy output excessive in proportion to the results obtained.

By attention to such matters the examiner makes his judgment. No item is conclusive by itself. The whole pattern of symptoms has to be considered by an experienced judge. If the recruit is then suspected of being too instable for military service, or if he feels himself unfit for service, he may be sent back for further training under special observation or to a hospital for observation. Many of the suspects turn out to be sound risks after all. Others need treatment or are returned to civilian life.

It is hard to say just how many recruits should be rejected for psychological reasons, but here is the early experience of the Newport Naval Training Station. Out of every 1,000 men, there were, on the average early in the Second World War, 154 who were suspected by the examiners of being psychologically unsuited to military life. Of these 154, there were 106 who were finally accepted as good risks and

48 who were finally rejected, being for the most part returned to civilian life through their draft boards. Later the proportion rejected was increased by improved techniques and higher standards. The numbers rejected would have been still larger had not the original 1,000 been already given a hurried examination at the induction center with rejection of the obviously unfit.

There are so many factors that cause emotional instability and other mental troubles that it is not possible to say *why* fifty men in a thousand are unsuitable for military service. There are, however, three especially important predisposing factors worthy of mention. (1) Men from broken homes, where parents have separated after living in disharmony, are especially likely to become psychological casualties. They have not as children acquired psychological strength in a happy family setting. (2) Men who are divorced or separated from their wives are more likely to be emotionally handicapped, to have more difficulty in adjusting to military discipline than single or married men. (3) Older men are also likely to be unable to make the necessary adjustments and to become psychological casualties. Youth is a period where adjustment to great changes is normal. Men over thirty adjust less easily, and, since they have more to sacrifice, the adjustments required of them are greater. Besides, psychopathic symptoms have had more time to develop in an older man, whereas such symptoms may be only latent and undeveloped in a young man.

At the front, when combat impends, and after combat, men who had been able to stand up before may suddenly break. They may suffer from *war shock,* the difficulty that was misnamed "shell shock" in the First World War. Leaders must be on the alert for symptoms of war shock for they may be able to avert it.

The first thing for them to watch for is anything that makes a man stand out as awkward or queer among his fellows, anything that makes him look odd to the other men, that sets him off as "not belonging." Does he stay by himself too much? Does he go for long periods without speaking? Is he known to other men as having queer ideas? Does he find conditions intolerable when other men manage to accept them? Is he a problem in the outfit? Does he refuse certain food? wet his bed?

Another thing for a leader to look for is any sudden change in the soldier's personality. If the man has been in the outfit for a long time, it is easy to note in him any reversal of habits or attitudes. Suppose a cheerful man becomes moody or depressed, or a quiet orderly soldier becomes boisterous and noisy and a disciplinary problem, or suppose a neat well groomed soldier becomes dirty and disheveled, letting his shoes go unshined and his hair uncombed, or a dependable man goes AWOL and is found drinking hard. What is the matter? These changes are likely to be symptoms of mental trouble, perhaps the beginning of war shock. They need to be looked into. The man may need the guardhouse less than a furlough or rest or a word of praise and encouragement, or possibly a chance to talk and medical attention.

There are other symptoms. Inability to sleep. Nightmares in which the battle is repeated over and over. Inability to eat. Buzzing or humming in the ears. Shakiness, general weakness, weakness in certain regions—the knees or the wrists, for instance. Dizziness. Fluttering or pounding of the heart, or its skipping a beat. Difficult breathing. Restlessness combined with the feeling of being penned in and an overwhelming desire to push other persons out of the way. Such things are danger signals and require the help of a medical officer.

At the extreme level there are the conversion phenomena of repression. Blindness. Anesthesia. Deafness. Paralysis. They have been discussed in the preceding section of this chapter.

The cure for all these troubles is sympathy and firmness, and rest in the care of a medical man who understands such cases. The soldier should be told that what is wrong with him is natural, that he needs treatment and that after a little rest he can shortly return to duty. The essence of good treatment is to keep the troubled soldier from feeling that he is relieved of responsibility for long, and yet at the same time to relieve him of enough responsibility long enough for him to be able to readjust.

Sometimes a soldier is helped by increasing his responsibilities, by moving him *closer* to the front rather than farther behind the lines. Psychiatrists in the Spanish Civil War found that this not only discourages malingering but also gets the soldier away from the rear where rumors and other forms of enemy propaganda are apt to be more rife. Men at the front know the worst. Men at the rear imagine the worst and may break the sooner, or having already broken be more resistant to treatment.

There is no man so strong that he will not break if the strain is great enough. But a man, who has been strong enough to stand the strain and meet the difficulties of war up to the time he broke, can stand them again if he is given a chance to recover and is not allowed to think that his "nerves" may furnish him with a permanent opportunity to escape. Prompt treatment is extremely important. It is just as important to give immediate aid to the suffering mind of a soldier or sailor who has broken in combat as it is to stop his bleeding. Delay may mean a much slower recovery.

All that is true in general. There are, of course, cases of war shock—many of them from the horrors of campaigns such as that on Guadalcanal—where rest and temporary relief could not come soon enough, where the soldier is broken, not necessarily permanently, but so seriously that no brief cure at a base hospital will turn the trick for him. Such men have to be sent home for prolonged treatment far away from the scenes of combat.

It is important for leaders and men to learn that mental breakdown is really a kind of sickness which calls for treatment and not for blame. The Army has made a special study of this problem and finds that most leaders and men have learned to make this distinction, treat breakdown with sympathetic understanding and tolerance, and call, when necessary, for medical aid.

HEAD INJURIES

A blow on the head may result in brain injuries, of which the symptoms are not unlike those of war shock. The man's skull may or may not be fractured. In either case the blow produces concussion and interferes with the man's ability to carry on. Concussion may also be produced by the blast of an exploding shell, especially if the man's head and ears are not protected by a proper helmet.

The symptoms of concussion are loss of persisting memory, a loss which may include events immediately preceding the blow or explosion, and confusion of thought. There may also be headaches, dizziness, vomiting, alternate sweating and shivering, or vacillations in temperature and pulse rate. The man may experience great fatigue. Such effects may last for a long time or may not occur until a considerable time has elapsed. A medical officer can diagnose them properly and can also determine by X-ray whether there has actually been a fracture of the skull, but it is important for men and their leaders to be alert to distinguish between a case of concussion and the psychological difficulties due to war shock and other cases of breakdown. In any event when a soldier behaves in a way very unlike his previous behavior, his leader should see that he gets medical attention at once.

THE PROBLEM OF ADJUSTMENT

It is not difficult now to formulate in summary the nature of the problem of adjustment for a recruit who has joined the armed forces.

(1) You have in the first place the recruit as material, just as he comes. Some recruits are emotionally strong and ready to adjust. The younger ones are usually better material than the older, but in general adjustability depends on the man's past, his insecurity in youth, his present feeling of inferiority, the degree with which he feels frustrated, and thus the way in which his use of defense mechanisms, escape mechanisms and repressions interferes with his social adjustments and his adjustability in general.

(2) Against the strength of his personality, you have to weigh the amount of strain to which it is to be subjected. The stronger the man, the greater the strain he can take. The greater the strain, the more the chances of even a strong man's breaking. A leader has constantly to try to adjust the one factor to the other, and to relieve strain, if possible, when it gets too great. He may not, however, relieve strain more than is absolutely necessary, for war requires the most that every man has to give.

(3) The immediate ways of preventing a breakdown, of curing it when it has occurred, are rest and medical care. They, too, have to be adjusted so as to give a man a chance to recover and yet not to remove from him any more responsibility than necessary.

(4) There are, however, ways of strengthening a weak personality. All the means of inducing good morale are means for making adjustment easier for everyone, of making men more capable of standing strain. These means have been discussed in the preceding chapter.

(5) It is also true that the understanding of human nature and of the psychology of adjustment makes adjustment easier, breaking more difficult, recovery after a break more rapid. The leader should know as much as possible about the psychology of motivation and the various mental mechanisms, in order that he may advise the soldier or sailor wisely, relieve him when necessary, and also not relieve him when it is not necessary. And the soldier or sailor himself should understand too about himself as a piece of human nature. The nostalgic recruit often recovers at once when he understands what is the matter with him. The war-shocked man needs something more than understanding for his cure, yet it helps him to understand that what has happened to him is not a disgrace nor unusual, that it is a normal malady that is often cured quickly.

(6) A great deal of the responsibility for avoiding breakdown comes back upon the leader, just as a great deal of the responsibility for good morale and the good adjustments that occur when morale is good also come back upon the leader. The leader furnishes all these mental first

aids. Serious cases pass out of his hands into the trained hands of medical officers, and for them this book is not written. But it is not the doctor who tells you to go to a doctor. That decision depends upon your own wisdom or the wisdom of friends or of some responsible person or leader who has your welfare at heart.

So the rule for building a sturdy army, an effective navy, is this: Get men who can stand the strain—or at least most of the strains they are likely to meet. Give them good morale. Give them also understanding of themselves as psychological machines, so that they may handle themselves wisely and know what is the matter when the mental machine goes wrong. Give them good leaders to help them build morale and achieve self-knowledge. And then let the leaders, if they can, reduce the strain when it proves, with all these precautions and aids, too great. If they cannot reduce it—and sometimes they cannot—then there will be psychological casualties, just as surely as there will be physical casualties when the enemy fights hard and well. Not all casualties are, however, fatalities. Many men recover and return to duty on the line of defense against the strains and terrors which beset morale and threaten to subdue the fighting man's spirit.

REFERENCES

1. A. ADLER. *The science of living.* New York: Greenberg, 1929. Pp. 264.
   A readable text by the man who first described inferiority and superiority complexes.
2. E. FROMM. *Escape from freedom.* New York: Farrar & Rinehart, 1941. Pp. 305.
   An interesting treatment of the disruptive and regressive mechanisms that lead men away from adequate and mature integration of personality in times of social catastrophe.
3. R. D. GILLESPIE. *Psychological effects of war on citizen and soldier.* New York: Norton, 1942. Pp. 251.
   Somewhat technical, yet clear, documented by case material.
4. K. HORNEY. *The neurotic personality of our time.* New York: Norton, 1937. Pp. 299.
   A psychoanalytic treatment of the neuroses peculiar to our culture with special emphasis on competition.
5. K. HORNEY. *New ways in psychoanalysis.* New York: Norton, 1939. Pp. 313.
   A psychoanalyst's description of modern methods of psychoanalysis based on the investigation of anxieties and their causes.
6. D. B. KLEIN. *Mental hygiene: the psychology of personal adjustment.* New York: Henry Holt, 1944. Pp. 498.
   A judicious account of what can be done to prevent mental disorders and to promote personal happiness and welfare.

7. K. MENNINGER. *The human mind.* New York: Knopf, 1930. Pp. 477.
Clear, non-technical; replete with illustrative cases about everyday problems of personality.

8. E. MILLER, ED. *The neuroses in war.* New York: Macmillan, 1940. Pp. 250.
A series of articles, written by selected authors, based on clinical findings from the First World War, and oriented toward civilian and military problems in the Second World War.

9. H. A. OVERSTREET. *About ourselves.* New York: Norton, 1927. Pp. 300.
A readable discussion of the adjustments of normal individuals.

10. L. F. SHAFFER. *The psychology of adjustment.* Boston: Houghton Mifflin, 1936. Pp. 599.
A good general textbook; emphasis on the rôle of mental hygiene in adjustment.

11. G. ZILBOORG. *Mind, medicine and man.* New York: Harcourt, Brace, 1943. Pp. 344.
A psychoanalyst's semi-technical treatment of such social problems as aggression, crime and religion.

See also references cited in Chapters 14, 16 and 18.

Chapter 16

Emotion: Fear and Anger

A man's actions are controlled by his needs—as we have seen in a previous chapter. In general he tries to do what he wants to do, though he may be frustrated by obstacles or one need may be in conflict with another.

The satisfaction of any need involves the exercise of *preference,* of choosing this rather than that. Expressing preference is the most fundamental thing that a man does. All interest, all attention consist simply in choosing. Shall I look at this or at something else? Do I want this or don't I? These are the questions a man asks himself and answers thousands of times a day.

So accustomed are men to make choices that they can do it on very slim grounds and yet do it consistently. A standard experiment in the psychological laboratories shows this fact. You can take a series of simple objects, like squares of colored papers each pasted on a card, and you give an observer every possible pair of them, asking him to indicate at once and without reflection which in each pair he prefers or likes better. He does that job without any difficulty at all. If you use ten colors, then you have 45 pairs for him to judge. If you use 25 colors, then there are 300 pairs. You count up the votes that each color gets, *and* you find, not merely that the colors have an order of preference, but that a given man remains consistent in his choice, makes about the same choices next month or even next year. He does not care a lot about them, but he does care a little. There is something about his particular needs, about his likes, that makes him consistent. This yellow, for instance, remains preferable to that light orange for a particular man, although another man may reverse the choice.

Nevertheless such preferences can be changed by experience or education when there is some reason for changing. Some of the changes happen quite easily. There is almost no simple thing that a man cannot learn to like or to dislike. It is true that he cannot learn to like frustration or fear, but they are not simple. Let us see how this is.

Pain is nearly always disliked. Yet a man will choose to give himself the pain of scratching an itching place. Sometimes the pain in a tooth cavity feels good—the kind of pain which causes its owner to worry the cavity with his tongue. Warmth is nearly always liked; yet when the day is hot and humid and the body needs coolness, warmth is avoided. Preference then depends on the total situation.

Or to take another example, children seldom like bitter tastes, generally prefer sweet. Not so, however, with experienced adults. They learn to like bitter coffee, bitter olives, and may even come to find sweets cloying. There is, nevertheless, a reason for the fundamental relation found in childhood. Sugars are good for men, and many bitter substances are harmful.

It is such simple mild preferences that turn, when they become intensified, into *emotions.* A man may like a vivid red, dislike a dirty green, but he is delighted by a sunset, disgusted by a rubbish heap. At the upper extreme of intensity he is overjoyed when he sees the enemy in full retreat, horrified when a bursting shell kills his comrade. Feeling and emotion can occur in all degrees.

Fear is an emotion which often begins as depression and ends in excitement, though it may begin in a sudden shock. It is always unpleasant. *Love* for a woman can reach the level of high excitement and may then, of course, be extremely pleasant. *Anger* is sometimes pleasant, sometimes unpleasant, depending on how much activity the anger involves. *Depression*—the depression of frustration—is always unpleasant. Depression, anxiety, fear are experiences that no one ever likes.

Anxiety is a depression or apprehensiveness not as intense as fear. It is a symptom of frustration or mental conflict. Sustained or recurring anxiety may occur as a sign that a soldier or sailor is likely to break under the strain of adjustment to service conditions—as a recruit or later under the horror of combat. In anxiety a man may feel either a haunting fear, a nameless dread, or a deep specific worry about himself, or often about his people at home. Very often, he may be at a loss to say why he is afraid, what he is afraid of. Or he may find a cause, rationalizing his anxiety, pinning the trouble on how his leader treats him, or what his girl friend said in her last letter. Such reasons are not the true reasons, though a man may have deep anxiety for a true reason, such as the probability that he will soon be in combat. His anxiety always arises from some frustration, from some conflict among his wishes. This matter was considered in the previous chapter (pp. 352f., 363-365).

The typical emotions, however they begin, usually end in states of excitement. No list of them can be made out because, like the needs, they are as various as the situations that cause them. Love, anger, and fear have been said to be the primary emotions. Certainly sex, aggression and escape present three different representative situations in which men are moved to strong and vigorous action. But there are hundreds of other special situations which occur in actual living and also involve emotion. In this chapter fear and anger are singled out for special discussion.

Emotion has a use for men. It is a state of preparedness for activity. The situation that arouses it may be pleasant or unpleasant, desired or disliked, but it is always one—if it introduces an emotion—which requires strong and vigorous action. In making love, fighting, running away, a man's strength and attention are fully mobilized to achieve his end, as effectively as his capacities and the opportunities of the moment permit.

PHYSIOLOGY OF EMOTION

The having of an emotion means that a man is reacting strongly to what is to him an important situation. At once his body prepares itself for activity. How does this state of preparedness come about? Is there an organ for emotion in his body?

In a sense there is—the autonomic nervous system.

Besides the brain, and the peripheral nerves, all of which make up the cerebrospinal nervous system, there is the *autonomic nervous system*. This consists of a series of nerve ganglia that lie just outside the spinal cord. These ganglia, which are knots of nerve-cells, control automatic actions of the body, actions which are for the most part not under direct voluntary control. The digestive processes and the vasomotor control of the blood—hunger and blushing—are autonomic processes. You also salivate and weep tears autonomically, and therefore automatically. You cannot will to make your saliva flow, but you can control it indirectly by thinking about delicious food. Sometimes you can cry too by having something truly sad to think about.

The autonomic nervous system is divided into two parts, the *parasympathetic* and the *sympathetic* nervous system. In general the two parts serve mutually exclusive functions. When one is operating, the other usually goes out of function. The parasympathetic, for instance, takes care of digestion and in general of those functions which conserve and build up the bodily resources. It probably functions in some pleasant emotions. The sympathetic, on the other hand, functions when the organism is threatened with danger. It mobilizes the resources of the body so that the danger, the emergency, can be met. For example, it stops digestion until the danger is past, until the body can again afford to use its energy for such a deliberate need as getting its food prepared for use in its blood. It is generally agreed that the sympathetic system functions in all unpleasant emotion.

The parasympathetic system is divided anatomically into two parts, the *cranial* system, for which the ganglia are grouped at the upper end of the spinal cord, and the *sacral* system, for which they are grouped at the lower end. The parasympathetic system acts specifically, that is to say one part of it can act alone without other parts. See Table VII for a list of its functions and Fig. 84 for the nerve connections. Slowing down of the heart, for example, does not necessarily mean that there is also an increase in the flow of saliva or in the contractions of the stomach.

TABLE VII

FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM

Organ	*Sympathetic Function*	*Parasympathetic Function*
Heart	speeded up	slowed down
Surface arteries	dilated; more blood	constricted; less blood
Visceral arteries	constricted; less blood	dilated; more blood
Pupil of eye	dilated; more light	
Tear glands	tears secreted	
Sweat glands	sweat secreted	
Hair on skin	hairs erected	
Adrenal glands	adrenin secreted	
Liver	sugar liberated into blood	
Salivary glands	salivation stopped	salivation increased
Stomach	contraction and secretion stopped	contraction and secretion increased
Intestines	contraction and secretion stopped	contraction and secretion increased
Rectum	defection inhibited	feces expelled
Bladder	urination inhibited	urine expelled
Genital organs	seminal vesicles contracted	erection induced

The parasympathetic system controls those vegetative functions about which there is no hurry, for which, in an emergency, there is no time. When a man must attack an enemy or escape from danger, he cannot afford to take time out to digest his food. His blood is needed at the surface of his body where his voluntary muscles are, not in his viscera

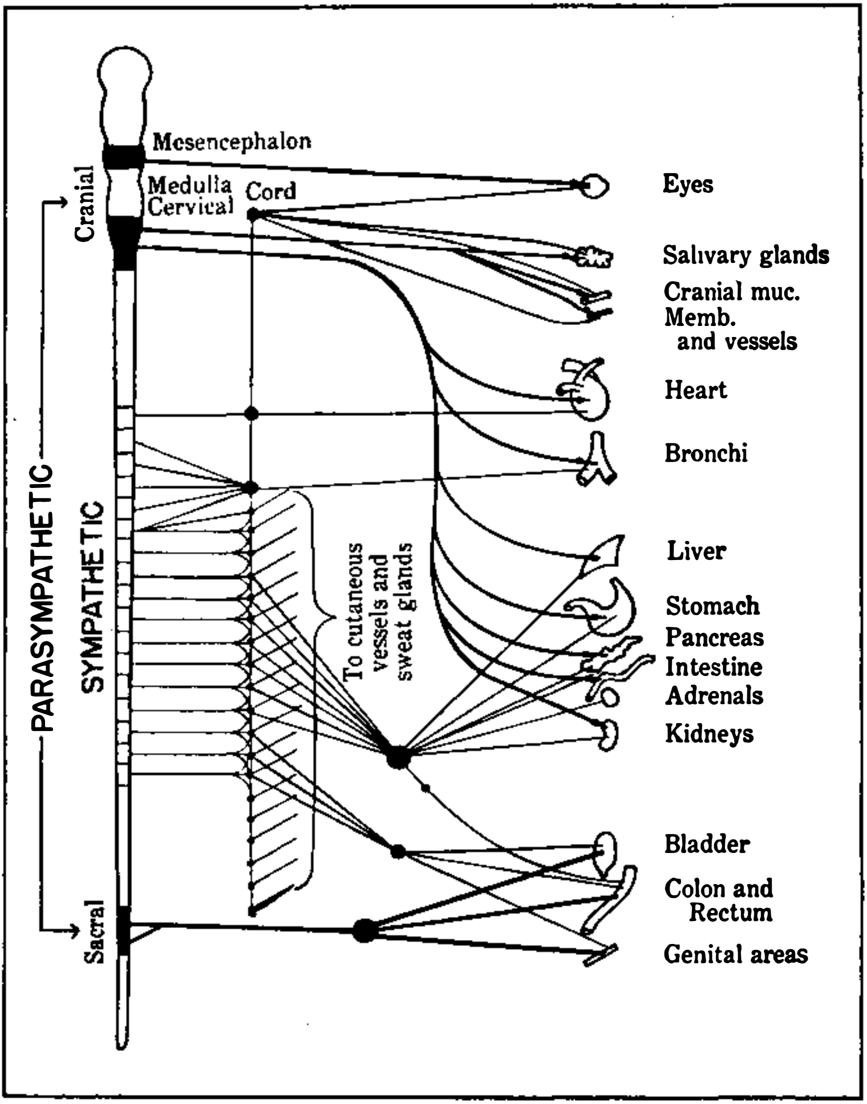

Fig. 84. DIAGRAM OF THE AUTONOMIC NERVOUS SYSTEM

Parasympathetic system (cranial and sacral together) in heavy lines. Sympathetic system in light lines. (Adapted from W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage,* 2nd ed. D. Appleton-Century Company, 1929, by permission.)

to aid his digestion. His heart must be speeded up; he needs plenty of blood in his muscles.

The sympathetic system, unlike the parasympathetic, tends to act as a whole. All of its functions usually occur together and all of them are useful as preparation for vigorous emergency action. A man's heart speeds up and his blood is shifted from his viscera to his voluntary muscles. The pupils of his eyes dilate letting in more light. The secretion of sweat cools his body, helping it to keep his temperature down to normal, in spite of the increased burning up of dead muscle cells which goes with the violent use of his muscles. In animals—cats and dogs—the hair is erected. That makes the animal look larger, is part of its war of nerves against its enemies. Under sympathetic action sugar is also liberated from the liver into the blood, for sugar is needed as fuel in burning up the destroyed tissues. On the other hand, a man's digestive functions are stopped. His mouth gets dry. The contractions of his stomach and intestines stop too, as does also the secretion of digestive juices.

The sympathetic system is the main organ for violent or unpleasant emotions. Everyone knows about some of these functions just by knowing about emotion. In love, fear and anger, the heart thumps. At least in anger and sometimes in love, the face is flushed from the blood that goes to the surface. For anger, you say the face is red. For love you call it a blush. Tears may come, especially with sorrow but sometimes with joy. The skin sweats, especially in fear. While the weak muscles of human hairs do not generally work in emotion, everyone knows how the dog's mane bristles in his anger, how the cat's fur rises in her fear or anger. A man's mouth goes dry in extreme unpleasant emotion. In fact that function is used in the ordeal of rice that is practiced in India. Men suspected of crime are asked to chew consecrated rice and then spit it out. The theory is that the guilty man, believing that consecrated rice has power to reveal his guilt, will have so much emotion that the rice from his mouth will be found dry. Violent emotion stops the flow of saliva. Everyone also knows that fear and anger are not good for digestion, that food may remain undigested in the stomach and turn sour while emotion continues. That is why no dinner is good when fear or anger dominates the meal.

There are exceptions to the rule that the parasympathetic system never acts in emotion when the sympathetic is being used. These exceptions occur in the sacral part of the parasympathetic system. Fear ought to lead to the retention of the feces, and it would be useful to man if it did. As a matter of fact, however, fear occasionally results in involuntary defecation and urination, because the sacral system can work along with the sympathetic. Athletes need to use the toilets before track meets, soldiers and sailors their latrines before combat.

There is another complication for the genital organs. Sexual interest should and does lead to erection in the preliminary stages via the parasympathetic system, but the height of excitement should bring the sympathetic system into action. Here, however, the sympathetic system does not work against the sacral. Erection continues. It is, of course, important for man that emotion should not interfere with the sexual act.

The body also possesses a number of *endocrine glands,* which pour their internal secretions into the blood. The most important of these for emotion are the adrenal glands, located on the kidneys. They are under control of the sympathetic system and release adrenin into the blood whenever in emotion the sympathetic system is thrown into action.

Adrenin has a number of uses for emergencies. Some of them are the same that the sympathetic system produces directly. Adrenin in the blood relaxes the digestive muscles and thus helps to stop the contractions of the stomach and intestines. It reduces fatigue in voluntary muscle, a most useful function for a man attacking or escaping. It helps to dilate surface arteries and constrict visceral arteries. It increases blood pressure, thus increasing circulation and incidentally providing a means of measuring the intensity of emotional excitement. It hastens the clotting of blood, a very useful function for prospective combat. It releases sugar from the liver and also causes the spleen to release new red corpuscles into the blood. The adrenin, which the sympathetic system gets the adrenal glands to produce, helps prepare for emergency in all these ways.

The autonomic system is not, however, the only organ of emotion. The *thalamus* in the brain is also involved. The thalamus is a portion of the brain with several functions. All the sensory impulses that contribute to a perception enter it and are redistributed there to the cerebral cortex, the organ of consciousness. The direct electrical stimulation of the thalamus in an anesthetized animal makes it look and act as if it were angry. When the cerebral cortex is removed by an operation, an animal also exhibits the behavior of anger—"sham rage," it is called. This pattern of conduct is supposed to originate in the thalamus. The cortex is believed to have a restraining effect upon the thalamus, which itself creates an emotion—or at least the behavior that indicates emotion—when the restraining influence of the cortex upon it is removed. Persons, whose nervous tissues in the region of the thalamus have been injured by disease, also often show strong emotional effects, as if the emotion, all ready to be created, appeared when the restraint of the cortex is shut off by the injury.

There are psychological methods for showing the presence of emotional excitement. Although none of them measures the intensity very accurately, they are still useful indicators of emotion.

There is, for instance, the *galvanic skin response*—the lowering of the electric resistance of the skin under emotional excitement or even under mere apprehension. One simply measures on a galvanometer the amount of current that can be conducted from one place on the skin to another. Since the resistance of the moist insides of the body is practically nothing at all, an increase in the current that will pass through the body must mean a decrease in the resistance of the skin. This change might be caused by sweating and thus indirectly by the action of the sympathetic system. If this were so, then the size of the galvanic response should be greater the greater the intensity of the emotion. The facts here are in doubt since these electrical responses occur in a great variety of nonemotional experiences.

The best measure of excitement is *blood pressure.* It increases under emotion and has been used for the detection of lying. If a liar, when he lies, is so inexpert that he feels emotion at telling the lie, then his blood pressure is almost sure to go up and to give him away. The trouble with this method of lie detection is, however, that it does not catch the practiced liar who feels no emotion when he lies, and it is apt to catch the honest person who is emotional just because he is being tested.

EXPRESSION OF EMOTION

Often—not always—you can tell by looking at a man whether or not he is having an emotion. If he shouts, stammers and gesticulates wildly, he is almost certainly moved. Probably he is angry. If he retreats from the scene, silently drawing himself together, with wide-open eyes and dilated pupils, looking quickly hither and yon, perhaps he is afraid. If we could see the adrenin and sugar being liberated into his blood, then we could know certainly whether or not he is moved, but most of the consequences of excitation of the sympathetic nervous system are invisible. Are there not sure visible signs of emotion, and can we not tell the different emotions apart by observing them, tell whether a man is afraid or angry?

TABLE VIII

BODILY ATTITUDES FOR AGGRESSION AND HELPLESSNESS

Helplessness is the "complete shrug" and may occur in fragmentary forms. After Darwin.

Aggression, Anger	*Helplessness, Apology*
1. Brows contracted (vertical furrows)	1. Brows raised (horizontal furrows)
2. Eyes wide open	2. Eyelids partly lowered
3. Teeth clenched and bared	3. Lips pouting and tongue depressed
4. Head erect	4. Head tilted to one side
5. Shoulders squared and chest expanded	5. Shoulders brought together, raised, one higher than the other, chest narrowed
6. Elbows out from body	6. Elbows close to body
7. Hands closer together than elbows; fists clenched	7. Hands far apart and open, palms up
8. Stance strong and firm, body and head erect	8. Body and head bent forward a little; knees slightly flexed

There are attitudes which express emotions, but in men they are confused and altered by experience and social education. For instance, a man can constrain his behavior because he does not want to show emotion, or, having no emotion, he can act out part of one, according to some conventional belief, in order to convey the idea that he is moved when he is really feeling pretty calm. There has been a great deal of experimental study of this subject, and it all goes to show that you cannot tell reliably how a man is feeling by looking at him. You can tell a little better how he wants you to think he is feeling.

That is why people, especially women, smile so much. A smile is understood as meaning that a person is happy, and happy people are liked and wanted by others. So the man or woman who wants to be liked learns to smile, no matter how depressed he (or she) may be feeling. You can trust a smile as showing what the smiler wants you to think about him but not as to how he actually feels. He may feel what his smile conveys, or the opposite; or he may be feeling any of a number of other things, such as embarrassment, impatience (or patience), or a lesser degree of good humor than the smile indicates. Most American smiles are not intentionally deceiving though many cover up other than pleasant feelings. Japanese smiles, on the other hand, often cover real sorrow, for it is contrary to the code of the Japanese to show evidence of giving in to sorrow or even anger.

Animals, since they do not try to hide their feelings or to communicate false impressions of themselves to others, can have their emotions judged by observation a little more reliably. The cat on the back fence with fur erect and back arched is afraid—of a dog probably. The cat, close to the ground, ready to spring, with fur erect, ears laid back and teeth and claws bared, is angry, ready to attack. But education has spoiled all these primitive expressions of emotion in man.

There is, however, one automatic human expression that can be relied upon, partly because it happens too quickly to be controlled voluntarily. It is the attitude for being *startled,* and it is produced by a sudden loud noise, like a revolver shot. The startle begins about 1/20 of a second after the sound occurs and may be all over in half a second or less. It can be examined only by taking rapid motion pictures of a startled man. It consists of a rapid movement of the head, blinking of the eyes, raising the shoulders and drawing them forward, turning the arms inward, bending the elbows, flexing the fingers, contracting the abdomen and bending the knees (see Fig. 85). Not all of these elements occur in every startle. Some drop out as the man begins to get accustomed to the startling sound, but the entire list naturally belongs together and startle of this sort occurs in adults, infants and animals.

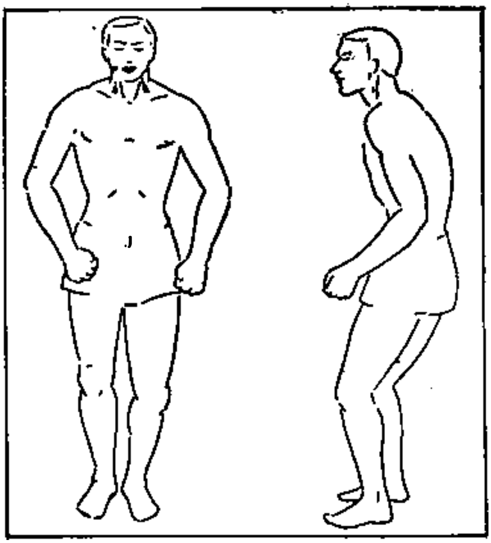

Fig. 85. THE STARTLE PATTERN (From C. Landis and W. A. Hunt, *The Startle Pattern.* Farrar and Rinehart, 1939, by permission.)

The difficulty in interpreting the more deliberate attitudes is shown in the case of the complete shrug. It is the attitude that means helplessness or expressed helplessness, which is apology. Note the eight movements that characterize it as they are listed in Table VIII, and the sketch in Fig. 86. Charles Darwin explained this attitude as being opposite in form and meaning to the attitude for aggression, whose elements are also listed in Table VIII, and drawn in Fig. 86. All these elements for aggression have a use in primitive combat—the brows contracted in order to protect the eyes, but the eyes wide open in order to see clearly, the teeth clenched and bared (so Darwin thought) because our animal ancestors fought with their teeth, the head, shoulders and body strong for action, the fists clenched and ready for fighting. Hence, the opposite bodily attitude comes to mean the opposite feeling. The raised brows make sense only because they do not protect the eyes. The lowered eyelids mean that there is nothing important to pay attention to. The tilted head, the unevenly raised and narrowed shoulders, the flexed knees constitute an attitude of inefficiency, or unpreparedness for action. The pouting lips are the attitude for spitting something out, an attitude of rejection.

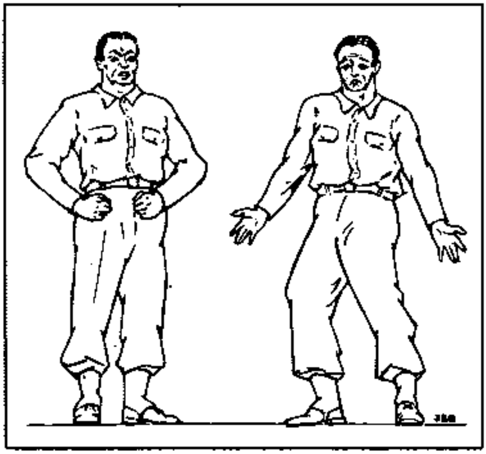

Fig. 86. ATTITUDES MEANING AGGRESSION AND HELPLESSNESS (THE COMPLETE SHRUG)

J. E. Garnsey made these sketches according to the specifications laid down by Charles Darwin.

There can be little doubt that this pattern of behavior exists in whole or in part in most men. The more helpless a man feels, the more of these elements are likely to appear in his behavior—unless, of course, he restrains himself. They appear more readily in Latin peoples who do not try to restrain their gestures than in the more stolid Anglo-Saxons. But you cannot count on the behavior. A man may shrug both his shoulders or only one shoulder, or merely raise his brows, or extend his empty palm because he feels helpless or because he wants to say: "I am sorry, but I can't do anything about it." And, if he does any one of these things, most people know what he means by the gesture, even though parents and schools do not teach this language. Men pick up the language of gesture casually by association with other gesturing persons and without specific instruction.

There is no sure way of telling about behavior in fear and anger.

The dilated pupil is perhaps the best sign, for it is unconscious and under the control of the sympathetic nervous system. The voluntary movements of fear and anger are, however, constrained by convention and there is no social understanding about what they should be. If a man wants to show he is afraid, he can draw back, shrink. If he wants to show he is angry, he can take a step forward, act aggressively. But you cannot always tell true fear from true anger. Civilized man controls himself too well.

FEAR

Fear is an unpleasant emotion. If intense it involves presently the whole physiological pattern induced by the action of the sympathetic nervous system. It differs from anger in that it is characterized by an attempt to withdraw from the scene or avoid the fearful situation. The energy, with which the sympathetic system provides the body in a fearful emergency, is normally used for escape, not for attack. Fortunately the energy can, nevertheless, be diverted from flight to attack, and thus fear may come to have a military use.

Fear thrives on frustration. It persists and grows when danger impends, especially if there is nothing the fearful man can do to lessen the threat against him. Action, on the other hand, always lessens or may even abolish fear, resolving the frustration and eliminating it. The soldier who transforms fear into escape, rushing headlong through woods, over fences, and across gullies, is usually too busy to feel afraid any more. Others will describe him as afraid, but the emotion that started his action—the gnawing, haunting, sickening dread—will itself very likely be gone. It may come again if he is stopped by an obstacle or a command, being forced to wait inactive for danger to come to him.

People tell you that fear and anger are sometimes mixed. It seems much more likely that what happens is that the fearful man at bay turns on his enemy to attack him, just as the fearful animal attacks when cornered. The man who is attacking, whether he be grappling with another man with life as the prize or shooting from a foxhole as the enemy comes across the clearing, is working his sympathetic system for all it is worth, but not any longer feeling very much afraid. He is much too busy. His mouth may be dry, he may feel a lump in his throat still and a little sick at his stomach—the sympathetic system does that to him—but at least you could not say whether he is afraid or angry. Chiefly he is active and moved—neither specifically afraid nor angry.

Fear, as distinguished from anger, is often identical with anxiety, that state of depressed, unpleasant, fatigued, apprehensive worry, which frustration always produces. Fatigue always accompanies prolonged anxiety and also those early stages of fear before the sympathetic system has released enough adrenin into the blood to abolish it. On the other hand, acute terror, suddenly aroused, is something more than anxiety. The terrorized person knows of what he is afraid and his sympathetic system may be energized too rapidly for him to feel fatigue. At any rate he will not in terror be noticing fatigue. What he notices usually is inhibition, inability to act, to run, to fight. So often terror immobilizes a man. It may, of course, mobilize him instead, make him run in panic.

The characteristics of fear are, then, unpleasantness, fatigue and the desire to escape, a state of mind that ends ordinarily in getting the sympathetic system to work and sometimes in vigorous action which replaces the fear—the action of attack or escape or of doing something else either about the danger or about some other thing that is important. A man may forget his fear when he suddenly has his wounded comrade to attend to—forget fear though his danger is not diminished.

The Army, using its excellent questionnaire method, has collected from combat troops a list of their felt symptoms of fear. Here is the list with the frequencies with which the symptoms were reported:

Violent pounding of the heart	86%
Sinking feeling in the stomach	75%
Feeling sick in the stomach	59%
Trembling and shaking	56%
Cold sweat	55%
Tense feeling in stomach	53%
Feeling of weakness and faintness	51%
Vomiting	24%
Losing control of the bowels	10%
Urinating in the pants	10%

The last three items are evidence of extreme excitation of the sympathetic nervous system and do not occur so often as the symptoms of the heart, the stomach, the muscles and the sweat glands.

Mostly fear makes sense to the fearful man because he knows of what he is afraid. He knows, not only that he is afraid, but that he has reason to be afraid. Sometimes he becomes anxious, however, without any assignable cause. He is scared but he does not know that he is.

He wants to get out of fighting, while his pride makes him want to fight. So he finds himself frustrated, in conflict, too proud to admit, even to himself, his desire to escape danger. He goes on about his work, depressed, tired, feeling sick at his stomach, not knowing the cause of his trouble. Actually he is afraid. You do not have to know of what you are afraid in order to be afraid, although you will seldom tell other persons about a fear that seems to you to have no reasonable cause.

It is because action is the cure for fear that courage and fear so often go together. A man is afraid—and because he is afraid his sympathetic nervous system is gearing him to activity. Physically he is in a good position to do something about the danger that haunts him. Shall it be escape or attack? Discipline, pride, confidence in leaders, belief in war aims and a host of other forces press him on toward bravery. Thus, his heart in his throat, he stumbles into action, finds action good, lets out a yell from his dry mouth, and soon is fighting away vigorously, his mouth moist again and his fatigue gone. His fear was useful. It provided the energy, and other things steered him to the right kind of activity.

On the other hand, fear does not always disappear in combat, perhaps because not all combat is active, or because activity is not strong enough to banish fear. The Army has questioned combat troops as to when they feel the most fear. Thirty-nine per cent of the men reported fear as strongest before battle, but 35 per cent said it was strongest during battle. There were 16 per cent who said the greatest fear came for them after combat, and 10 per cent who could not decide about the matter.

