Innovators and Entrepreneurs: An Endangered Species? (1978)

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Innovators and Entrepreneurs—An Endangered Species?

Presentations at the Technical Session
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Foreword

This document contains the keynote presentations of the technical session held in conjunction with the Thirteenth Annual Meeting of the National Academy of Engineering on November 10, 1977.

Academy members Ralph Landau, Richard S. Morse and Kenneth H. Olsen discussed various environmental, financial, legislative and psychological factors in today's society that adversely affect the process of moving innovative technology from its conception to its introduction in the marketplace. The presentations were based on the personal entrepreneurial and management experiences of the speakers in the chemical, high-vacuum and computer industries. Inductive in approach, they were intended to identify problem areas as well as remedial approaches deemed necessary to revitalize the art of innovation and entrepreneurship in both new enterprises and large corporations. The papers reproduced herein represent the views of the authors; they are being published by the National Academy of Engineering in response to many requests for copies received subsequent to the meeting at which they were presented.

In the first paper, Dr. Landau presents a case history detailing his personal entrepreneurial experience in the chemical process industry beginning shortly after the end of World War II. He includes some observations on the continuing interest in entrepreneurship as evidenced in the student bodies of universities with which he is presently associated. This interest and desire continue despite various barriers to innovation imposed by the government, which Dr. Landau classifies as regulatory, tax, inflation and uncertainty. He discusses each of these categories and offers suggestions for ways to eliminate or moderate the effect of these governmental barriers to innovation. Dr. Landau concludes with some ideas on organization for innovation, recognizing the continuing need for entrepreneurship, risk-taking and innovation.

In the second paper, Dr. Morse presents some general observations on the state of the national environment for technological innovation and generation of new technical enterprise. He notes that many factors in the national en-

vironment, encompassing the government and industrial sectors and probably the academic community, have changed to produce adverse effects on innovation and entrepreneurship. Three major factors influencing innovation—government R&D, new enterprise generation and the industrial environment—are discussed. In conclusion, Dr. Morse presents results of a broad survey on these subjects including the opinions of the principal executives and the directors of research of major US corporations, heads of selected small high-technology companies and venture capital organizations.

In the final paper, Dr. Olsen draws on his personal experience in the early days of computer development to provide a perspective on the current condition of the entrepreneurial spirit. His comments highlight the major points raised by Dr. Landau's detailed case history and Dr. Morse's general observations on the state of innovation and entrepreneurship. He concludes by recommending a positive attitude and encouragement for entrepreneurial investment as an important element in the economy of the United States.

The general discussion that followed the three presentations underscored the major current barriers to innovation and entrepreneurship highlighted by the speakers, including government taxes and regulations. However, other factors were cited as being of equal importance. These included productivity, technology transfer, labor and engineering education concerned with productivity and product development.

The Contributors

DR. RALPH LANDAU is a recognized entrepreneur by his industry. In 1973, the Society of Chemical Industry (American Section) awarded him the Chemical Industry Medal for "conspicuous service to applied chemistry", and in 1977 the Winthrop-Sears Medal for "chemical entrepreneurship" was awarded him by the Chemical Industry Association. Mike Hyde of London's *Chemical Insight* called him "one of the few true entrepreneurs of the manufacturing chemical industry". He is co-founder and chairman of Halcon International, Inc. Dr. Landau is a trustee of the University of Pennsylvania and a life member of the MIT Corporation. He is vice-chairman of the American Section of the Society of Chemical Industry, and a former vice president of that British society. He was elected to the NAE in 1972 and to its governing Council the following year.

DR. RICHARD S. MORSE, President and Founder of National Research Corporation, is a pioneer in the field of industrial applications of high vacuum technology. He organized Vacuum Metals, Minute Maid and NRC Equipment Corporations. He has also served in government for many years, including positions as Director of Research and Assistant Secretary of the Army (R&D); with the Department of Commerce; and as a member of the Defense Science Board. Dr. Morse has had a long association with the Massachusetts Institute of Technology—of which he is an alumnus—notably as President of its Development Foundation and Senior Lecturer, Sloan School of Management. He also serves as director to numerous organizations. Dr. Morse was elected to the National Academy of Engineering in 1976.

MR. KENNETH H. OLSEN, a newly elected member of the Academy, is President of Digital Equipment Corporation, which he founded in 1957. This company has influenced in a major way the development of the computer field. In fact, Mr. Olsen is often called the "father of the minicomputer". The first fully transitorized computer, the TX-O, was built at MIT's

Lincoln Laboratory by the section which he headed. Mr. Olsen's public service has included appointments to the President's Science Advisory Committee, the Governor of Massachusetts' Management Task Force and the National Academy of Sciences Computer Science and Engineering Board. He is also a member of the MIT Corporation and a director of several other organizations.