If fear is very intense, if a man is panic-stricken, he has but one thing to do, escape. He is likely to run—whether forward or back is largely a matter of chance. Some heroic acts may be of this order—the man "escapes ahead," is blindly aggressive, attacks the enemy mercilessly. His comrades, unaware of the basis of his actions, may be stirred to follow him and what might have been mere rout may become unified attack.

This is not the same as foolhardy, willful scorn of danger. Foolhardiness is not wanted in the armed forces. There are some men who feel no fear, who proudly, scornfully take unnecessary risks. They are not good soldiers. The Army and Navy need maximal battle efficiency from all their men. Their units cannot afford to have the added losses foolhardiness always brings. Men are taught not to be reckless with their equipment. How much more should they endeavor not to waste the human machines which are the most valuable matériel of the fighting forces. Fear is a normal response to danger and has a use. Unless it takes the form of terror, it energizes man for action, yet it also counsels caution, and the most efficient battlecraft has caution as a principal basis. The armed forces can use fear but they need bravery too, the kind of pride and discipline that makes men fight because of fear and in spite of fear.

FIGHTING FEAR

A great deal can be learned about fear from a study of the rules for overcoming it. Here they are:

(1) **Action dispels fear.** In the suspense before combat, when men are ready for action and waiting for the signal to start, fear is at its height. It will disappear for many of the men when action commences. A questionnaire given to several hundred members of the Abraham Lincoln Brigade, veterans of the Spanish Civil War, disclosed that 71 per cent of these men experienced greater fear before going into action than during action and only 15 per cent experienced more fear during action.

If men who are ready for action have to wait long for the starting signal, then they had better find something to do or their leader had better find something active for them to do. Work keeps fear down. Men who have been in battle before and who know this rule sometimes get impatient for action to begin. They do not like fear and they know they are likely to lose it when they enter upon important action, even though it is very dangerous action.

Airplane pilots, who had distinguished themselves in action against the Japanese, said, when asked whether they were scared during those moments of acute peril: "Why, I don't know. There was too much to do. I didn't have time to think." A member of the crew of a torpedoed ship wrote afterward: "Most of us were scared at first, sure we were. But when the torpedo hit us, we forgot all about it. There wasn't much time and there was too much work to do."

(2) **Knowledge of the situation lessens fear.** The unfamiliar is always more fearful than the familiar. You cannot even plan how to meet a strange and ill-defined danger. Men in combat should therefore be told as much about the enemy as possible—where he is likely

to be met, and in what strength, and what kinds of weapons he is likely to use, what tactics. In intervals of waiting between phases of an attack, soldiers should be learning from their leaders more about the terrain between them and the objective, looking at the ground ahead if possible, or at a map or air photograph of it. Seasoned troops feel less fear than green troops because they have been through it all before, they know what happens in combat, what the enemy is like and how he fights. They also know that you can come through unhurt.

It is because the unfamiliar is always more fearful than the familiar that news that the enemy will soon use a new weapon is likely to increase fear and lower morale. Thus the sudden appearance of clouds of strange-colored smoke blowing over from the Franco side is said to have thrown the Spanish Loyalist soldiers into flight. The smoke was a harmless but effective ruse because it was strange.

The soldier needs correct news about the war and how it is going, even when the news is bad. The informed man, who knows that he can depend on the information that comes to him from his headquarters and his country, is armed against lies and rumors. He can fight his battle without in addition having to fight the fear that is engendered by inadequate or incorrect information. If you know the worst you can prepare yourself accordingly. If you are left guessing you imagine the worst and become panicky or hope for the best and take inadequate precautions.

Through the Army's Information and Education Division news and general orientation information are provided. The training schedule of every company unit in the Army requires a weekly discussion group. A basic orientation library is furnished to every such unit in addition to other publications for the same purpose. Army newspapers go to all units overseas and the Army Library Service furnishes monthly kits of numerous magazines. All of this has the purpose of bringing unbiased information and news to the soldier for his better understanding of the war. The British Army has the ABCA—Army Bureau of Current Affairs—for the same purpose. This is one effective way to increase morale and lessen fear.

(3) **Habit makes fear less effective.** Fear is disorganizing. It makes men less alert, takes their attention from important matters, causes them to act for inadequate reasons. That is how panic gets started. But discipline, fortunately, controls them and gets them started on the right actions. Then, in action, the mind clears up as the fear disappears.

Discipline is the soldier's friend in emergency. It carries him through when he might otherwise fail.

Soldiers sometimes report that they are much more afraid during a bombardment when on furlough in a city than they are on the firing line. They have been trained for battle and in battle they have their job to do.

Some men yield to fear more easily than others because they have not formed the habit of suppressing emotion and acting on judgment. There are differences in the emotionality of people that depend upon their habits and training. It is sometimes thought that certain races—Latin peoples and Negroes—are more emotional than others. If there are such differences, they are almost certainly due to cultural habits which can be unlearned. There is, for instance, no evidence that the disciplined Negro is less brave in combat than the disciplined white man.

(4) **Calm behavior lessens fear.** It lessens fear in others, for both fear and self-possession are contagious. For this reason each man has a responsibility to control the signs of his own fear, and the successful leader is, of course, a man who can remain calm in danger. If a soldier goes to pieces and becomes panicky, then he should, when possible, be removed from the sight of the other men. Assumed calm does, moreover, lessen fear in the man who assumes it. He finds his pride working against his panic.

(5) **Humor fights fear.** In trying times and tense moments a laugh can be a lifesaver. There is a story from the First World War of American troops facing an unexpected horror. They were being fired on by another battalion of their own regiment. The men were nervous and afraid, ready to fire back on their comrades. The Captain restored morale. It was unintentional, but he did it.

"Jackson!" he called.

"Yes, Captain."

"Where are you?"

"Right here, across the road."

"Stand up, so I can see you."

"Captain," Jackson shouted in a lull between bursts of machine-gun fire, "if you want to see me, *you* stand up."

The chuckle that ran down the line restored order. Commands were given. The men crept out of the zone of fire, reached a wooded place that afforded cover, and then rushed to the other battalion to stop the fire.

(6) **Companionship decreases fear.** Men should, whenever possible, be within sight or hearing of other men in time of battle danger, although not bunched together so that they make a common target. The sight of another man who seems not to be panicky is reassuring.

Roll calls also help. They remind the men that they are not alone, that each is part of a close-knit organization in which he has an important position. The artillery's "call out your numbers loud and strong" reassures each man through the smoke that the others are still in their places, doing their parts, and that they want to know that he, too, is still at his job, that they are thinking about him.

(7) **Knowledge of statistics helps fear.** Even when casualties are heavy, comparatively few men are killed. The chances that any one man will be mortally wounded in any one battle are small. In the entire Allied Armies in the First World War only one man in nine was killed or died as the result of wounds in all the four years of fighting. That is a reassuring thing for a man to know and to remember. Seasoned troops take it for granted, for they have learned from experience. This is a bit of knowledge that can, when it is fully realized, take much of the dread out of the coming attack.

Many soldiers fear things other than death. They fear that they will be wounded. They especially fear injuries to the abdomen, eyes, brain and genitals. Others have specific fears of mental breakdown. If it can be shown that injuries most often feared are in fact not the most common, these men would be greatly reassured. For example, some facts on mental breakdown in war are already known. The incidence of breakdown among civilians had been found to be no greater in war than in peace. Moreover, many individuals who had previously broken actually improved under war conditions.

(8) **Religious faith diminishes fear.** The men who believe in God's protection and in immortality may be greatly sustained in that period of fear before a battle. They can pray, too, and for them prayer works, as it has worked for so many men throughout the ages. Even the man alone in a shell hole is not alone if he feels that God is with him. All reports from the fighting fronts show that religious faith is an efficient enemy of fear. Many leaders encourage prayer before combat among their troops. Few men in foxholes, they say, are atheists.

(9) **Loyalty works against fear.** The man who lacks this faith in God may nevertheless be controlled by a deep loyalty and responsibility to his comrades, to his unit or to his leader. Another important antidote for fear is belief in the cause for which one is fighting. Men must have a clear idea of what is at stake—what they stand to lose or to win.

Nearly all prudent men are afraid in the face of danger, but not so many of them are inhibited by fear, are terrorized by it. Every emergency, every great danger to a group, reveals many quiet heroes. And the greater the morale of the unit, the greater the number of unpretentious heroes in it. Men will crawl out of foxholes under shell fire to gather up the remains of a shattered comrade because—because that is the sort of men they are. Affection and responsibility are not strangers to the battlefield and they can overcome fear.

(10) **Good physical condition works against fear.** Tired, sleepy, hungry men are much more likely to be fearful than men in good physical condition. The tired man does not think clearly; he is more prone to illogical fears, to belief in rumor, than the rested man. The healthy man can do something about fear, the ill man lacks the energy to combat it.

(11) **Knowing about fear reduces fear.** So many inexperienced soldiers are afraid of being afraid. Fear itself is the great unknown of which they are fearful. They wonder whether they will be able to stand the test. These men are potentially the strong men whose pride will make them responsible, will make them brave in spite of fear. They should know what fear is like, why it comes to all normal men, that it is inevitable because it has a physiological basis, that it is overcome by knowledge and experience, that it generally disappears in action, that it is not incompatible with bravery but is a natural antecedent to courageous action. Most men are helped by bringing their fears into the open. It is good to know that others are afraid, too. It is good to know that the enemy is also afraid. When soldiers know that fear in combat is natural, is highly contagious and almost inevitable, but that courage is also contagious, then part of the battle against fear is won. Not all. There are still all these other things. The final victory over fear is won by various psychological tactics and the strategy of self-control, which we have just considered.

Anger, like fear, is an emotional response to frustration. If a man feels that his freedom of thought or of action is threatened, it makes him angry. And when he is angry he is likely to be aggressive, to be on the offensive. Place any insuperable obstacle in the path of a man's strong desire and he is likely to attack it. Or if he dares not attack it, he may just give up. If he gives up he is likely to be on the defensive, to suffer the depression of failure and perhaps anxiety. But he may attack the obstacle, even though he knows he cannot overcome it. He abuses it or assails it, "butting his head," as we say, "against a stonewall." He also meets anger with anger, because attack by another person is itself an obstacle. When the obstacle lies within himself, is due perhaps to his own conflicting wishes, he is more likely to lapse into the depression of anxiety, but not always. Sometimes he turns anger against himself, abusing himself, belittling himself.

Fear and anger often blend. Apparent fear may mask anger, especially when fear is strong. The child may resent the order the bully has given him, but he is afraid to say so, afraid to rebel. Pale and trembling, he carries out the order when he would really like to knock the bully down. Or apparent anger may mask fear. The commanding officer worried about the turn in battle, afraid that the enemy will overpower his men, may bark his orders, threaten, insult and otherwise offend the men. He covers his own fears by authoritativeness, seldom realizing that he is doing so.

Such blends of fear and anger probably occur most frequently when the situation arouses anxiety. In any case even when the two do not blend the general rule seems to be that fear is a withdrawal in the face of frustration, anger and aggression. The frustrated man when afraid wants to run away. The frustrated man when angry wants to attack. In a sense the one is defensive, the other offensive.

Anger, like fear, has the support of the sympathetic nervous system. It also is man's response in an emergency. Any threat to a man's vital interests or any attack upon them will arouse anger. Threaten or destroy a man's cherished property, or his loved ones, or his own pride and equally beloved self-esteem, and you have almost inevitably an angry man on your hands. His anger then tends to warp his judgment, for an angry man is rarely as wise as he is when calm, and his anger itself may be unreasoned. It has been said that a prize fighter sometimes tries to get his opponent angry, so as to make him less skillful in his fighting.

The angry man may attack blindly, keeping his anger, attacking by words or fists and blundering into his opponent with the handicap of his diminished wisdom upon him. He may even attack senselessly, as when he vents his spleen futilely on a superior who has only to turn on his heel and walk away, or when he throws his tools on the floor and curses them because he cannot get a machine put together on time, and so is going to miss his chance to go to town.

Just as all fear is not inefficient panic or terror, so not all anger is blind useless rage or fury. Anger against the enemy aids in combat since it helps a man to take the offensive, yet it is surprising how little soldiers feel anger after the intense activity of combat has begun. There is also, moreover, a cool sustained anger that may motivate a man successfully for long periods of time. He resents, perhaps, the cruelty and injustice and originally unprovoked aggression of the enemy, and he is determined upon vengence. Such anger is good, especially when combined with the peculiar kind of elation which comes from talks by able leaders before battle. It does not warp judgment unduly and is the cause of righteous action.

Anger, then, properly aroused, directed and controlled is useful in the services. Hatred, on the other hand, is not useful. Hatred immobilizes, since hatred is repressed anger. A repressed emotion, as we have already seen in the previous chapter (pp. 359-362), may show itself in unexpected and harmful ways. Hatred, then, is to be avoided except as it is accompanied by anger.

It is easy enough to feel both anger and hatred toward a cruel enemy who breaks what you regard as the rules of warfare, who is dangerous in unpredictable ways. The Americans soon learned to hate the Japanese, who fight to the death for their Emperor. If a wounded Japanese tries to knife you when you offer him water, and if you learn that this is the way all his fellows play the game of war, then soon you will be hating the Japanese, be angry with them, and be a more effective soldier in consequence. In Africa, where the Germans surrendered, the Americans did not hate them so much, but in France and Germany it was easy to hate the German soldiers, especially the arrogant cruelties of the SS troops. In other words, hatred is easiest as a response to hatred and cruelty.

It is because of this reciprocal relation between hatred and cruelty that Nazi philosophy requires the special training of men to be cruel to those who are weak and inoffensive. In general, this kind of cruelty is not natural for most persons. It has to be learned and practiced.

Anger is not ordinarily aroused by admonition and advice, but it can be. Propaganda—true and honest propaganda—arouses anger when it shows a man how his vital concerns are threatened, how his country is jeopardized or his self-respect put in danger. The leader of a mob, with less wisdom and less honesty, arouses anger by his harangue. Anything that will make a man feel himself threatened is enough. The indoctrination of soldiers ought to show them why anger against the enemy is justified, and, if possible, to make them feel that their own interests are threatened.

Once aroused, anger must be properly directed. It is very easy for it to get transferred to the wrong objects. Soldiers, frustrated by hardships, may blame their leaders when they should be blaming the enemy. Sometimes leaders can direct such injudicious anger against the true obstacles.

In any case anger ought to be controlled—by the angry man himself. Let him consider whether he understands fully the causes of his frustration, so that he can choose the right persons for blame. Let him not be hasty but know what he does in anger and why he does it.

If this seems a large order, it may nevertheless be filled—at least at times—by the man who knows what anger is, what uses it has for him, how it warps judgment, and how, under control, it may become a valuable contributor to his morale.

REFERENCES

1. W. B. CANNON. *Bodily changes in pain, hunger, fear and rage.* New York: Appleton-Century, 1929. Pp. 404.
   A readable and important book on emotions.
2. J. DOLLARD. *Fear in battle.* New Haven: Yale University Press, 1943. Pp. 83.
   A non-technical survey of the results of a questionnaire study of 300 veterans of the Abraham Lincoln Brigade after their return from front-line action in the Spanish Civil War.
3. J. DOLLARD. *Victory over fear.* New York: Reynal & Hitchcock, 1942. Pp. 213.
   A popular treatment of how normal people can overcome their fears.
4. E. GLOVER. *The psychology of fear and courage.* New York: Penguin Books, 1940. Pp. 128.
   A readable and practical text on the control of fear under wartime conditions.
5. E. MIRA Y LOPEZ. *Psychiatry in war.* New York: Norton. 1943. Pp. 206.
   A psychiatrist's view of the effects of war with special emphasis on the findings in the Spanish Civil War; see especially Chapters 2 and 3.
6. C. T. MORGAN. *Physiological psychology.* New York: McGraw-Hill, 1943. Pp. 623.

A good general textbook; technical, clear, oriented toward theoretical concepts; see especially Chapter 17.

7. C. A. RUCKMICK. *The psychology of feeling and emotion.* New York: McGraw-Hill, 1936. Pp. 529.

A technical handbook; good survey of the literature in this field.

8. P. T. YOUNG. *Emotions in man and animal.* New York: Wiley, 1943. Pp. 422.

A clear general textbook on emotions; technical, but not difficult reading.

See also references cited in Chapter 15.

Chapter 17

Sex

The reason that sexual need plays such an important rôle in human society, creates so much trouble and requires so much attention, is that the sexual need is more often frustrated than any of the other strong dominating needs. In the armed forces this need becomes especially important because there sexual frustration is almost certain to be greater than in normal civilian life.

The bodily needs for air, water and food are vital because a man cannot live without some of each of these three essentials. Sex is not vital; a man does not die if he is denied sexual expression. In that sense the sexual need may be said to be not so strong as the need for air, as thirst and hunger. Deprive a man of air, water or food for a long enough time and his whole concern and attention become centered upon his deprivation and how to relieve it. It is not so with sex. He will not, when crazy with thirst, be thinking about sex at all, no matter how long he has been without sexual gratification. But when the basic vital needs are supplied, even though they may not be fully satisfied, then sexual desire appears in a normal man, somewhat variably though partly in accordance with the accumulation of sexual secretions, and this desire can temporarily be all-absorbing and dominating, changing character and leading to unexpected behavior, which in men is often violent and sometimes even criminal.

Some animals have their sexual frustrations when they cannot find mates at the time of the reproductive period, but men seem to have greater difficulties. In the first place, they have no sexual period and are always subject to the arousal of sexual desire. In the second place, they are constantly thrown into frustrating conflict because nature and society have evolved in ways that are not always compatible the one with the other. Both law and religion in America require that a man have but one wife, and both assume that he will found a family on a monogamous marriage. When children are born and the family comes into existence, it is now known that the mental well-being of the children usually requires that the family be kept together in love and harmony, that children grow up into emotionally stable adults most often when they have experienced love and security in childhood, when they are not reared in homes broken by the jealousy, the aggressive reaction to frustrated love, that is aroused when either parent finds sexual satisfaction outside the home. Thus psychology adds a sanction to the forces of law and religion for the preservation of monogamous marriage.

Psychologists recognize, however, that there are two sides to this picture. Sexual frustration often occurs in marriage, and the frustrated man, as a preceding chapter has shown, is likely to become a maladjusted man or even a neurotic, unless he chances to make a very fortunate use of the mental mechanisms in resolving his frustration. The mental quirks of one parent may easily be opposed to the well-being of the other parent and of the children, or both parents may think it advisable to break the home which, being broken, renders the children insecure and potential emotional casualties when they have become adults.

There is no general solution for this conflict at the present time. Wise men disagree about divorce. Even if the law and the church were not important parts of the picture and the matters were left solely to the psychologists, there would be no better solution than an adjustment worked out for each individual.

There are, however, fairly satisfactory adjustments that often can be made for sexual frustration, and by no means is everyone doomed to frustration. When love persists in marriage and too frequent pregnancies do not destroy the mother's health or the family's economic solvency, then the sexual forces inherent in the bodily system can create long continued happiness and lend themselves to the reenforcement of other useful creative activities.

Marriage does not, however, provide the solution of the sexual problem for men in military service since ordinarily in wartime the married man cannot have his wife with him. In the armed services, therefore, frustration is bound to occur, and the problem of the services is how to lessen the sexual need and to substitute, even though inadequately, for it.

PHYSIOLOGY OF SEXUAL NEED

The nature of sexual need in man can be best understood by considering animals first. In animals sexual behavior is simpler. It is not so complicated by learning, experience, and ideas as it is in man, nor does it seem to spread so far into those other activities which do not lead directly to procreation, yet form in man a definite part of his total love life.

That the sexual life has a physiological basis is shown by the fact that sexual desire waxes and wanes in cycles. (1) In the first place, there are the life-cycles in both animals and man. The specific desire for the sexual act does not arise until the animal is sexually mature—in man not until puberty. And it diminishes and gradually disappears in old age. (2) Many animals have seasonal cycles. Birds mate in the spring, dogs in the spring and fall. (3) Female mammals have what is called an estrus cycle. During the major part of this cycle the female is unreceptive to the male. For a short period, however, she is in estrus or "heat." This is the period of sexual receptivity that depends directly on the maturing of the ova, the female germ cells. When the cells are ready for fertilization the females become receptive to the advances of the males. The menstrual cycle in woman is an estrus cycle, but sexual desire in women is not completely controlled by the events of this cycle.

Sexual need and behavior in the higher animals depend primarily upon the presence in the blood of certain *hormones,* the secretions of internal (endocrine) glands. The organs which form the germ cells—the testes in males, the ovaries in females—are called *gonads* and these gonads, besides forming the male and female germ cells, the spermatozoa and ova, secrete the hormones that are most immediately responsible for sexual desire. The testes of the male secrete *androgens,* the ovaries of the female *estrogens.* Besides the gonads, the *pituitary gland* located in the brain is also an important determiner of sexual need and behavior, because certain of the hormones secreted by it have the effect of stimulating the secretion of the androgens and estrogens. In fact, the pituitary gland and the gonads interact to control each other's secretions. The hormones from the pituitary gland stimulate secretion by the gonads, but excessive secretion by the gonads tends to stop the secretion of the pituitary gland. In this way a proper balance of androgens or estrogens is maintained within the body.

If the part of the pituitary gland that secrets these gonad-stimulating hormones is removed from an animal, sexual desire and behavior cease, unless androgens or estrogens are artificially introduced from outside into the animal's blood by injection. Removal of the ovaries stops sexual behavior at once in a female animal, but removal of the testes by castration at first only diminishes sexual desire in the male, although it leads ultimately to permanent loss. Probably in the male the pituitary hormones act directly on the nervous system as well as on the testes.

In higher animals, then, sexual desire is almost entirely dependent upon the presence of hormones in the blood. In infrahuman females it comes and goes with the estrus cycle. When not in heat, the female does not want the male, resists him. On the other hand, in mature males who are not yet senile, desire is continuous, or at least is set off at once by the presence of a receptive female.

Along with the secretion of the gonadal hormones goes increased general activity. Female animals are most active when in heat. Castrated male animals eventually become relatively inactive. The injection of estrogens into a female when she is not in heat at once increases her general activity, as does the injection of androgens into a castrated male. In other words, castration not only lessens or abolishes sexual desire in an animal, but also decreases the efficiency and intensity with which it conducts its business of living.

There is strong evidence that mating in animals depends only secondarily on the perception of a mate. Being aware of the presence of a mate does not stimulate sexual desire unless the necessary hormones are present in the blood. Nor is any particular set of sensations requisite. Smell, sight and touch may act together, or one sense may act alone when the animal is deprived of others. In this respect sexual desire is like thirst or hunger. Water is tantalizing only when the animal or man is already thirsty, food only when he is already hungry. If he is thirsty or hungry and sees no food, then he gets restless, becomes more active than usual.

There is no evidence that the sexual act in animals is learned. Animals who have been isolated until maturity will mate when a male is brought together with a female in heat, and both male and female will show in this initial mating all the peculiarities of behavior and conduct that are characteristic of their species. The natural pattern of mating develops without practice as the animal matures.

Now what about man?

SEXUAL NEED IN MAN

There can be no doubt that sexual need in man depends in part upon the hormones, just as it does in animals. The fact that desire is weaker in old men and women, added to the fact that man is simply a higher animal, argues for this point.

It is, nevertheless, also true that in man sexual desire depends upon many other factors—upon learning, upon thought, upon ideas. Old men, even when they have become impotent, may still have desire, may love at least to look at beautiful women. And men do not lose their attractiveness for older women. Desire is, moreover, not clearly cyclical in women; it does not have the usual fixed relation to the time of ovulation in the menstrual cycle. As a matter of fact, it is usually reported to be greatest just before and just after menstruation, although elicitable at other times as well. This is not true of the mammals below man, where desire is greatest in the middle of the sexual cycle instead of at the beginning and the end. We have to assume, therefore, that habits of thought and action are superposed in both men and women upon the activities of their hormones, that, having learned to want sexual relations, they continue to want them even when the power of procreation is missing.

There seems to be no question that the androgens in a man increase his energy and efficiency, have thus an effect upon his usefulness and effectiveness in living. Nevertheless, when vigor and the androgens diminish in old age, many old men remain surprisingly energetic. That is because their habits of activity, their strong motives and goals continue to drive them even when their bodily vigor has diminished. Still, habits and ambitions are not everything. Castration, for example, would not be a solution for persistent problems of sexual frustration, for it also impairs bodily vigor, intellectual verve, and the power of creative thinking.

For this reason men of the armed forces need the androgens and the pituitary secretions. They must be complete, normal, vigorous men, even though the services can make for the men no satisfactory provision for a normal wholesome sexual life. Some increased sexual frustration seems to be one of the necessary hardships of war.

Because sexual desire in man is not wholly a matter of the effects of hormones, the meaning of love in the life of man becomes very broad, nor is it always possible to say when love is sexual, and when it is not. The fact seems to be that love between a man and a woman can persist when sexual mating is impossible or even not desired, and that there are substitutes for it in other kinds of love and in the creative esthetic life which often furnish reasonably satisfactory adjustments for sexual frustration. These phenomena fall into three classes.

(1) **Continuity.** Love is more stable and continuous than sexual desire. It does not follow an estrus cycle in women. It is not temporarily abolished by the sexual act in man or woman. It lasts in both men and women after procreative power has lapsed with age. It persists as fidelity through long separation.

In other words, love, which arises because of sexual need under the influence of hormones, can become fixed upon a particular person and persist when the original need is frustrated or has disappeared. This extension of love beyond the immediate satisfaction of need, an extension which turns it into a permanent fixed goal or ambition, is largely a human characteristic, although fidelity is not unknown among the higher animals.

(2) **Transfer.** In a human being love is not limited to some one person. It is extended to include children, parents and friends, both men and women. It cannot, of course, be demonstrated that all human affection is sexual, and yet there is room for doubt that any affection can ever be entirely separated from sex. The reason for this doubt about the independence of love and sex lies in the fact that human affection often satisfies—at least imperfectly—sexual frustration.

The widow, frustrated in her sexual life, may solve her problem by lavishing affection on her son, or even on her daughter. The widower may relieve his frustration by a bond of affection with his daughter or son. All sorts of affectionate relations between friends can grow up to relieve the loneliness that is the characteristic of sexual frustration. Of such persons it is not unreasonable to say that sexual love has been transferred to another person or to several persons and is no longer specifically sexual in character.

(3) **Sublimation.** Sometimes sexual frustration is relieved by emotional activities that are not primarily relations of affection for other persons. The artist, the poet, the man with an intense religious life, all find in their work and thought an emotional experience which may act as a substitute for sexual love, or may, on the other hand, intensify it. Such a draining of sexual desire over into the satisfaction of other needs for creative achievement is called *sublimation.* In fact, almost any goal pursued with enthusiasm may have a sublimative effect upon sexual frustration. A woman, sexually thwarted because she has chosen a career instead of marriage, may throw herself into politics or war work with a fervor and enthusiasm that seem, to some extent at least, to satisfy her emotional needs. Not always though. If in her enthusiasm she remains over aggressive and unreasonably resentful of opposition, it is likely that she is still experiencing frustration, that sublimation does not provide for her a perfect adjustment. In similar manner, sexually frustrated men may seem to lose themselves in the intense and emotional pursuit of other goals, accomplishing a reasonable, if imperfect, adjustment of their emotional lives.

It is doubtful, however, that transfer or sublimation ever provides a perfect substitute for the normal sexual life of a man or woman during the normal reproductive period. Marriage, too, often fails in this regard. When sexual frustration does prevail, the basic difficulty lies, of course, in the conflict between biological need, on the one hand, and the requirements of society and the needs of the family, on the other.

THE FIGHTING MAN'S SEXUAL PROBLEM

Although most young men suffer from sexual frustration, men in the armed forces face an especially difficult problem. They find themselves in what is practically a world without women—except as they meet women casually outside the military confines. Their needs are not changed. Their pituitary glands are still working. The androgens are in their blood. The accumulation of sexual secretions puts them periodically in special need of relief. What are they to do about this?

In the first place there are the substitutes—the transfers and sublimations. Sexual hunger may first come to the man in the form of loneliness. He feels less lonely if he can have some contact with women. For one thing, his difficulty is lessened if he gets continual, though remote, attention from the women he loves at home—his sweetheart, his wife, his mother. It helps him if they write to him, express affection for him, suppress their own troubles in their letters, are concerned about his troubles, send him presents. Many a man manages his sexual problems throughout a war on nothing more than that.

It helps a man also if he can have some association with women and the social world which contains women near his own station. He needs to meet women whenever possible, to go to dances, to have the attention of hostesses at canteens, to be entertained in private homes. Even a Sunday dinner at a home not too different from the homes he knows best, where there are no girls and the hostess is twice his age, can do much to dispel the feeling of loneliness, for it takes him back into the world where women belong.

Few persons realize how much food has to do with sex, how the sex-hungry man gets food-hungry. He wants a girl, he does not know that he wants to be with a girl, he goes to the PX and buys chocolate bars, and may even spoil his digestion, because no number of chocolate bars ever really can satisfy him as well as being with a girl could. Drinking and smoking may also play this rôle in the life of the sex-hungry man. Some psychologists have attempted to explain this relation by saying that eating, drinking and smoking all have to do with the mouth, and the satisfaction to be got from kissing shows the mouth to be a secondary sexual organ! Be that as it may, it is certainly true that food is associated in the minds of most men with women—their mothers, their wives, their sweethearts. Women are told that the way to a man's heart is through his stomach, and certainly it may be a way when both stomach and heart are so often fed by the same woman. At any rate there can be little doubt that chocolate bars, coca-cola, and cigarettes contribute in at least a small way toward diminishing sexual unrest in the armed forces.

Other nonsexual ameliorators of sexual need are hard work, fun and religion. There is plenty of hard work in the Army. It takes a man's mind off his sexual problems while he is at work, and his tired body may demand sexual relief less than it did when active and rested. Play, games, band concerts, and all the social contacts that grow up among the men of a unit with good morale also serve as substitutes for sex. They diminish loneliness and help men to forget sexual problems. A strong religious life may also provide an emotional substitute for sex, and religion contains a moral philosophy which helps the sex-starved man to accept his frustration and directs his attention to other matters.

These things, however, are not enough for most men. They feel the need of something more directly sexual, and the first phase of their adjustment is then apt to occur by way of fantasy. They daydream about girls and sexual relations, and they talk much about them, too. If the tensions from accumulated secretions become strong, they also dream at night about these matters and have nocturnal emissions. Some men with strong moral scruples about sex may be worried by such emissions or feel guilty about them. They should not be. The emissions are natural and normal, as any wise medical officer would tell them.

Most boys when the tensions are strong learn to relieve themselves—by masturbation. Some men continue it, and, except for the often grave psychological difficulties that arise from conscience, it would be the simplest solution for the frustrated man under strong tension. In moderation, masturbation, accompanied as it almost invariably is with daydreaming, forms a physically harmless mode of relief, but for most men there are psychological difficulties inherent in it. In the first place, most men have been taught as boys that such an act is wicked and evil, have had this precept impressed so firmly upon them that it has become an ineradicable part of their consciences. Such a man is likely to feel guilty about his act and may even develop a strong anxiety about it. Since his feeling of guilt seldom diminishes his practice (anxiety, in fact, may actually increase sexual tension), his emotion about himself may mount until it interferes seriously with his efficiency. He needs advice and reassurance from some wiser man whom he respects.

He needs especially to have the common misconceptions about masturbation cleared away. He ought to know, for example, that masturbation is not rare, that most people, in fact, have resorted to it at some time during their lives, that it will not cause feeble-mindedness, insanity or impotence, that in moderation it will not damage health and make him unfit for military duty, and that it is not a disease or a symptom of one. If these things are made clear to him by a medical officer, a chaplain or even a friend, his load of anxiety can be reduced. And with the lessening of anxiety, he is likely to find that he transfers or sublimates much or even all of his sexual tension more readily into other channels—religious satisfactions, thoughts and dreams of the women he knows best, and his daily activities of combat, work, or relaxation.

Other men experience inferiority rather than guilt. They feel that obtaining relief by masturbation is unmanly, that they would be able to get normal sexual satisfaction if only they were more virile. They, too, need reassurance and clear understanding, also, of the fact that normal sexual gratification in the armed forces carries other dangers with it.

Military life, moreover, is so public that masturbators are likely to be found out and made the butt of joking. That increases their sense of guilt or inferiority, feelings which never do anyone any good.

There is another psychological danger in masturbation. It is the danger that a man may use it as an escape mechanism to adjust his sexual problem, may come thus to prefer daydreaming sexual fantasies to the normal relation, and may then find himself less suited to a normal sexual life when the opportunity for it comes again. A man needs to know that he need not feel anxious or inferior about it; he should also be advised that it is a poor substitute for the more natural relation. This is perhaps contradictory advice, but the contradiction is inherent in the military situation.

Some men try to solve their sexual problems by resort to prostitutes or by other promiscuous relations. Into the age-old problem of this social evil it is not the purpose of this book to enter. Prostitution never furnishes more than an unsatisfactory solution of the basic conflict between biological and social needs. It is enough to say that many men in the armed forces do not attempt to resolve their sexual frustrations in this manner, and that many of them would suffer psychological damage if they did. These many men never bring themselves to the point of sacrificing their ideals about the relation of sex to love. Other men, on the other hand, do engage readily in sexual promiscuity without psychological damage and remain excellent fighting men.

When these men talk freely about their sexual exploits they make it more difficult for their comrades by exciting them sexually and by making them feel inferior because they do not get such direct relief for themselves. All sexual talk in the Army and Navy may have this effect. And it is hardly to be expected that the continual talk about this ever-present problem should grow less in the armed services since conditions of war make sex hunger so general.

Aside from the advice of the chaplains and a few other wise leaders, the Army and the Navy have chief concern about the prevention of venereal disease. Sex instruction by means of films and talks appears to be designed primarily to scare the men away from prostitutes or at least to scare them into medical examination when they have been with prostitutes. A man lost to the Army or Navy from venereal disease reduces its battle efficiency just as much as a man lost from other illness or accident, or from wounds inflicted by the enemy. Venereal losses can so weaken a military unit that it can hardly operate at all, and this has happened in the armies of past history. There is thus the soundest of military reasons for impressing men with the prevalence and dangers of venereal disease and with the need for immediate prophylaxis after contact with prostitutes.

It is probable that this type of instruction does tend to brutalize the sexual relation in the minds of some men. Some who would never go to a prostitute anyhow may feel disgust at the instruction—even though they would rarely admit it—and may be turned away from the normal wholesome sexual relation by this disgust, made less able to enter later into a relation which for most men constitutes one of the essentials of a complete life. But the armed services have their vital military problem to solve, their problem of keeping physically fit as many men as possible. Their straightforward methods of warning, when thoroughly put into use, have unquestionably kept the venereal rate very low.

HOMOSEXUALITY

In the developing embyro it is practically impossible to tell one sex from the other. In later stages of growth it is, however, possible to distinguish a male from a female because the genital organs begin to take on their specific characteristics. There is thus correspondence between the male and female genital structures. For every part in one sex there is a corresponding part in the other, and it would seem that the first stage of a new individual, the new being formed by the union of the male and female germ cells, might develop in either direction, might become either a male or a female.

Development goes in one direction or the other because of the existence of a sex-determiner in the united germ cell, a determiner that comes from the male germ cell. If the male parent contributes an "*x*-determiner" to the union, then the offspring is a female; if a "*y*-determiner," then the offispring is a male. Thereafter sex depends on the presence of the kind of gonads which were started developing by these determiners. If the testes of a young male animal are removed and some tissue from a female ovary is implanted in his body, his sex is largely reversed and he develops practically into a female. Such artificial reversal of sex is less complete the older the animal and the further its development has already progressed.

In this sense all animals and man are *bisexual*. Each has all of the essential sexual parts although they have developed in different directions—male or female. There are gradations in this development such that some men are so feminine as to be partly female, and the converse is true for women. For instance, all men have nipples, but some men have the beginnings of breasts.

Animals are also found to be bisexual in the patterns of their mating behavior. The male and female behavior in the mating act are, of course, very different. These patterns seem to depend on connections established in the nervous system of a maturing individual and to be the consequence of inheritance only, for in animals they are not modified by experience—they are not learned. It appears, nevertheless, that, although a rat or a guinea pig has in its nervous system mostly the pattern of mating behavior proper for its sex, it has also a little of the pattern for the opposite sex. A female rat, if she is strong and is very greatly excited sexually, may try to mount another female and to act the rôle of the male. Or a male rat may similarly accept the rôle of the female to a more dominant and excited male. That is what is meant by bisexuality in behavior.

In human beings we find persons who prefer relations of love and sex with a partner of the same sex—a man with a man, a woman with a woman. The degree with which this unusual development dominates the person varies, just as the roots of the homosexuality may vary. In an extreme case, a man may feel no love interest at all in women but may feel it strongly for other men. Such cases are usually homosexual by virtue of inborn constitutional factors and such individuals are rarely interested in members of the opposite sex. In other cases where the homosexuality is based, for example, on early childhood seduction by an adult homosexual, or on previous frustration in love relations with women, the man under social pressure may become engaged to a woman and even marry her. Such a marriage is likely to fail, however.

It does not seem to be possible in persons of strong homosexual tendencies to change this preference. Presumably the abnormal mating pattern has become established in the nervous system in the process of maturing and has become unalterable. Social pressure and will power are powerless to induce a change, although they can lead to the suppression of homosexual acts and to consequent frustration of the homosexual person. On the other hand, a bisexual man may change his conduct or remain unsure of his preference. In the Army or Navy where for long periods men are commonly in the company of only men, a bisexual man may turn to homosexuality for a time, and yet revert to normal heterosexual behavior again when circumstances change—perhaps on demobilization.

Society, convention and religion are strongly opposed to homosexual relations, which do not, of course, help society by furthering the procreation of the race. A man with strong heterosexual needs feels, moreover, a violent repugnance for the advances of a homosexual man. He is apt to react with an anger or scorn that is out of all proportion to the harm which has been done him. He believes that the homosexual man should feel ashamed. These pressures create great difficulty for the homosexual man.

Whether or not the homosexual man is ashamed of his preference depends on the strength of his homosexual needs, the reasons for his homosexuality and the effect of social opinion or of conscience upon him. The constitutional homosexual, who is not deterred by rebuffs, feels no shame at what is a basic characteristic of his nature. The bisexual man, in conflict with himself about his preferences, may feel shame and guilt, even though he continues homosexual practice. Such a man actually needs sympathy, understanding, and help, not villification.

The aggressive shameless homosexual makes trouble because he is so often offending other men. He is most likely, therefore, to be separated from the services by action of the authorities, for he probably cannot change his ways. The armed services try to keep such men out in the first place, but they do not always succeed. On the other hand, the homosexual man who has learned to conceal the nature of his needs and the bisexual man who is in conflict and is really trying to conform to social standards do get into the services and may make excellent fighting men.

The absence of normal heterosexual opportunities in the services increases any tendency toward the establishment of secret homosexual relationships. A man of strong sexual drive, who in more normal conditions of life never dreamed of homosexual relations, may be seduced to them. He may feel shame and guilt because the pattern of his conscience has been set the other way. He may suffer agonies of mental conflict, yet still yield to such seduction. He may fear that he is becoming permanently reversed, that he may not be able to resume the normal sexual attitude after the war when the opportunity is again his. These fears are likely to have a strong psychological effect upon him, though they are probably groundless for men who have already demonstrated their bisexuality. Having changed once, he may be able to change again. The extreme constitutional homosexual, however, apparently never changes.

Although a man who has been seduced into homosexuality through heterosexual frustration should not torture himself about what he has done, he also should not continue the practice. The social consequences and social problems are too great. Such a man should seek psychiatric help and advice toward gaining sexual relief or sublimating it in the other ways which are of help to heterosexual men.

RESUMÉ

The needs of sex are insistent but they are not vital. Men do not die because these needs are not satisfied, but they get into much trouble on account of them. The trouble occurs because the needs of the body are not well adjusted to the needs of society. Adjustment is necessary.

In the animals sexual desire depends on the hormones—in males upon their androgens. In man, however, sex is more complicated. It does not depend in women solely on the estrus cycle. In both men and women it may continue after the gonadal secretions have stopped with the change of life in advancing age. At any time sexual desire spreads into all the various manifestations of love. Such complications make this need more general in man than in animals, but they also provide ways in which sexual frustration can be ameliorated.

The adjustment of sexual frustration in the military life, as in all life, can come about by sublimination and transfer. Contact by letters with women at home and social contact with other women where the man is stationed may partially satisfy the need. Religion aids a great deal, partly because it reenforces habits of fidelity and partly because as a phase of the emotional life it acts as a sublimination. Eating, drinking and smoking may imperfectly reduce the loneliness that is the symptom of this frustration. Hard work and exercise help on the bodily side. Fun helps on the psychological side.

Men also get relief from sexual frustration by daydreaming and fantasy. Often such dreams are accompanied by masturbation, which in moderation is not physically harmful in itself, but is harmful if it is disapproved by the man's conscience and makes him feel anxiety and guilt, if it makes him feel inferior because he has to accept a second-rate substitute for his normal needs, if it becomes for him more desirable than the normal means of satisfaction.

Prostitution, the frequent recourse of sexually frustrated men, has the disadvantages of degrading the sexual relation and threatening the man with venereal infection. It can also raise all the conflicts with conscience that are raised in some men by masturbation.

Homosexuality is always undesirable because it leads to so many social complications. A confirmed homosexual may interfere seriously with the morale of his unit. Some men, however, are seduced into homosexuality without ever coming to prefer the homosexual relation, and may again be able to resume the normal relation when it becomes available.

REFERENCES

1. R. E. BABER. *Marriage and the family.* New York: McGraw-Hill, 1939. Pp. 656.

   A sociological analysis of the family combined with practical guidance in marriage and family relationships.

2. H. BECKER AND R. HILL, EDS. *Marriage and the family.* Boston: Heath, 1942. Pp. 663.

   An important textbook in the field of the history of marriage in the past and preparation for marriage in the present.

3. G. H. GROVES AND C. GROVES. *Sex fulfillment in marriage.* New York: Emerson Books, 1942. Pp. 319.

   A well-written presentation of such important topics as the experiences that influence sex courtship, anatomy and physiology of sex, and sex hygiene.

4. N. E. HIMES. *Your marriage.* New York: Farrar & Rinehart, 1940. Pp. 434.

   A frank, honest, scientifically accurate discussion of some of the real problems facing young men and women today.

5. F. KAHN. *Our sex life.* New York: Knopf, 1939. Pp. 459.
A useful and informative book concerning the psychophysiology of sex, hygenic aspects of marriage and kindred topics.

6. T. PARRAN AND R. A. VANDERLEHR. *Plain words about venereal disease.* New York: Reynal & Hitchcock, 1941. Pp. 226.
A frank, authoritative, popular discussion of the medicosocial implications of the venereal disease problem.

7. L. M. TERMAN. *Psychological factors in marital happiness.* New York: McGraw-Hill, 1938. Pp. 474.
A somewhat technical report of a study of 792 married couples with an analysis of the psychological and psychosexual factors which make for a successful marriage.

8. K. WALKER. *The physiology of sex and its social implications.* New York: Penguin Books, 1940. Pp. 183.
A readable text mainly on the psychology of sex. It treats such topics as what is normal and what is not normal in sexual relationships, the concept of romantic love, sex and education, and sex in marriage.

See also references in Chapter 16, especially item No. 6 (Chapter 20).

Chapter 18

Leadership

There is no skill that the armed forces need so badly as the capacity to lead men. They need it because it is vital to the working of the military machine, and they are aware of this need because it is so inadequately supplied. There are not enough good leaders—not enough men with the capacity to establish discipline, to build up morale and to integrate groups of men into efficient fighting machines, machines which work with little friction and stand up without breaking under strain of combat.

"Through training in discipline the Army prepares its men to carry out its ultimate missions under command and according to plan." That is the military scheme. Plans can be executed by command only because there is discipline. Most persons think that commands are enforced by authority, but the relationship between leaders and their men is not nearly so simple. A command to be effective requires not only discipline, but also morale, understanding and motivation. A command is not merely some words which act like a match to a fuse or a firing-pin on a bullet. Command—effective command—means that the men who receive it understand it, trust it and obey, having been trained by leaders to understand, to trust and to obey. Leaders have to do much more than issue orders. They must teach. They must inspire confidence in themselves. They must motivate action which will be carried out in spite of confusion and fear. Only by long and careful training can men learn to respond immediately and correctly to oral and written orders and oral commands. And only by long and careful training can men be trained to assume the responsibilities of giving the orders and commands.

Command is like a motor nervous system for the Army and Navy. As the nervous system carries action all the way down from the brain through the lower nerve-centers to the muscles, so command proceeds from the commander in chief through a succession of commanding officers down to the soldiers and sailors who finally execute the actions. Since successful command depends on good leadership, it is equally true that leadership also goes all the way down the line through all the COs and NCOs. Every man from the corporal up is a leader, and all the other men are at least potential corporals.

Followership is important too. All the leaders as well as the privates have to be led by leaders, but the dearth of followers is not so great as the dearth of leaders. Nevertheless, followership is also an art and has to be trained. The development of morale in a unit is largely the training of followers.

When you come right down to the bottom of the matter, leadership and followership are complementary. The men with good morale accept leadership and make it effective. The leader, on the other hand, has not only to give effective direction to morale, but he is also, as another chapter has shown, the most potent influence in building up morale. He has both to build it and to use it.

What then, we may ask, is leadership? And what is followership?

LEADING AND BEING LED

Accepting leadership is easy and natural for most Americans! That is because they have been taught from early childhood to obey commands and accede to requests. If you should stop a stranger on the street, point to the top of a building, and say to him, "Look!", the chances are that he will stop and look. This is especially true if you say it in a voice of command and with a manner of authority. Such immediate unquestioned acceptance of a command is called *suggestion.*

A great deal of leadership depends on *suggestion.* Ask a man to stand erect with his back near the wall of a room. Tell him not to move, but to keep his head directly under a plumb bob that hangs from the ceiling, one which he knows is there but cannot see while he is erect. Then tell him that he is leaning forward. Urge him to stand straight, but insist that he is leaning. He will almost certainly sway forward. Or stand a "stooge" against the opposite wall and let the "stooge" keep swaying forward while the first man watches. Again the first man will sway forward. Sometimes, if you have a good line of talk, you can tell a man to interlock the fingers of his two hands across his chest and then tell him that he cannot pull them apart. He will try and may find himself unable to get them apart. That is suggestion at work. But for suggestion to be effective it is necessary that the man who makes the suggestion have acquired, by talk or otherwise, a good deal of prestige with his victim. Obviously no military leader would want to make suggestions of the sort described above to his men. But it is possible that he will have to persuade a man weak with fatigue or loss of blood that he can keep walking or crawling until he reaches safety. Through suggestion a leader can accomplish this.

The most extreme form of suggestion occurs in *hypnosis* between a *hypnotist* and his subject. This is an extreme leadership relation. The most important attribute of a hypnotist is prestige. He must—by talk, by persuasion, by the ballyhoo of advertising, or by the use of mysterious contraptions—persuade the subject that he *can* hypnotize him. The subject must want to be hypnotized or at least he must believe that he is going to be hypnotized. In other words, he must believe in hypnosis and the hypnotist. It helps, in this special kind of leadership, to tire the subject's eyes by making him look fixedly at a bright object held so high that the eyes have to strain to see it. Then the hypnotist keeps telling the subject that he is going to sleep, that his eyes will close, that he cannot keep them open, that, when shut, he cannot open them. So the subject's eyes do close. After that he can open his eyes only on the command of the hypnotist as long as he remains in the hypnotic state. He passes out of hypnosis when the hypnotist tells him to wake up. He will also wake up, without the suggestion to do so, if the hypnotist should tell him to do something which is contrary to his moral code, something which he would be quite unwilling to do when awake.

The hypnotized subject accepts the ordinary commands of the hypnotist. He will do what the hypnotist tells him to do, feel what he tells him to feel, not feel what he tells him not to feel, forget what he tells him to forget, and usually remember what he tells him to remember. You can produce anesthesia (insensitivity) in hypnosis, simply by *telling* the subject that his arm or his leg is insensitive. Elaborate surgical operations have been carried on in this way, with the subject apparently insensitive.

By post-hypnotic suggestion a subject can be got to do certain acts after he has been waked up. While the subject is under hypnosis the hypnotist says: "Sometime after you have awakened, and when I blow my nose, you are to jump up on the table and crow like a rooster." Then, even a couple of hours after the subject has been waked up, when the hypnotist blows his nose, the subject jumps up on the table and crows, as nearly as he can, like a rooster.

Hypnosis has no direct military value for leadership or followership. It is too uncertain, too unreliable to rely upon for winning victories. Moreover, the Army and Navy want men who act intelligently, not blind automatons. Since not all men can be hypnotized, and since only a small percentage of those who can be go into deep hypnotic sleep, even hypnotic anesthesia is not nearly so useful as the various medical means available. But the state of hypnosis does, nevertheless, exhibit the nature of suggestion and the degree to which command can be exercised. The conditions of hypnosis are abnormal, but the main fact of hypnosis, the fact of social suggestibility and of the readiness of men to accept command, is not abnormal. It is the commonest and most basic social relation, the relation that makes coöperation and group endeavor possible. Men naturally accept command.

It is not enough, however, to say that the hypnotist and the leader exercise command because they possess prestige. Prestige is a vague term. The able leader has many qualities which enable him to command, and the specification of these qualities is the main business of the present chapter. Any attribute of a leader which helps him to acquire the confidence and loyalty of his group is a quality of leadership, as are also those qualities of the men who are led, the traits which enable them to have confidence in and be loyal to a leader.

In other words, the problem of leadership is the problem of social *ascendance* and *submission,* if we use these words in their technical senses. In every social relation between two people there has to be a certain amount of adjustment. The most natural adjustment is for one person to assume leadership and the other followership. There are many different degrees of ascendance and submission in different people and even in the same person in different situations. Take people as you find them, and some are much more ready to lead than others, more ready to assert themselves, to suggest to others what they should do. It is an interesting fact, however, and a good omen for the needs of the armed forces, that submissive persons can more readily learn to be ascendant than can ascendant persons learn to be submissive—at least that is true in America. Both of these traits have, of course, great military usefulness.

That fact raises the question as to just what the follower contributes to the leadership relation. What is the rôle, in leadership, of the soldier or sailor who is led? He contributes "submission," that is to say, an acceptance of the leadership. His good morale is his willingness to coöperate and suboperate in this manner. There is nothing ignoble about this kind of submission. There has to be order in the Army and Navy, order got by commands which are obeyed, and too many cooks would spoil the broth. So the soldier or sailor contributes his acceptance of the rôle of being led.

Accepting the rôle of being led is *discipline.* While ascendant men do not accept discipline easily, they can, nevertheless, learn to accept it, and fortunately it is not so difficult for men to be submissive in new situations where they lack a feeling of competence. Then, if ever, they accept without difficulty control by others who are competent, by men whose right to leadership is clear to them.

In America the best leadership assumes a *democratic character* rather than the character of unilateral suggestion. The leader does not demand obedience without explanation, if he is in a position to let his followers see the reason for his decision. Nor does he arbitrarily make demands upon the followers as to the details of action. Rather he invites initiative, encourages coöperation instead of suboperation, sets a problem, exhibits means for its solution in as far as they are known to him, and asks his subordinates to carry on from there. Quite properly he accepts advice from his subordinates, although he never transfers to them responsibility for his decisions. That principle works excellently in industry, as well as with the direction of children, and there is increasing evidence that it works in the Army and Navy, too.

Opposed to such democratic leadership is *authoritarian leadership,* where the leader commands arbitrarily and the follower, under threat of punishment if he fails, executes the commands, without participation in the decisions or the exercise of initiative in carrying them out. There is no doubt that discipline can be enforced in this way, as indeed it has been most cruelly enforced by the Gestapo in German concentration camps. There men came ultimately to accept the Gestapo's point of view about the propriety of their own submissiveness. This kind of discipline, however, secures obedience but not achievement, for it is based on fear, not loyalty. The Germans do not use it in their armed forces. In the Army they expect the leaders to encourage the soldiers to participate in solving problems, to use initiative in the accomplishment of their missions. To a certain degree the German officer is asked to fraternize with his men in order to maintain morale and initiative in them, even though he must at no time break down their sense of his superiority and responsibility, nor their reliance upon him for the ultimate decisions.

The Army has made many investigations of the relationship of leadership to morale. It finds that there is great variability between different companies in the opinions which the men have of their leaders, and this difference is presumably due to the difference among the leaders. It also finds that confidence in the leaders varies directly with the men's belief in their leaders' concern for the men's welfare, as well as with other factors which are mentioned later in this chapter. All in all the Army has done an excellent job in its investigation of soldiers' opinions about their leaders and of the conditions that make for good morale.

THE FOLLOWER'S ROLE IN LEADERSHIP

So the good soldier or sailor accepts leadership in part by *discipline.* This means that the relation of the ascendance of the leader and the submission of the follower is established, that instantaneous obedience is thus always obtained even when the reasons for such obedience cannot be disclosed immediately. The follower must have habits of attention and obedience. These habits must, moreover, be firmly rooted in his nervous system. They must have become second nature to him.

How are such habits formed? By motivation and practice. By practice you teach a dog to salivate when a dinner bell is rung for him, provided he really wants food. You simply always ring the bell before you give him food. At first the bell means nothing to him and his saliva does not begin to flow until he sees the food; but after many repetitions his nervous system catches on to the relationship, that the ringing of the bell is followed by food, and the saliva flows at the sound of the bell. That new relationship will not keep on for life, but it will continue as long as the bell actually leads to what he expects, as long as you continue to give him food after you ring the bell. The reason the dog needs practice is that it usually takes some repetition before a fixed new relation is established, although not always. A dog can get porcupine-shy through one experience. Motivation is, moreover, always necessary. The dog must like food and have already the habit of salivating when he sees it. He must dislike the pain that arises when porcupine spines stick into his nose.

Discipline that arises through drill and practice comes about in the same manner, through the building of habits.

Take the habit of *attention.* At the sound "AttenTION!" uttered by a noncom, the soldier springs to his feet, drops whatever else he is doing, puts his hands at his sides, and stands still looking straight ahead unless directly spoken to by the officer whose appearance is the reason for this change in his activity. It may take some repetition before this habit becomes instantaneous and automatic, but not many repetitions are required if the soldier has failed once and has been bawled out before the others for his failure. If the soldier had, on the other hand, no motive for conforming, he would never form the habit.

The habit of attention is important. It is basic to discipline. A soldier cannot obey unless he first sees or hears commands. The command "AttenTION" means his stopping all activities that might interfere with his looking or listening. Upon this command he takes an attitude of readiness to obey the next one. For example, if his full attention is desired while his leader talks, the next command given is "At ease," upon which the soldier relaxes from the highly alerted position of "Attention," and looks at his leader, keeping still to hear what he says.

If the habit of formal attention did not become second nature with the soldier, a leader would, in an emergency, have to compete for attention—by shouting or gesticulating. That would not do, for he might not succeed in getting the attention of the men.

So discipline is calculated to insure this preliminary attention by placing certain restrictions on behavior whenever an officer is present or appears upon the scene. When the habit has become second nature, then it is part of the soldier's or sailor's standard equipment. It can be taken for granted and presumed upon when active thought needs to be given to something less routine.

The stimulus for attention has, of course, to be military rank, not any particular men or personalities. If a leader is killed, another must be ready to take his place and lead his men. And the men who lose a leader must be ready to follow without question the commands of his successor. That is why armies are uniformed and the insignia of rank standardized.

As with the habit of attention, so it is with all the other basic habits which are learned and made second nature in drill by means of motivation and practice. The successful follower of a leader must have an assured repertoire of habits which the leader can count upon. It is part of the leader's task to secure this discipline as he trains his men, but he secures it as a set of responses to any leader, not merely to his own person.

The soldier or sailor acquires his repertoire of habits, his discipline, best by actual performance. It helps if he understands how to do what he must do and why he does it, but lecturing and explaining are never so effective for discipline as practice supported by motivation. That is why the soldier learns in training to wriggle his way along the ground toward an imaginary enemy under a constant fire of real bullets which will actually get him if he does not keep his body close to the ground. The bullets provide the motivation, and repetition ultimately makes the action second nature.

So the follower contributes discipline—his repertoire of habits—to the success of leadership, although it is the leader who has to help him to discipline in the first place. Besides habits, the good follower also contributes his good morale—his readiness to follow leadership and to coöperate by directing his own initiative toward success whenever habits alone are not adequate, as is so often the case in battle.

The attributes of good morale—in both training and combat—have been the subject of an earlier chapter. Like discipline, morale is something that the junior can bring to the relation between leader and led, but, also like discipline, it is something that the leader originally has helped his junior to acquire. Again and again military success turns out to depend on good leadership. No wonder leadership is considered important when good leaders are so hard to find and take so long to train.

Another thing which the follower contributes to the success of leadership is his *pride.* A man who is praised can be more easily led than one who is blamed. When the leader criticizes, he will usually speak impersonally, condemning the poor work, not the man, leaving the man's pride untouched, letting pride work to make him do a better job the next time. The leader, therefore, tries to develop each man's belief in his own indispensability in his unit, as he can do in the course of training by making special assignments to particular men. It helps too for the leader to assign a man to a job he thinks he can do well. The soldier, for instance, who thinks he is good as a scout will devote all his energies to perfecting himself in this rôle if he is given a chance to use this ability. It is important that he be proud of what he is doing for ultimately his pride extends from himself to his unit; he feels at last that he belongs and is essential. To this result each man himself contributes, but he has to have had a good leader if he is to make this contribution.

THE ATTRIBUTES OF LEADERSHIP

It is not easy to make out a job analysis for military leadership. If you study the qualities of one successful leader and think you have an inventory of the conditions of his success, then you are likely to find another successful leader with a different set of attributes. Perhaps neither has all the desirable qualities; perhaps each succeeds in spite of some of his characteristics. Nevertheless an inventory is needed, and as a matter of fact there has been enough study of the problem to make an inventory fairly satisfactory. The items for such an inventory are derived from the solicited opinions of soldiers about what they want in leaders, psychological studies of social relations, and the experience and wisdom of many good military leaders who have considered the problem and made their experience known.

In most of the complaints and suggestions which have come from soldiers and sailors there is implicit the belief that leadership is essentially a democratic relationship, that the man who is led contributes as much as the leader, is as essential to the leadership as is the leader. The leader plays one rôle; the follower the other. The relationship is not exactly a game because the leader has to command genuine respect, but the follower must feel that he accepts command either because it is in the rules or because he voluntarily accepts it as in his own interest. He must have reason for pride in accepting leadership.

There have been studies of leadership in civilian life—among children's groups and in industry. In these studies the authoritarian attitude of the leader has been contrasted with the democratic attitude. Authoritarian leaders have been retrained as democratic leaders with great success and greatly improved results in the effect of their leadership.

For instance, a study of the leadership in a midwestern welding plant revealed the following situation. The managers were putting pressure on the foremen to use aggressive action for getting control of their men and increasing their production. The workers, who were strongly unionized, resisted such aggressive action. The foremen felt that an aggressive attitude would not work because they themselves were not strongly enough supported by the management, so the foremen tended to follow a course of greatest safety, one which involved having the least possible personal contact with the workers. In this way they could "get along" and hold their jobs without "losing face."

The foremen in this organization held a position which was one of conflict. Having no power to resolve the conflict, their leadership deteriorated. They were no longer effective. It is plain that, in order to be effective leaders, they needed the freedom to determine their own relations to their men, and other studies show that what they really needed was not power to control the men but freedom to cultivate morale, to establish friendly, helpful relations with the men.

In a study of garment workers in a southern factory the foremen had the job of training beginners. These foremen received eight hours of training from a psychologist in methods of increasing personal contact with the workers and of changing their attitude toward their men from an aggressive, high-pressure authoritarianism to a friendly and encouraging leadership. In this relation the worker came to feel that the foreman was his friend and was working for him as well as for the management. The result of this "democratic" relationship was a definite increase in morale as well as an increase in productivity. Presently beginners were able to learn in one week what had previously taken others five. This experiment shows that important changes in ability to exercise leadership can be procured by even a little training of leaders.

While one may not reason from garment workers to soldiers and sailors, this much is clear—as indeed it would have to be from what is known about human motivation. Good leadership never creates slaves. It establishes the feeling of responsibility and initiative in those who are led. Out of such attitudes come the best morale, the quickest learning, the most effective action. A subordinate does not need to feel inferior when his superior makes him feel that he is contributing voluntarily to the success of a common enterprise. In fact, the leader himself succeeds only when he assumes the rôle of commanding servant to his men and to the whole military enterprise.

The Army has made a careful investigation of the relation of morale to respect for leaders. It rated men with regard to the following indictators of good morale: (a) faith in the cause and in the future, (b) pride and confidence in the outfit, (c) belief in the mission, (d) confidence in training and equipment, (e) realistic appraisal of the job ahead, (f) satisfaction with job assignment, and (g) belief in the Army's concern with individual welfare. And then it classified the men according to their respect for their leaders. In every one of the seven cases the men with the most respect for their leaders rated, on the average, highest in the given indicator of morale. Respect for leaders and good morale are inextricably related, and good leaders help to make good morale.

What, then, makes a leader good?

(1) **Authority.** The leader starts out with authority. The military and naval systems give it to him. His uniform gives it to him. Authority is essential to discipline. It forms the background of all leadership. Yet most of the power that the leader needs in order to lead well is not given him. He wins it for himself. He must win the respect and loyalty of his men so that they trust his judgment. He must lead, not drive them. He must build up their morale. Such powers depend upon his own attributes, not on anything that goes ready-made with his rank.

(2) **Personal Characteristics and Attitudes.** An inventory of the personal characteristics of good leaders is essential if leaders are to be selected or if they are to be trained. No one supposes that a poor leader can become a good leader merely by reading a list of what he ought to be. On the other hand, it is surprising how much insight and understanding, when backed up by intelligence and ambition, can do toward improving leadership. Leadership can be learned by many of the poor leaders who have the basic mental equipment.

(a) The good leader must be *competent.* He must "know his stuff."

The soldiers put this attribute first and they are right to do so. The leader must command the respect and confidence of his men. Only by that route can he build up their morale and get their maximal coördinated effort from them. He must know what should be done and have also the drive for getting it done.

Competence includes both wisdom and executiveness. Wisdom can be acquired by experience and hard work. Executiveness is not so easily learned, but ambition and training may produce it. Soldiers and sailors prefer a leader who gets things done and gets them done promptly. With such a leader they can feel pride in their unit, for their leader's accomplishments also become their own.

(b) *Industry*—hard work—is another necessary quality of the good leader. Not only is it necessary for the acquisition of competence; it is also essential to morale. The men must feel that the leader shares their hardships with them, that he asks no more of them than he would undertake himself. If he has some special privileges, that is because he also has extra responsibility and extra work. Men will respect authority when the leader takes his job as seriously as he expects them to take theirs.

(c) The leader must have a decisive, confident *manner.* His bearing and physique are both important. He must seem to his men strong and energetic enough to make them secure in trusting him, and his tone and bearing must suggest assurance and confidence. It is helpful to have a clear strong voice. The leader who sounds confident inspires confidence in others. Even in giving simple commands, the manner has as much to do with the efficiency of the result as have the words. The words tell what to do, but the manner determines how it will be done.

(d) The leader must always be ready to accept *responsibility* and to make *decisions.* Soldiers and sailors are ready to be commanded but they have to know just what it is they have to do. The leader has to decide this. Not all of his decisions have to be made quickly. Often he can ponder the best course of action. He can take advice, even from his subordinates, but he must keep for himself all the responsibility for his judgment. That he cannot shift to others.

Often he has to make a decision—either after consideration and advice or immediately in an emergency—on insufficient evidence. He must learn, therefore, that good judgment is *not* tested by its success. Often the best judgment on the evidence at hand leads to action that fails, when a different judgment might have succeeded. The leader must keep reminding himself of this truth, nor must he blame himself when the best possible judgment (under the circumstances) proves to have been the wrong one.

It is these requirements for responsibility and decision that make the leader *lonely.* He gives to his men something that they cannot return to him. The acceptance of isolation and loneliness is a hard order for many a man, but he may be helped by realizing that loneliness and responsibility go together, that his isolation is a tribute to his importance.

(e) Closely related to the acceptance of responsibility and loneliness is *self-possession.* The leader must be a man who can keep his head in emergencies. He must be able to control fear in his men—the gnawing fear that grows out of inaction in the presence of danger. He may control it by requiring action. He must be able to control fright—the sudden fright that leads to panic when unexpected danger suddenly presents itself. He may control fright by his own demeanor. The making of a joke often punctures fright. Can he joke when he himself is frightened? He must be able to control frenzy—the wild, pointless, inefficient and often fool-hardy action that may take hold of panicky men. He must be able to keep his head, to let his sense of responsibility put him above fear and panic—or at least he must not show the fear that grips him. Some men find they have this self-possession when they meet an emergency. Some acquire it through training in handling emergencies and repeated experience with confusion and danger. There are doubtless many who cannot learn it, and they should not be chosen to lead.

(f) The leader must have *integrity* and let his men see that he has it. Sincerity builds morale. Hyprocrisy gets found out and destroys morale. The leader must play no favorites and let his men see that he plays none. Men of the armed forces want leaders "who do not save the dirty work for the fellows they don't like." And they do not want leaders who trick them into volunteering for an unpleasant job. A man who responds to a call for "drivers" does not want to find himself running around camp with a wheelbarrow collecting garbage. One experience of this sort teaches a man never to volunteer for anything.

The leader must work as hard as the men, though at different things. He must be loyal to them, working for them and their success in the achievements and missions that are his and their assignments. In this way he will to some degree lessen his own loneliness, for he will receive from his men respect and often even affection.

(g) Finally, the leader must have *teaching ability.* The soldiers and sailors have to learn in order to succeed. They know this and they want a man who can teach them what to do and teach them well. They want a man who knows his job thoroughly and can help them to master their responsibilities.

(3) **The Leader's Relations to His Men.** Of course, all of the leader's personal qualities have to do with his relations to his men, for leadership is that relationship. The leader must know his men, understand them, be loyal to them and proud of them, must work with them and for them. There are, however, many other special "rules" which help in this relationship, rules which can be listed here.

(a) The leader gives *personal recognition* to each of his men whenever he can. A company or squadron commander and leaders of equivalent naval commands should know every man by name and use the name. Even the captain of a battleship and the colonel of a regiment can know the names of many enlisted men and can show personal interest in the work of men whose names they do not know. They can, moreover, ask a private or a seaman who is doing a good job what his name is.

(b) *Praise* is much more effective for motivation than blame. The leader must school himself to commend good work until he does it by second nature and without having to remind himself. He need not, in fact, should not, be effusive. Sometimes a single word is sufficient. Sometimes no word at all is needed; it is enough for a man to see that his leader is watching and has noticed his accomplishment and seems pleased by it.

(c) When a job is poorly done, the leader should *criticize* the job, not blame the man. Blame hurts the man's pride, and the leader needs to help the man maintain his pride since pride is a motive to which he can appeal. A man who has no pride, who has been convinced that he is "no soldier," will no longer contribute effectively to the common effort. But when the emphasis is on the poor job, not on the poor man, the man may respond with the determination that he will succeed next time. Blame puts the man's attention on himself as a failure and often leads to discouragement. Criticism of his work and performance, if it does not destroy pride, may act as a motive to renewed and increased effort. The leader must, of course, criticize whenever negative judgment is called for. He must not praise poor work, for then he would fail to get improvement and would cheapen with the other men the value of his praise.

(d) The leader must try always to be *clear.* His men have the right to know exactly what is required of them. When they are in training—and the training of no unit is ever complete—they need all the help he can give them. A leader will be clear in his instructions and commands, if he can put himself in the place of his men, understand their problems and difficulties, devote himself to their progress.

(e) The men need to know the *reasons* for what they do whenever the leader knows the reasons himself and such knowledge is consistent with military requirements. They need in maneuvers to know "what it's all about." They are not machines. They can think too, and like to know that their leader believes they can think. Soldiers and sailors are interested in long-time strategy as well as in immediate objectives. Many are concerned with the remote ideology of the war. All are vitally concerned with today's problems. These principles hold both in training and combat.

(f) The military leader should train his men to expect *surprises* and *reverses*. There will perpetually be the unexpected, especially when the best judgment has to be based on insufficient evidence. The men must learn this principle, not think they are poorly led when the enemy turns up in the wrong place or when they are fired on by their own troops.

(g) The leader should have in mind the effects of *mental strain* upon his men, protect them from too much of it when he can, treat a man who has gone to pieces like any other casualty. He should encourage his men in all devices that will help them to stand up mentally in combat. He should encourage religious faith in those who are ready to use it. He may even good-naturedly encourage superstition by not poking fun at it in those men who find security from danger in that fashion. It is a good thing that the story should go the rounds that General Eisenhower carries seven lucky coins in his pocket. His superstition may encourage many a soldier to cherish a psychologically helpful talisman. Superstitions are psychologically unsound only if a man is more careful to make sure that his "rabbit's foot" is in his pocket than that his equipment is in good order.

(h) It is especially important that the leader should teach his men the right *attitude toward death*. He must speak to them as if the important thing were to live for the day. He must keep telling them that death itself matters much less than how you die. "If you must die, let your death count for something." He must teach respect for the dead. When affection for a comrade continues after death, a soldier fears his own death less. It does not seem to him so much like a complete separation from the others.

(i) In times of danger, fear or fright, the leader must plan *activity* for his men. Activity drains fear off. Fear thrives on inactivity. The men need their minds occupied with something other than the danger, and they also need to think that they are doing something about the situation instead of waiting quietly for danger, and death perhaps, to come to them. A good leader, whatever his own fear, plans active work when danger impends, unessential work if he can think of nothing better, but at best some work that may seem to be directed toward lessening the danger.

(j) Offense is the best defense in the realm of the mind as well as in grand strategy. The leader should try to give his men the attitude of the *perpetual offensive.* This injunction means that there should be constant activity directed against the advantage of the enemy. The defensive attitude is bad for morale, just as inactivity is bad for emotional stability in time of danger. The leader who can keep his men perpetually busy in some design to outwit or discomfort the enemy, even when the tactical situation is itself a defensive one, will find that the aggressive attitude gives his men greater confidence, better morale.

(k) A good leader *adapts his commands* to his subordinates. He needs to have constantly in mind the particular men whose action he requires. This principle holds for the corporal and his squad, for the colonel and his staff. A few succinct words of command will do for one man, more elaborate explanation is needed for another.

(l) And a good leader keeps his immediate subordinates from feeling *isolated* from him. He keeps contact, be he corporal or colonel. His men depend on him and must know that he has not forgotten them and their mission. He makes himself available to listen to their personal problems and advises them to the best of his ability. It is particularly important for men to feel that their company, battalion, and regimental commanders—and the equivalent commanders in the air and sea forces—can be turned to freely for advice about personal problems concerning family matters at home. The commander must also give his men the reassurance of his constant concern in their success—success in what he as a leader is requiring of them.

(4) **The Leader as a Symbol.** Although the leader takes account of all these personal relationships between him and his men and uses them as motives in building morale and accomplishing missions, he is to his men in the last analysis a symbol rather than another man. He represents to them the authority to which they are willing, if they have good morale, to submit. He represents also the chief source of their security when they are in trouble—and the soldier and sailor may have plenty of trouble all the way from training to combat. His men need him, need to respect him and to depend on him. Any final admonition to a leader should be: Do not let your men down! If a man complains, do not tell

him you don't like the service any more than he does. Such remarks destroy the man's confidence in his leaders and discourage him from striving for advancement.

The leader's rights to personal satisfaction are less than his men's, for the men depend on him to be what they think their leader should be. They want to be proud of him, and he may have to accept loneliness and many other discomforts in order to give them what they have a right to demand of him. He must find his satisfaction in his own pride as a successful leader.

SELECTION OF LEADERS

If leadership is the psychological capacity that the armed forces need most because they lack it most, it would seem that good methods of selecting leaders would have been developed, that we should know how to inventory the essential characteristics of leadership in man and how to select the best persons—perhaps training their aptitudes to get just the right sort of abilities. This is unfortunately not the case.

It has been said that there can be no rigid system of selection of leaders because good leaders differ so much from each other in personality that there would seem to be many very different patterns of personality, each of which would succeed as a leader. Such a statement means, however, little more than that few qualities are essential and that the best actual leader is still not perfect. Perhaps it means also that the obvious personality traits are not always the important ones. A gruff, abrupt, hot-tempered leader may seem on superficial acquaintance to fail to fulfill some of the recognized requirements for good leadership, yet turn out to have in his unit excellent morale, the respect and loyalty of his men. Further study of the man may reveal, however, that his gruffness covers kindliness, that abruptness is just his manner of expressing a decisiveness that reflects a uniformly good judgment, that his hot temper is most often used in support of the interests of his men, or is felt by them to be a minor human failing which is at the same time a mark of force and decision.

It must also be remembered that the qualities of the good leader will vary to some extent with the character of the men to be led and the nature of the job. A good leader of college students or a good labor leader may not fit the military requirements. A good leader of a unit in one of the Army's service corps would not necessarily be a good leader of combat troops—though the opposite is usually true. The particular situation in which leadership is wanted has to be kept in mind.

In combat troops the best you can hope for is a versatile leader who can adjust himself somewhat to different kinds of men. No leader can be perfection for all. Educated and uneducated men will need different qualities in their leaders. Strong, athletic, outspoken men and weak, sensitive, quiet men ideally should have different sorts of leaders to whom they are asked to give respect and loyalty. They will not get them. The best that can be done is to choose an average leader for the average men, even though most of the men are not average.

There are at present no suitable tests for leadership. Leaders should be intelligent and alert, and the requirement that men should not go to Officer Candidate School unless they score above average, 110 points or higher on the Army General Classification Test, is a good requirement. As a matter of fact the AGCT is a good test for officers in the Quartermaster Corps or the Adjutant General's Department. But the AGCT alone is not enough for leaders of combat troops. Too many of the personality traits discussed in the preceding section have no relation at all to ability to do well on the AGCT. The psychological tests for combat leaders are still waiting to be discovered and developed.

The Germans have tried to test for initiative and responsibility by giving men actual military problems to solve in spite of inadequate resources. They want to see whether the men will give up, come back for help, or solve the problem in some special way. If you are given materials to build a bridge across a stream and there are not enough materials, if the timbers are the wrong size or do not fit together, what will you do? You can cut down some trees to supplement the insufficient timbers, or tie parts together when there are not enough spikes. There are possibilities in such a procedure, but leadership is something greater than ingenuity in meeting emergencies.

Can the qualities of leadership be rated separately for a man and the selection made in accordance with his total score? That is essentially what has been done in selecting men for Officer Candidate Schools and the results are reasonably satisfactory. They check up fairly well with later performance in combat, but not so well that there is no room left for improvement. The difficulty is that this list of qualities is too uncertain, the names of the desirable characteristics too vague. You want, for instance, a man who can secure loyalty in subordination. Just *how* does a man secure loyalty? You can write down a dozen attributes in a leader that would seem likely to get him loyalty, and then you find a good leader who secures loyalty—with his particular group on their particular job—in a thirteenth or fourteenth way. Military men and psychologists need to keep working on the inventory of essential qualities for leadership.

The same difficulties arise with any list of questions which the candidate for leadership might be asked. There is as yet no final satisfactory list.

The consequence of all this is that leadership can best be judged by actual performance under the conditions and with the kind of group in question. There must be judges who note what the man has done as a leader, what he is doing, and who also inquire into his past for evidences of actual leadership. The judges will want interviews with the prospective leader, and they also need records of what he has been doing. To get the best result in this manner, there are four principles which should be observed.

(1) The judgments must be based on *actual performance,* either as observed by the judges or as known from objective records of accomplishment in leading. Especially must the judges not rate the man on his performance in an interview, for there conceit and modesty play too great a rôle. The aggressive, incisive man, who stands up well under the ordeal of being judged, may be quite incapable of understanding the needs of his men well enough to win their respect and loyalty. The man who is modest and retiring in interview may nevertheless have the competence and insight that make him a splendid leader. No, leadership must be judged by actual performance.

(2) The judges must be *competent,* and that means that they must have proved themselves good judges by good predictions of aptitudes for leadership in the past. Good leaders are not necessarily good judges of leadership. The things they do best they are apt to take for granted without realizing how valuable and exceptional is their knack. No, quality of judging must also be judged by actual performance in the past.

(3) A jury of competent judges is better than a single judge. The single judge may have a bias. Some one characteristic of a candidate may prejudice him favorably or unfavorably. That is less likely to happen when several good judges discuss the case together. There should be perhaps five judges, but that does not mean five incompetent judges. Quality comes first, quantity second in judging. You do not get one good judgment as the average of five bad ones.

(4) Improper as it may seem, the judges will do well to get the judgments of men who are equal to the candidate in rank or subordinate to him. Subordinates know, if anyone does, whether a man is a good

leader or not, and for the most part they do not grudge honest appreciation to a superior. If a leader has the loyalty of his men, they will want to express it. The men of a platoon can size up one another excellently, can pick the men who deserve advancement more consistently than can their leaders, for they know competence when they see it and they are always seeing one another. Nor does this method hurt discipline when the judgments are obtained quietly and tactfully. Certainly a good leader, who has the confidence of his men, can get their opinions about promotions without jeopardizing discipline. That is just the sort of thing a good leader can do. Judges ought not to overlook this valuable source of information, nor fail to use it whenever it is at all practicable.

In judging potential leadership from demonstrated leadership, *age* must be taken into account. Although young men can make excellent leaders, leadership develops with experience. Higher standards must, therefore, be set for older men. The man of thirty, who is only just as good as the man of twenty-two, is not going to improve as rapidly as his younger competitor. It has taken the older man longer to get where he is and it will take him longer to make the next advance.

TRAINING OF LEADERS

Are leaders born or made? Obviously both. A man who combines the intelligence and ambition necessary for him to become competent and resourceful as a leader, with great interest in the welfare of his immediate associates, has the first requisites of being a good leader. Are intelligence, ambition and human interest inborn or learned?

It all depends upon how you define these terms. Most psychologists use the word "intelligence" to refer to the native or inborn *capacity* for learning and for adapting to the environment. Intelligence, in this sense, cannot be learned; it is inherited. But what a man does with his inherited intelligence—the extent to which a man is ambitious or the extent to which he is interested in his fellows—depends upon how he was brought up and even upon his environment at the present time.

The brightest of men are not able to exercise their intelligence when they are over-fatigued, under-nourished, in want of oxygen, fevered or drunk. And they cannot make wise decisions if they are without experience in the given situation.

Certainly there are great differences in aptitude for leadership among men as they enter the Army or Navy. The question of whether these differences are the result of heredity, or are the effects of early training and environment has no practical importance in the selection of men for training as officers.

Leadership improves with experience. Leadership can be learned, given some aptitude and enough motivation.

Competence can be acquired with intelligence, motivation and practice. That is how competence is always achieved.

Interest in other men can be increased by motivation, and that means that the man who wants to become a good leader can make his men a special object of study. Teaching ability, and clarity, and confidence of command follow along as soon as the would-be leader has his attention fixed on what his men are getting from him, instead of on what he thinks he is giving to them. The civilian studies on training leaders in industry and in dealing with children all show that it is possible to learn by voluntary effort to take the followers' point of view, to see things from their angle, and so to become more effective as leaders.