Contents

Entrepreneurship in the Chemical Industry and in the United States

RALPH LANDAU

Brief History of a Technological Enterprise— Halcon International, Inc.

There are many definitions of entrepreneurship, but I like Norman Macrae's description of what it is not as well as of what it is:[1]

> [My critics say that I] confuse originality and innovative talent with business judgment and the sensible assessment of risk; [they say] it is the latter two which in ordinary language are the skills of the entrepreneur. Oh no, they aren't. Those are the skills of the banker. The role of the entrepreneur (the 'man who undertakes') is that, having identified a market opportunity for widgets or for some particular service, he strives every day to find a better way (sometimes an innovative way, sometimes an organizational change) of producing more widgets or more units of that service more effectively. There is a grave danger when that role is . . . lost in the recesses of business bureaucracies.

The entrepreneur, in short, brings people, money, concepts, skills and markets together to create something that did not exist before, and is profitable; that is essentially our company's role from our inception as a systems, multinational, high-technology organization.

However, the concepts of "systems", "multi-national" and "high-technology" used to describe our company's early beginnings had not yet been invented in our day. They evolved from experience and the needs of the marketplace. No ideology or preconceived philosophy has led to the wide usage of these terms, since in other entrepreneurial companies, too, they were responses to market needs. And this is the hallmark of the entrepreneur—he listens to the market, and shapes his strategy accordingly. Following is a brief account of how we evolved, leaving out many of the setbacks, frustrations, failures and heartaches that are the lot of the entrepreneur!

Our corporation, initially called Scientific Design and founded in 1946, provided the "systems" approach to design of chemical plants, adapting ideas from the pre-war period as applied to petroleum refining. We perceived a need for organic and petrochemical technology as a result of World War II. The greatest areas of devastation (Europe, then Japan) offered us broader market opportunities than a more prosperous US; hence, the early introduction of the "multi-national" aspect of our work. And, because we knew that innovation and proprietary high technology had been the keys to the successful development of roughly comparable companies like UOP and M. W. Kellogg in the petroleum field, we started our own original research early in our career (1947) with a laboratory on 32nd Street near Park Avenue in New York. Our direct oxidation ethylene oxide research was commenced there; we realized that the chlorhydrin process used since World War I to make this valuable chemical would have to become too expensive and we considered this a challenge to our technical skills (although the discovery that ethylene could be oxidized with molecular oxygen over a silver catalyst had been made in the '30s by Lefort in France and commercialized shortly thereafter by Union Carbide). Since then we have licensed 30 companies, designed 66 plants in 24 countries, and they provide more than one-third of the world's installed capacity. Evidently our understanding of the requirements of the market was not mistaken.

Nevertheless, in the first five years of our existence, we hung on literally by our eyeteeth. Without any capital resources of our own (so typical of young technological companies), we could sell only services and ideas. Then came our first US engineering work, and a bit later (1954) our first really original chemical discovery—the bromine-assisted air oxidation of p-xylene to terephthalic acid (the main ingredient of polyester fibers), replacing the previously utilized nitric acid oxidant. We wanted very much to use this process as a basis for entering the manufacturing area ourselves, but couldn't quite muster the muscle. As an alternative, we sold the whole technology to Standard Oil Company (Indiana), where it now forms one of the principal businesses of Amoco Chemicals Corporation. Something like 6 billion pounds per year are currently made by Amoco and its licensees. So, by 1956 (the end of our first 10 years), we were moderately well known, and had some capital and new annual income.

Most of the income was invested in more research, which generated in 1959—among others—our second piece of original chemistry, the oxidation of cyclohexane in the presence of boric acid to make the basic intermediates for nylon, in much higher yield than had previously been attainable. We now have 1.6 billion pounds per year of capacity licensed to ICI, Monsanto, Rhone Poulenc, Farbenfabriken Bayer and Mitsubishi Chemical, among others. Also flowing from the research in this period came our maleic anhydride process, which accounts for approximately 60% of the world's capacity of that im-

portant chemical intermediate, widely used in resins, insecticides, etc. While this technology was not invented by us, radical improvement in the catalyst and the modernization of processing methods have led to the establishment of our widespread position in this product.

We had, a little earlier (1957), also formed a catalyst manufacturing company and entered the chemical plant construction field as well. The flow of royalties and other income thus building up permitted us to think once again about entering the chemical manufacturing business ourselves.