Even decisiveness can be learned. If the would-be leader cannot make up his mind quickly, let him make it up slowly, taking advice. Then when he has made his decision, let him announce it decisively and let him stick to it. As his competence increases, he will come to make his decisions more rapidly too.

The would-be leader had best pattern himself on some skilled leader whom he knows well and admires. He will be surprised to find how many of the accomplished leader's attributes he can copy. When he cannot copy the habits of thought, he may at least be able to imitate the manner and behavior of his model, and then appropriate habits of thought may follow on later.

The would-be leader should also study what is known about leadership, read the books on leadership and discussions like the present chapter. He should examine himself in respect of the attributes of leadership which he learns about, try to adjust himself, first in behavior and presently in thought, to the ideal attitudes. There is no doubt that wisdom, backed up by a desire to learn, can effect great changes in ability to lead other men.

Are leaders born or made? All leaders are made. Whether the aptitude, upon which they build, is in-born or learned cannot be said. Not all grown men have it. But those that have what leadership takes, even though they have never led, can learn to lead. Here, as everywhere else among the military skills, the two keys to the creation of successful ability must be employed: selection and training. Select potential leaders and then train them.

REFERENCES

1. L. Farago. *German psychological warfare.* New York: Committee for National Morale, 1941. Pp. 133.

A reference handbook. Survey of German publications in this field from the inception of the Nazi regime to the outbreak of the Second World War. Chapter 4 is especially relevant.

2. GENERAL CHARLES DE GAULLE. *The army of the future.* New York: Lippincott, 1941. Pp. 179.
   A French general's plans and hopes for a modern, well trained, well equipped army.
3. N. C. MEIER. *Military psychology.* New York: Harper, 1943. Pp. 395.
   A well written textbook which emphasizes the importance of psychological preparation for warfare, with excellent bibliographies at the end of each chapter. See especially Chapters 6 and 7.
4. COLONEL E. L. MUNSON, JR. *Leadership for American army leaders.* 2d edition. Washington: Infantry Journal, 1944. Pp. 99.
   A practical, interesting, and very complete manual by a man whose business it is to know, train and lead soldiers.
5. L. A. PENNINGTON, R. B. HOUGH, JR., AND H. W. CASE. *The psychology of military leadership.* New York: Prentice-Hall, 1943, Pp. 288.
   An important textbook on military psychology, military training, and leadership.
6. P. B. REED, JR. *Personal leadership for combat officers.* New York: McGraw-Hill, 1943. Pp. 116.
   A handbook for the combat leader; the objectives and responsibilities of the leader and the principles he must use for successful leadership.
7. FIELD MARSHAL SIR ARCHIBALD WAVELL. *Generals and generalship.* New York: Macmillan, 1941. Pp. 36.
   A short treatise on the qualities of a good general, his relations to his men and to the statesmen of his times.

See also references in Chapter 14, especially item No. 8 (Chapter 8).

In many books of military and naval history and biography there are examples and analyses of leadership. A full list is beyond the scope of this work. Below are listed several important examples:

8. WINSTON CHURCHILL. *Marlborough: his life and times.* (6 volumes). New York: Scribner's, 1937. Pp. 2559.
   Detailed study of a famous British commander of the 17th Century.
9. J. C. FITZPATRICK. *George Washington himself.* Indianapolis: Bobbs Merrill, 1933. Pp. 544.
   Based chiefly on Washington's own records, correspondence and public statements; shows his habits of leadership.
10. D. S. FREEMAN. *R. E. Lee.* (4 volumes). New York: Scribner's, 1935. Pp. 2421. *Lee's Lieutenants.* (3 volumes). New York: Scribner's, 1944. Pp. 2395.
   The special value of Freeman's works lies in the analysis of the relationships between higher Confederate leaders as well as in the delineation of their characters and their methods of leadership.
11. PHILIP GUEDALLA. *Wellington.* New York: Harper, 1931. Pp. 536.

Balanced account of a famous general upon whose leadership there have been differences of opinion.

12. CAPT. B. H. LIDDELL HART. *Foch, the man of Orleans.* Boston: Little Brown, 1933. Pp. 532.

Character and qualities of leadership of the chief Allied leader of World War I with particular reference to the effect of his earlier military training on his leadership.

13. COL. G. F. R. HENDERSON. *Stonewall Jackson and the American Civil War.* (2 volumes). New York: Longmans Green, 1919. Pp. 975.

Clearly shows the characteristics which made Jackson famed as an able leader.

14. COL. T. E. LAWRENCE. *Seven pillars of wisdom.* New York: Doubleday Doran, 1936. Pp. 672.

Methods of leadership in guerrilla warfare.

15. LLOYD LEWIS. *Sherman: fighting prophet.* New York: Harcourt, Brace, 1932. Pp. 690.

General Sherman's striking military successes are explained in terms of his methods of leadership.

16. A. T. MAHAN. *Life of Nelson.* Boston: Little Brown, 1899. Pp. 764.

Character and leadership ability of a great British naval leader.

17. FIELD MARSHAL SIR ARCHIBALD WAVELL. *Allenby, a study of greatness.* New York: Oxford University Press, 1941. Pp. 311.

Frank study of an able military leader which does not overlook his faults.

Chapter 19

Rumor

Rumor is mouth-to-mouth communication of unconfirmed stories and anecdotes. It is the most primitive kind of news, and it is just as inefficient and inaccurate as it is primitive.

Civilized countries in normal times have more reliable kinds of news than rumor. They have the newspapers and the radio. But in times of stress and confusion rumor emerges and becomes rife, still further increasing the confusion. At such times you may find two kinds of news in competition: the supposedly authoritative confirmed information imparted by press and radio, on the one hand, and the unconfirmed information of the grapevine, on the other. Especially do rumors spread when war requires secrecy on many important matters. The customary sources of news no longer give out enough information, both because the news is unavailable to them and because, even if it were available, censorship is often expedient. If people cannot learn through legitimate channels all that they would like to learn or are anxious to learn, they pick up "news" wherever they can get it. When that happens, rumor thrives.

Rumor thrives in the armed forces as well as among civilians since it is so often necessary to keep the soldiers to some extent uninformed, especially as regards future military operations. Military leaders have, however, to guard against rumor because it can disrupt carefully prepared plans by leading to loss of morale, or even to panic and defeat.

It was a rumor that helped to start the great Indian Mutiny in 1857. In those days the soldiers, with muzzle-loading rifles, had to bite a greased patch of paper from the end of each cartridge in order to release a charge of powder, which they then poured into the muzzle of the gun before ramming the bullet home. The mutiny was really ready to start anyway; the rumors about this grease merely speeded it up. The Moslems heard that the grease was pig grease—lard—and that they had been defiled by putting grease from an unclean animal in their mouths. The Hindus heard that it was cow grease and that they had lost caste by putting grease from a sacred animal in their mouths. These rumors spread rapidly, each in its appropriate group. The British tried in vain to correct them, to let the men grease their own powder-papers with butter, but it was too late. Rumor had touched off an explosion and the mutiny was on. Still the rumor would not have spread if the men had not for other reasons already been suspicious of the British and angry with them.

Rumors spread because, in spite of the fact that they lack supporting evidence, most people who hear and repeat a rumor are ready to push it along. Why? It might be better not to pass along an uncertain tale about an important matter. The answer lies, however, in the fact that the matter is important to the person who repeats the rumor. A person will repeat a rumor only if it satisfies some one of his needs. A rumor that supports a suspicion or a hatred, verifies a fear, expresses a hope, will be repeated, and it gets reënforced by the emotions of the teller. Thus, when rumors spread rapidly and far, it means that hates, fears or hopes are common to the many people who are doing the repeating.

It follows that rumors are repeated even by those who do not believe in them, because they provide a chance to express an emotion which would otherwise have to be suppressed. If a soldier hates his commanding officer, he will not literally shoot him in the back. In wartime, he would not even come out and openly say that he thinks the Old Man is a tyrant. Suppose, however, that the soldier hears a rumor that his commanding officer has been drinking so much that his health has suffered and that he is likely to be retired. There may not be a shred of evidence in support of this rumor, yet what will happen? The soldier will pass the rumor on. He does not feel guilty, for he is not responsible for the story. It is just something that people are saying. Yet in listening to it and telling it, he gets a great deal of satisfaction. It relieves his pent-up feelings about the officer and about other things connected with the Army, too.

Passing on a rumor that the commanding officer has been drinking too much may indicate more than conscious hatred of him. It may mean that the soldier is accusing the officer of doing just what he himself would like to do and dares not do. And so the soldier, with righteous indignation, repeats the rumor to other soldiers.

Rumors of this sort are called hostility or *wedge-driving* rumors. In spreading them the teller gets rid of some of his own feelings of hostility and he encourages others to do the same. It is not necessary that a man understand why he gets satisfaction from passing along a wedge-driving rumor. It is enough for him that he feels better after telling it.

It is the same way in civilian life, or anywhere that men or women meet and exchange a few words of idle chatter.

Workers gathered in knots at lunch time will pass on a yarn about some unfair treatment of labor. Bankers at the City Club will tell the story about the labor union that called a strike on a vital war contract because the plant employed a few Negroes. The workers, dependent on the bosses for their jobs and resenting their insecurity and dependency, are ready to believe that labor has been treated unfairly. The bankers, dependent on workers for turning out capital goods, and resenting the growing strength of labor, are ready to believe that labor unions are unreasonable. These too are wedge-driving rumors. The workers arouse other workers against capital, and capitalists arouse other capitalists against labor. Wedge-driving rumors are especially dangerous since they foment hostility and distrust between allies or between particular groups within a country. If a man dislikes a particular group, he believes the rumor and passes it along. In this way wedge-driving rumors are used to create scapegoats.

The Office of War Information published a list of the targets at which the 1942 crop of wedge-driving rumors—the "hate rumors"—were aimed. They were: Army administration, business, Catholics, defense workers, draft boards, English farmers, Jews, labor, Negroes, profiteers, rationing boards, Red Cross (blood donor services), Russia and unions.

Some rumors spread because people are anxious. They are all afraid of the same things and are therefore ready to believe rumors about those things. After the Japanese attack on Pearl Harbor, men were afraid and the rumor spread that a large part of the Pacific Fleet had been destroyed. It was true that the destruction had been great, but the facts were kept out of the true news and the stories spread as rumor, exaggerated and unverifiable, because men were afraid. In 1944 there began to be rumors about the great numbers of men sent home from the European and Pacific theaters of war as "insane." It is true that many men were returned to America because they proved unable to stand the strain of combat, but only a few of them were "insane," were unfit for military or civilian service at home. This rumor was spread by the anxiety of parents, wives and sweethearts for their loved ones. Such rumors, based on fear, are known as *bogey* rumors.

There is still another kind of rumor and another reason why rumors spread. When a man is tense and anxious he will clutch at any favorable straw. He will indulge in wishful thinking. There is pleasure in believing and repeating what you hope is true. Rumors based on a wish are known as *pipe-dream* rumors. They spread because they make people feel happier.

Three common pipe-dream rumors, current shortly after the Japanese attacked Pearl Harbor, were:

"The Japanese do not have enough oil and war supplies to last six months."

"There will soon be a revolution in both Germany and Italy."

"Lloyds of London and Wall Street are betting 10 to 1 the war will be over by next autumn."

Some rumors appear freely in the press and radio. They are frankly reported as rumors. If they do not get exaggerated by repetition and continue to be labeled rumors they may do little harm.

Others are covert and secret, being repeated *sub rosa* and often growing to fantastic proportions. They are dangerous. The teller, having no responsibility, is free to let his wishes, fears, and hostilities work.

Most rumors can be accepted passively. They are insidious but work slowly to undermine confidence.

Other rumors, however, incite to action. They are the *panic* rumors that come as reports of military defeat or of the approach of enemy troops. With them the danger is real, palpable and immediate, for the listener tends to do something about them suddenly and violently. He packs a few of his most cherished possessions in a wheel-barrow, collects his family and starts trudging out of town away from the enemy. Then he himself becomes a rumor, and the rumor becomes a fact, for people see him going and decide to go, too. Presently the procession along the road is the most potent rumor of all, a visual symbol that needs no words. Everyone seeks to join it. Panic is on.

RUMORS AS AN INDEX OF MORALE

Since the telling of a rumor satisfies some need of the teller, rumors constitute an important index of morale. Pessimistic rumors about defeat, disaster or treachery—bogey-rumors and wedge-driving rumors—are a straw in the wind to show that people who repeat them are worried, anxious or hostile. Optimistic rumors about record production or coming peace—pipe-dream rumors—point to complacency or confidence—to overconfidence often. Both the pessimistic and the optimistic rumors may betoken low morale.

The anxiety rumors always indicate low morale. Overconfidence rumors usually point to it also. Overconfidence makes a man more susceptible to other pipe-dream rumors and less susceptible to the true facts. "Why go into a defense plant if the war is to end in a few months?" A study of the rumors current at any one time, then, provides an index of the prevailing needs and emotions of the groups among whom the rumors are rife.

Rumors are also an index of the morale of particular groups. Since rumors typically are spread by word of mouth, a man who hears a rumor is likely to tell his friends, neighbors and fellow workers. A soldier spreads it in his unit. Since a rumor usually passes along more or less established networks, certain rumors become current in one group or unit, while other rumors are current in other groups. Some of these groups will believe rumors of one emotional coloring; others, rumors of another coloring. The needs of the different groups—their wishes, fears and hostilities—are revealed by the unverified stories current among them.

The number of rumors current in a given group is an index of the degree to which the formal system of communication—among civilians, the newspapers and the radio—satisfies their need for information. If there is a high incidence of rumor, the people are not getting enough information from official sources. Prevalence of rumors may also mean that the group does not trust the formal communication system. In France in 1940 before the Battle of Flanders, when people distrusted the radio and press, rumor was very widespread. The British, on the other hand, have so much trust in their press that they had comparatively few rumors.

A commanding officer, if he can keep track of the rumors that are going the rounds among his men, will learn a great deal about their current fears and hopes. He will have a sort of barometer that registers the rises and falls in their morale.

For this purpose, he would need to find out the answers to just three questions:

(1) Among whom are rumors current? It makes a difference which groups of men are spreading these tales.

(2) What are the rumors about? Here lies the clue to what the men are thinking, what they fear, what they hope.

(3) What emotions do the rumors express? Do they betray depression and discouragement, or are they cheerful? Do they reveal resentments and conflict?

The officer who is able to answer these questions will know a great deal about the morale of his men.

RUMORMONGERING

The conditions which promote the spread of rumor are to be found both in the general atmosphere of social groups and also in the personal needs of the individuals who make up the groups.

Rumors spread most easily in a *homogeneous* group where the feelings are alike—in a community, a city or an army. War helps rumor because it establishes common intense emotions in men who are similarly related to the war. They share the hope of victory, the fear of defeat, the frustration of separation from loved ones, and hostility against both enemy and all others who threaten them with failure. A rumor that gives expression to these emotions is easy to tell, easy to hear.

Lack of information about important things favors rumor. People demand information about what concerns them most. The greater their concern the more information they require. When civilian censorship is strict or when news is scarce and interest high, as it is in wartime, newspapers have to string out their accounts of trivial events in order to satisfy the public appetite. Then it is that rumor spreads easily. People want news, something, anything. They accept any report that appears to be news, and they lack the factual information that would contradict and stop a false rumor.

In the same way the morale of soldiers depends in part upon the information which they have about what is going to happen to them or is likely to happen to them (see p. 330). Leaders should explain reasons for orders and spread information about reasonable expectations for the men of their units, whenever military security makes this course possible. Otherwise rumor is substituted for truth and morale goes down.

Rumor is encouraged by *discontent, frustration, boredom* and *idleness*. That is why rumor spreads so easily in small communities, like prisons, hospitals and camps. Men really need to be active, and idleness puts them under tension. Gossip and rumor provide release for this tension—some release, although it is not very satisfying. So a leader has to fight rumor and boredom by keeping his men busy, even though they are ready for action and forced to wait through the months until a new front can be established.

Expectation also fosters rumor. Men are eager for news, eager for action, eager to hear of victories, eager to be off to the war, eager to be home from the war. If no one feeds them facts, they will take half-facts as better than nothing. Men readily believe what previous events or experiences have prepared them to believe, and they discount stories that are contrary to what they expect.

Men differ with respect to the types of rumors they believe, and, therefore, with respect to their likelihood to transmit rumors. The pessimist accepts anxiety rumors, the optimist wish rumors. The man who is anxious about one thing is susceptible to rumors which make him anxious about other things. The idle, bored, disorganized man will accept a rumor and spread it as a way of creating excitement and of relieving his monotony.

The motivation for passing a rumor on is usually complex but there are several typical ways in which individual needs enter into the process —over and above hostilities, fears or wishes:

(1) *Exhibitionism.* This consists of drawing attention to one's self. A man may tell a rumor in order to increase his prestige, to make others think he is important because he is "in the know." Or he may tell a rumor merely to engage another person in conversation or to entertain an audience.

(2) *Reassurance and emotional support.* Here the rumor is told in the hope that the hearer will be able to deny or disprove it. Or the telling of a rumor may reduce the teller's own tension by sharing the burden with another. In this case a man may be seeking sympathy rather than denial.

(3) *Projection.* A man may tell a rumor because the rumor "externalizes" fears, wishes and hostilities which he may not be consciously aware of in himself. Unconscious motivation of this sort has been discussed in Chapter 15 (p. 356f.).

(4) *Aggression.* A man may transmit a rumor in order consciously to injure some person—he may be engaging in slander, gossip, "scapegoating."

(5) *Bestowing a favor.* A rumor may be passed on in order to curry favor with or bestow a favor upon the hearer. It may start as a complimentary remark, with little or even no basis in fact. Soon it turns into a "stated fact."

CENSORSHIP AND RUMOR

Censorship, since it blocks important news, favors rumor. When censorship is strict, all sorts of demoralizing rumors are current. Where the censorship is fairly lenient, rumor is neither widespread nor demoralizing.

The censor is, of course, between the devil and the deep blue sea. If he lets too much be told, the enemy benefits unduly. If he stops too much news, he demoralizes his own people. Somewhere between these extremes he must make his choice.

For instance, the American censor during the German submarine campaign in the Second World War suppressed from the news all statements about the places at which ships were torpedoed. He wished to prevent the Germans' learning of the success and whereabouts of their own submarines. In the spring of 1942 a ship was torpedoed off the coast of Cape Cod, and the dead and wounded were brought into Provincetown. There were hundreds of witnesses, but the news was suppressed from the papers. So the false rumors at once began to fly:

"15,000 troops were lost off Provincetown."

"The bodies of 200 nurses have been washed up off Provincetown."

"The whole end of Cape Cod is under martial law and great numbers of bodies are being washed ashore."

"All the hospitals and hotels in Provincetown are filled with wounded and dying."

"All the cold storage space in Provincetown is filled with corpses."

"All the troops washing up at Provincetown are Negroes."

"The shores on Cape Cod have been lined with undertakers for days."

Personal knowledge of a military event may be less direct and still lead to the spreading of fact as rumor. A naval vessel is attacked by the enemy. The wounded sailors are sent back to the United States for hospital treatment. Relatives are notified. Often the relatives of several wounded men are acquainted and hear of each other's bad news. Then the items get pieced together and the rumor starts that the ship has been damaged. Soon the rumor has it—always getting to be a better story—that the ship has been sunk—yet the newspapers still cannot publish the facts.

Or the rumor may be only a shrewd guess based on a few known facts and yet turn out to be true. Troops waiting in camp or embarking for an unknown port are concerned about their destination. Many are the guesses they make and many the rumors that float about camp. An overheard remark, a guess based on the nature of the equipment, is repeated as fact—and it may, indeed, be fact—yet military security prevents affirmation or denial.

HARDY RUMORS

Surprisingly enough the rumor you hear today as though it were fresh news may be a veteran of many wars dressed up in modern uniform. It was told in 1918; it may have been told in 1861. Here is one such rumor in the 1942 version:

"An American prisoner in Japan writes home that all is well. At the end of his letter he asks that his family save the stamp on the letter for his collection. So the family soak the stamp off, and beneath it they find the message: 'They have cut out my tongue.' " In 1918 this rumor was told about a prisoner in Germany.

Rumors persist because the human needs, the fears and hopes and hatreds that the rumor satisfies, are very much the same from generation to generation. The persistent rumor in 1915, that Russian troops had been seen in England, lived because the British wished it to be true. It had a cousin in 1942, the rumor in Russia that the British were landing forces to defend Russia.

Other reasons why rumors become perennials, cropping up year after year, and in war after war, are because they are timely, short—therefore easy to remember and easy to repeat—plausible but not too plausible to be impressive, and unverifiable.

To survive for posterity, rumor, like other more reputable forms of literature, must have qualities that command attention. It must have punch, be striking, with maybe a wry and unexpected twist like the slogan, "England will fight to the last Frenchman." It is helped tremendously by humor, for everyone notices, remembers and repeats a good story.

"The British could not use the American tanks that they got because Americans made tanks without reverse gear." Americans chuckled over that gibe; they remembered it, repeated it because it was obviously funny—only subtly malicious.

HOW RUMORS CHANGE

Because men become the partisans of their own stories and resent any doubts about them, their answers to skeptics become more positive or more detailed in order to increase the rumor's plausibility. At an early stage the rumor is generally attributed to an "authoritative source"; later it becomes known as the statement of a "prominent officer" or of "someone at GHQ" or "a War (Navy) Department authority." This assertion helps the rumor to pass as fact even though the one who passes it on usually will say that it is just a rumor: "I heard this, but I don't don't know whether it is true or not." "You know, I don't really believe this, but all over the camp they are saying that. . . ." Such a formula frees the man who tells the rumor from any feeling of responsibility, lets him tell it without any qualms of conscience. It also gives him a chance to embroider it, to exaggerate a little, adding a detail or two to make it a better story.

That is the way the sailor from the German submarine got equipped with a ticket stub from a New York theater. The rumor was that a submarine had been sunk off Cape Cod and that they had picked up the body of a German sailor who had in his hat a two-day old stub from a New York theater. It would not be likely that the body would still have its hat with it, that the stub would still be in the hat, but it was a good story to tell, and the rumor spread at the time when public worry about submarines off the Atlantic coast was great.

Names, numbers and places are typically the most unstable components of any rumor. There are many rumors circulating in different countries, all of identical plot, yet each uses the names and places familiar to the local populations.

A rumor always tends to get more concrete and vivid no matter how vague it was in the beginning. Concrete references are more easily remembered and reproduced and that is why vague references get lost or altered.

Rumor plots tend to be assimilated to the cultural traditions of the group and to approach stereotyped forms. Thus the rumors of the secret weapon rife in France early in the Second World War had their origin in the Big Bertha of the First World War. And the charges heard in the whispering campaigns in American politics likewise follow stereotyped patterns: "It is said that he has Negro blood"; or "He is a dipsomaniac." And one well liked candidate was defeated by his opponents who spread the "rumor" that he was a *sex*agenarian.

USES OF RUMOR IN WAR

Rumor is very effective in psychological warfare because it comes to the hearer without the taint of appearing to be propaganda. It comes self-propelled. What the Germans started as a short-wave broadcast in Germany, or as a story planted by a German agent, was presently being told by Americans about Americans in America. Its German origin was completely lost. The hearer could not ask for evidence, because the teller never claimed to have evidence. He was repeating only what he had heard and belief is easier than disbelief, especially if hope or fear supports the rumor.

These are the ways in which rumor is used in propaganda's war of words:

(1) **For disruption.** Rumor can be made to play havoc with morale. At the fall of France in 1940 the Germans disrupted French morale in this manner. They alternated optimistic rumors with pessimistic. In the confusion of the German attack the French kept shifting between elation and despair. Soon they no longer knew what to believe, ending up in utter uncertainty and more confusion.

Propagandists also start rumors to foment distrust among allies, or to increase disunity within a country. Necessary coöperation can be ruined merely by the rise of plausible suspicions. Rumor never proves anything. It does its work if it creates distrust.

(2) **As a smokescreen.** Rumor can hide the truth.

The propagandist's technique is to tell so many secrets that the true secret cannot be detected among all the conflicting reports. The Germans were past masters at this art of letting many conflicting "inside stories" slip out of Germany into the countries which they wished to confuse.

(3) **For discrediting news sources.** This is a special technique.

In 1941, the British tried several times to bomb the chief railroad station in Berlin. They failed, but the Germans planted "unconfirmed reports" that the British had succeeded. When these rumors came back to England, the British took them as confirmation of their success and broadcast them. Then the German Ministry of Propaganda took American newspaper men to the scene to prove that the British statements were not true, thus discrediting the British broadcasts.

(4) **As bait.** Rumor may be used to learn the truth.

The Japanese in the Second World War often started rumors about American losses in a naval engagement. They did not know what the losses were and they wished to know. The rumors, when this technique was new, spread, affecting American morale. If the American government, to bolster morale, had then broadcast the truth, the Japanese would have had information they sought.

CONTROL OF RUMOR

Officers or officials, who must try to control rumor among their men or in dealing with civilian populations, will find these rules, based on scientific observation, helpful.

(1) **Assure good faith in official communications.** If the public loses confidence in the reliability of the communiqués of the armed forces, and of the press and radio, then rumors begin to spread.

(2) **Develop faith in leaders.** People can stand censorship and lack of news when they feel sure that they are not being told falsehoods and that what is held back is held back for good reason. That applies to all

leaders from the President to the humblest schoolteacher, from the general to the sergeant.

(3) **Tell as many facts as possible.** Let the press and radio give as full and circumstantial news as they can without giving too much aid to the enemy. Let the armed forces do the same. Men want facts. When they cannot get facts, they take rumor.

(4) **Keep men busy.** Prevent idleness and monotony. Empty minds are easily filled with untruths and worries. Idle hands make busy tongues.

(5) **Fight rumormongering.** Campaign against rumor. Expose rumor as well as enemy propaganda. Discredit specific rumors by showing that they are inaccurate and false. Caricature rumormongers.

A camp may keep a *rumor board.* That is a bulletin board on which apparently false rumors are posted. After a while the exhibit becomes ridiculous, because the board has on it so many rumors that contradict each other, and many already disproved by publication of the truth.

There is also the *rumor clinic.* Such a clinic collects all the rumors it can get hold of from interested citizens, from persons who monger their rumors to the clinic, from men like bartenders who hear lots of idle talk. Then it investigates them, publishes them, refutes or corrects them, and incidentally, by showing that rumors are usually false, ridicules them.

A company commander could have his own rumor clinic, along with a rumor board. He can also encourage his men to form the habit of asking, in the words that experienced American soldiers have used for many years, "What latrine did you hear that one in?"

When emotions are aroused and there is a lack of authentic news, it is impossible to stop rumor. That fact cannot be too strongly emphasized. The effects of rumor can, nevertheless, be controlled and made negligible by the use of these various devices. The devices work—not only among civilians but also with the soldiers among whom they have been tried out.

All in all, the best way to scotch rumors is to oust them from the mind. Men in the armed forces should keep busy, be kept busy. Since nobody can keep the great public busy, there have to be these rumor clinics and campaigns but soldiers and sailors ought to have no time to listen to unverifiable surmises about what is going to happen. Victories come sooner if the fighting men have confidence in their leaders and are too busy with their jobs for wishing, worrying and passing guesses along.

REFERENCES

1. G. Britt. *Rumors (made in Germany).* Council for Democracy. New York: Finston, 1942. Pp. 13.
   A popular presentation of the types of rumors circulated by Germany in the early days of the Second World War.
2. B. Hart. *Psychopathology: its development and its place in medicine.* New York: Macmillan, 1927. Pp. 156.
   A historical survey of the various attempts to study rumor scientifically. See especially pp. 94-124.
3. R. H. Knapp. "A psychology of rumor." *Public Opinion Quarterly,* 1944. Vol. 8. Pp. 23-37.
   An excellent systematic treatment of the causes, types, and consequences of rumor with a consideration of how rumor may be controlled.
4. A. Ponsonby. *Falsehood in wartime.* New York: Dutton, 1929. Pp. 192.
   An analysis of the use of lies in wartime for purposes of psychological warfare with special emphasis on the falsehoods circulated during the First World War.
5. R. H. Thouless. *Straight thinking in wartime.* London: English Universities Press, 1942. Pp. 224.
   Striking illustrations of the ways in which bias and prejudice can influence thinking in wartime.

See also references cited in Chapter 22.

Chapter 20

Panic and Mobs

Panic is not foreign to war. Tired, hungry, defeated troops called upon to retreat may be panicked by the enemy, especially if they are green troops. Seasoned troops are panicked less easily; they are more disciplined. Yet even seasoned troops under disaster and after decimation may break discipline, turn and flee in disorder, every man for himself, out of control. To forestall panic, leaders and their men must know about panic, about the conditions that give rise to it and the conditions that prevent it.

After all, panic in the enemy is the aim of every military operation. Defeat is the first aim, surrender the ultimate aim. But between these two there lies the possibility of enemy retreat after defeat. Shall that retreat be orderly, enemy forces withdrawing in good order to reform and fight again? Or shall it be in disorganized panic, units dispersed and their fighting power destroyed?

It is also true that soldiers and their leaders should understand the panics which occur among civilians in occupied territory, among both friendly and enemy civilians. Civilian panic hampers military operations. It is a good thing when streams of terrified citizens deny the highways to the enemy, a bad thing when they interfere with the movements of your own troops. Psychological warfare can be used to enhance panic in enemy country, to reduce it in friendly country.

The psychology of panic is closely allied to the psychology of mobs. Only rarely do mobs form among soldiers and sailors. Mob action among troops is mutiny. There have, indeed, been many famous mutinies in military history from the mutiny on the ship *Bounty* in 1789 to the mutiny of the German Navy at Kiel in 1918. But mutinies are rare. Armed forces work and fight under a necessary discipline, and only when leadership and discipline have disintegrated is mob action possible. Military laws and the regulations of all armies make mutiny a serious crime. The Articles of War of our own Army not only set death as the maximal punishment for this serious military offense, but also lay down equally heavy punishment for the leader who fails to do his utmost to prevent rebellion against military authority.

Nevertheless an understanding of mob action aids greatly in the understanding of panic. A mob has a certain aim and organization. A panicked crowd is a disorganized mob, usually without leadership, and with only the vague unplanned aim of escape from danger. Mobs are dominated by hostility, panics by fear; yet the line between anger and fear is not sharp for hostility often arises as the result of deep-lying unconscious fear.

We shall, therefore, do well to understand something about mobs, in spite of the rarity of mutinies, because mob psychology is an introduction to the psychology of panic, and also because soldiers, sailors and marines often have to do with civilian mobs.

MOBS

A mob is not merely a crowd. A *crowd* is a throng of people who have a common interest, a common focus of attention—a fire, an accident, a building under construction or perhaps a street-corner fakir. The members of a crowd share some common emotion and express that emotion openly. The emotion may be curiosity, playfulness, admiration, religiosity, or it may be fear or anger.

A crowd turns into a *mob* when the common emotion is intense and especially when that emotion is intense anger. It is then that a crowd is likely to decide upon or to accept a particular course of action directed against the object of their emotion, and it is then that the crowd is likely to become a dangerous mob. A mob denied relief for a common emotion by peaceful action will seek relief in violent action. Thus a mildly curious crowd will not become a mob but an infuriated group may. If a crowd which has gathered to buy bread in time of famine is allowed to purchase it, there will be no violence; if the supply seems likely to give out before all can buy, the hungry crowd may become a mob. Or, if the crowd has come together "looking for trouble," trouble is very likely to result.

The greater the similarity of interests and the greater the intensity of the needs of the individual members of the crowd, the more rapidly will the crowd turn into a mob.

A mob forms, thus, only when the crowd has some common *motive* for aggressive action, some long-standing frustration or fear that makes its members feel insecure or wronged.

A mob, moreover, acts only when it has a definite *goal* which gives direction to the action, a suspected criminal to punish, or, once, a Bastille to storm. Its attention must be *focalized* upon the goal—sometimes by the appearance of a leader, who suggests a course of action or discovers some means—a store to be looted or a flag to be torn down—whereby the mob can wreak its vengence.

Impelled by emotion the mob acts with a *narrowed field of attention.*

The acts of an angry man do not show wisdom, judiciousness, self-criticism, nor an adherence to law, order and conventional ethics. The angry man is intent only on his aggression and its goal; for the most part he shuts out of his mind the broader considerations which his conscience or judgment would force upon him in calmer moods. If conscience comes into the picture for him at all, it comes in most often as a rationalization: the angry man justifies his anger as righteous anger or retribution and thus he feels no conflict about his righteousness.

The man in a mob also has his action reënforced by the fact that he is a member of a large co-acting group. Its size gives him a sense of power as well as the feeling that he is right. It also gives him anonymity so that he runs little risk of being apprehended and punished for his acts.

A man is not a different man in a mob from what he is alone. He is just a less inhibited man. Thus only a man of strong convictions can stay with a mob and try to dissuade it from action while holding aloof from participation in what it is doing. Most men who would condemn mob action feel helpless about it, leave the vicinity quietly while the mob is still forming.

Not all people with common troubles accept mob action as a solution of their difficulties. A man who becomes a member of a mob is further characterized by the fact that he is not aware of the real causes of his difficulty, or at least is not convinced of them. Because he has little or no understanding of these real causes, he readily accepts the suggestion of a leader—the thing to do seems to him to be the getting rid of a certain Negro or the stoning of an embassy.

(1) **Motive.** The common motive that brings the mob together in action is usually some long-standing frustration. The men are angry about something; but, because it is a long-standing frustration or because the sources of frustration are deep-seated, the anger is likely to be intense. The men want to do something about it. They are in an aggressive mood.

The ground for anger may be specific and clear. The men in a prison camp may be ready for riot because the food is insufficient and bad. Strikers may attack scabs because the scabs threaten the success of their strike and thus their standard of living and economic security. Lynch law used to be invoked in the west against horse thieves and cattle rustlers, because the living of men on the plains depended on horses and cattle, and fear took possession of them when this kind of property was not safe. In such cases both the motive and the goal are clear to the mobsters—there is a common unsatisfied need and a common intense emotion associated with this need.

It is also true that frustrated men are ready for any aggressive action, even though it be not directed against the object that causes the frustration. Soldiers wearied by the constraints of discipline will sometimes join a fight when they do not even know the purpose of the fight, feel only the need for the release of their pent-up feelings. The suppressed people of occupied countries who have been forced into inactivity and non-aggression are ready for aggression, any aggression that will relieve their feelings of frustration. In fact, everyone meets with enough frustration to have in him some *latent aggression,* some desire or readiness to destroy or hurt.

There was an experiment in which children were put in a room, one at a time, with many inflated balloons. They were told they could break the baloons, encouraged to break them. A child so situated finds himself in conflict. He knows it is wrong to break things, yet now he is told that he may. He starts out hesitatingly, expecting reproof. Some children, when they find there is to be no reproof, get to work lustily, smashing balloon after balloon. Others, either because they have in them less latent aggression or because the dictates of conscience and the fear of punishment are too strong, never fully abandon themselves to the destruction. The point here is that some persons, persons who have been obliged to suppress their desires for aggression, find in mob action a sudden outlet for this need for power, as the mob unexpectedly provides them with a sanction for aggressive action. Others have so many socialized inhibitions and restraining attitudes that they would never take part in mob-violence.

(2) **Focalization.** The mob that has come together with common grievances will not act unless it knows what to do. Either the course of action must be obvious or a leader must appear to tell it what to do. It is angry. It wants to do something. Usually it wants to do something about something, but it lacks specific direction, perhaps lacks any knowledge of appropriate means of action. Then someone shouts: "Break into the jail!" And later, when the jail withstands the pressure of human bodies: "Get the rail over there and batter in the door!" Such suggestions serve to give direction to its anger, and the riot or lynching is on.

Or one man may assume and retain leadership of a mob. He may harangue the crowd, suggesting action and a means for making anger effective and continue to guide the mob as it moves from one riotous act to the next. Such a leader may be a wise and skillful Mark Antony, who plays on the mob with his oratorical ingenuity, or a relatively stupid man who, inflamed by anger, merely keeps shouting some obvious suggestion of aggression to the crowd. The leader does not often sway the crowd to his will. He gains his power because he provides a means for the expression of emotion which the crowd already feels or—in the case of Mark Antony—which it is ready to feel when cause for anger is suggested to it. The leader may, indeed, show great courage, if he has to lead the mob into danger, but more often, with the power of the mob behind him and his own perspective limited by his emotion, he is acting just as blindly and destructively, in consequence of his anger, as are his followers.

Every man at every moment thinks and acts within the limited field of his attention. The things that come most insistently under his attention are for him at the moment the most important things. He can read in the paper of the tortures of a thousand men in a concentration camp three thousand miles away and soon put the matter out of mind, although he could not stand having a cat tortured in the next room. The *field of attention* is always limited at any moment, although its boundaries are vague. One man acts only with respect to the present. Another keeps tomorrow or even next year in mind, or brings into his attention those general principles of wisdom or morality which he is accustomed to consult.

Emotion tends to narrow the field of attention. Mob action is uncritical because mobs are activated by strong emotion and strong emotion inhibits thought. Hence focalization of the mob's anger not only sensitizes it to the suggestions of the leader but also makes it impossible for the individual to give such suggestions any reasonable or critical consideration. This, in effect, narrows the field of attention to just the single action that is suggested or is in progress at the moment. If the mob could be diverted to another action, the first one would be immediately forgotten—but it is difficult to divert it.

Another consequence of the narrowing of the field of attention is the strong anti-intellectualism which characterizes mobs. Mobs are virulently anti-highbrow and will ridicule and even abuse anyone who attempts to reason with them. The mob does not want to be told of the complexity of the issues at stake. It wants action, and the more destructive the better.

(3) **Reenforcement.** The mob's action is thus determined by emotion, suggestion and the narrowing of its field of attention. Such focalized action is, in addition, reenforced by other conditions.

(a) First there is *imitation.* Whether imitation is an inborn instinct or whether it is simply a form of the need for approbation, so that in Rome one does as the Romans do, need not concern us here. The fact is that the social pressure to do what other people are doing is very strong indeed. The pressure to conform in dress, in conduct, in speech and even in thought is tremendous. Only a man who is supported by some strong conviction can go to a formal party in overalls, when all the other guests wear evening clothes. It is hard to speak up for convictions in a crowd where everyone else thinks differently—as Simon Peter found out. And the larger the crowd, the greater the pressure. If the large crowd is also an emotional crowd, likely to turn its anger against a dissenter, then the pressure for conformity becomes maximal.

(b) The size of the mob also contributes a reenforcing sense of *power.* Most men like power and will exercise it when suddenly they find themselves possessed of it. The man who identifies himself with a mob seems to himself to have its total strength, although he does not accept its total responsibility. He feels both strong and irresponsible, a dangerous combination.

(c) The *righteousness* of an anger also reenforces an angry action. The mob inevitably feels right. It is partly that for most people might tends to make right in thought, and partly that, if a majority is likely to be right, unanimity cannot seem to be wrong.

(d) All these specific directives of mob action are further reenforced by *latent aggression,* the desire of frustrated men for any aggressive action that they can undertake with reasonable security. It is not necessary that members of the mob be clear as to the specific cause of their frustration. It is enough that they are suffering and that someone must pay for their suffering.

Not every angry man is mob material. Not everyone with latent aggression will join a mob. The more gentle, sensitive, kindly people dissociate themselves from a mob if they are caught in it. They go home, or at most stay on the fringes of the mob and do not participate as much as those in the center.