Our ticket of entry to manufacturing appeared when we invented a third piece of original chemistry (in 1962), the direct oxidation of propylene to propylene oxide, again in lieu of the older and universally employed chlorhydrin process, but by very different technology than that involved in ethylene oxide. This led to our reorganization to exploit it, by forming Halcon International, Inc. in 1963 (17 years after we started). Within three years, our changed mode of organization had successfully identified the best commercial opportunity for us, and led to the formation in 1966 of the Oxirane Group with the Atlantic Richfield Company. Thus, 20 years after our founding, we had created enough capital and technology to accomplish what we had hoped for since at least 1948, namely, the establishment of our own chemical manufacturing, without surrendering control of our enterprise to outside financial sources, via a 50:50 joint venture. Much has been written elsewhere of the extraordinary success of this effort in its first 11 years,[2] but once again I want to pay tribute to the imagination and innovative business skills of a great oil company, our partner, ARCO. These qualities are often difficult to sustain in large enterprises. At ARCO, the Chairman, Robert O. Anderson, is himself one of the leading entrepreneurs in the US, and this accounts significantly for ARCO's innovative spirit.

Since then our fourth major discovery has occurred (1968), in the form of our new high-yield direct ethylene glycol process, which has just started up at Oxirane. But we are also developing our fifth, sixth and seventh pieces of original technology, which we believe offer us opportunities for further diversification. We recently announced the organization of Halcon Chemical Company to focus the efforts of the Halcon Group on continuing to explore various forms of investment in our manufacturing. We are working on many aspects of the initial endeavors of this company, as well as other joint ventures (we have had one for several years in Brazil), and acquisitions, but we are confident that our original work to develop new processes for such products as vinyl acetate, methacrylic acid, methyl methacrylate, ethylene oxide, phenol, aniline and other important chemicals will lead to commercialization in a variety of forms in the future.

The foregoing brief account, it is hoped, will have some general meaning for others. I am not all that sure: we started at a particularly fluid moment

in history, when life was simpler, the needs seemed greater, and the now existing obstacles to progress from governments had not all been invented yet.[3] In short, I doubt we could start today and expect 31 years from now to achieve a comparable success in this very competitive and capital-intensive industry of ours. I have dealt with the current characteristics of this industry in a recent address.[4] Indeed, I feel it is virtually impossible now to enter the chemical manufacturing business, except in the specialty areas where capital requirements are low, unless one is already a large company. Luck will beat brains any time, and we were lucky in our timing. Nevertheless, I have some views of a more general nature, and I would like to put them down herein. My discussions over the years with many entrepreneurs, executives, financial experts, university economists, lawyers, government officials, technologists and other specialists have helped me in formulating what follows.

The Desire to be an Entrepreneur Still Flourishes

Entrepreneurship is not dead, is needed, and can be nurtured. In my academic experience as Adjunct Professor at the University of Pennsylvania, I have seen how eagerly young people today seek opportunities to go into business for themselves. At my other alma mater, the Massachusetts Institute of Technology, 25% of the graduating doctoral students in chemical engineering have similar desires. Both institutions are searching for ways to teach entrepreneurship. We at Halcon have funded a Professorship of Technological Entrepreneurship at Penn which will link the Wharton School and the Engineering School. Other institutions no doubt are active in this area. The United States is unique in this attitude, and I hope we will seek to encourage it in every way, although the paths will surely be different from the ones we followed. *Science* recently carried an article[5] on the reasons for the failure of West Germany and Britain to encourage growth of new companies based on technological innovation, yet these two countries were leaders in this activity in the nineteenth century! There is no permanent advantage for any country, unless it is assiduously cultivated.

The current changing climate in this country is best summarized in a recent article by Gene Bylinsky, who has specialized in studying the technological entrepreneur, and says:[6]

> Despite recent successes, the atmosphere in which all these entrepreneurs have operated is unquestionable less encouraging than that of the 1960s when new companies proliferated. . . This, of course, limits the opportunities for untried innovators.

Once a new company gets on its feet, it may need new capital for expansion, and since few enterprises can go public, many face the choice of either stagnating or selling out to large corporations. That limits competition in new fields.

Whatever the obstacles, the most talented of the entrepreneurs will find ways to win. . . Because the best of the breed is good at clearing hurdles does not, of course, mean that the hurdles–such as burdensome regulations and punitive tax schedules–are good for society.

It is my purpose in this paper to add my own verification and amplification, based on direct experience, to Bylinsky's astute journalistic observations. Entrepreneurship is fragile, and requires, even more than big companies do, the creation of a climate that is uniquely favorable, for it to flourish.

Barriers to Innovation from Government

I have said in previous papers,[7] in chorus with many other businessmen, that there are excessive and unnecessary barriers to innovation imposed by governments, which barriers may be classified as regulatory, tax, inflation and uncertainty.