On the other hand, it is surprising how many potential mobsters there are. Sometimes a mob forms very quickly. The driver of a car, having killed a child, finds himself set upon by angry men and women who five minutes ago were peaceful pedestrians, seemingly a normal cross-section of the population. It is only the first release of latent aggression—the getting started—that makes the potential mobster hesitate. When a man has once begun violent action, perhaps in a burst of passion, he is almost sure to keep on if he has the security of mob support and the excitement of others around him whose cries, pushes and violent actions serve to enhance his own destructive impulses.

Protected by the anonymity of numbers, and spurred on by its own sense of justice, the mob acts as a unit and will regard those who try to thwart it as enemies who must be overcome.

(4) **Fatigue.** Fortunately mobs fatigue and after a few hours of concentrated emotional action, the members are ready to be diverted or to disperse. Of course, one mob may be spelled by another mob, as in a revolution. Then violence becomes continuous.

CONTROLLING MOB ACTION

The rules and principles for *preventing* mob action ahead of time are as follows:

(1) *Stop grievances and frustrations before they accumulate.* Counteract rumors. Carry on a specific and carefully directed information campaign to show the people concerned what the basic causes of their dissatisfaction are, what is being done to remedy them and why nothing more can be done at the moment. Teach them that scapegoats are not malefactors.

(2) *Prevent the allegiance of any large number of people to potentially troublesome leaders.* Discredit the leader ahead of time but do not make a martyr out of him.

(3) *Try to give everyone some sense of status.* Encourage the mechanisms of democratic choice. Encourage organization and participation of all groups in communal activities. The organization itself prevents the disorganized action of mobs.

(4) *In times of tension, prevent throngs from forming.* Enforce strict discipline. Introduce curfews from dusk to dawn because it is at night that the anonymity and destructiveness of the mob is greatest. Ban large assemblies. Proclaim martial law. But in doing these things recognize that you merely postpone the outbreak of aggression, unless you can also remove the cause.

Here are some rules and principles for the quelling of mob action once started:

(1) *Disperse the throng before a leader takes control.* The sooner the surer. After a mob has formed, a leader found, and action begun, it is almost always too late to disperse it. Counteraction is most effective in getting a crowd to scatter before a leader is in control. Dispersal of

crowds which are potential mobs may be accomplished by argument, by mild ridicule, by countersuggestion—giving them something else to do—or, if these fail, by police action.

(2) *Deflect mob action: do not try to stop it.* When the mob is formed and intent on action, it is usually fruitless to argue against it. The successful defender of law and order will then be he who is ingenious enough to assume leadership of the mob and to substitute some harmless action for its evil intent. If the mob cannot be redirected toward desirable objectives, they can at least be fatigued by a wild goose chase to some objective which turns out not to be there.

(3) *Be decisive.* That is a rule for all leaders, and the leader who would deflect mob action can make use of all the rules for leadership except those that require deliberate preparation. Often only inspiration at the moment in view of the prevailing circumstances can give the clue to mob redirection. But, whatever the redirection or suggestion, a firm, assured, unhesitating manner is best. Shouting may be necessary in order to be heard, but it should not be the shouting of anger or impetuosity. Mobs have been quieted by assurance and confidence, especially when the confident leader is suggesting positive alternative action—what to do, not what not to do.

There is no simple rule about harsh action. Should troops fire on a mob? Should an officer shoot ringleaders? Will a threat, like firing over the heads of a mob, frighten it into dispersal or infuriate it into more destructive action? Increasing the mob's fear may lessen *or* increase its anger. It is a question of what force is stronger under particular circumstances. In general, however, it can be said that strong decisive counteraction is more likely to be effective early in the formation of the mob than later, when emotions have been reenforced and the field of attention is narrowest.

(4) *Control yourself.* He who tries to quell a mob is human and subject to the same influences as the members of the mob. It requires strong convictions to stand out against a mob clamor which claims to be righteous indignation seeking justice. Let the restraining leader be on guard lest he end by inciting to violence instead of quelling it. It is very easy to narrow the field of attention when there is no supporting voice for keeping it broad. Let the would-be leader beware lest the mob lead him.

PANIC

Panic is caused by fear. Its goal is escape—escape from an apparent catastrophe. Let us compare panic with mob action.

(1) **Motive.** The motive of a mob is hostility which arises from frustration. The motive of a panic is fear, which also depends on specific frustration. The mob's motive may be clear or latent; it may know what it is angry about, or it may be expressing latent aggression, acting against a scapegoat without awareness of the deeper sources of its emotion. Panicked men generally know what they are afraid of, what they are escaping from. Nevertheless panic, like mob anger, is contagious. Panic spreads, and a man will join a disorganized fleeing crowd of soldiers without stopping to ask why they are running, whether flight is right or necessary. The obvious fear among the panicked men counts as evidence that there is something to be afraid of, to escape from.

(2) **Focalization.** A panic is not generally focalized upon a definite goal by a leader. Some men start running and the others run. Nevertheless there may be leaders or at least initiators of panic. Someone has to be the first to break and run. Someone may shout: "Let's get out of here!" Someone may even give direction to fearful men by saying: "Don't go that way! The enemy's over there! This way, behind the hill, it's safe!" The goal is, however, less specific than in mob action; there is seldom need for the detailed directives of a leader.

The field of attention is quite as much narrowed by emotion in panic as it is in a mob. Fleeing men are unreasoning, unintelligent, forgetful of honor and discipline. You cannot stop them by reasoning with them, though you may control them by ridicule or the example of your own bravery.

(3) **Reenforcement.** Imitation, which also reenforces mob action, is the strongest means of increasing panic—the strongest after the basic motive, fear. There is also in panic, as in the mob, the effect of the strength of numbers. Alone you might have stuck it out. With everyone running it cannot be so bad for you to run too. And your fear is increased by the others' fears, your field of attention is narrow, you lose your critical judgment and you run without too much thought.

There is no time or attention in panic for rationalized righteousness. You may think it all out later, but in panic fear is so strong as to be its own justification.

Nor is the fear latent, as may be the hostility that leads to mob action. The panicked man knows what it is he is afraid of. He may be wrong in his facts, but he is always right in that what he thinks is true is something to be afraid of—he is, unless he has just joined the other men without knowing what started them.

With panic-ripe troops it takes very little to start panic. A single cry of "Gas!" or "Run!" or "We're cut off!" may be enough.

The enemy, aware of this fact, plays upon it whenever possible. In the First World War, agents were sometimes planted among American troops to yell "Gas" when times of confusion made them think they might start a panic. It even became necessary to work out a code-warning for the actual presence of gas—a code known only to trusted men. "New York" would mean gas one day, "Minneapolis" the next. The other men were instructed never to cry "Gas!"

In the first year of the Second World War dive bombers and shrieking bombs were used in part to frighten the soldiers and create panic. Actually the dive bomber does surprisingly little damage to trained troops who know what to do when such planes attack, but panic may make green troops expose themselves to other dangers—to machine-gun fire or tank fire. When troops learn this fact and become hardened to the dive-bomber's terrifying noise, they have robbed the attack of more than half its danger.

The history of warfare is full of instances where panic has been started by the most trivial incidents. In 1866 a dust cloud was enough to start the cry, "The German cavalry is charging!" among exhausted and frightened Austrian troops. That dust cloud was raised by a herd of frightened pigs. In 1918 a runner handed a message to a battalion commander. The major read it, called to his adjutant, "Come on. Let's beat it!" The two started off toward the rear at a run. The entire battalion was immediately in wild flight behind them. The message, however, was only an order to report to the regimental command post.

In 1904 in the Russo-Japanese War a shadow in the dark turned a well trained, rested, Russian rifle brigade into a fighting milling mob of men and animals. Shortly after dusk, in the vague shadowy twilight, several Russian soldiers had gone into a near-by rice field. One of these men saw something and shouted, "The Japanese are coming!" That was enough. The panic was on. What did he see? Whatever it was, it was not the Japanese. They were not coming.

What makes troops *panic-ripe?* What makes fear stampede them?

Diminished bodily efficiency is one cause of panic. Fatigue, lack of sleep, poor food, perhaps especially the lack of vitamin B_1 are others. Too much alcohol—either today or yesterday. *Bad living conditions*—dirt and vermin. All these things sap morale, make troops more readily a prey to their fears.

Some *mental states* are danger signals for panic. Anxiety and worry.

Repeated threats of danger. Continued disaster. Defeat. Retreat continued over a long period, even without losing great battles. Discouraged troops easily become fearful. Discipline—the normal protection against panic—falls off with continued fear. A long continued defensive may have the same effect. A leader should contrive to make a defensive seem like an offensive in the smaller day-by-day activities of his men.

In short, panic comes when *morale is bad.* The Russian rifle brigade, which was terrified in 1904 by what one scared soldier thought he saw in the twilight, was ripe for panic because it was already torn by internal strife and dissension among its officers. Its panicked flight was stopped by the calm and unperturbed front presented to it by another unit camped in the same region, a unit in which morale was high.

Rumor can ready men for panic. During the invasion of Abyssinia by Italy in 1896, rumors, added to poor morale, to mutual distrust among the soldiers, to dissension among the officers who betrayed their fright before their men, prepared the way for a panic that reduced an army of 15,000 men to 3,500. The men heard stories about how the Abyssinians tortured and mutilated their prisoners. One unit, advancing through a deep defile, was suddenly attacked by wildly shouting native troops. The supporting artillery failed to get the range. Almost at once the Italian infantrymen discarded their rifles and rushed away in wild disorder. Fear conquered discipline because morale was low.

Since morale depends so much upon leadership, *poor leadership* can sometimes, as in the instance just cited, be held responsible for panic. In fact, anything that impairs the confidence of men in their command makes panic more nearly possible. Contradictory or ambiguous orders. Vacillations of officers or their apparent stupidity. Prolonged waiting under tension. Frequent false alarms. Long retreats. Unexplained retreats. All such strains undermine confidence and favor panic.

The death of a leader in whom the men have placed great confidence may also make them insecure, make them ready for panic.

Felt *insecurity* in any form prepares for panic. An enemy threat, imagined or real, to the flank of a unit or to its communications and supply may be enough. Surprise by the enemy, especially when the surprise comes by way of new and unexpected weapons. Defeat, high casualties, disorderly retreat through ranks of unburied dead. Being lost in the woods at night or in a heavy fog or smoke screen. Being separated from the unit in or near enemy territory—even the momentary fear of such separation. Ignorance of the position of the enemy. These are the kinds of things that were never met in their full intensity during maneuvers, which fight against morale and discipline, and lead, when they win out, to panic.

It is possible to make a fairly complete summary of the causes of panic. Here is one.

(1) *Physical causes.* Climate (too hot; too cold); scarcity of food and water; disease conditions; scarcity of arms or ammunition; present evidence of death and disaster. All these physical conditions are effective because they determine mental states. The list could be increased indefinitely.

(2) *Physiological causes.* Hunger, bad nourishment, lack of vitamin B_1; thirst; fatigue, sleeplessness, irregular sleep; depression, exhaustion; alcoholic intoxication and its after-effects.

(3) *Emotional causes.* Danger, real or imaginary; emotional tension, expectant waiting, prolonged waiting; surprise threats to life, unexpected weapons; anxiety, uncertainty; insecurity, ignorance of the military situation; isolation, physical or psychological.

(4) *Social causes.* Emotional contagion, suggestion; cultural factors like the greater emotionality of uneducated men; treachery; the effect of maladjusted men on the others.

(5) *Morale.* Bad morale; loss of confidence in leaders; loss of discipline; the psychological attitudes that arise in continued retreat, or from a continued defensive; homesickness; boredom.

(6) *Leadership.* Absence of leaders; loss of a good leader; vacillating leadership, contradictory commands, loss of confidence in leaders. The leader can, moreover, affect nearly all the other causes of panic, for on him morale primarily depends.

EXAMPLES OF PANIC

On October 30, 1938 thousands of people heard a radio broadcast by Orson Welles—a dramatic description of a fictitious invasion of the world by men from Mars. Some listeners, though not physically together as a group, were panic-struck. They telegraphed relatives to come home at once. They telephoned to warn neighbors. They got into cars and drove far into the country.

What made these people so firmly convinced that men from Mars were actually invading the world? Why did they not use adequate, effective means to determine whether the "news" was authentic? Why did they not telephone newspapers and police stations?

In 1938, the Second World War was imminent. People were scared. In 1938, the country was still in the depths of an economic depression.

People were depressed and jobless. They were in a "frame of mind" which made them more suggestible and ready to accept what in normal times their "better" judgment would cause them to reject. The radio was the accepted, the commonly used vehicle to communicate important news. The program was presented as a "news" broadcast. What need then to check with newspapers and police stations?

Because elaborate details of names, titles, times and places were given in the broadcast the drama had a vividness, definiteness and certainty that caused people to believe it was really true. They acted on the "news" and panic was widespread.

Brigadier General C. T. Lanham has analyzed eight famous instances of panicked troops. From his descriptions many of the examples given in this chapter have been drawn. The nature of panic becomes, however, clearer when all the details of the cases are set down together. For that reason General Lanham's eight occasions of military panic are abstracted in the table below.

This table, after identifying the occasion of each panic, indicates first as the *predisposing situation* the various conditions, in so far as they are known, that tended to make the troops panic-ripe as well as the other conditions that tended, or should have tended, to support discipline. Morale, training, fatigue, hunger, insecurity, fear, and all the rest are noted. Then the table shows what may be regarded as the *immediate stimulus* to the panic, the events and circumstances that set off the disorderly flight. It is obvious that the stimulus often seems quite inadequate. Similar troops under similar conditions might not at another time be panicked by such a stimulus. There is always this chance element in panic. None would run if there were not a first man to run. What happens at that crucial moment of "choice," when all the men are almost ready to break and the first man "decides" on flight, when his fear overcomes his discipline? And then finally the table gives the *results,* the serious consequences of panic, sometimes of quite unreasonable panic, the military moral, as it were. Here is the table.

EIGHT CASES OF PANICKED TROOPS

(1) Date: June 27, 1886 Place: Trautenau, Austria.

Panicked troops: Austrian Brigade Grivicic.
Enemy: Prussian I Corps.
Predisposing situation:
Difficult retreat among own dead and wounded.
Heat. Dust. Drinking water scarce.

Prussian Corps across line of retreat, and rumor to that effect spread among the troops.

Immediate stimulus:

Prussians engaged.

A few shots are heard on the flank.

A cry arises and spreads: "We're cut off."

Results:

Men threw away their rifles and fled.

Brigade not reassembled until next day, 15 miles away.

It lost 65 per cent of its strength (95 officers, 2,700 men).

(2) Date: November 1, 1896 Place: Adowa, Abyssinia.

Panicked troops: Italian Army.

Enemy: About 100,000 Abyssinian spearmen.

Predisposing situation:

Bad night march through wild mountain passes.

Men had straggled and at dawn they found themselves separated by deep ravines into three parts.

Officers and men had never worked with each other, or the infantry with the artillery. There was a lack of trust and faith in one another.

Troops had heard that the enemy tortured and mutilated their prisoners.

Troops heard their commander express fear at being separated from the rest of the army.

Immediate stimulus:

Troops of the left part were suddenly confronted by milling savage hordes.

Their artillery failed to get the range and was not effective.

Results:

Men flung away their rifles and rushed toward the center, which was then stampeded toward the right.

They clubbed down officers who sought to rally them.

Only 3,500 men of 15,000 escaped.

(3) Date: August 1, 1904 Place: Haitshong, Manchuria.

Panicked troops: Russian Rifle Brigade.

Enemy: Japanese troops.

Predisposing situation:

Poor morale. Dissension and petty feuds among the troops.

Troops depressed by Japanese victories.
(Nevertheless these troops were well trained, well equipped, well fed, rested, and in secure positions in reserve behind the lines.)

Immediate stimulus:
Soldier, relieving himself in a rice field, was startled by something and set up the cry: "The Japanese are coming!"
The cry spread at once.

Results:
Men grabbed their rifles and fired in all directions.
Then they fled. General Kuropatkin himself failed to quiet them.
One part of them fled to a camp of corps trains and panicked them. This part was not rallied for several days.
The other part fled to the camp of a regiment with good morale, and was restored to order by the calm demeanor of these troops.

(4) Date: November 9, 1870. Place: Coulmiers, France.

Panicked troops: Rayeau Cavalry Division of the French First Army.
Enemy: I Bavarian Corps of the German Army.
Predisposing situation:
Troops had been hastily organized, were poorly trained and poorly disciplined.
They were despondent from many defeats, and impressed with the superiority of the Germans.
They were ordered to turn the right flank of the Bavarians, who were about to retreat.
They were told that their left flank would be covered by French irregulars.
Progress was slow and difficult; the Bavarian artillery had inflicted a few casualties on the French.

Immediate stimulus:
Patrols rushed in reporting that Germans were driving in on French left flank. (There were no Germans there; the patrols mistook the French irregulars for German troops.)
The report spread rapidly among the troops.

Results:
They fled to the rear until they reached their bivouac area of the morning.
The Bavarian Corps, although greatly outnumbered by the French, made good its retreat.

(5) Date: 1743. Place: Branau, Austria.

Panicked troops: A Bavarian Corps.
Enemy: Austrian troops.
Predisposing situation:
- Troops were new and unseasoned.
- They were tired and hungry, without food all day.
- They had failed to capture an Austrian fort and were retiring at night.

Immediate stimulus:
- Troops heard heavy firing in the rear.
- Rumors spread that the Austrians were attacking from the rear and had broken through the rear guard.
- Their commander sought in vain to rally them to attack against the Austrians.
- At that point a subordinate general rode up and shouted that the Austrians had encircled the right flank.

Results:
- Immediate flight of 10,000 men in panic.
- The commander could assemble the next morning only a few officers and cavalrymen and about 200 infantrymen.

(6) Date: October 11, 1806. Place: Weimar, Germany.

Panicked troops: Prussian Army of Hohenlohe.
Enemy: French troops.
Predisposing situation:
- Troops were discouraged, though actually quite safe from the enemy at the moment.
- They were hearing disheartening reports.

Immediate stimulus:
- A rider galloped down the road, gesturing frantically, shouting "Back! Back!" and then disappearing toward the rear. (Actually he had only been told to clear the road for other traffic.)

Results:
- Immediate wild flight to the rear.
- Panic spread through the valley of the Salle, and Prussian troops miles away at Jena fled into the night.
- Order was restored only after many hours.

(7) Date: June 24, 1866. Place: Mount Cricole, Italy.

Panicked troops: 2d Brigade of the Italian 1st Division.

Enemy: Austrian cavalry.

Predisposing situation:

1st Brigade had advanced to Mangalia Ridge.

2d Brigade advanced to support it, but its progress was slow because it had not arranged for local security.

Immediate stimulus:

A squadron of Austrian cavalry appeared suddenly at the crest of Mount Cricole and charged.

An Italian artillery platoon, attacked by the Austrians, turned and fled into the 2d Brigade.

The Austrian cavalry followed at a gallop, penetrating the 2d Brigade, scattering its troops and killing many of its men and officers.

Results:

Panic swept the 2d Brigade.

Five battalions flung away their packs and rifles and fled.

The 2d Brigade was not rallied until the next day.

The 1st Brigade, finding itself unsupported, withdrew.

Meanwhile the battalion first attacked in the 1st Brigade had rallied and had destroyed the Austrian squadron.

(8) Date: November 25, 1863. Place: Missionary Ridge, Tennessee.

Panicked troops: Confederate Army of the Tennessee.

Enemy: Federal Army of the Cumberland.

Predisposing situation:

Confederate troops were veterans of two and a half years' service, recently victorious at Chickamaugua. They were numerically inferior, but held a superior position on a steep ridge which they should have been able to defend.

Morale was low. There were quarrels among high officers. The commander, General Bragg, had relieved one popular general and preferred charges against him, had relieved another popular division commander and broken up his division. General Longstreet was openly critical of General Bragg and apparently disloyal.

Dissension was rife in the Army.

Union troops in great numbers were marshalled on the plain below in full view of the Confederates, who were greatly impressed by what they saw.

The Confederates knew that the Union troops were under the

command of General Grant, recently victorious at Vicksburg.
The Confederate troops were disposed in two lines, one at the foot of the ridge, the other at the crest (a tactical error).

Immediate stimulus:

Union troops overran the Confederate line at the bottom of the ridge and charged, contrary to orders, up the hill to the crest, suddenly displaying the Union flag at the top.
As they charged they mingled with the Confederates retreating up from the bottom, with the result that the Confederates at the top could not fire effectively for fear of shooting their own men.

Results:

The Confederate Army broke in panic, division after division, and the enemy occupied their originally superior position.

STOPPING PANIC

Most of the rules for quelling mob action also apply to stopping panics. A *leader* is usually necessary, one who will not himself yield to panic. He must gain the attention of the panicked men, speak decisively and calmly, if possible deflect their flight to some other activity. If no officer is present when troops begin to flee, any self-possessed man can assume leadership and give the scared men what they need—clear confident direction. If escape is necessary, the men should be given instructions as to means of escape.

The leader's example of confidence in himself and in his men must compete with the examples of the others who are running away in terror. Unconcerned calm and routine attention to duty are effective, if he can but get full attention. One officer in the First World War got attention by standing on a stump and laughing as he pointed at the panic-stricken men who came running by him. They stopped.

The best way to stop a panic is, however, never to have it at all. Discipline and morale prevent panic. Men should be trained to have confidence in themselves, their leaders and their weapons. Their leaders should be such men as can build morale in their units. They should forever seek to gain the confidence of their men. They should eliminate all the conditions for panic—hunger, fatigue, boredom, lack of information, rumor and the rest—insofar as they can. They must help their men to fight the feeling of insecurity and give evidence of feeling secure themselves. They must tell the men all they can about the enemy—where he is, what he is like, how he attacks, what weapons he is using. They must provide for the men a psychological conditioning to the horrors they will have to face, so that these will not be wholly unexpected. They must maintain in the unit a "psychological offensive," engaging the men constantly in activities that make them feel aggressive toward the enemy and competent in facing him. The ultimate defense against panic lies in good leadership—not only when panic starts, but also in the months of training during which the troops are becoming seasoned.

REFERENCES

1. H. Cantril. *The invasion from Mars, a study in the psychology of panic.* Princeton: Princeton University Press, 1940. Pp. 228.
   An analysis of why certain members of the radio audience reacted with panic to Orson Welles' program dramatizing a hypothetical invasion of the Western World by the Martians.
2. H. Cantril. *The psychology of social movements.* New York: Wiley, 1941. Pp. 294.
   A clear systematic account of the psychological factors involved in the formation and functioning of social groups.
3. S. Crane. *The red badge of courage.* New York: Modern Library, 1944. Pp. 267.
   This classic American novel contains an accurate and detailed portrayal of panicked troops.
4. Brigadier General C. T. Lanham. "Panic" in the *Infantry Journal Reader.* New York: Doubleday Doran, 1943. Pp. 274-289.
   The full account of the eight military panics cited in the text.
5. A. McLee and N. D. Humphrey. *Race riot.* New York: Dryden Press, 1943. Pp. 143.
   A clear and detailed account of the Detroit race riots with constructive suggestions for community prevention and control of similar riots.
6. N. E. Miller and J. Dollard. *Social learning and imitation.* New Haven: Yale University Press, 1941. Pp. 341.
   An experimental and theoretical analysis of how learning takes place in social situations; clear and well written.

See also references cited in Chapter 16, especially Nos. 4 and 8.

Chapter 21

Assessing Opinion and Discovering Facts

Every man who is responsible for groups of other persons, who has to lead them or try to control them, has an advantage if he knows what these persons are really saying to their close companions, what they are thinking, and what their preferences and opinions are. Otherwise he cannot act as wisely in influencing them or in planning that part of his action which depends on their spontaneous response to what he does. A company officer or the commander of a ship needs to know what his men want, what they dislike in general as well as what they dislike in particular about their immediate lives and duties, whether they are confident or afraid. A commanding general or an admiral needs to know the state of mind of the men in his army or fleet, the level of their confidence and morale. An officer in an occupied country has a great advantage if he understands what the native people are thinking, afraid of, hoping for. Only then can he lay down wise plans for his future action or arrange to change opinion by altering conditions.

At the highest levels, it is governments which are helped by knowing about public opinion in their own countries, in allied countries, in occupied countries and in enemy countries. On such information psychological warfare and propaganda are based. You cannot bolster the home front effectively unless you know that it needs bolstering, why it needs bolstering and how it should be bolstered. You cannot by propaganda undermine the confidence of an enemy people quickly unless you know that the enemy is already weakening, and why, and how. It was psychological warfare, it was propaganda, when Roosevelt and Churchill told some unpleasant truths in their address to the Italian people, the address that was dropped by airplane and beamed by short-wave radio all over Italy immediately after the fall of Mussolini. Those two allied leaders knew, however, that there was already dissension among the Italian people. Mussolini's fall had told them that. There would have been no use in their attempting such an appeal when Italy was still confident of ultimate victory.

Under dictatorships what people are thinking is important in a negative way—because it may be dangerous to the dictator. If the dictatorship is to survive, opinions which do not support the leader must be known and suppressed.

In democratic countries the opinions of people are important in positive ways—because:

(1) There is evidence that the judgment of a group of people is wiser than the judgment of any one man—provided, of course, that the group is informed and interested in the subject in question.

(2) No policy can be successfully put into practice against the will of most of the people concerned. In these days wars are fought over the possession of land or money or other material things, and even more over religious or political philosophies and the right to hold them. If large groups of people are dissatisfied with a policy, their dissatisfactions will show themselves in a hundred different ways, all detrimental to effective governmental action.

In an organization such as an army, it is not practical to take a vote of all the men on strategy or tactics. Yet it is important to know what the men are thinking. Since the discipline of an army or navy makes it impossible for the soldier or sailor always to make his opinions freely available to his officers, it is necessary for the leaders to take special steps to learn what their men are experiencing and thinking.

Recently scientific techniques have been developed for assaying the opinions of groups with great accuracy and thoroughness. These techniques have been employed successfully and on a large scale in the United States Army. For instance, investigations have been made of what subordinates think of their superiors, and of the plans of soldiers to obtain more education after the war. The methods have also been employed to discover how effective are certain films shown for the purpose of influencing soldiers' attitudes, especially their attitudes toward allied peoples.

It may be only the thoughtful enlisted man who is interested in these larger matters of the assessment and control of opinion in large groups and small. A good company commander needs but little advice on polling opinion in his company. If he is a successful leader, he already has his techniques for finding out what his men want and how they feel. In larger units it becomes difficult, however, for a leader to know what is going on in the minds of the men who compose it. Advice as to techniques is then in order. As a matter of fact, more than one opinion may be current in the same unit; there may be divided feeling between different groups or uneveness of morale among different units. A leader must know how to assess opinion throughout his entire command.

Nor is it possible for military leaders to ignore psychological warfare. General Eisenhower early in the Tunisian campaign sent for three hundred specialists in propaganda. Leaders have, moreover, to deal with civilian populations and the enemy as well as with their own men. They may often find that they have political responsibilities added to their military duties. At the very least they wish to understand what the various governments—their own, their allies', the enemy's—are undertaking in psychological warfare and how victory and defeat are being helped along on the propaganda front.

Since opinion has to be understood before it can be changed or account taken of it, the assessment of opinion comes first and the use of the data in propaganda or otherwise comes second. It is, moreover, easiest at the outset to understand the techniques for assessing opinion in large groups—in countries or regions or communities. With that knowledge acquired, it is not difficult to see when and how the principles for large groups can be applied to smaller ones—to a factory or a battalion.

PUBLIC OPINION POLLS

The establishment of polls of public opinion in England, Canada, Australia, Sweden and the United States makes it easy in those countries to assess opinion on important topics and to follow its changes. Since the newspapers publish many of the results, both allies and enemies can see clearly what is going on in people's minds. Before Pearl Harbor the Germans could tell, by watching the polls, the strength of isolationism in the United States and could see it giving place to interventionism. Similarly the British could tell how the United States felt about British policies, about India, imperialism and the "school ties," about Dunkirk and the bombing of London.

These polls also show how opinion divides among different groups and in different regions of a country. Before Pearl Harbor, was the Middle West more isolationist than New England? Yes, it was. The polls said so. Was rural America more critical of wage increases for labor than urban America? The polls said how much. German propaganda could use these divisions of opinion in the United States to try to stimulate these quarrels, to make America inactive by helping her to be uncertain of her own goals.

America, too, uses the same data to help make its democracy work. The leaders in all branches of the Government and many of the people themselves want to know what the people want. The polls tell them—with surprising accuracy. The elections may later check the polls, but a democracy needs to keep knowing immediately how opinion is changing, and also what an election seldom tells—how opinion stands on each separate issue.

After December 7, 1941, the polls became more discreet in respect of international issues, yet not much more so. From January to March of 1942 the people of the United States were polled on their attitudes toward: the President, strike legislation, sales taxes, enforced savings, tire rationing, prohibition, the merger of the American Federation of Labor with the Congress of Industrial Organizations (CIO), particular labor leaders, the union check-off, the Irish Free State, Russia, Great Britain, the drafting of men with dependents, total mobilization, the drafting of women for industry.

In 1944 the polls were asking about party strength in different parts of the United States (it was an election year), whether Americans know their Congressional representatives, Americans' attitudes toward taxes, toward the government regulation of public utilities, toward Negro labor, their beliefs about the duration of the war, about the drafting of unmarried women, about unconditional surrender for Germany, about reparations from Germany, about the probability of another war in the next fifty years, about the United States' joining a union of nations, about postwar employment.

The publication of such data helps the enemy by providing information about ourselves, the enemy's enemy, but it also helps the democracies, which abide by the principle that it is better for everyone to know the truth than for nearly everyone to be ignorant of it. In Germany there were no such published polls. It would have been useful to the Allies had there been.

A totalitarian government is not, of course, wholly independent of public opinion. Like the democracies, it needs constantly to know what its people believe and hope. Since the expression of opinion is, however, not free, since polls cannot be openly conducted and the results published in the newspapers, the totalitarian country has to resort to a kind of espionage.

In Germany, in the first years of the Second World War, this system was complicated. The Nazi party leaders in small sections of every community were required to keep themselves informed of the changing attitudes of the people in their sectors. They had to use indirect methods, for the German had learned always to subscribe to the official doctrine when asked a direct question by someone other than a trusted friend. Such data are not always reliable, yet the leaders got a great deal of information—from overheard conversations and from the observation of what people actually did.

These leaders prepared reports for the district leaders, who summarized the data in reports to the regional leaders, who put everything together for the use of the Ministry of Propaganda. That indirect method of assessing opinion is a kind of public opinion poll, but it is less reliable than the polls in the democracies because the sample of opinion polled cannot be selected openly and in accordance with the principles that make it a fair sample.

Facts as well as opinions can be got by polls.

You can poll to find out the effect of propaganda. The Army does. It does it with captured prisoners, using polls and skillful interviews to discover the effects of leaflets previously dropped behind the enemy lines, or the effects of radio and loud-speaker programs directed at the lines.

The Army has also used polls to find out what the American soldier thinks about the problems of Army life. Some of such soldier thoughts are mere opinions, but others are facts. If you ask soldiers to say how they like to spend their off-duty hours, they can tell you how and probably are correct about what they want. Soldiers have even been asked to say what they think makes a good leader, what inspires in them loyalty to a leader and what hinders loyalty. The soldiers do not always know the correct answers to such questions but it is useful to have their opinions and many of their opinions on this matter seem to be facts. For instance, they say they like and respect competence in a leader more than any other single attribute, and in that they seem to be telling the truth about themselves, for they obey a competent leader more consistently than an incompetent one.

HOW TO POLL

The methods of reliable polling are now pretty well understood. Here are some of the more important rules.

(1) **Remember that opinion in a large group is apt to be divided.** So sample widely enough to get all views. *What the French think* probably does not exist. Different Frenchmen think different things. *A majority of Frenchmen think* is almost as bad a statement. A majority may be 54 per cent or 96 per cent. You need to know the percentage that holds each opinion, and that question is answered only after careful planning of the poll.

(2) **Spread your sources of information as widely as possible.** Do not rely only on the people with whom you usually have contact. If you are sampling civilian opinion, sample all walks of life—lawyers, shopkeepers, housewives, streetcar conductors, peasants, society women,

munition workers, bankers, waiters, preachers, bootblacks, men you pass in the street, men you find in cafés. If you are after opinion in the Army, go to large units and small, regular outfits and specialized services, units at the front and units in training at home, units which you think have good morale and others that are probably bad, privates, NCOs and, if you really want everything, officers of all ranks.

(3) **Plan a fair sample if possible.** That is always done in the large public opinion polls. Here you must use your past experience and your wits to predict what conditions will make a difference in the opinions you are polling. If you are successful in doing this, your sample will be a fair sample. Experience shows that income is important in social and political questions. You must arrange to include in your sample the right number of people to represent the different income levels in the population you are sampling. If you have the wrong quantities in your sample, then you multiply the votes by the right numbers to make the proportion correct.

Religion is important when religion is involved—as in questions about the Spanish revolution or about birth control, where the attitude of Catholics makes a difference. Age and sex are important, when they are important—as in questions about the draft. Young people are also more often radical in social philosophy than are old. Occupation is not often important unless the issue is an economic one, but education may be important. Education is especially important where factual knowledge gives insight into implications, as, for example in polls dealing with postwar problems. Grade and length of service are important in Army polls. Height, weight and hair color can generally be ignored, unless, of course, the question is: Are Army cots long enough? Then you must be sure to get the right number of tall men. Geography is very important. So often opinions are determined by the region in which a man lives or in which he was brought up.

Such samples are called *stratified samples* (rather than random samples) because they select persons proportionately from the various strata or subdivisions of the group being polled.

(4) **Take a sample of the right size.** If wisely selected, the sample need not be large. You can get a pretty good idea of political opinion in the United States from 3,000 interviews, properly distributed over the country among people with different amounts of income. Excellent reliability can be got from a sample of 10,000. In Canada very accurate

TABLE IX

SIZE OF SAMPLE NECESSARY TO BE PRACTICALLY SURE OF ACCURACY IN A POLL OF OPINION WITHIN PREDETERMINED LIMITS OF ERROR

Range of error in per cent	*Where Opinion Divides Percentagewise as Follows:* 20-80%	30-70%	40-60%	50-50%
0.1%	1,400,000	1,890,000	2,160,000	2,250,000
0.5	57,600	75,600	86,400	90,000
1.0	14,400	18,900	21,600	22,500
2.0	3,600	4,725	5,400	5,625
5.0	576	756	864	900
10.0	144	189	216	225
20.0	36	47	54	56
40.0	9	12	14	14

analyses of opinion on the question of conscription for the army were made with samples of only 200 each. Assuming your sample is a fair sample, the larger, the greater the accuracy; but the third thousand does not increase accuracy nearly so much as did the second thousand.

Table IX shows how big a sample is needed, in theory, to get a given degree of accuracy when opinion divides itself in the different ways in a large total population. A 20-80 division might require less than 600 persons in the sample to predict the actual division to within five per cent of error, but a 50-50 division would need a sample of 900 to give the same accuracy. This is theory, yet practice shows that the theory works when the sample has been fairly selected.

Actually it is possible to predict an election among 50,000,000 persons from polling only 10,000—a polling of only one man in every 5,000—unless the election is going to be very close indeed. People generally do not believe that statement, but it is true nevertheless.

(5) **Make out the questions for the poll with great care.** Make them brief and to the point, for long questions confuse. Use simple words and phrases and avoid misunderstanding. Avoid words with strong emotional coloring, lest people respond to the word and not to the total question in its exact meaning. Be objective, so that the person polled cannot think that one answer will please the interviewer more than another. Let the person interviewed talk freely in answering the questions, while you keep your own views entirely out of sight.

The Office of Public Opinion Research has made a special study of how questions should be worded. The data have been grouped around the following problems:

(1) **Effects of context.** Before Pearl Harbor, in measuring a very general attitude—should the United States intervene in the Second World War?—it was found that the context in which the question was presented had an important effect upon the results obtained. When the question was worded like this: Do you think the United States Navy should be used to convoy ships carrying war materials to Britain?—then 56 per cent of the people polled said *Yes*. When the question was worded like this: Should the United States enter the war now?—then only 18 per cent said *Yes.* That left 42 per cent in favor of convoying and opposed to war, a pretty large percentage in view of the great probability that the active defense of convoyed vessels would lead to war. The fact seems to have been that the word *war* determined the attitude of many of the persons being polled. Persons without strong convictions generally lie in some such middle group, being thrown in one direction or the other by the special contexts which the questions introduce. For this reason, good polling generally includes the reply "no opinion," so that persons without a definite opinion are not forced to make up a casual one for the occasion.

The context of the question thus becomes important in the interpretation of any general opinion. To avoid misinterpretations the Office of Public Opinion Research suggests the use of questions which place a general opinion in a number of contexts surrounded by a number of contingencies. Early in 1941 they asked: "Should the United States go into the war and send an army to Europe?" and "Would you prefer to have the United States go into the war rather than see Britain surrender to Germany?" Only 8 per cent of the people polled said *Yes* to the first question, whereas 61 per cent said *Yes* to the second. That is a large difference.

The position of a question on a ballot also influences the answers. On one form of a questionnaire issued before Pearl Harbor people were asked: "Should the United States permit its citizens to join the French and British armies?" The next question read: "Should the United States permit its citizens to join the German army?" This order, Form *A*, yielded:

		Join British and French armies	*Join German army*
Form *A*	Yes	45%	31%
(British and French	No	46%	61%
precede German)	Don't know	9%	8%

Reversing the order of the questions, Form *B*, resulted in:

		Join German army	*Join British and French armies*
Form *B*	Yes	22%	40%
(German precedes	No	74%	54%
British and French)	Don't know	4%	6%

Having endorsed enlistments in the armies of the Allies, some people apparently felt obliged to extend the same privilege to those wishing to join the German forces. When the right to join the German forces came first, however, Americans were less often willing to allow fellow Americans to join the German armies.

(2) **The alternatives presented.** There are three forms of questioning.

The *open* or *free* question—"What do you think should be done about strikes in war industries?"—leave the pollee free to say what he thinks, to show the intensity of his feeling, to indicate the extent of his information on the subject. On the other hand, this procedure often leads to vague results, providing a chance for the bias of the interpreter to operate in his classification of the replies. Such questions are useful when opinion is as yet not well formed.

The *cafeteria* or *multiple-choice* question provides a number of possible answers among which the pollee must choose. For instance, this question was asked early in 1941 before Pearl Harbor: "Please tell me which of these policies you think the United States should follow at the present time." A choice among six answers was provided: "Go to war at once against Germany and Italy"; "Supply Britain with all the war materials we can send and also use our Navy to convoy ships carrying these materials to Britain"; "Supply Britain with all war materials we can, but do not use our Navy to convoy these materials"; "Return to our previous policy of supplying only those materials which Britain can pay cash for and come and get here"; "Keep completely neutral by limiting our aid to Britain to food-stuffs and medical supplies"; "Stop all further aid to Britain."

Most yes-no polls allow cafeteria choice by adding "no opinion" to "yes" and "no" as possible answers. You get more information about the state of opinion if you do not count as "yes" or "no" opinions formed on the spur of the moment by persons who have for the time being no definite opinion. Weakly held opinions change too easily to be significant.

Sometimes the questions are *categorical* or *dichotomous,* allowing only "yes" and "no," or a choice between two candidates for an elective office. Such questions are useful in predicting the result of a vote, in which even persons with weakly held opinions must make up their minds and choose between alternatives.

(3) **Deviations from objective wordings.** Emotionally toned *symbols of prestige, stereotypes,* and *biased wordings* affect the results of polls to a marked extent.

In June 1941 a question showing the negative *prestige* of President Roosevelt's name was given in two forms, one form to half of a stratified sample, the other form to the other half. Form *A* asked: "So far as you, personally, are concerned, do you think President Roosevelt has gone too far in his policies of helping Britain, or not far enough?" Form *B* merely substituted "the United States" for "President Roosevelt." The results were as follows:

	"President Roosevelt"	*"The United States"*
Too far	20%	15%
About right	57%	46%
Not far enough	17%	32%
No opinion	6%	7%

People were willing to let the United States go farther than President Roosevelt, although actually one could not go far in such an action without the other.

The effect of *stereotypes* may be illustrated by the following example. The question was asked in September 1939: "If Canada is actually invaded by any European power, do you think the United States should use its Army and Navy to aid Canada?" Seventy-one per cent said *Yes.* But when the same question was worded: "If Canada is actually invaded by any European power, do you think the United States should go to war to defend Canada?—then only 64 per cent said *Yes. To go to war* is more emotionally toned and less acceptable than *to aid.*

In the same way, 57 per cent will vote for freedom of speech for those opposed to our present form of government, but only 20 per cent will indorse it when the specific label "freedom of speech for Communists" appears in the questions.

Biased wordings also affect opinions. A pro-union phrasing of a question—"Because every man is entitled to safe and healthy working conditions, labor (in defense industries) should be allowed to strike for them"—yielded 45 per cent *agree* and 45 per cent *disagree.* An anti-union phrasing—"Because working conditions in this country are the best in the world, labor (in defense industries) should not be allowed to strike about them"—yielded 74 per cent *agree* and 17 per cent *disagree.*

The way a question is worded, then, has an influence on the results obtained. On the other hand, the better informed the people are, the less readily are they influenced by the emotional tone of the question.

OTHER METHODS FOR DISCOVERING FACTS AND OPINIONS

The following methods have been used for discovering and evaluating opinion in large or small groups at home or in the *allied countries* where the methods can be freely employed and where information is readily available. The problem of assessing enemy opinion is different and presents many more difficulties.

(1) *Public opinion polls,* as discussed in the two preceding sections.

(2) *Interviews* can be employed in a less formal manner without obtaining a fair sample. It is the method ordinarily used by the press in assessing opinion, and by politicians and statesmen. It is involved in the German method already described.

(3) *Newspapers* give information about public opinion, because most people read the papers with whose opinions they agree. A study of the circulation figures for the papers, as related to their editorial and news policies, gives a rough idea of the distribution of opinion among the persons who read newspapers. That is not, of course, everyone. You could not sample opinion in this fashion in a district where only a few people or only the people of one class read the papers.

The general policy of the paper, the attitude that makes people like or dislike the paper, is found not only in the editorials. It may appear in the selection and placing of news, in the woman's page, in the advertisements sometimes, in the letters to the editor, and in the cartoons always. The cartoons are, in fact, editorials. On the other hand, it is not true that circulation is a reliable index of the popularity of specific editorial policies. Roosevelt was supported in 1944 by only 20 per cent of the newspapers, but by 53 per cent of the voters. It is general policy which counts. If you read a paper because you like its policy, you do not stop reading it because it offends you on one count.

(4) *Radio commentators* provide similar information. The size of their audiences indicates the popularity of their views. The number of

listeners is indicated roughly by the volume of mail which the programs bring in, by changes in current consumption when the program comes on or goes off the air, or sometimes by a poll which questions people as to which are their favorite commentators. People have less hesitation in stating their preference for a commentator to an interviewer than in stating their opinions on a controversial topic.

(5) *Movies* also furnish information about opinion, especially concerning the popularity of public figures. You simply wait until the pictures of important military or political figures appear on the screen, and then estimate the volume of the applause. Sometimes the audience boos, a kind of negative applause for unpopular great men. By this method it became obvious that Willkie was a more popular candidate for president than Roosevelt in Evanston, Illinois, in 1940, whereas at the same time Roosevelt was being applauded more than Willkie in South Chicago. The Swiss reported in 1942 that "Marshal Pétain's image is slipping badly," because only one person cheered his picture in a newsreel, one person in an audience that loudly cheered an American western film that followed the newsreel.

The Japanese once used this method to test out opinion in China. They interrupted a film to show a picture of Dr. Sun Yat-sen, China's George Washington. The audience hesitated; then applauded. Then they showed Generalissimo Chiang Kai-shek. There was a thunderous ovation. Next they showed the Chinese quisling, whom the Japanese had placed in power, Wang Ching-wei. The audience booed, and the Japanese had the answer to their question for that particular audience.

Of course, the audience must feel free to express their opinions if the "applause chart" is to mean much. Perhaps the Chinese were not quite free in the instance just cited, since they were in Japanese-occupied territory. The picture of Sun Yat-sen was, however, shown first for the purpose of freeing them, of getting them in the mood of applauding by letting them see first a revered character who had no relation to the current war.

(6) *Public addresses* indicate how opinion is going, both by applause and attendance. People, by and large, go to hear men tell them what they already believe, not to get their opinions changed or to study the arguments on the other side. So, when a speaker, who represents a certain view on an important question, draws a huge crowd, you can conclude that his views are becoming popular—or at least have notable support.

(7) *Mass observation* is a term applied to a British method of as-

sessing public opinion. It is a kind of eavesdropping. Observers mingle with crowds in the movies, in the pubs, in other public places. They listen—listen to what people are saying and doing all over the country. They listen in the streetcars, too. In America they could listen in Pullman smokers, but only for the opinions of those men who ride in Pullmans. In this way they catch people off guard and hear real opinions which would have been more restrained if an official investigator had been asking a formal question.

By the use of these methods it is possible to know pretty well how opinion goes on the home front and what is the state of civilian morale. It is, however, just as important to learn about public opinion in enemy countries and that undertaking is much more difficult. The following four methods are employed.

(8) *Interviews with travelers* who have left enemy territory for neutral territory tell a great deal. Such reports can be invaluable if the traveler is a careful and judicious observer, but it must be remembered that such a traveler presumably had no special means of assessing opinion in enemy country. He knows only what he saw and heard in limited circles. If it requires special techniques to assess opinion at home, then a stranger in the enemy country without the advantage of such techniques is at a great disadvantage.

(9) *Intercepted mail* from enemy countries to neutral countries is likely to tell more than travelers if there is enough of it from persons in different situations and different parts of the enemy country. It is, however, likely to be written with an eye to the censor. Thus its interpretation becomes a battle of wits between the enemy censor and the interceptor or recipient as to the significance of apparently innocent statements. "All the family have colds and five of our friends have had pneumonia this winter" may mean that the enemy is short of fuel for heating. If the letter adds, "It wasn't really necessary," then perhaps the writer thinks his government has not managed well.

(10) *Espionage* is the accepted and traditional method of gaining information about what is going on inside enemy territory and about the state of enemy morale. Without the intelligence agencies both the government and the armed services would be poorly off.

(11) *Monitoring* of radio programs is another important source of information. Most of the countries early in the Second World War established listening posts to monitor the domestic programs of enemy countries. For twenty-four hours a day trained linguists listen in to hundreds of radio stations scattered all over the world. They take notes

on the programs and can, when something of special importance comes on, record a program simply by pressing a button that starts the recording machine.

These monitors find out by indirect inference what the enemy people are thinking. If a German station launched an attack on "misguided German grumblers," the analyst knew that such grumbling had increased and that the German Propaganda Ministry was trying to counteract it. Likewise, when the German radio began to insist on the impregnability of the European Continent, it was clear that many Germans were beginning to doubt European impregnability. The German propagandists knew opinion in their own country and fitted their propaganda to it. You had only to look for the reason for the broadcast.

The monitoring stations also know that short-wave propaganda beamed from home to the enemy countries is received in the enemy countries because they find the return propaganda from the enemy taking account of these broadcasts and answering the argument in them. Of course, that does not show that the enemy are hearing the forbidden propaganda, nor that the enemy people can listen to anything more than the long-wave broadcasts of their own country. It may mean only that the enemy monitors have been listening to the domestic and foreign short-wave, as it is their duty to do.

(12) *Company interviews after combat* constitute a new method of fact-finding in the army. Good tactics depend on past experience. Usually in the past, responsible officers, aided by a few other men whom they consult, have pieced together accounts of important actions, and these records have then become the materials for the case study of tactics. Nowadays a historian is attached to large units, like divisions, and it is his duty to obtain records of what has actually happened after a victory, a defeat or some other unusual event in combat. If he selects his informants he is likely to miss crucial data, the facts which explain how the tide was turned, how lost morale was regained, how surprise was effected. Sometimes the single action of one man at a critical moment provides the key to the whole event. He may miss that item unless he interviews everyone who was in the engagement and who is still living.

For this reason the company interviews after combat have been developed. The interviewer—the historian perhaps—brings all the men together for collective interview, company by company. They work hard —three hours in the morning and three hours in the afternoon, and perhaps again the next day—piecing the facts together with discussion, cross-criticism, correction of one another, and the insertion of additional facts when some new item refreshes the memory of a man who had already reported. Officers and men meet together on an equal footing. Rank is not forgotten, but great care is exercised not to staunch the flow of facts by allowing the juniors to defer to their superiors. If a private believes that his leader's interpretation of an occurrence is incorrect, he speaks up and says so. Men are never reproved for unwise judgment in action or for conduct that was less than brave, but they may be briefly commended by the interviewer for especially intelligent or courageous acts. All techniques for successful interviewing (see p. 254) are useful in this situation. The men speak up loudly so that all the company can hear, and the interviewer dictates the record, sentence by sentence, to a typist. When one man mentions what other men did, the others are asked at once to verify or correct his statement. No hearsay fact is recorded except when the man directly concerned is dead or too badly wounded to be available. No witness is ever cut short except when he runs off into irrelevancies. Then the interviewer stops him with some tactful remark that will not tend to inhibit the next witness. When reference is made to other companies or units, the different records are carefully checked against each other.

It is possible in this way to get full accounts of events, to discover the small crucial acts that are large in their consequences. The method also brings the acts of the individual man into relation with the larger action of his unit. You can see in the record how an experience that is fear to each of fifty men is translated into a little panic when you regard the unit as a whole. You can see how the best judgment of which each man was capable at the time becomes—perhaps with no one at fault—unwisdom for the action of the unit. In victory you can see how nonchalance in nearly every man becomes heroism in a company.

INTERPRETING OPINION

Most of the errors made in assessing opinion are due either to ignorance or to bias. The propagandist often errs because he is ignorant of the cultural situation in the country which he is addressing. He must know the background and habits of action of his intended audience if he is to be correct. He must know how their opinion works.

Many of the Japanese, noting before Pearl Harbor that the United States was agitated by dissension among its isolationists, its short-of-war interventionists and its war interventionists, believed that the United States was too much torn by internal strife to wage successful war. That was ignorance. Those who understood American public opinion knew that an attack would instantly unite the American people.

The Germans similarly misinterpreted foreign public opinion in 1914 and again in the Second World War. In 1914, it seemed reasonable to them that Great Britain might be kept out. They had the same hope in 1939. Later they misjudged Brazil, and Brazil entered the war against them. It is, however, very difficult to understand the habits of thought and action of strangers. The analyst is apt to take the familiar principles of action at home and apply them to the other nation.

Another source of error occurs when the appraiser makes up his mind too soon. Then he is prejudiced and his mind is at least partly closed. There is an instance of a reporter who had to visit a large number of Army camps and report upon conditions in them. He made a preliminary report when his task was only one-fourth done. Then he finished up and rendered a similar report. The first camps he visited were not, however, a fair sample of the whole; but, having formed an opinion, he proved to be unable to change it, although later he was confronted by different facts.

With this principle in mind Charles Darwin always wrote down at once any observation that seemed to contradict one of his theories. He knew how easy it is to forget or to misremember a fact when it is something other than what you want it to be.

There is also experimental evidence that people tend to hear and remember what fits in with their wishes or prejudices. College students, divided between men with conservative beliefs and men with liberal beliefs, have been tested on their memories of a political speech which touched upon questions in which this difference of political faith mattered greatly. The two groups of students were found to recall the speech in quite different ways. Each remembered more of the items which favored its own point of view, and interpreted other items in favor of that bias. They were all sincere victims of their prejudices.

For this same reason appraisers of opinion, who report on overheard remarks or on applause at public addresses, have to follow Darwin's rule and write down their observations immediately. Later their memories are likely to shift in the direction that their wishes want them to go.

Pride also acts as a prejudice and source of error. For instance, there is the desire to tell a good story. A small exaggeration or the suppression of a detail makes a report impressive, and the reporter knows that for only a slight distortion he will receive a big reward in prominence.

Choosing evidence is a kind of fishing, and what happens to fish stories is well known.

A general at his headquarters has to rely on the reports of his subordinates for information, often relayed orally from one reporter to the next. The temptation of the reporters is to tell the general what he wants to hear. In the First World War Haig's intelligence kept exaggerating the German casualties. When he realized what was going on, Winston Churchill complained: "The temptation to tell a chief in a great position the things he most likes to hear is one of the commonest examples of mistaken policy. Thus the outlook of the leader on whose decision fateful events depend is usually far more sanguine than the brutal facts admit."

The need for objectivity of interpretation is, of course, not peculiar to the field of assessing opinion. Most scientific research aims to test some hypothesis and a hypothesis is, in a way, an opinion. A great deal, not all, of scientific method is an arrangement for getting facts in such a way that the preferences of the scientist cannot affect the result. In assessing opinion you have, however, to make an especial effort to avoid bias because the interpretation is likely to begin at the moment of observation. The man who is estimating the volume of applause is apt to know what the applause is for and to be influenced in his estimate by whether he hopes the applause will be loud or faint. He really needs an electrical sound-meter for recording the total intensity of the noise.

MILITARY IMPORTANCE OF KNOWING ABOUT OPINION

A correct knowledge of opinion is important, not only to a government and to the high command of its army which have to consider political as well as military matters, but also to commanders who have to make military judgments at lower levels. It is necessary in connection with psychological warfare and with the maintenance of morale.

It is *psychological warfare* when a commander, having questioned prisoners, decides that the enemy is on short rations and that he had better let the loud speakers blare the news across the lines that all prisoners will be well fed. It is psychological warfare when he decides to attack sooner because he knows the enemy's morale is low. These matters are dealt with in the next chapter, but we may note here that all the rules about getting accurate opinion apply to them: the interpreter of opinion must guard against his own wishes and prejudices and he must remember that a sample of prisoners may not be a fair sample of the enemy.

A more general use of opinion sampling is possible in relation to *morale.* We have seen elsewhere that data on the relative importance of different qualities in leadership have been obtained by questioning a sample of enlisted men on that matter and on other topics that concern the welfare and contentment of soldiers. A good leader must know what his men are thinking about, what they want, how they feel about the topics which are of importance to them.

The Army has not been slow to make use of these methods, both for sampling the opinions of soldiers and leaders, and for finding out facts about them. Its Information and Education Division has conducted many investigations upon fair samples of soldiers by the use of anonymous questionnaires, carefully controlled and tried out before their general use. Some indication of the variety of information obtained in this manner is given by the following list of polls of opinion and fact that this service has conducted. The list gives the general conclusion that was based upon an analysis of the answers to the questions.

(1) The respect of soldiers for their leaders is, on the average, high when the soldiers rate high in each of seven different indicators of good morale.

(2) The opinions of soldiers about their leaders varies greatly from company to company, when the men are asked to rate their leaders on five different qualities which the soldier thinks make a good leader.

(3) Soldiers' confidence in combat leaders increases with the soldiers' belief that the leaders are concerned with the welfare of their men.

(4) Infantry privates, promoted to be NCOs, tend to rate high on the seven indicators of good morale.

(5) Men who go AWOL have, on the average, the least schooling and the lowest scores on the AGCT. More often than not they are married.

(6) Both men and their leaders believe that the "black sheep" who is often in the guardhouse is nevertheless likely to do well in battle.

(7) The higher the rank among company officers the greater the belief of the officer that promotion policies are sound.

(8) Soldiers who rate high in the seven indicators of good morale usually approve the objectives of the orientation courses.

(9) In general soldiers think that the procedures in censoring their letters are about correct.

(10) Even soldiers with good morale would like leave to go home when possible.

(11) The best marksmen are, on the average, also the men who favor fighting on foreign soil, who desire combat duty and who rate high in self-confidence.

(12) Most combat veterans think that Army training is about right in its degree of toughness, although some (30 per cent) think it not tough enough and a few (7 per cent) think it too tough. This investigation also determined the soldiers' opinions of ten different kinds of training.

(13) Officers of South Pacific battles express their opinions of the battle leadership of their superiors.

(14) Respect for the infantry is highest among men who have fought through the toughest campaigns.

(15) Pride of being in the infantry increases with length of service in the infantry.

(16) A soldier's desire for combat increases with his belief in his own physical fitness.

(17) The chief worries of combat troops are various and can be listed in order of frequency. The lists are different for officers and men.

(18) Married soldiers, on the average, worry less than unmarried soldiers, and married soldiers who are expectant fathers worry least of all.

(19) Hospitalization decreases men's confidence for later combat, especially in the case of malarial patients.

(20) During combat, morale is aided greatly by men's concern for the welfare of others, by prayer, and by hatred of the enemy.

(21) Most leaders and men regard breaking in combat as an illness and treat it with understanding and not with contempt.

(22) Leaders cite seven ways of fighting fear among their men: (a) giving the men the "big picture," (b) mobilizing the will to fight, (c) taking all possible precautions, (d) reassuring the men before battle, (e) prayer, (f) getting the men's minds off the dangers ahead and (g) leading by example.

(23) The greatest fear occurs before battle (39 per cent) or during battle (35 per cent), but sometimes after battle (16 per cent). A few men (10 per cent) cannot answer this question.

(24) Soldiers can list their physical symptoms of fear, and the frequency of these symptoms follow about what might be expected from the physiology of the sympathetic nervous system.

(25) Soldiers in New Guinea spend their leisure time in the following activities, which are ranked in the order of their frequency: writing letters, reading magazines, seeing movies, playing games, listening to the radio, athletics, group singing.

(26) As participants, soldiers like swimming, baseball and soft ball, in that order. As spectators, soldiers like baseball, swimming and soft ball, in that order. Their preferences for many other sports have been determined.

(27) American soldiers in Britain tend to like the British, and their liking increases the longer they remain in Britain.

(28) Soldiers get to like Russians more and more, the more they are in contact with them.

(29) In general white soldiers like films which show the contributions of Negro soldiers to the war, and there is not much difference in this respect between southern and northern white soldiers.

(30) Several films, intended to encourage American soldiers to like the British, have more effect than a single film.

(31) The educational background of soldiers in the Second World War is higher than in the First World War. For instance, the number of college men increased from 5 to 15 per cent, whereas the number of men with only a grade school education decreased from 80 to 36 per cent.

REFERENCES

1. A. B. BLANKENSHIP. *Consumer and opinion research.* New York: Harper, 1943. Pp. 238.

   An elementary handbook on the preparation of polling questions, on the processes of testing the questions before their general use, on sampling, interviewing, reporting and validating the results.

2. H. CANTRIL. *Gauging public opinion.* Princeton: Princeton University Press, 1944. Pp. 318.

   A technical survey of many of the important problems in the field of public opinion polling. The assets and liabilities of present research are considered in some detail.

3. G. H. GALLUP. *A guide to public opinion polls.* Princeton: Princeton University Press, 1944. Pp. 104.

   The best brief exposition of the rationale and techniques of polling; requires only four hours to read.

4. G. LUNDBERG. *Social research: a study in methods of gathering data.* New York: Longmans Green, 1942. Pp. 426.

A textbook on practical techniques of securing basic data on sociological questions with specific suggestions for further research.

5. COLONEL S. L. A. MARSHALL. *Island Victory.* Washington: Infantry Journal, 1944. Pp. 213.

An intimate, accurate, psychologically rich account of the taking of the atoll of Kwajalein in January and February 1944, prepared from data acquired by the method of company reviews after combat, a technique which is fully described in the foreword and the appendix.

6. G. MURPHY AND R. LIKERT. *Public opinion and the individual.* New York: Harper, 1938. Pp. 316.

A technical treatment of the psychological bases of individual differences in opinion on such public issues as internationalism, imperialism, and the problem of the Negro.

7. P. YOUNG. *Scientific social surveys and research.* New York: Prentice-Hall, 1939. Pp. 619.

An introductory sociological text and reference book on the background, content, methods and analysis of social studies.

Chapter 22

Propaganda and Psychological Warfare

Defeat in war is ultimately a conquest of the mind. The infliction of death and suffering on the enemy and the destruction of his property have only one purpose—surrender. And surrender is a state of mind, a psychological attitude which makes a man want to abandon aggression.

It is natural to think of war in terms of actual military action—the use of soldiers, sailors, weapons, ships, and airplanes to win battles. But battles have surrender as their final goal. Destroy enough of the enemy's ships or planes, and the other vessels or planes turn and flee. Kill enough of the opposing army's men, and the others may give up. Why should they continue fighting when victory is no longer possible?

Thus morale, a state of mind, is basic to both offense and defense, being just as important in military value as men or guns. The Russians proved that in 1943 at Stalingrad, where they withstood the German assaults from siege guns and dive bombings for seventy-five days without surrender and eventually gained the victory. The German army had already overcome with much less effort other cities with military defenses just as good, but at Stalingrad they met an especially strong will to resist. They lost.

In total war economic, military and political action are all used to bring about submission in the enemy. Economic action deprives the enemy of vital materials. Military action destroys his armies by killing, capturing or scattering the soldiers, by capturing or destroying the guns, tanks, planes, trucks and other matériel; and naval action works toward similar ends. Successful political action may deprive the enemy of his will to resist by removing his hope of success. Few men will continue fighting—none but the fanatics—when victory is clearly impossible. Thus all warfare has as its aim the bringing about of a change of mind, the conversion of the *determination to resist* into a *willingness to accept defeat.* The only alternative is the destruction of the enemy. Vanquished men must either submit their wills to the victor or die.

Most men and most nations fight for some goal. When the goal is found to be unattainable, they may accept a lesser goal. Even when victory is at last accepted as impossible, they may continue; they may still fight on in hopes of obtaining less harsh terms of surrender. But, in general, they will stop fighting; they will surrender or allow themselves to be captured, when the material disadvantage of defeat is no longer greater than the disadvantage of continued resistance. That has been the rule for all wars among great occidental nations for a long time.

In the Second World War we have run into a deviation from this general principle, a deviation that arises from the fanaticism of the Japanese and Nazi soldiers.

The Japanese soldier fights for his Emperor, knows that surrender means dishonor and that death for the Emperor means glory and happiness after death. Surrender for him spells only dishonor and shame, enough shame to be cancelled by nothing less than suicide. Death in battle is for him a kind of victory. Such soldiers have to be destroyed to be conquered. There is no chance of forcing them in large numbers into surrender.

The Nazi philosophy produces a similar state of mind in its more fanatical adherents. It teaches that death is preferable to a surrender of the will, that death for the state is glorious, and that a survival which sacrifices the good of the state is shameful. Some of the German SS troops have therefore preferred to fight to the death rather than accept the inconceivable humiliation of surrender.

It is plain that warfare against such fanatics cannot, even when victory is certain, be sure of victory by surrender. It may be necessary to destroy all the enemy who will not submit their wills. At the present moment of writing it is, however, too early to foresee what will happen to this fanaticism in the Second World War. The German people and the German soldiers may surrender or submit to capture when their leaders have been destroyed or rendered impotent. The Nazi fanaticism does not hold all Germans securely. As for the Japanese, it is hard to believe that a whole people would resist to the death. Somewhere in the rising tide of hopelessness in both Germany and Japan it would seem that a point must be reached where the will to aggression will no longer seem better than the acceptance of defeat.

PROPAGANDA AND MORALE

Although all warfare is thus indirectly psychological in that it aims to create the will to surrender, the term *psychological warfare* more often is restricted to the attempt to influence opinion directly by the use of words—by argument, suggestion, enlightenment, obfuscation and other means of direct communication. The means for this activity is called *propaganda.*

Propaganda has, in war, the primary goal of the development in the enemy people, soldiers and civilians, of a state of mind which will make it possible to defeat them with a minimal expenditure of manpower, time and matériel. It is aimed at bringing about in the enemy a collapse of his morale and of his will to fight, to make him view the prolongation of war as a greater evil than defeat.

PROPAGANDA AIMS AND TARGETS

Propaganda, to be effective, must always be aimed at a particular target. The propagandist must know his listeners, their needs and wishes at the time, or he will not be successful. It follows that propaganda to a foreign country can seldom be addressed to a whole nation but must be limited to some single group within the nation, some group with common interests, attitudes, traditions and habits of thought.

Even in a totalitarian country the same argument will not appeal to all the people alike. In Germany there is a difference between the young people who have grown up in Naziism and the older people who knew Germany before Hitler. Catholics require certain arguments, Protestants others. There are rich men and poor, well-fed and hungry, professional men, laborers and scholars—and the best appeal is different for each group.

Soldiers form an important target for propaganda. They are closely united by similar experiences, almost sure to feel common fears, anxieties, frustrations and doubts. The soldier at the front may be moved by telling him news from home. He can be told about the hunger, the bombings, the epidemics, the strikes and riots, the production failures, the war profiteering, the incompetence of his government. He may also be told the bad news from other fronts. Such propaganda—it may be nothing other than true news selected with a purpose—tends to make him sick of fighting, to break his morale, even to despair of victory.

Women in an enemy country form another good target. They are all anxious about their men at the front. So the propagandist tells them of all the unpleasant things that are happening at the front. He reminds them of the hunger of the soldiers, of cold at the front, of ammunition shortages, of casualties, of the lack of medical care, of the increasing danger of death. He gives them fear and worry, because it is his business to break down their morale, to make them despair of the fruits of victory.

Labor is still another good target. Organized labor is already united by a common bond. The propagandist can, therefore, exploit the traditional grievances of labor, and blame the enemy government for long hours, child labor, low wages or high prices and labor conscription. When he knows dissatisfaction is strong, as in the case of the forced labor of the people of conquered territories, he can suggest sabotage.

PROPAGANDA ESPIONAGE

The propagandist must know exactly what is going on inside the enemy country and in the minds and hearts of its people if his propaganda is to be successful. He must fit his work to that accurate information.

He needs to know how much food the enemy people are getting, what their prospects are for the coming winter. He must know about labor conditions—how long the workers have to work, what wages they receive. He wants to know about health in the factories and out, about sanitation, about fuel shortages, about taxes. Especially is he interested in what the people feel about the war, what they consider to be their chances of winning, how they are reacting to air raids, to victories and defeats.

He needs to know of their ignorances, too. Are casualty lists published? Are defeats reported? Are the home folks getting news from the men at the front? An enemy broadcast will surely get listeners if some loved ones—prisoners, perhaps—speak into the microphone. News, even bad news from the front, is sought by people deprived of knowledge of what is going on.

In short, the propagandist needs to know about enemy morale and about all the conditions of living that affect morale. How does he find out?

Many of the large nations maintain a well organized corps of agents and fifth-columnists where they would be useful in the event of war. In addition, friendly contacts can be set up with unsuspecting people by "tourists"—Germany used this device notably in Norway long before invasion of that land in the Second World War. Such direct means are primary ways of obtaining information.

Monitoring the enemy's domestic broadcasts, noting the propaganda that the enemy uses to support the morale of its own people, is another means for obtaining knowledge of the enemy. All important nations at war maintain listening posts for this purpose. What the enemy government is trying to make its people believe is important because that sometimes shows what the people really do believe. If the enemy government is telling its people that they have enough fuel to maintain health, then it would appear that the people are complaining that they do not have enough fuel for comfort. Comparison between the enemy's short-wave broadcasts for reception abroad and his local long-wave broadcasts for domestic consumption during the same period may be informative, showing what the enemy does not want his people to know.

Neutral countries in time of war are important exchange posts of information. Mail goes back and forth between these lands and the belligerents. Newspapers and magazines, even when rigidly censored, betray what people are doing and thinking. In Germany, for example, when the wording of death notices for soldiers printed in newspapers was changed from "Died for the Führer" to "Died for the Fatherland" that was interpreted abroad as indication of a change of sentiment. When, later on, death notices were limited or cut out, that was undoubtedly significant, too.

The propagandist will not, however, be able correctly to interpret all this information unless he has a solid background knowledge of the country from which it comes. He must know about the group affiliations there, the leaders' personalities, the economic relationships, the class frictions, the ideologies, the religious differences, and he must command the enemy language, too. Yet, when all these facts come together, then—and then only—does he know how to proceed, how to make sense out of what is going on and how to adjust his interpretation of events to his special audience.

PROPAGANDA AND EVENTS

The best propaganda is always based upon some event of recent occurrence which is of great importance to the audience to which the propaganda is addressed. There are two reasons for this procedure.

In the first place, the importance of the event assures attention for the propaganda which is offered as an interpretation of it. The audience is all ready to listen.

In the second place, the propaganda is likely to be accepted and believed when attached to an event that is known to be true. This principle holds because the propagandist asks less of his audience, has had half of his work done for him by the events. Truth—or at least credulity—is infectious. If the facts of an argument are accepted as true, then the argument itself is more easily accepted. Statements of fact also affect one another in the same manner. If a witness asserts ten facts about an event and the jury already believes that eight of them are true, it is very likely to believe the other two.

In a sense, then, the best propaganda is the *truth*—at least to the degree that an honest lawyer's argument is true. The basic facts are true and the propagandist is merely engaging himself in special pleading. On the other hand, propaganda can, of course, lie as to facts. Hitler said that a big lie often repeated will be believed. Certainly a startling, attention-getting lie is apt to be believed if people do not know of facts that contradict it—just as rumor tends to become accepted as truth unless it is shown to be false. Lies are, however, much less stable than truth. Facts that contradict them appear later and the confidence of the audience in the source of propaganda is lessened. The best propaganda always bases itself on truth because in that way its audience comes in time to trust it.

Similarly, the best propaganda consists of events themselves. When the North African campaign was undertaken by the British and American armies in the Second World War and brought to a successful conclusion, it of itself had a tremendous influence upon opinion in enemy and neutral countries. Italian morale declined, to be broken later by the victorious campaign in Sicily. German morale was affected adversely. Turkey stiffened its attitude toward the Axis and swung closer to the Allies. So did Sweden. It is easy to see what was the proper propaganda under these circumstances. The allied nations had only to spread news of what had actually happened and to interpret those events as meaning certain eventual defeat for the Axis.

The Axis counter-propaganda, finding it useless to deny the events, took the line that North Africa was unimportant, that Fortress Europe was impregnable, that the American troops were too green to venture to attack the Continent.

The facts were clear and interest in them was ready-made. The war of propaganda lay entirely in the interpretations of them.

The same principle works on a small scale, too. When it is known that the enemy facing you is short of food and that he would get better rations if he gave up and were taken prisoner, then the local propaganda to the enemy by loud speaker, radio or leaflets dropped from airplanes starts with this fact, trying to persuade the enemy into surrender. But it has to be a fact that the enemy *is* short of food, that food is something already uppermost in his mind.

TIMING OF PROPAGANDA

Propaganda cannot create a situation or an event. It can only seize upon situations and events as they occur and utilize them. You should not tell the enemy about his food shortages or his oil shortages until he has them. After the grumbling begins, the propagandist can get busy. You cannot insist to the enemy upon his inevitable defeat, when his armies are sweeping all before them. He will not listen to you. You have to wait until his armies are stopped before this kind of propaganda can effectively begin.

Then you must act immediately, partly to utilize interest when it is at its height, and partly because the first story put in circulation is always the most effective. Being first, it finds the field of attention empty and is likely to be accepted as a true interpretation. A later story, launched as counter-propaganda, has to overcome the first story as well as to establish itself.

So the rule for the propagandist is always: *act quickly.* Otherwise your propaganda may be so late that it becomes only counter-propaganda, and counter-propaganda is at a disadvantage because it does not have a clear field. Propaganda must march with events, and in war events move quickly. (Cf. p. 278f.)

INTERPRETATION

Although good propaganda starts from true facts, the interpretation of the facts is special pleading. It tries to make a case. Nor is it hard to see gray as either white or black, according to one's favorite bias.

When Prime Minister Churchill went to Moscow in 1942, his visit was immediately interpreted by the German Propaganda Ministry as a desperate attempt to explain to Stalin why it would be impossible for the British to open a second front in Europe. But when Hitler visited Field Marshal von Mannerheim in Finland, the same Propaganda Ministry interpreted the visit as evidence of the increased cooperation that would presently be forthcoming between the German and Finnish armies. In propaganda what is bad for the goose is good for the gander.

In the first years of the Second World War the German Propaganda Ministry never called a military action a *battle* unless it believed that Germany was going to win. If they were doubtful about the outcome, they spoke of a *temporary advance, a minor activity, sporadic attacks* or at most a *strategic retreat, elastic defense,* or *disengaging operation.* Thus ultimately they could prove that Germany was never defeated in battle. These are mere words, it is true; but people think with words and often do not think at all beyond them. It is the realistic and circumstantial interpretation that is most effective. Even lies become plausible when they are packed full of details, half of which are true. Such propaganda describes minor engagements in minutest detail, gaining acceptance for the official interpretation by saying so much that the listener gives up doubting every item. And, if he cannot doubt each, he is likely to end by doubting none.

An example of varying and not wholly consistent interpretations appears in the following seven explanations which German propaganda offered its people of the unexpected invasion of North Africa by the United States' Armies on November 7, 1942. All these interpretations were given out during the first week after the invasion.

(1) Soviet Russia is suffering such tremendous setbacks by German troops that the United States has been forced to come to her aid. The Americans are, of course, not prepared to wage a real campaign.

(2) Since time is no longer with the Allies, the Americans have been forced to act before they are ready.

(3) The American invasion is really a good thing for the Germans, since now the German U-boats will not have to travel so far to find the Allied ships. In fact, the U-boats are having a field-day picking off Allied ships in the Mediterranean.

(4) Victory can never, after all, be achieved in North Africa. The real war front is in Europe, but the Allies do not dare attack Fortress Europe.

(5) The loss of North Africa will mean that the French will have less to eat because the Americans and British will take over all the food and the French will no longer be able to import food from North Africa.

(6) The disputes between the British and Americans over the control of North Africa constitute further evidence of the imperialistic intentions of these two powers, for there is no chance of North Africa's ever being returned to France.

(7) The British have suffered such great territorial losses to Japan that they are in desperate need of new colonies and expect to get them in North Africa, whereas the Americans are trying to substitute for their loss of the Philippines.

DISTRIBUTION OF PROPAGANDA

Some propaganda is distributed by ordinary *news channels,* both in the countries where it originated and abroad where censorship is not rigid. The speeches of great men are broadcast and printed in newspapers all over the world. The Atlantic Charter of Churchill and Roosevelt was excellent propaganda and both the Allied countries and their enemies got to know about it through regular news channels.

Specially directed propaganda is beamed by *short-wave radio* to the country where resides the group for which it is intended. This goes on in war all the time in all the proper languages. Although totalitarian countries forbid their peoples to listen to foreign propaganda and threaten them with severe punishment if they do, yet many do listen and spread what they hear by rumor. Because there is censorship and information is scanty, the rumor spreads readily and easily without contradiction.

Dropping *leaflets* and newspapers from airplanes is a common form of propaganda, which is directed at soldiers at the front as well as at civilians at home. The enemy prescribes penalties for keeping or reading the material dropped, yet it is kept and read. It gains some importance by being forbidden. In the first thirty months of the Second World War the British dropped about two hundred and fifty million leaflets over Germany and the occupied territories. Churchill's and Roosevelt's address to the Italian people in July 1943 was scattered over Italy, and was then actually printed in the Italian newspapers.

On p. 494 is an example of a leaflet designed to make the Germans distrust their leaders.

BLACK PROPAGANDA

An especially subtle method of the distribution of propaganda, one which depends heavily on suggestion, is known as *black propaganda.* It was new in the Second World War, because it depends upon radio broadcasting.

Black propaganda asserts that it is being broadcast by secret radio stations operating within the enemy country. Actually it is broadcast from another country. For instance, such a station could claim to be a secret station in Germany operating in opposition to the German Nazi government, whereas in reality it would be a British station broadcasting to Germany.

Such a station, having the advantage of irresponsibility, could broadcast scandals and rumors without discredit to the British government. Since the speaker is supposed to be in opposition to the German government, he gets a sympathetic hearing from disaffected groups within that nation. It is to such groups that the propaganda is usually addressed. On the other hand, since he is supposed to be German, he would get more sympathy in Germany than would anyone known to be British.

The most effective technique of black propaganda is to spread rumor

WARNING!!

DON'T PICK UP THIS LEAFLET

The Gestapo Have Forbidden You the Truth

DO YOU KNOW . . . ?

1. Do you know that the entire continent of North America and most of South America have combined all their resources to insure the ultimate defeat of the Nazis?
2. Do you know that the American navy will soon be the largest in the world, and combined with the British navy will have complete control of the seas?
3. Do you know that American planes will soon be able to fly a quarter of the way around the world and back, and that America can build more of them than all the rest of the world together?
4. Do you know that there will soon be enough planes in England to keep 2,000 or more over German territory every night?
5. Do you know that America is building huge armies of tanks, which are far more efficient than the best German tanks yet designed?
6. Do you know that the average American soldier is two inches taller and twenty pounds heavier than any other soldier in the world?
7. Do you know that the greatest army the world has ever known is now massing in England, preparing to invade Germany?

Didn't you know these things?

Haven't your leaders told you?

Why not?

CAN THEY BE AFRAID?

by denying it or to put new ideas into the listeners' minds by arguing against them. For instance, a British station pretending to be German could broadcast to Germany a denial of rumors which it claims are rampant within the Reich. It would deny, perhaps, that scrap dealers in Germany are holding onto scrap iron in anticipation of a rise in prices—thus putting the idea into the heads of many German dealers who would otherwise never have thought of profiteering. The broadcast would then go on to say that this stupid rumor has caused many German citizens to resort to various ruses in order to hold the scrap in expectation of getting a better price. Then the broadcast describes the ruses that have been used to hold on to the iron, thus telling the unpatriotic German how to carry on this particular kind of profiteering.

In 1940 black propaganda was used on the German troops in Norway. They were given broadcasts of health programs. In one of them they were warned against eating potatoes which had been frozen, being told that in many people such potatoes induced a new disease called "potato grippe." The symptoms of potato grippe were described as ailments which almost anyone is likely to have or to imagine he has if he is worried about his health: headache, eye-strain, muscular aches, coughing. Soldiers were warned to watch carefully for the development of such symptoms and to report them immediately "because potato grippe in its later stages is extremely dangerous." The purpose of this broadcast was not merely to scare the soldiers away from eating an important food. It was hoped that the broadcast might help to create in them a hypochrondriacal anxiety.

COMBAT PROPAGANDA

Special propaganda tricks are used to break the fighting morale of enemy troops.

In both the First and Second World Wars the Americans used the following device against enemy soldiers. Leaflets were dropped among them. Each leaflet carried a coupon which provided safe conduct across the enemy lines for any soldier who would surrender. Then it described the rations of the United States Army and promised the same food to prisoners. For many soldiers hunger overcame patriotism in those last trying days of the war. They used the coupons—used them as *meal tickets.*

The Russians early in the Second World War published a newspaper for the benefit of the German troops. They called it *The Truth* and dropped it behind the German lines. By April 1942 there had been 250 issues of this paper and fifteen million copies of it had been distributed. German prisoners taken by the Russians were found to have read many issues of *The Truth,* being thus confronted with the Russian interpretation of the events in which they were participating. When information is not free, truth is often the best propaganda—as the Allies found in their broadcasts from North Africa to Italy.

British bombers dropped little newspapers over Germany, and they too told the truth. These papers had four pages, each eight inches square, were rolled up to the size and shape of a cigarette and were issued in several languages. They had illustrations and carried the latest news—the real news of the progress of the United Nations, the news which could not pass the enemy censor.

Combat troops nowadays are accompanied by propaganda units. They use public address systems, installed at headquarters and in mobile units, to talk to enemy soldiers. They also broadcast to the enemy and drop or shoot leaflets behind his lines.

It was such German units who broadcast prematurely to the French soldiers in 1940 the "news" that a commission from France was going to meet with the German authorities to sign an armistice. That broadcast had a devastating effect. When the rumor of it reached the French troops in the front line, they reasoned: "Why hold the line and be shot today, when the war will be over tomorrow?" The consequence was sweeping advances for the Germans.

At the very beginning of the Second World War the Germans wanted the French to think that the war was "phony" and not to fight until Germany had got Poland out of the way. So their propaganda units began to encourage fraternization between the French and German troops at the Maginot Line. They used their loud speakers to bellow friendly greetings at the French and sometimes even warned the French that a shell was coming over.

ORGANIZATION OF PROPAGANDA

If propaganda is to be successful there are certain preliminary steps which must be taken. These steps are:

(1) *Establishment of policy.* What do you want to accomplish by the propaganda? Are you trying to get the enemy to surrender? Are you interested in bringing about a demobilization of industry? The more clearly the policy is formulated, the more effective can the propaganda be.

(2) *Organization.* Who is to propagandize? Is there to be a special bureau or officer? Who is to have censorship power? What are the limits of free speech?

(3) *Conditions for the reception of the propaganda.* Where and at whom is the propaganda to be aimed? If the radio is to be used, where does the short-wave carry? Have the people got radio sets and tubes for these sets? Can they understand English? Are they allowed to listen? What are their sentiments? What do these people want?

(4) *Strategy.* What are you trying to do? Do you want to be friendly to these people? Do you want to convert them? Will you use whopping lies? Will you attempt to "divide and conquer," "disillusion and conquer" or "dishearten and conquer?"

(5) *Theme.* What are you going to talk about? Will you play on Germany's desire for *Lebensraum?* If so, then you can tell them that, if they continue to fight, they will certainly lose the war and will not gain *Lebensraum.*

(6) *Tactics.* How can you be sure your propaganda campaign will be successful? There are rules, based on psychological facts, which can be followed. They are listed in the following section.

TACTICS OF PROPAGANDA

It is easiest to understand the way in which propaganda works by observing the rules to which the successful propagandist adheres. Here they are:

(1) **Keep your audience in mind.** Address a specific audience, a particular group. Adapt your words to the mentality and frame of mind of that group. Base your speech on up-to-the-minute information about current attitudes in that group. Cite names and events that are familiar to the group and that have prestige for them. Make use of the desires and aversions already present in that group.

(2) **Beguile.** Do not antagonize. Treat the enemy for the moment as if he were a friend. Avoid abuse, taunts and reproaches. Respect the public figures which the enemy admires. Be objective about enemy defeats; describe them without animus.

(3) **Initiate rumor.** Use material that will get itself repeated to others, and put it in such form that it will get repeated. Use familiar terms and simple ideas, therefore. Tell anecdotes, the kind that people

will repeat. Tell news suppressed by the enemy, because people will always repeat that. Give facts and figures. Spread rumor by acknowledging it as rumor, so as to protect your own good faith, but spread it. It will soon be repeated as fact without being labeled as rumor.

(4) **Link words with action.** Confuse the enemy by doing contradictory things as well as by saying them. The propagandist himself cannot do this, but his government can order troops concentrated at borders when no attack is intended, and can threaten simultaneously a variety of mutually incompatible actions. Confusion is terrifying and demoralizing.

(5) **Attack weak points.** Exploit and magnify disagreement and discontents which you know already exist. Play up the enemy's mistakes. Arouse his guilt feelings.

(6) **Be timely.** Get there first with your interpretation and seize every opportunity to exploit an event immediately.

(7) **Be wily.** Use suggestion. Use short, catchy statements—"England will fight to the last American." Incite subversive action by describing it without recommending it. The listener may adopt the suggestion and think it his own idea. Use positive rather than negative statements. Be clever, and not too obvious in your rationalization. Capitalize on anxiety. Worry the home front about the troops and the troops about the home front. Suggest positive action only after anxiety, doubt and guilt have become strong. Choose arguments that counter-propaganda cannot easily turn against you.

FORMULA FOR A PROPAGANDA VICTORY

There is a definite pattern for propaganda victory. Here it is.

(1) First *the enemy people must be war-weary.* They must be sick and tired of the deprivations, destruction, bloodshed and devastation of the war. For the most part this state of mind is produced by military and economic warfare, but psychological warfare can help disillusionment along once it has begun. Propaganda can, on the other hand, scarcely touch a triumphantly conquering nation.

(2) The second step in this process is to *change disillusionment into despair,* to convince a war-weary people that victory is impossible, that it is folly to continue to believe in their leaders, to coöperate with

their fellows or even to go on fighting or working as individuals. All three kinds of warfare—military, economic, psychological—work together here too, for the inhabitants of a bombed city may reach despair without being prodded to it by argument. Yet interpretation of events to a people, or to the soldiers of an army, may speed the process, may undermine morale that would have stood up, had it not been attacked.

(3) The third step is to offer to despair a *promise of something better,* a way out. The cornered beast fights to the death unless he sees how to escape. So propaganda must offer a solution—a just and honorable peace, reassurance against indiscriminate reprisals upon the enemy people, something constructive that makes underground activities and surrender look better than continuing the war. Woodrow Wilson's Fourteen Points did much in this manner to shorten the First World War.

(4) To the formula for a just and tolerable peace which is promised as a substitute for intolerable despair there usually must be added the thought that *it is the enemy's own government which is responsible for continuing the war and the suffering.* The enemy leaders themselves are unlikely to see any advantage in surrender. Their people must force them to surrender, if there is to be a change. There are, however, exceptions to this rule. A general may surrender an army which is hopelessly trapped in order to save the lives of his men. Could a benign dictator ever do the same for his country?

REFERENCES

1. F. C. Bartlett. *Political propaganda.* Cambridge, England: University Press, 1940. Pp. 158.

   An analysis of the difference between democratic (long range) and authoritarian (short range) propaganda with examples drawn from both the First and Second World Wars.

2. G. L. Bruntz. *Allied propaganda and the collapse of the German Empire in 1918.* California: Stanford University Press, 1938. Pp. 246.

   A seasoned history of the part played by Allied propaganda in the German collapse of 1918, classifying propaganda under headings of enlightenment, despair, hope, and particularistic appeals.

3. L. W. Doob. *Propaganda.* New York: Henry Holt, 1935. Pp. 424.

   A study of the psychological rules of propaganda derived from the study of the attitudes of individuals.

4. L. Farago. *German psychological warfare.* New York: Committee for National Morale, 1941. Pp. 133.

   A reference handbook; survey of German publications in this field from the inception of the Nazi regime to the outbreak of the Second World War.

5. A. HITLER. *Mein Kampf.* Boston: Houghton Mifflin, 1937. Pp. 297.
The best single source for the study of Hitler's plans for the new Nazi order.
6. J. R. MOCK AND C. A. LARSON. *Words that won the war.* Princeton: Princeton Universtiy Press, 1939. Pp. 327.
A summary of the work of the Committee on Public Information from 1917-1919 based on documentary evidence in the files of this Committee.
7. E. TAYLOR. *The strategy of terror.* Boston: Houghton Mifflin, 1942. Pp. 279.
A popular but significant account of the rôle of Nazi propaganda in the fall of France.

Chapter 23

Differences Among the Peoples of the World

Modern total war places many responsibilities upon the soldier, the private as well as the general. His main task is to destroy the enemy; but psychological warfare requires him to play another rôle—he must help to win friends and allies for his country in strange lands. To be successful he must understand the nature and origins of differences among peoples, and he must be able to establish contacts with persons all over the world on the basis of mutual sympathy and friendship.

In the South Seas, in China, in Africa, as well as in Europe and the Americas, it matters a great deal whether the native people, as well as the soldiers of allies, like Americans or resent them. To these native peoples, the American soldier is America's representative. If he offends them, it will be America and Americans who seem offensive—not merely the soldier himself. For instance, an American who breaks a Moslem taboo by entering a mosque with his shoes on could counteract, in the area in which he is stationed, all the friendly deliberations of generals and diplomats in a palace in Algiers. Friendships between individual Americans and Irishmen, on the other hand, represent links between peoples that no German propaganda could weaken.

There are no infallible recipes for making friends the world around; but there are two basic rules for all soldiers in the manual of psychological arms. (1) Mind your own manners; (2) understand and respect the manners of strangers, especially of strangers who might help both you and the cause for which you are fighting.

Army surveys have brought out the fact that acquaintance makes for tolerance and understanding, even for liking. In general the Army found that the American soldiers stationed in Britain liked the British—63 per cent of the Americans who had been in Britain less than three months liked the British. But at the end of the year 78 per cent of the Americans were liking their British allies. The same thing happened in Iran with the American soldiers and the Russians. The Americans who had had the most contact with the Russians liked the Russians best—not universally, of course, but on the average. It is the strangeness of strangers that puts you off them.

NATURE vs. NURTURE

Men differ from one another in their natural inborn characteristics, and in the habits of thought and conduct which they have acquired in the course of their life histories. These acquired differences are particularly important to the American who wishes to make friends and to obtain coöperation and help from natives in the lands in which he is fighting.

Nature settles the question as to whether a man will be dark or fair, or whether his hair will be curly or straight, and it also has much to do with whether he will be bright or stupid. Individuals and families differ from one another in their inherited capacities. At the same time environment—education, learning—has a great influence on the way in which these capacities are used, and it may greatly affect the level of achievement reached by the individual. We know, for example, that foster children, who are taken from poor homes and placed in homes of well-educated people, show a marked rise in their level of achievement as measured by an intelligence test. Psychologists are still uncertain as to just how great an increase in such test scores can be brought about by an environmental change, but they are agreed that a very substantial improvement is possible. (See pp. 228-230.)

Environment settles the question whether a man speaks English or Chinese, whether he can read and write, whether he is a Catholic, a Baptist, or a Moslem, whether he likes baseball, cricket or lacrosse, whether he eats rice or spaghetti or corn on the cob, whether he uses a fork or a spoon when he eats green peas.

No one knows exactly which is more important, heredity or environment. *Nature* vs. *nurture,* this never-settled argument is called. Actually nature is never found entirely separated from nurture. You may like poetry because your mother taught you to like it, but you must have enough inborn intelligence to read and understand it; or perhaps you like poetry because you were born with a club foot and became a bookworm instead of playing football with the other boys. Nevertheless, environment may make of one cripple a bookworm, of another a mechanic, of still another a daydreaming recluse. In your contacts between men it does not really matter in most cases which is more important, nature or nurture, because the important thing is that grown men change their habits to some extent if the need is sufficiently great. Men are different from one another. They can change, but only with difficulty in many matters.

Differences among peoples concern every soldier. The average American soldier, who goes abroad to Great Britain, North Africa, China, Australia or anywhere else, meets people who think and look and act in ways which are strange to him. He needs to know how they differ from the men and women with whom he is most familiar, and even more why they differ. He should be told what the differences mean, and especially what he himself can best do about them.

CLASSIFICATION INTO RACES

There are a number of possible differences among the many peoples of the world. One or another of these differences has been used as the basis for classifying people into races. First there are the *inherited physical differences.* These differences are sometimes very conspicuous, and so attract attention first. They are of many kinds—color of skin, stature, texture and color of hair, form and color of eye, shape of the head, and so forth. Such differences, of course, are also found among persons in a single community and even among members of one family.

There is general agreement among scientists that a *race* means a group of people who have inherited similar physical characteristics. You can classify people by skin color or you can classify them by shape of head or, indeed, by both. If you use both criteria you have many more classes, and, when you include still other characteristics, the distinctions become very numerous. Such distinctions would have practical usefulness only if persons of different kinds did not keep marrying each other, thus "mixing the races." The fact is that you do not, in general, find persons of the same physical type living together and sharing the same languages and customs. For this reason it is better, when the practical matter of getting along with "foreigners" is the business in hand, to forget about races and all the complications that go with that kind of classification, and to talk about *peoples* and *nations,* the social groups which have the same language and customs.

There are, of course, *national differences* among peoples. Nations are groups divided from one another by geographical boundaries, by history, and frequently by form of government, language, customs and religion. One nation may differ from another also in physical features, but that is usually more or less accidental. Being all mixed in physical characteristics, the nations also overlap with one another greatly in physical appearance. We usually think of Norwegians as blond, and many of them are, but there are a great many dark Norwegians. There are blond Germans, but also many dark ones, especially in the southern part of the country. As a matter of fact, many of the people of South Germany are more similar in physical appearance to the people of central France or of northern Italy than they are to the people of northern Germany. To speak of a "pure" German makes no more sense then than to speak of a Nordic soul within a non-Nordic body. Everywhere we go we find that various physical types have mixed in the make-up of different nations. It is still true, however, that a Japanese is more likely than a Chinese to have wavy hair, a beard and short legs, yet a sentry had better not try to decide between Chinese and Japanese, one an ally and the other a foe, by their looks alone.

Distinguishing between friend and foe among strange peoples is made more difficult because of the fact that, until you get used to them, you are inclined to think that all of them look alike. It is equally true that all Americans tend to look alike to a Japanese or Chinese when he first makes their acquaintance. On better acquaintance, however, the differences appear to distinguish one person from another within the same national group.

Since different nations have different languages, another way to classify peoples into races might be on the basis of *language differences.* Nevertheless a race is not a group of people differentiated by its language, since not all people speaking the same language have inherited the same physical characteristics. The anthropologists tell us, for example, that there is no Latin race, though there is a group of languages of Latin origin. Again, the term *Semitic* has linguistic, not racial, significance. The Semitic languages include Hebrew, Arabic and the official language of the Ethiopians, Amharic.

The term *Aryan* was first introduced to refer to a group of Asiatic languages. Later, an English philologist of German origin recognized certain similarities in vocabulary between the Aryan languages and most of the European languages. He extended the term *Aryan* to include both the Asiatic and these European languages—the Indo-European or the Indo-Germanic family of languages. The next step was the creation of what has been called "the Aryan myth," the belief in the racial superiority of peoples using these languages. It was the "Aryans," of course, who invented that doctrine, but there is no conclusive evidence to support it. The peoples of every nation are too various to say that any one nation or people is inalterably superior to others. It is true that civilization is further advanced in some lands than in others, but that is not to say that the differences depend upon inheritance and race. The wealth of a nation and the prevalence of education among its people may be the determining factors. On the other hand, scientific caution requires also the contrary statement: Neither do we know that there are not inherited differences in mental capacity. Certainly it would seem that the "intelligence" of an individual is partly, though not entirely, dependent on his inheritance.

It was this Aryan dogma that appealed to a defeated and disheartened Germany at the end of the First World War. The Germans preëmpted it for themselves, and the rest of the story is well known. Thus history repeats itself. As Tacitus, in the second century, glorified the Germanic tribes at the expense of the Romans, so Hitler, in the twentieth century, and for similar reasons, glorified the tall, blond, blue-eyed "Aryans" at the expense of all other peoples.

DIFFERENCES IN INTELLIGENCE, TEMPERAMENT AND CHARACTER

Although it is true that the features which most people note in the physical appearance of others are of no direct importance in determining the character of a person, it is, nevertheless, also true that many people dislike other persons whose physical appearance differs markedly from their own. This dislike, when it occurs, is often based in part on the belief that peoples who differ in looks also differ in intelligence, temperament and character. Is there evidence for this belief?

There has been a great deal of discussion of the question of the existence of native psychological differences between peoples of varying physical appearance or national origin, and many scientists believe that such fundamental unchangeable differences do exist. They think, for instance, that some groups are less intelligent than others, that they have an inferior capacity for rapid and accurate learning, and that they always do poorly on intelligence and achievement tests, as, for example, on the Army's General Classification Test.

The basic fact beneath this assertion has never been proved. It is, of course, true that certain groups are consistently poorer on certain tests than other groups, but we do not know that such difference is actually due to race, that it is a matter of nature and not of nurture. For instance, the southern Europeans in the United States Army in the First World War did much more poorly than the northern Europeans or the American-born soldiers in the Army's intelligence tests, but that was because the southern Europeans in the Army were for the most part poor immigrants who had had very little schooling in Europe or America. There were plenty of bright Italians back in Italy. There were also many bright Italian Americans in this country. It is true, moreover, that, as the economic and educational level of the Italians who have come to America rises, their scores on intelligence tests approach more and more closely the level of the other groups with which they are associated. Nurture helps the score on an intelligence test.

Again, the average American Negro soldier does not do well on the Army's General Classification Test, but the Negro soldier has generally lacked the educational advantages of the white soldier. Where educational opportunities for the Negro are more nearly equal to those of the whites, many Negroes attain superior scores on intelligence tests. There is no conclusive evidence that, given the same opportunities, people with skins of other colors could not do as well as whites in intelligence tests, in the skilled trades, in business and in professions.

Nor is there conclusive evidence that skin color does *not* make a difference one way or the other. We are certain that educational and economic advantages affect the scores on tests of general ability favorably, affect them so much that we cannot tell what differences we might find left if we had for comparison large groups of American Negroes and Whites who had had for a couple of generations equal education and economic advantages. But not to know that there is a difference is not quite the same as to know there is no difference.

There is presumably some inheritance of genius, some effect of nature in addition to nurture—identical twins, for example, tend to be very much alike in ability even when they have been separated from birth. Such differences again do not run by nations or races. Large groups of people, like nations, are made up of so many kinds of persons with so many degrees of native ability, that the average differences between nations, the differences that might be inherited, become relatively so small that they cannot be demonstrated at all. They may not exist, or, if they do exist, we cannot tell which way the difference lies.

There have been many attempts to relate psychological to physical variations, but in general they have not been successful. Intelligence or general ability is not directly related to stature, to color of the skin, to shape of the head, to character of the hair, or to any other of the physical features which have been used in racial classification. Nor is there any difference in the blood or the size or weight of the brains of various racial or national groups which would justify an assumption that such groups are at different levels of biological development. For example, careful examination reveals no consistent physical difference between the brains of Negroes and white persons.

There is, on the other hand, some evidence that there is a correlation between *temperament* and *bodily build*—that well-rounded, soft people are friendly and not very aggressive, that those with large, square frames are aggressive and dominating, and that the tall, lean persons tend to be more intellectual and less social than the others. This relationship is, however, not completely substantiated, and there is as yet no conclusive evidence that bodily build of this sort is characteristic of different races or peoples.

Some people think that there are inherited national differences in *emotionality*—that, for example, the British are stolid and diffident, whereas the Italians are excitable and voluble. There are, of course, such differences on the average, although we must always remember that many Britishers are excitable and many Italians stolid. Nevertheless, these differences between nations appear not to be native, inherited traits, but learned habits of conduct. A man may gesture freely with his hands in the course of conversation if others with whom he is associated do so, too. Careful study has shown that, although many Europeans in America gesture volubly, their children tend to take over the usual American habits and gesture but little. Rapidity of speech is similarly influenced by the customs of the community. People also learn to suppress evidence of emotion if their parents and friends have always been quiet and restrained, condemning violent emotional outbursts. They can even learn to express their emotions differently—smiling in sorrow as the Japanese frequently do, or opening their eyes wide in anger, according to the custom of the Chinese.

In any event, it is not the trait of emotionality that creates serious misunderstanding between individuals of different national origin, and it certainly does not matter much to the soldier or sailor abroad whether emotionality is learned or native, or even whether it is a distinguishing character among different peoples.

What matters most are the *learned traits,* the habits of thought, the customs, the national folkways, which a people follow without criticism or question. A Moslem, for example, never eats with his left hand. This may seem to an American to be very peculiar. A Chinese peasant may be fond of dog meat. An American might find that revolting, for he has been brought up to think of dogs as pets and friends. An orthodox Hindu would be equally disturbed by our habit of eating beef; to him the bull and the cow are sacred animals. It is all a matter of custom and tradition. A Moslem takes off his shoes and keeps on his hat when he enters a church; an American takes off his hat, but keeps his shoes on. Both acts are an expression of reverence. The Moslem's act is more cleanly; ours is a symbol of deference.

The advent of the Second World War found a large proportion of German and Japanese youths hating the democracies and the democratic way of life. This, too, was a habit of thought that they had learned.

It is these beliefs and habits of thought that constitute the important national differences; and the American soldier, who serves abroad, needs to be familiar with them. Many American lives might have been saved early in the war with Japan if our soldiers had understood the Japanese attitude toward surrender. Americans, attempting to save Japanese who had had to jump into the water from sinking transports, were killed in their act of mercy. They did not realize that many Japanese would rather die than be rescued under such circumstances, that the Japanese code of honor made rescue and surrender practically impossible for them. The soldier needs to study the ways of his enemies as well as the ways of his friends and allies.

Some of these differences of thought and custom between other peoples and Americans are striking, but the mistake should not be made of thinking that all the individuals in a particular national group are more alike than are Americans. In the United States, there are differences in behavior between country and city, between North and South and Middle West, between rich and poor, between doctors and teachers, between Baptists and Unitarians and Catholics, between men and women, between young and old—and also between individuals who do not differ in any of these other respects. In a well-known study of a typical mid-western community, "Middletown," the investigators were able to demonstrate that the inhabitants exhibited, in addition to certain fairly common American characteristics, wide individual and group variations in their attitudes and behavior. The many public opinion polls have also shown that there is a great variety of opinions on which Americans are far from unanimous. Unanimity, even approximate unanimity, is the exception rather than the rule. So it is with other peoples. The political differences in Ireland, the caste differences in India, emperor worship in Japan, the religious differences in North Africa—these represent only a fraction of the kinds of variations which we must keep in mind in trying to understand the people of a foreign country. We can only be misled by setting up *stereotypes*—fixed patterns to which different peoples are expected to conform. Notions of what other peoples are like in general must be continually modified by actual experience with individuals. There are, indeed, group differences; yet every individual is unique.

PREJUDICE AGAINST PEOPLES

It is extremely important that men and officers in the Army and Navy understand clearly some of their own peculiar American habits of thinking and acting. One kind of prejudice is common to Americans, Germans and all other peoples. It is usually called *race prejudice,* but actually it is not always racial difference that creates the prejudice. Men tend to be prejudiced against others who differ much from them in their inherited physical appearance, in religion, in language, in customs, or in any other ways that mark the victim of prejudice off clearly from the person who has the prejudice.

Prejudice in itself is nothing more than the holding of a biased opinion, but it readily goes over into actual discrimination against the disliked persons. Discrimination, when extreme, becomes persecution, which in turn often lends itself to scapegoating. Persecution is a form of aggression in which you get relief for your own feelings of frustration or guilt by blaming another person or group of persons. When the blame is entirely unjustified, then the persecution is *scapegoating.* Scapegoating and persecution have been analyzed. They are psychological aggressions. Ordinarily they originate in a feeling of guilt, in frustration, in fear, in anxiety, in feelings of insecurity or inferiority, in desire for power, in the wish to conform to the thinking of others, or sometimes merely in intellectual laziness and the need to see all people simply as either good or bad.

All these motives that lead to persecution and scapegoating lead also to prejudice. They operate as complexly as do all human motives to thought and action.

One extremely important factor in prejudice is the feeling of insecurity. Everyone wants to feel secure, and this feeling is more easily maintained in familiar surroundings among the people we know. For this reason we may feel resentment when strangers come among us, get jobs, and settle down to make themselves at home. We do not easily understand such "foreigners," and we may as a consequence be somewhat afraid of them. We resent the unexpected things they do, the unusual ideas they express. This resentment may last until we have become used to strangers by travel or by living among them as friends. At the very least such prejudice may cause us to belittle the stranger or to ridicule his behavior. When the unconscious fear of strange foreigners is great, it may lead to the actual violence of "race riots." Or it may merely be that the new boy in the neighborhood is picked on by the local gang just because he is new and seems different.

Such a feeling of insecurity is frequently economic in origin. When men are uncertain of their livelihood and must compete with others for jobs, they may—often quite unconsciously—try to keep others in a position of inferiority. Usually they rationalize this attitude, they invent—still unconsciously, for they are "rationalizing"—good reasons for keeping others in inferior positions. They persuade themselves then that the others deserve to be regarded as inferior.

Another cause of prejudice lies in the fact that, when things go badly, men tend to look around for a scapegoat on whom to place the blame. It is normal for frustration to produce aggression, and aggression requires an object to attack. If no object is available, then a substitute object, a scapegoat, must be found. For example, there are more lynchings of Negroes in the United States when economic conditions are bad than when conditions are good. Presumably, the Negroes behave as usual but are made the scapegoats of the worried and frustrated whites. Smarting under the defeat of the last war and under their economic hardships, many Germans found strength and confidence—and satisfaction—in abusing the Jews.

Color of skin often becomes the occasion for prejudice because it is so clearly a badge of difference between peoples—a mark that sets one people apart from another. American whites have been prejudiced not only against black skins, but also against yellow, and against the copper skin of the American Indian. The United States excluded both Japanese and Chinese from immigration when economic competition became great, and when our western states no longer needed their help. The German Kaiser employed the catch-phrase, "the yellow peril," when he wished to unite Europe against the Asiatics. It was easy to put all Asiatics in one group because their skins made them look different from Europeans.

Sometimes the prejudice against Negroes flares up in the Army. It is not a problem, however, in a camp where a soldier in an American uniform is thought of simply as a soldier—not as white or Negro, as Christian or Jew, as rich man or poor, but as a soldier—and as such worthy of respect. Race prejudice will, nevertheless, continue to exist because men cannot easily change attitudes which have been strongly held for a lifetime, which they have perhaps learned in childhood from their parents; but it is possible even for men with prejudice to forget the skin color and respect the uniform.

Not everyone feels race prejudice. There are many white men who associate freely with black, brown and yellow men of education, culture and ability. These white men have learned that skin-color alone is neither a sign of inferiority nor superiority, and they usually forget about it, regard it as unimportant. There are many brown and yellow men of intelligence and standing in such countries as India and China who feel no particular prejudice against those of us who are white. Prejudice is learned and can be unlearned. There is no instinctive or innate basis for it. It arises out of the early training that parents give a child and the attitude of the community in which a man lives later.

In war, the American soldier or sailor may go among people who do not share his prejudices and who find it hard to understand why the American shows antagonism against other Americans or his allies solely on account of their color. The white American himself may in turn be surprised at these more liberal attitudes. If, however, the American soldier can come to understand that his attitudes, as well as those of the men he meets, toward skin color or religion are just as much things he has learned as are his own affiliations to a political party back home, he will avoid much friction and embarrassment.

Strange people will, nevertheless, still seem unusual to him if their customs and habits of thought are novel, but the American will be on the right track when he realizes that the differences are superficial, that other peoples, though unlike his own, are not necessarily inferior. The soldier cannot tell from a man's color whether that man will bandage his wounds skillfully, guide him to camp when he is lost or help him repel enemy invaders. Skin-color in itself tells nothing about the intelligence, wisdom, honesty, bravery, or kindliness of a man. Foreign service gives the American soldier a chance to become acquainted with men of many races and nations, and to satisfy himself that this principle is true.

One of the marks of an educated mature man is his respect for the manners and customs of others. He will realize that they have as much right to their customs as he has to his own, and that he has no reason to condemn them just because they are different. He will make the attempt to understand these customs, trying to discover their function in the community in which they have developed.

ORIGIN OF CUSTOM

It is not always easy to know how manners and customs have arisen or whence they have come. Sometimes a custom seems to have arisen by mere accident. There is, for instance, a tribe in Madagascar in which a man is permitted to have two wives, provided they are not sisters.

This tribe believes that sisters cannot get along together, merely because there was once an actual case in which two sisters married to the same man got into a bad fight. Among certain tribes of American Indians, on the other hand, a man used to be encouraged to marry two sisters, for exactly the opposite reason that sisters would get along together better than would two unrelated women. There are a great many customs which grow up on the basis of historical accidents. In most cases the origin of the particular custom is forgotten, but sometimes a careful study of history can reveal what actually happened.

Climate has much to do with customs, particularly with those related to clothes and dwelling places. Clothes do not make the man—in spite of the popular saying—but they may be indirectly of considerable importance. For one thing, they serve as an occasion for prejudice because they constitute national badges which distinguish the people of one nation from those of another. Thus they may help prejudice to operate in men who have not become accustomed to the differences.

Another custom resulting from climate is the siesta. In towns in the South Pacific as well as in the Mediterranean area, everything closes up tightly for a few hours in the middle of the day. An American soldier, accustomed to a continuous working day with only a brief interruption at noon, may think of the siesta as a mark of indolence, typical of the lazy nations of the world. After he has lived a short time in a hot climate, he changes his mind. Human beings need to rest when it is very hot, saving their activities for the cooler parts of the day. A siesta is not a sign of laziness, but of common sense.

Still another effect of climate and environment on national habits arises because food, in many tropical regions, is plentiful and easy to get. New Caledonia has cobalt, iron and nickel mines, but the natives do not like to work in them. Coconuts and fruits are abundant. They have plenty to eat. Shelter is easy to arrange. There is little point in working. The American brought up to believe that idleness is a vice may feel contempt for such a lazy attitude toward life. He comes from a land where living is more difficult, where hard work is necessary to secure shelter and food, where industry produces power, property and a host of useful mechanical appliances. But his contempt is perhaps misplaced. Work is a means to an end. The New Caledonian, lucky to live in a land of plenty, would regard himself as being intelligent instead of ambitious. Ambition is not so necessary for his living.

Religion is responsible for many differences in custom. The Moslem bows toward Mecca and prostrates himself in prayer five times a day.

He avoids dogs as unclean, will not touch pork or anything cooked in lard, abstains from alcohol, refuses to expose his body. He has his special customs and taboos, just as Catholics, Jews, Episcopalians and all the other sects so well known in America have theirs. Many Americans feel that they must eat fish on Friday, abstain from pork, resist divorces, require women to wear hats in church. There may be reason to regard one set of taboos as superior to another, but seldom are men rational about taboos.

Taboos exist, and since they are not easily changed, they must be understood. The caste system of India is not the ideal of democracy and Americans want nothing like it in the United States. As a matter of fact, there are increasing numbers of people in India itself who dislike the caste system and are trying to abolish it gradually. This custom has, however, to remain a local affair so far as the Army is concerned. As individuals, American soldiers have their own ideas about how the world can be improved, but, except when directed to do so by military orders issued for a military purpose, they should not interfere in the way of life of the people in whose country they happen to be stationed.

Religion also has a great deal to do with determining the attitude of men toward women. In a Moslem household, for example, the women reserve the sight of their faces for the men of their own family. They live in a separate part of the house. If a strange man enters, he calls out so that they can put on their veils or retire. No Moslem ever touches a woman not of his own household, not even to help her in difficulty. He would be ridiculed if he did, and his action would be resented by the men of the woman's family. When other men dine with a Moslem, the women, with their faces covered, appear silently to serve the food.

We do well to remember that most of our American culture has come from other peoples, and that our customs are to a large extent borrowed. We use cotton, which was first domesticated in India; wool, from an animal native to Asia Minor; silk, the uses of which were first discovered by the Chinese. Our clothes are variations of originals first used by ancient nomads of the Asiatic steppes. We drink coffee, which comes from an Abyssinian plant first discovered by the Arabs, and fermented drinks invented in the Near East. We eat waffles, which are Scandinavian in origin. When it rains, we sometimes use rubbers, discovered by the ancient Mexicans, or an umbrella, invented in India. Cigarettes are a Mexican discovery, and cigars were first used in Brazil. Even our newspapers are printed in characters invented by the ancient

Semites on a material first used in China. The whole world has contributed to our way of life.

WHEN TO BE TOLERANT

A man in his relation to other men faces the fundamental dilemma of social adjustment. Shall he assert his will trying to make others agree with him, or shall he yield to their wishes? This is the basic dilemma between egoism and altruism, between self-assertion and social adaptation, between leadership and followership. The dilemma cannot for any one person always be resolved in the same manner. Even the dictator must often fail to have his way. Even the slave can find ways of asserting his own will. A normal healthy man shows a fair balance between self-assertion and social adaptation.

To understand your own likes and aversions as being learned habits and preferences, to be able to see them as prejudices, is the mark of the emotionally mature man who is able to make great social adaptations when the occasion requires. Such altruistic insight is, however, difficult to come by, for man is born an egoist but has to learn altruism. This chapter has, therefore, paid attention to the grounds for altruism, the grounds for racial tolerance. It puts forward the following two basic principles.

(1) The chief differences between peoples—and they are great—are learned differences—the differences of language, religion, custom and habit. Some of these peculiarities have obvious immediate usefulness; others appear arbitrary, having been handed down by social tradition through generations. All are hard to change, but usually we have no way of saying that one set is "better" than another. Every man likes his own.

(2) These differences that depend on learning are so great that they obscure any average inherited differences that might occur between peoples. We do not know that there are any such differences. If there are, they must be small or they would have been discovered.

If the soldier, sailor or marine is to be taught to be tolerant of foreigners as he travels about the earth on his missions, here in these two principles lies the proper scientific ground for his tolerance. That is all right as far as it goes, but science does not settle the question of when it is good to be tolerant and when bad. That question takes us into ethics, and diplomacy, and also the field of military morale.

Be friendly with allies but do not fraternize with the enemy. That is the basic rule. The Army has indoctrination films and booklets to teach its fighting men how to make friends with allies. An American soldier or sailor in England in the Second World War should keep the principles of tolerance in mind. He is an ambassador of his country and should make as large a contribution of social adaptation as he can toward mutual good-will between allies. An American soldier in Germany has a very difficult responsibility. If he has been in combat with fanatical Nazi troops, there is little danger of his wanting to fraternize with German soldiers, but he may be under orders not to fraternize even with the civilians of occupied territory, with the enemy women and children. There is a time for tolerance and a time for self-assertion. It is the part of wisdom to discriminate between friends and enemies.

The rules for *making friends with allies* run somewhat as follows:

(1) Let the soldier or sailor try to understand the strange customs, habits, and ways of thinking of foreign peoples. Some of these peculiarities depend on climate, some on religion, some on very old traditions.

(2) Let him respect these customs and habits even when he cannot understand them. They are as natural to the peoples who have them as his customs are to him.

(3) When he cannot respect foreign customs, let him suppress his disapproval. When he can respect them, let him show his respect.

(4) When he associates with foreign people, let him try to adopt their manners, not asking them to adopt his. If he tries to go all the way, he may succeed in meeting them half way.

(5) Let him suppress his own peculiarities when they go counter to the customs of the land.

(6) When foreign customs do not affect him directly, then let him ignore them entirely.

(7) In general, let him be friendly. If he can feel friendliness, then he will automatically speak the international language of emotion and he needs few rules.

Those are the rules for allies. What is to be said about *not fraternizing with the enemy?* For the most part the enemy takes care of that in combat. You do not like men who have tried to kill you, who have killed your friends. Especially do the American soldiers, sailors and marines of the Second World War not like the cruelties and the fight-to-the-death philosophy of the German and Japanese soldiers. It is, however, much harder for a lonely soldier to remember not to play with an enemy child, not to flirt with a pretty enemy girl, not to go out of his way to be kind to an enemy old woman. In such cases he must remember the rules about fraternization, whatever they may be in the given case, remember that in these modern days war is total and that the enemy people cannot be completely separated from their government. This pretty friendly enemy girl—do you know that she has not a much-loved brother who is a guard at a German concentration camp?

Emotional maturity makes tolerance possible. Intellectual maturity tells you when to be tolerant and when not. Men have always had to distinguish between mercy and justice, and the fighting man needs to know when to be friendly and when stern.

REFERENCES

1. *ABC's of scapegoating.* Chicago: Central YMCA College, 1943. Pp. 72.
   An excellent psychological analysis of the psychological mechanisms of prejudice and scapegoating written by the Morale Seminar of Harvard University.
2. R. BENEDICT. *Race: science and politics.* New York: Modern Age Books, 1940. Pp. 274.
   A graphic and non-technical presentation of the scientific findings on the topic of race differences.
3. R. BENEDICT AND G. WELTFISH. *The races of mankind.* Public Affairs Committee Pamphlet No. 85. New York: Public Affairs Committee, 1943. Pp. 31.
   A popular, non-technical presentation of the fallacies of the race myth and of the steps being taken in the United States to dispel race prejudices.
4. J. DOLLARD. *Caste and class in a southern town.* New Haven: Yale University Press, 1937. Pp. 502.
   A dynamic view of social conditions in a small town in the deep South based on an extensive research program on Negroes.
5. K. GOULD. *They got the blame: the story of scapegoats in history.* New York: Association Press, 1942. Pp. 63.
   A non-technical and readable survey of the important scapegoats from ancient times to the present.
6. E. A. HOOTON. *Apes, men and morons.* New York: Putnam's, 1937. Pp. 307.
   An energetic and uncomplimentary description of men as the product of biological and social evolution with the conclusion that men must now help evolution or deteriorate.
7. O. KLINEBERG. *Social psychology.* New York: Henry Holt, 1940. Pp. 570.
   A readable orientation to the field of social psychology with primary emphasis on anthropological material; see especially Chapters 11 and 14.
8. A. MCC. LEE AND N. D. HUMPHREY. *Race riot.* New York: Dryden Press, 1943. Pp. 143.
   A crisp, authoritative account of the Negro-white riots in Detroit, with a keen discussion of the causes of race tension and some of the remedies.

9. J. L. MORENO. *Who shall survive?* Washington: Nervous and Mental Disease Publishing Company, 1934. Pp. 440.

A technical presentation of the new method of studying the interrelationships of people in groups and of the way in which such interrelationships affect the welfare of a community.

10. G. MYRDAL. *An American dilemma.* New York: Harper, 1944. 2 vols. Pp. 1,483.

The most comprehensive factual study of the Negro in America to date.

11. P. B. SEARS. *Who are we Americans?* The People's Library. New York: Macmillan, 1939. Pp. 116.

A non-technical treatment of what Americans are like and of what their ideals and goals have been and still are.

12. H. J. SELIGMAN. *Race against man.* New York: Putnam's, 1939. Pp. 248.

An anthropological study which emphasizes the fact that social behavior is determined by historic background and changes with social status rather than with race.

Chapter 24

The Use of Psychology in War

If, now at the end of this book, the reader still has any doubt as to what it is about and why it was written, he might turn back and reread the preface and the first chapter. It has all been said there; yet perhaps a retrospect is different from a prospect and we had better echo that initial discussion, saying again just why a psychology for the armed services should be written.

Psychology is the study of acting man, of human thinking and behaving and of the underlying causes and conditions of man's thought and conduct. Thus it is concerned with perceiving, feeling, learning, remembering, thinking, and acting, and also with all of the social relations between men, how they feel about one another, act toward each other.

The armed forces are organized bodies of *men.* To make military organizations efficient, you have, therefore, to know about the capacities and limitations of men, about differences among men and how one man can be best at one job while another is best at a different job, and about the ability of men to have their abilities changed by training. You have also to know about men's motives and their personalities, about their adjustment in novel situations, about how they learn to like to do what they have to do, about how and why they break down when adjustment is impossible. And then you need to know about their social relations—in leadership and followership, in panic, in accepting and spreading rumor, in association with foreigners. You also need to know how to assess the opinions of large groups and to control the thought and action of large groups by propaganda and other means. All that is psychology which the military man needs.

A great many of the facts and rules that are useful in war have been given in this book. Many more new-found facts will be available after the Second World War when their publication no longer jeopardizes security. Many of these facts and principles will, however, be too technical for a general text and will then find their way into field manuals and handbooks. Since human problems enter into every phase of military activity, it is doubtful as to whether all of the details of psychology useful in war would ever be collected in a single book.

There is, however, for the present text a second purpose, additional to the exposition of that psychological information which is useful to military men. This book seeks to train men in the armed forces to think psychologically. It is not enough for military men to know the rules and the facts that have already been selected as relevant to particular situations. They need to know in general what human nature is like, why men behave as they do. They need to be able to take the psychologist's point of view toward brand new military problems that have never been discussed in any book. The possession of a compendium of psychological facts could never be of as great value to a military man as could a basic understanding of human nature.

It is no demand impossible of achievement to ask that every leader in the armed forces be on occasion himself a psychologist, that he understand the basic principles on which human nature operates, that he be trained in this mechanical age to think of man as the most complicated machine, of which the output depends in part upon the input, and in part upon the properties of the machine, some of which can be changed and some of which cannot. No leader need neglect his other training to learn to think thus psychologically about men, to think of the use and control of men in scientific terms. And every leader who adds the psychological point of view to the repertoire of his thinking is thereby prepared to face novel and unexpected human problems with a skill and sophistication far surpassing the abilities of the leader who thinks of discipline and exhortation as exhausting the means for human motivation and improvement.

It is for this reason that every chapter in this book begins with a discussion of the general principles and basic properties of the human organism that control the abilities or behavior that is under discussion. The book asks the reader to see what the principles are, and then how they work. It asks him to learn the facts and the rules, not because they will make him expert in any one field—they will not—but because in such exercises he will form the habit of thinking scientifically about the problems of human nature and conduct. The leader needs this psychological insight.

And he needs it more or less in proportion to his responsibility. The private and the seaman can use it, yet they have less responsibility for planning for other men. The junior officers need it more, and the senior officers who command the most men need the capacity for psychological thinking most of all. Everyone knows how science has determined the machine age, and how the machine age has affected the conduct of war. Now is the time for every man who commands men to learn to apply the principles of science to his men, the human machines who are the only machines that can make war.

Index

Abilities, correlation, 230f., 234f.
general,
Army grades, 233, 240, 246-8, 254f.
Army tests, 231-3, 235f., 240f., 250, 254f.
definition, 226f.
environment, 228-30.
feeble-mindedness, 228.
genius, 227f.
growth, 231.
heredity, 228-30.
individual differences, 240-3.
individual tests, 232, 242f.
occupations, 246-8.
peoples, 505f.
schooling, 250.
learning, 280f.
Navy tests, 235f.
overlap, 230f., 234f.
special, 234-6.
Accidents,
anticipation, 196.
circumstantial, 194f.
frequency, 193.
mechanical, 193f.
prevention, 193-7.
proneness, 195f.
psychological, 195.
Accommodation, visual, 24f., 37f.
Acuity,
hearing, 109f.
small, 131f.
visual,
age, 30.
brightness, 29f.
contrast, 29f.
glare, 30-2.
illumination, 29f.
Landolt ring, 27f.
measures, 27-9.
night, 60f.
perceptual form, 29.
threshold, 28f.
Adamsite, 137.
Adaptation,
hearing, 109f.
smell, 132.
vestibular, 148f.
visual, 51-60.
Adjustment,
combat, 348f.
compulsion, 346f.
death, 348f.
dynamics, 368-70.
function, 344f.
killing, 349.
loneliness, 347f.
means, 369-70.
Adjustment,
mental breakdown, 363-8.
frequency, 365f.
prediction, 364-6.
mental health, 363.
military psychology, 8f.
morale, 348.
neurosis, 352f.
nostalgia, 346.
privacy, 346.
psychological mechanisms, 350-63.
recruit, 345-8.
time perspective, 349.
Adler, A., 370.
Adrenin, emotion, 378.
Aerial perspective, 36.
AGCT, 232f., 235, 240f., 250, 254f.
Aggression,
attitude, 380-2.
frustration, 322.
latent, 448, 450.
mobs, 447f.
need, 318.
psychological mechanisms, 438.
Air crews, assignment, 258f.
Air sickness, 150-2.
Air Surgeon, selection, 17f.
Alcohol,
bravery, 218.
depressant, 214f.
effects, 214f.
fatigue, 216.
flying, 217f.
frustration, 218.
intoxication, 215-7.
morale, 217f.
tolerance, 215-7.
uninhibitor, 215.
use, 217f.
Allport, G. W., 22, 342.
Alpha examination, 231f.
Altitude,
air pressure, 210f.
blood oxygen, 211f.
critical heights, 211-3.
See also Anoxia.
Ampullar sense.
See Vestibular sense.
Anastasi, A., 262.
Androgens, 397f.
Anger,
fear, 391.
frustration, 391.
hatred, 392.
mobs, 447f., 450.
propaganda, 393.
Anoxia,
blood capacity, 212.

Anoxia,
blood pressure, 212.
effects, 208-10.
parachute jumping, 213.
physiology, 210-2.
rapid breathing, 212.
tissue poisoning, 212.
See also Altitude.
Anxiety, 373.
Aptitudes,
definition, 225.
tests, 244f., 255.
See also Selection.
Armstrong, H. G., 223.
Army General Classification Test, 232f., 235, 240f., 250, 254f.
Arthur, G., 262.
Aryan myth, 504f.
Ascendence, leadership, 413.
Assignment,
air crews, 258f.
aviation technicians, 259f.
truck drivers, 260f.
See also Selection.
Association, 268f.
Attitudes, morale, 329-34.
Audiogenic seizures, 119.
Audition.
See Hearing.
Autokinetic movement, 47.
Autonomic nervous system, emotion, 374-8.
Aviation psychology,
World War I, 13f.
World War II, 17f.

Baber, R. E., 408.
Bárány chair, 149f.
Barcroft, J., 223.
Bartlett, F. C., 499.
Basilar membrane, 106f.
Bats, hearing, 103f.
Becker, H., 408.
Benedict, R., 516.
Benzedrine, 222f.
Bills, A. G., 197.
Bingham, W. V., 262.
Binocular parallax, 40-6.
Bird, C., 299, 342.
Bisexuality, 405.
Blankenship, A. B., 483.
Blind flying, 149.
Blindfold chess, 158.
Blister gases, 136.
Blood Pressure, emotion, 379.
Body temperature.
See Temperature, body.
Bogan, E., 224.
Boredom, efficiency, 186-8.
Boring, E. G., 50, 62, 96, 128, 152.
Breakdown.
See Mental breakdown.
Breckenridge, R. P., 96.
Brightness, color, 66-9.
Britt, G., 444.
Britt, S. H., 22.
Bruntz, G. L., 499.
Burtt, H. E., 197, 223, 262.

Caffeine, 221f.
Camouflage,
attention, 77f.
background, 89f.
brightness, 78, 83f., 86-8.
color blindness, 73f.
confusion, 77.
contours, 76, 87f.
counter-camouflage,
filters, 95.
infra-red, 91-95.
new objects, 94f.
photography, 91-5.
shadows, 86f., 95.
stereoscopy, 45, 94.
dazzle painting, 88.
movement, 78.
object perception, 74-7.
patterns, 81-3.
photography, 91-5.
shadows, 86f.
size, 78.
sound, 126f.
stereoscopy, 45, 94.
texture, 84f.
uniqueness, 79-81.
Cannon, W. B., 393.
Cantril, H., 463, 483.
Carr, H. A., 50.
Case, H. W., 430.
CAVD test, 242.
Censorship, rumor, 438f.
Chemical sense, 131.
Chisholm, G. B., 343.
Chronic fatigue, 187f.
Churchill, W., 430, 480.
Classification,
interviewing, 253f.
personality, 255f.
testing, 254f.
See also Selection.
Climate, efficiency, 207.
Cochlea, 105-7.
Cold,
effects, 204f.
efficiency, 199-207, 204f., 221f.
frostbite, 207f.
parachute jumping, 213.
Color,
adaptation, 52.
attributes, 66f.

Color,
brightness, 66-9.
circle, 65-7.
discrimination, 67.
hue, 66-9.
infra-red and green, 69.
limits of vision, 64f.
military use, 73f.
mixture, 67-9.
primary hues, 66.
reflectance, 69.
saturation, 66-9.
solid, 67.
Color blindness,
partial, 70f.
tests, 71-3.
total, 69f.
Color circle, 65-7.
Color cone, 67.
Color weakness, 70f.
Combat fatigue, 366-8.
Committee on Medical Research, 18.
Communication,
masking, 112-5.
speaker-listener, 117f.
speech sounds, 115-8.
telephone, 115-8.
Company interviews, 477f.
Compensation, psychological mechanism, 323, 353-5.
Concussion, 368.
Conditioned response, 266f.
Cones, retina, 52-8.
Constancy, perceptual, 74-7, 134f.
Convergence, eyes, 39f.
Conversion hysteria, 360-2.
Coordination, visual-motor, 48-50, 150, 243.
Copeland, H., 343.
Correlation, abilities, 230f., 234f.
Counter-camouflage.
See Camouflage.
Crane, S., 463.
Cristae, 145-8.
Culture.
See Differences of peoples.
Customs,
climate, 512.
national differences, 507f.
origin, 511-3.
religion, 512f.

Dallenbach, K. M., 152.
Dark adaptation, 53-62.
Darwin, C., 382, 479.
Davis, H., 129.
Dazzle painting, 88.
Deaf mutes, equilibrium, 146f.
Deafness.
See Hearing.
Death, fear, 348f.
Defense compensation, 323.
Defense mechanisms, 353-7.
Deficiency compensation, 323.
de Gaulle, C., 430.
Delusions, 357.
Dementia precox, 362.
De Silva, H. R., 197.
Deuteranopia, 70f.
Dichromats, 70.
Differences of peoples,
climate, 512.
customs, 507f., 511-3.
emotionality, 507.
intelligence, 505f.
national, 503f.
nature vs. nurture, 501f.
Negroes, 506.
physical, 503.
prejudice, 504f., 509-11, 514-6.
religion, 512f.
temperament, 506f.
tolerance, 501, 514-6.
Direction finding, acoustic, 125f.
Discipline, leadership, 415f., 419.
Diurnal rhythm, 192.
Divingshofen, H. V., 224.
Division of Information and Education, 19.
Dollard, J., 393, 463, 516.
Doob, L. W., 499.
Drill.
See Learning, practice.
Drive.
See Needs.
Drugs, stimulants, 222f.
Dusser de Barenne, J. G., 153.
Dynamic psychology.
See Motivation, Needs, Psychological mechanisms.

Ear,
basilar membrane, 106f.
cochlea, 105-7.
cristae, 145-8.
deafness, 107-12.
injury, 109-11.
inner, 105-7.
middle, 104f.
military use, 97.
organ of Corti, 106f.
ossicles, 104f.
otoliths, 144f.
outer, 104.
oval window, 106.
round window, 106.
saccule, 143f.
semicircular canals, 143-8.
utricle, 143f.
See also Hearing.
Ear plugs, 111.

Education,
general ability, 250.
military success, 248-50.
personality, 252.
Efficiency,
accidents, 192-7.
alcohol, 213-8.
altitude, 208-13.
anoxia, 208-13.
body temperature, 199-205.
boredom, 186-8.
chronic fatigue, 187f.
climate, 207.
clothing, 204f.
coffee, 221f.
cold, 199-207.
conditions, 169f.
drugs, 222f.
fatigue, 171-85.
group, 170.
heat, 199-207.
illumination, 184f.
job analysis, 170f.
learning, 280-87.
military, 5f., 167f.
monotony, 186-8.
nature, 168f.
noise, 184f.
optimal temperatures, 205-7.
planning work, 172f.
rest, 179-83.
sleep, 188-92.
tea, 221f.
temperature, 199-207.
tobacco, 218-21.
ventilation, 200-2.
work conditions, 183-5.
work decrement, 177-9.
work habits, 170-3.
Efficiency reports, 256.
Emerson, H., 244.
Emotion,
adrenin, 378.
aggression, 380-2.
anger, 391-3.
anxiety, 373.
auditory stimulus, 120f.
autonomic nervous system, 374-8.
blood pressure, 379.
complete shrug, 380-2.
emergency theory, 374-8.
excitement, 373f.
expression, 379-83.
fear,
characteristics, 384.
control, 386-90.
nature, 383f.
feeling, 372f.
galvanic skin response, 379.
national differences, 507.
Emotion,
physiology, 374-9.
preference, 372f.
startle, 381.
sympathetic nervous system, 374-8.
thalamus, 378f.
See also Mobs, Panic.
Emotional instability.
See Mental breakdown.
Emotional stability, selection, 250-2.
Endocrine glands, 378.
Endurance, selection, 256.
Environment, general ability, 228-30.
Equilibrium,
adaptation, 143, 146-50.
gravity, 141f.
inertia, 141f.
vestibular clues, 141f.
visual clues, 141f.
See also Ear, Vestibular sense.
Escape mechanisms, 357-63.
Espionage, propaganda, 488f.
Estrogens, 397f.
Exhibitionism, 356, 438.
Eye,
brain connections, 25f.
fatigue, 32-4.
fovea, 24f.
foveal blindness, 60.
function, 24-6.
lens, 24.
military instrument, 23.
pupil, 24f., 53-5.
retina, 24f.
structure, 24.
See also Vision.

Facial vision, 160.
Facts,
assessment,
Army questionnaires, 481-3.
company interviews, 477f.
See also Public opinion, assessment.
Fantasy, psychological mechanisms, 323, 358f.
Farago, S., 22, 429, 499.
Fatigue,
alcohol, 216.
chronic, 187f.
combat, 366-8.
learning, 296.
mental, 173-6.
mental blocks, 176.
mobs, 451.
morale, 329.
physical, 173f., 176-8.
physiology, 176-8.
rest, 179-83.
sensation, 177-9.
stimulants, 221-3.

Fatigue,
visual, 32-4.
work, 171-85.
work decrement, 177-9.
Fear,
activity, 384, 386.
anger, 383f.
calm, 388.
companionship, 389.
control, 386-90.
courage, 385.
frustration, 383.
habit, 387f.
health, 390.
humor, 388f.
ignorance, 386f.
knowledge, 386f., 389f.
loyalty, 390.
religion, 389.
symptoms, 384.
Feeble-mindedness, 228, 309f.
Fitness report, 257.
Fitzpatrick, J. C., 430.
Flavor, smell, 131.
Fletcher, H., 128.
Flying, blind, 149.
Followership.
See Leadership.
Fourier analysis, 98-100.
Fovea, 24f.
Freeman, D. S., 430.
Freud, S., 352.
Friedmann, H., 96.
Fromm, E., 370.
Frostbite, 207f.
Frustration,
aggression, 322.
alcohol, 218.
apathy, 322.
conflict, 319-21.
consequences, 320-5.
defense compensation, 324.
deficiency compensation, 323.
fantasy, 323.
fear, 383.
identification, 323.
projection, 324f.
psychological mechanisms, 321-5.
rationalization, 325.
repression, 323.
scapegoats, 320.
tolerance, 321.
Functional autonomy, motives, 317f.

Gallup, G. H., 483.
Galvanic skin response, 379.
GCT, 232f., 235f., 240f., 250, 254f.
General ability.
See Abilities.
General Classification Tests, 232f., 235f., 240f., 250, 254f.
Genius, 227f.
Geotropism, 141.
Gillespie, R. D., 370.
Glare,
causes, 30f.
fatigue, 33f.
Polariod glasses, 31f.
Glover, E., 393.
Goethe, J. W., 227-9.
Gonads, 397f.
Gould, K., 516.
Gray, A. A., 129.
Greene, E. B., 262.
Griffith, C. R., 152.
Groves, C., 408.
Groves, G. H., 408.
Guedalla, P., 430.

Haig, D. H., 480.
Harmonics, 98-100.
Hart, B., 444.
Hatred, 392.
See also Tolerance.
Head injuries, 368.
Hearing,
acoustic parallax, 121-6.
age, 108f.
analysis of sound, 98-101.
audiogram, 102, 108, 110.
communication, 112-8.
deafness, 107, 12.
dichotic, 123-5.
direction finding, 125f.
ear plugs, 111.
efficiency rules, 127f.
emotion, 120f.
fatigue, 109-11, 119f.
fusion, 101.
hysterical deafness, 112.
limits, 102-4, 108-10.
localization, 121-6.
intensity effect, 123-5.
time effect, 123-5.
loudness, 101.
malingering, 111f.
masking, 112-5.
airplane noise, 113f.
noise, 101, 118-21.
Ohm's law, 99f.
perception of distance, 123.
physiology, 104-7.
pitch, 101.
quality, 101.
resonance of ear, 106f.
right-left localization, 122-5.
sound camouflage, 126f.
speech, 115-8.
stimulus, 97-104.

Hearing,
telephone, 115-8.
thresholds, 102-4, 108-10.
tonal gap, 109.
tonal island, 109.
tone, 102-4.
ventriloquism, 121.
voice frequencies, 114f.
See also Ear, Sound.
Heat, efficiency, 199-207.
Height finding, visual, 42-5.
Heinrich, H. W., 197.
Helplessness, attitude, 380-2.
Henderson, G. F. R., 431.
Henry, H. B., 299.
Heredity,
general ability, 228-30.
races, 501f.
Hilgard, E. R., 299.
Hill, R., 408.
Himes, N. E., 408.
Hisey, W. S., 224.
History, military fact finding, 477f.
Hitler, A., 500.
Hollingworth, H. L., 224.
Homeostasis, 199-203.
Homing, 154-6, 165f.
Homosexuality, 404-8.
Hooton, E. A., 516.
Hormones, sex, 397f.
Horney, K., 370.
Hough, R. B., Jr., 430.
Hue, 66-9.
Hull, C. L., 224.
Human engineering, 20f.
Humidity, efficiency, 202.
Humphrey, N. D., 463, 516.
Hypnosis,
leadership, 411-3.
post-hypnotic suggestion, 412.
Hysteria,
conversion, 112, 360-2.
deafness, 112.

Identification, psychological mechanisms, 323, 355.
Ideology, morale, 339f.
Illiteracy, training, 308f.
Illumination, efficiency, 184f.
Incentives, learning, 281f.
See also Needs.
Individual differences,
education, 248-50, 252.
general ability, 240-3.
perception, 243f.
personality, 250-3, 255f.
Individual tests, 232, 242f.
Inferiority feeling, 351.
Ingersoll, R., 343.
Insight,
learning, 272-4, 285f., 294, 351.
problem solving, 351.
Instability.
See Mental breakdown.
Instinct.
See Needs.
Instruction.
See Learning, Training.
Intelligence, testing in World War I, 13.
See also Abilities, general.
Interviewing,
method, 253f.
opinions, 474.
Intoxication.
See Alcohol.

Jenkins, T. N., 166.
Jewish problem, 354f., 504.
Jobs,
analysis, 170f., 236-9.
families, 238f.
morale, 333f.
specifications, 236-8.

Kahn, F., 409.
Klein, D. B., 370.
Kleitman, N., 198.
Klineberg, O., 516.
Knapp, R. H., 444.
Köhler, W., 299.

Landolt ring, 27f.
Langfeld, H. S., 50, 62, 96, 128, 152.
Lanham, C. T., 457, 463.
Larson, C. A., 500.
Lashley, K. S., 166.
Lawrence, T. E., 431.
Leadership,
activity, 423f.
age, 428.
approbation, 422.
ascendence, 413.
attributes, 417-25.
authoritarian, 414, 418f.
authority, 419.
candor, 423.
clarity, 422, 424.
competence, 419f.
contact, 422, 424.
criticism, 422.
death, 423.
decisiveness, 420.
democratic, 414, 418f.
discipline, 415f.
followership, 413-7.
hypnosis, 411-13.
industriousness, 420.
integrity, 421.
isolation, 338f.

Leadership,
loneliness, 421, 425.
mental strain, 423.
military function, 9f., 410f.
morale, 337-9, 417-25.
panic, 455f.
personal recognition, 422.
pride, 417.
responsibility, 420.
selection, 425-8.
self-possession, 421.
submission, 413.
suggestion, 411-3.
symbol, 424f.
teaching, 421.
training, 428f.
See also Morale.
Learning,
blame, 270.
competition, 282.
conditioned response, 266f.
contiguity, 276.
distractions, 283, 296.
drill, 265.
errors, 284f.
failure, 270f., 281f., 296f.
incentives, 281f.
inhibition, 278-80, 296.
insight, 272-4, 285f., 294.
interest, 270, 281.
memorization, 265f., 292f.
morale, 271f., 281.
motivation, 268-72, 317f.
nonsense, 275, 292f.
overlearning, 286f.
participation, 271, 282.
plateaus, 267f., 295-7.
practical aids, 282f.
practice, 265-9, 286, 292.
praise, 270.
principles, 264f., 268f., 276-8.
problem solving, 265, 272-5, 294f.
punishment, 270.
reading, 289-92.
recognition, 297-9.
reenforcement, 278-80.
repetition, 268-70, 277f., 286f., 292.
reward, 270.
sense relationships, 276-8.
skills, 267f.
social facilitation, 282.
study, 287-9.
success, 270f., 281f., 296f.
trial and error, 268, 294.
understanding, 272-5, 285.
wholes vs. parts, 286.
Lee, A. McC., 516.
Lens, eye, 24.
Lewis, L., 431.
Lewisite, 136.
Liddell Hart, B. H., 431.
Lie detection, 379.
Likert, R., 484.
Liquor.
See Alcohol.
Localization of sound, 121-6.
Love, 398-400.
Lundberg, G., 484.

MacCurdy, J. T., 343.
McGeoch, J. A., 299.
McKown, H. C., 311.
McLee, A., 463.
Mahan, A. T., 431.
Malingering, deafness, 111f.
Maps,
mental, 154-65.
orientation, 163.
Marquis, D. G., 22, 299.
Marshall, S. L. A., 484.
Masking, hearing, 112-5.
Mass observation, public opinion, 475f.
Masturbation, 402f.
Maze learning, 268.
Meier, N. C., 430.
Memorizing, 265f., 292f.
Memory,
inhibition, 278-80.
reenforcement, 278-80.
See also Learning.
Memory systems, 292f.
Menninger, K., 371.
Mental blocks, 176.
Mental breakdown,
frequency, 365f.
leadership, 423.
prediction, 364-6.
symptoms, 366-8.
treatment, 367f.
war shock, 366-8.
Mental health, 363.
Mental maps, 154-65.
Mental tests.
See Selection.
Miles, W. R., 224.
Military psychology, 1-21, 518f.
Aviation in World War I, 13f.
Aviation in World War II, 17f.
foreign contributions, 20.
German, 14-6.
point of view, 20f.
topics, 3-11, 15-9.
World War I, 12-4.
World War II, 16-20.
Miller, D. C., 129.
Miller, E., 371.
Miller, N. E., 463.
Mira y Lopez, E., 393.
Mobs,
aggression, 448, 450.

Mobs,
anger, 447f.
attention, 446-9.
control, 451f.
fatigue, 451.
focus, 446-9.
goal, 446-9.
motivation, 446-8, 450f.
mutiny, 445.
Mock, J. R., 500.
Monitoring, radio, 476f.
Monotony, efficiency, 186-8.
Morale,
adjustment, 348.
assessment, 341f.
attitudes, 329-34.
cleanliness, 328.
competition, 336.
control, 341f.
fatigue, 329.
group, 335-7.
hunger, 327f.
ideology, 339f.
jobs, 333f.
leadership, 337-9.
letters, 330.
mental health, 363.
nature, 313, 325-7.
news, 330.
opinion sampling, 481.
panic, 454-62.
psychological warfare, 486-99.
recreation, 331f.
religion, 340.
rumors, 435f., 440-4.
self-importance, 332f.
showing off, 336.
sleep, 329.
social relations, 334-9.
thirst, 327f.
vitamins, 328.
warmth, 328f.
See also Leadership.
Moreno, J. L., 517.
Morgan, C. T., 50, 152, 393.
Moron, 228.
Mosely, N., 311.
Motion sickness,
causes, 150f.
drugs, 152.
remedy, 151f.
Motivation,
conflict, 312, 319-25.
frustration, 312, 319-21.
learning, 268-72.
mobs, 446-8, 450f.
needs, 312-9.
panic, 453-5, 457-62.
See also Needs, Psychological mechanisms.
Movement,
autokinetic, 47.
visual, 46-8.
Movies, public opinion, 475.
Munson, E. L., 311.
Munson, E. L., Jr., 430.
Murchison, C., 152.
Murphy, G., 484.
Mustard gas, 136.
Munity, 445.
Myrdal, G., 517.

National Defense Research Committee, 18.
National differences.
See Differences of peoples.
Nazi philosophy, 14f.
Needs,
activity, 316f.
aggression, 318.
autonomy, 317f.
ego, 345.
food, 314-7.
gregarious, 318.
habit, 317f.
oxygen, 313f.
physiology, 314f.
primary, 313-7.
religion, 319.
secondary, 317-9.
self-assertion, 318f.
self-preservation, 317.
sex, 314-7, 395-401.
sleep, 316.
social, 345.
socialization, 317.
vital, 313-6.
water, 314-7.
See also Psychological mechanisms.
Negativism, 358.
Negroes, intelligence, 506.
Neurosis,
breakdown, 363-8.
repression, 359-62.
Newspapers, public opinion, 474.
Night blindness, 57f.
Night vision, 51-61.
Night workers, 192.
Noise,
distraction, 118f.
efficiency, 184f.
emotion, 120f.
fatigue, 119f.
stimulant, 118f.
Nostalgia, cryptic, 346.
Nystagmus, 145f.

Object constancy, perception, 74-7, 134f.
Observation,
camouflage, 74-96.
military psychology, 3-5.

Observation,
night, 61f.
See also Camouflage, Perception, Recognition.
Occupations, general ability, 246-8.
Odor.
See Smell.
Office of Scientific Research and Development, 18.
Olfaction.
See Smell.
Opinion,
Army polls, 468.
Army sampling, 481-3.
interviews, 474.
military psychology, 11.
See also Public Opinion.
Optic chiasm, 26.
Orientation,
bodily, 141-50.
gravity, 141f.
See also Equilibrium, Vestibular sense.
topographical,
animals, 154-6.
blindfold chess, 158.
clues, 164f.
facial vision, 160.
homing, 154-6, 165f.
maps, 163.
mental maps, 154-65.
nature, 154-6.
points of compass, 160.
practice, 159, 164f.
stars, 161-3.
O'Shea, M. V., 224.
Ossicles, 104f.
Otolith organs, 144f.
Overstreet, H: A., 371.
Oxygen mask, 209-13.

Panic,
causes, 454-62.
fear, 453-5, 457-62.
focus, 453.
leadership, 455f.
Mars invasion, 456f.
military examples, 457-62.
military function, 445.
morale, 454-62.
motivation, 453-5, 457-62.
rumor, 455, 458-60.
stopping, 462f.
See also Mobs.
Parachute jumping, 213.
Parallax,
binocular, 40-6.
monocular, 36f.
Parasympathetic nervous system, 374-8.
Parker, G. H., 139.
Parran, T., 409.
Parsons, J. H., 96.
Pennington, L. A., 430.
Perception,
auditory space, 121-6.
camouflage, 74-96.
individual differences, 243f.
military psychology, 3-5.
object constancy, 134f.
objects, 74-7.
rotation, 145-50.
See also Camouflage, Recognition, Vision.
Personal adjustment.
See Adjustment.
Personality differences, 250-3, 255f.
Personnel, classification in World War I, 13.
Personnel Research Section, A.G.O., 13, 17.
Personnel work.
See Assignment, Classification, Selection.
Phosgene, 136f.
Photopia, 52-8.
Pituitary gland, 397.
Poffenberger, A. T., 198, 224.
Polls.
See Public opinion.
Ponsonby, A., 444.
Posture, 141-4.
Practice.
See Learning.
Preferences, 372f.
Pressey, L. C., 299.
Proactive inhibition, 279, 296.
Problem solving,
insight, 294f., 351.
trial and error, 350.
Projection, psychological mechanism, 324f., 356f., 438.
Propaganda,
aims, 487f.
black, 493, 495.
combat, 494-6.
distribution, 492f.
espionage, 488f.
events, 489f.
interpretation, 491f.
military psychology, 11.
morale, 486f.
organization, 496f.
tactics, 497f.
targets, 487f.
timing, 490f.
truth, 389-92.
victory formula, 498f.
See also Psychological warfare.
Prostitution, 403f.
Protanopia, 70f.
Pseudisochromatic tests, 72.
Pseudoscopy, 45f.
Psychoanalysis, 352.
See also Psychological mechanisms.
Psychological General Staff, German, 15.

Psychological mechanisms,
adjustment, 350-63.
aggression, 438.
compensation, 353-5.
defense, 353-7.
defense compensation, 323.
deficiency compensation, 324.
escape, 357-63.
exhibitionism, 356, 438.
fantasy, 323, 358f.
frustration, 321-5.
identification, 323, 355.
inferiority, 351f.
negativism, 358.
projection, 324f., 356f., 438.
rationalization, 325, 355.
regression, 359.
repression, 323, 359-62.
rumors, 437f.
schizophrenia, 362.
seclusiveness, 357f.
sublimination, 400f.
substitution, 353.
Psychological warfare,
fanaticism, 486.
military psychology, 11.
morale, 486f.
public opinion, 464-6, 480f.
rumor, 441f.
surrender, 485f.
See also Propaganda.
Psychology,
German military, 14-6.
history, 11f.
military, 1-21, 518f.
point of view, 20f., 519.
World War I, 12-4.
World War II, 16-20.
Public opinion,
assessment,
addresses, 475.
enemy, 476f.
Germany, 467f.
interviews, 474.
mass observation, 475f.
monitoring, 476f.
movies, 475.
newspapers, 474.
radio, 474f.
fair sample, 469f.
importance, 464-6.
interpretation, 478-80.
polls,
Army, 468.
cafeteria questions, 472.
methods, 468-74.
multiple-choice questions, 472.
open questions, 472.
questioning, 470-4.
samples, 469f.
Public opinion, polls,
stratified sample, 469.
targets, 466f.
weighted questions, 473f.
psychological warfare, 464-6.
See also Facts, assessment.
Pupil, eye, 24f., 53-5.
Purkinje phenomenon, 56.
Pursuit meter, 49f.

Qualification cards, 13, 256f.

Race differences,
cultural, 503-5.
nature vs. nurture, 501f.
physical, 503.
See also Differences of peoples.
Race prejudice, 509-11, 514-6.
Radiation, body, 202f.
Radio,
monitoring, 476f.
public opinion, 474f.
Radiotelegraphic code test, 244f.
Rail walking test, 150.
Range finding, 42-5.
Rationalization, 325, 355.
Reaction,
coordination, 48-50, 243.
individual difference, 243.
Reading,
habits, 290-2.
speed, 289-92.
Recognition, 297-9.
odor, 132-8.
schools, 297f.
Reconnaissance,
camouflage, 74-96.
color, 73f.
night, 61f.
stereoscopic, 44f.
See also Camouflage.
Recreation, morale, 331f.
Recruit, adjustment, 345-8.
Reed, P. B., Jr., 430.
Regression, psychological mechanism, 359.
Religion,
fear, 389.
morale, 340.
need, 319.
Repression, 323, 359-62.
hysteria, 360-2.
lapses, 359f.
Rest periods, 179-83.
Retina, 24f.
Retinal disparity, 40-6.
Retroactive inhibition, 279f.
Roberts, A. B., 311.
Rods, retina, 52-61.
Roethlisberger, F. J., 343.
Rotation, perception, 145-50.

Ruckmick, C. A., 394.
Rumor,
bait, 442.
board, 443.
bogey, 434.
causes, 436-8.
censorship, 438f.
change, 440f.
clinic, 443.
control, 442-4.
disruption, 441f.
mongering, 436-8.
morale, 435f., 440-4.
nature, 432.
panic, 455, 458-60.
pipe-dream, 434f.
psychological mechanisms, 437f.
psychological warfare, 441f.
recurrence, 439f.
smokescreen, 442.
spread, 433-5.
targets, 434.
wedge-driving, 433f.

Saccule, 143f.
Saturation, color, 66-9.
Scapegoating, 320, 509f.
Schizophrenia, 362.
Schmeidler, G. R., 22.
Schooling,
general ability, 250.
military success, 248-50.
personality, 252.
Schrumpf-Pierron, Pr., 224.
Schwesinger, G. C., 262.
Scoptopia, 53-62.
Scotomata, 26.
Sears, P. B., 517.
Seasickness, 150-2.
Seclusiveness, psychological mechanism, 357f.
Selection,
air crews, 258f.
aptitudes, 244-50, 255.
Army grades, 246-8, 254f.
aviation technicians, 259f.
education, 248-50.
individual differences, 239-53.
interests, 252.
interviewing, 253f.
leaders, 253, 425-8.
learning ability, 280f.
military principles, 225f.
military psychology, 6f., 17f.
perception, 243f.
personality, 250-3, 255f.
pilots, 149f.
reaction, 242.
testing, 254f.
trade knowledge, 245-8, 255.
Selection,
truck drivers, 260f.
various jobs, 261.
See also Abilities, Jobs.
Seligman, H. J., 517.
Semicircular canals, 143-8.
Sensitivity,
hearing, 109f.
smell, 131f.
vision, 27-30, 54-6.
Sex,
androgens, 397f.
biosocial conflict, 395f.
bisexuality, 405.
complication in man, 398-401.
continuity, 399f.
cycles, 396f., 399.
determination, 405.
estrogens, 397f.
food, 401f.
homosexuality, 404-8.
hormones, 397f.
innate behavior, 398.
love, 398-400.
masturbation, 402f.
need, 314-7, 395.
personal problem, 401-4.
physiology, 396-401.
promiscuity, 403f.
resumé, 407f.
sublimation, 400f.
substitutes, 401f.
transfer, 400.
Shaffer, L. F., 371.
Sham rage, 378f.
Sight.
See Vision.
Simple harmonic motion, 98-100.
Skills, military psychology, 5-8.
See also Selection.
Sleep,
conditions, 191f.
deprivation,
limits, 189-91.
symptoms, 188-90.
morale, 329.
need, 316.
requirements, 191f.
rhythm, 192.
Sloane, E., 96.
Smell,
adaptation, 132, 138f.
attention, 131, 134, 138f.
camouflage, 138f.
chemical sense, 131.
classification, 132f.
discrimination, 132.
flavor, 131.
ground sense, 130.
man's use, 130f.

Smell,
masking, 139.
mixture, 139.
object constancy, 134f.
prism, 133.
qualities, 132-5.
selective adaptation, 139.
sensitivity, 131f.
taboo, 130, 134.
taste, 130f.
threshold, 131f.
war gases, 135-8.
Smile, functions, 380f.
Smoking.
See Tobacco.
Social facilitation, learning, 282.
Social relations, military psychology, 9-11.
Sound,
analysis, 98-101.
auditory stimulus, 97-104.
camouflage, 126f.
conduction, 97f.
Fourier analysis, 98-100.
localization, 121-6.
nature, 97f.
Ohm's law, 99f.
resonance, 99f.
sensation, 101.
simple harmonic motion, 98-100.
supersonic, 103f.
transmission, 100f.
See also Hearing.
Special training.
See Training.
Spectrum, 64f.
Speech,
intelligibility, 116-8.
pitches, 115f.
Speed, visual perception, 46-8.
Stars, orientation, 161-3.
Startle response, 381.
Static sense.
See Vestibular sense.
Stereoscopic vision, 40-6.
Stevens, S. S., 129.
Study, rules, 287-9.
Sublimation, 400f.
Submission, leadership, 413.
Substitution, psychological mechanism, 353.
Suggestion,
leadership, 411-3.
post-hypnotic, 412.
Surgeon General, selection, 13, 18.
Sweating, efficiency, 201.
Sympathetic nervous system, emotion, 374-8.

Tachistoscope, 297f.
Taste, smell, 131.
Taylor, E., 500.
Tea, efficiency, 221f.
Teaching.
See Learning, Training.
Tear gases, 137.
Telephone communication, 115-8.
Telesteroscopy, 42-5.
Temperature,
body,
homeostasis, 199f.
radiation, 202f.
regulation, 200-5.
sweat, 201.
optimal, 205-7.
Terman, L. M., 409.
Tests.
See Selection.
Texture, camouflage, 84f.
Thalamus, emotion, 378f.
Thouless, R. H., 444.
Tiffin, J., 198.
Tobacco,
effects, 218f.
habit, 220f.
morale, 220f.
social value, 220f.
ulcers, 219.
visual acuity, 219.
wind, 219.
Tolerance, social, 501, 514-6.
Tonal Gap, 109.
Tonal island, 109.
Topographical orientation.
See Orientation, topographical.
Total war, 14f.
Trade tests, 245, 255.
Trades, general ability, 246-8.
Training,
all-around attack, 302f.
Army teachers, 300f.
coach and pupil, 307f.
English, 309.
feeble-minded, 309f.
illiterates, 308f.
leaders, 428f.
mass instruction, 306-8.
methods, 304-8.
military psychology, 7f.
monotony, 303f.
motivation, 301f.
physical handicaps, 309.
rapid, 301-4.
special, 308-11.
visual aids, 303, 305.
See also Learning.
Transfer, learning, 278-80.
Trial and error, problem solving, 350.
Trichomats, 70.
Troland, L. T., 50, 62, 96.
Truck Drivers, 260f.
Twins, 229f.

Uniqueness, camouflage, 79-81.
Utricle, 143f.

Vanderlehr, R. A., 409.
Veltfort, H. R., 22.
Venereal disease, 404.
Ventilation, 200-2.
Ventriloquism, 121.
Vernon, H. M., 198.
Vestibular sense,
  acceleration, 148.
  adaptation, 143, 146-50.
  aftereffects, 146-50.
  blind flying, 149.
  deaf mutes, 146f.
  habituation, 149f.
  illusions, 146.
  motion sickness, 150-2.
  nystagmus, 145f.
  physiology, 144-50.
  rail walking test, 150.
  rotation, 145-50.
Vision,
  accommodation, 24f., 37f.
  acuity, 27-32.
    smoking, 219.
  adaptation, 51-60.
  aerial perspective, 36.
  afterimage, 52f.
  autokinetic movement, 47.
  binocular parallax, 40-6.
  brain, 25f.
  camouflage, 74-96.
  clues to depth, 35-46.
  color, 63-9.
  color blindness, 69-74.
  color mixture, 67-9.
  convergence, 39f.
  fatigue, 32-4.
  focusing, 24f., 37f.
  glare, 30-2.
  height finding, 42-5.
  interpretation and depth, 36.
  light and shade, 37f.
  military use, 23.
  motor coordination, 48-50.
  night blindness, 57f.
  object perception, 63f.
  perception of movement, 46-8.
Vision,
  perception of speed, 46-8.
  perspective, 36.
  pseudoscopy, 45f.
  Purkinje shift, 56.
  range finding, 42-5.
  relative movement, 36f.
  retinal disparity, 40-6.
  sensitivity, 64.
  sensitivity curves, 56.
  size and depth, 35f.
  stereoscopic, 40-6.
  threshold, 51, 54-6.
  tridimensional,
    binocular, 39-46.
    monocular, 35-9.
  See also Eye.
Visual-motor coordination, 48-50, 150, 243.
Visual purple, 55.
Viteles, M. S., 198, 262.

Waitt, A. H., 140.
Walker, K., 409.
War gases,
  detection, 136-8.
  recognition, 135-8.
War Manpower Commission, 19.
War shock, 366-8.
Warden, C. J., 166.
Warner, L. H., 166.
Watson, G., 343.
Watson, J. B., 166.
Wavell, A., 430f.
Wechsler, D., 263.
Weld, H. P., 50, 62, 96, 128, 152.
Weltfish, G., 516.
Wilkinson, G., 129.
Woodworth, R. S., 50, 62, 96, 129, 140.
Work decrement, 177-9.
Work habits,
  fatigue, 171-3.
  job analysis, 170f.

Yerkes, R. M., 22, 263.
Yoakum, C. S., 22, 263.
Young, P., 484.
Young, P. T., 394.

Zilboorg, G., 371.

National Research Council.
Psychology for the Armed Services.

BF121.N3.,c.1.
National Research Council.
Psychology for the Armed Services.

DATE DUE	BORROWER'S NAME	ROOM NUMBER