A. REGULATION

Society must have some regulation, and there always has been. For example, businessmen have never been allowed to shoot the competition's chief executive or burn down his building. Where a society concludes a particular minimum of social behavior is necessary in the marketplace, the rules must be binding on all so that no one competitor can have an unfair advantage. Thus, there exists a legitimate basis for regulations as to child labor, pollution, sales to potential enemies, unsafe factories, toxic or otherwise unsafe substances or products, and the like.

However, it is essential that regulation-makers come to understand that every regulation has its price and its practical limits–in the cost people pay for the goods and services produced, in competitive posture worldwide, in impact on jobs and in possibly stifling new investments that, if successful, can mean a better quality of life for our people. In other words, there are always tradeoffs and each must be carefully weighed, debated and decided. As the *National Review*[8] put it, "The [Federal Drug Administration's] saccharin ban crystallized a well-nigh universal anti-regulatory sentiment that had hitherto been confined to highbrow journals. . . Even *The New York*

Times joined the roaring masses: 'Consumers want safety, but total, absolute safety–assuming that were possible–would have as its price a bureaucracy of staggering cost, reaching into every corner of American life.' "

This saccharin episode thus dramatized for the public at large what the business community, the economy generally, and especially the entrepreneur have long suffered from in obscurity. As an example, E. A. Gee, Senior Vice President of du Pont (the largest chemical company), recently made the following statement:[9]

> [Du Pont's] expansion and modernization program for the next ten years will be capital-limited. We expect to have about $10 billion available. Air, water and noise pollution abatement facilities will soak up $3 billion of that amount if present trends continue–30%, up from the 12% estimated for this year. Three billion dollars spent on productive capacity would, incidentally, build the equivalent of about 27 new plants and directly create in du Pont over 20,000 jobs, and about $4 billion in annual sales.
>
> Now, here's the punch line–three quarters of the $3 billion will be unjustified in terms of environmental improvement–in short, it will be wasted. And it doesn't end here–annual operating costs for environmental facilities by 1985 will be over $1 billion–about 8% of sales–unless the present trend is changed.

If this is du Pont's situation, one can imagine how smaller and especially new companies would be affected!

The Small Business Administration (SBA) was created in an attempt to aid smaller business. But, as *Fortune* says:[10]

> The main capital-raising problems plaguing small businessmen today are created largely by government itself, through programs and policies that have rendered investment in small businesses less and less attractive. For one thing, as the spread between the maximum federal tax rate on capital gains and ordinary income has narrowed, the individual has lost a lot of his incentive to sink money in risky small businesses. Smaller pension funds, which many hoped would become a major source of capital for small business, have just about stopped investing in risky ventures because of highly restrictive fiduciary standards set by the Employee Retirement Income Security Act (ERISA) . . .
>
> The simplest solution to this problem is not a government loan program. It is to reform the tax, pension and other laws that increasingly weigh on small business . . .
>
> Another genuine need of the small-business community is for relief from the large and growing burden of government regulation. The SBA's loan

programs for regulatory compliance seem a roundabout way to get at this problem, and in any event they do nothing to ease the nonpecuniary costs of regulation.

There just must be some way that the businessman (and those financing him) can have reasonable assurances in advance of investing thousands or more likely millions or billions in a product, process or plant, that he won't go broke after proceeding in good faith, because the rules of the game change in the sixth inning. The *speed* with which the ground rules have been changing in the last decade has had a great deal to do with the declining growth rate of the economy, which for private plant and equipment, excluding pollution control expenditures, was an average 4.3% per year in 1965-70, 3.3% in 1970-75, and may be expected to decline further to 2.5% per year in 1975-77.[11] Dr. Charles L. Schultze, now Chairman of the Council of Economic Advisers, has recently written a very interesting analysis of some of these problems,[12] and favors economic incentives over regulations wherever possible.

An entrepreneurial company often finds that premature "going public" soon alters its innovative attitudes, and the management, under SEC* and other external pressures, shifts to a short-term and less risky strategy, often to the detriment of its long-term growth and innovation. Privacy is a great help to boldness, but if boldness is to be sustained over longer periods of time, the investors must be confident that ultimately they will be rewarded by financial gains.[13] Here, tax considerations are playing a major role, and these are examined in greater detail below.

B. TAXES, CAPITAL FORMATION AND TECHNOLOGY

It is no secret that if the nation is to get the capital investment it so desperately needs, the tax laws have to be revised. We are faced presently with a sick situation, and Wall Street is sending us a message which is not capricious.[14] A 1975 US Treasury study showed that for 1960-1973 the US ranked last among the seven principal industrialized countries in business fixed investment as a percent of real gross domestic product, last in rate of percentage growth in productivity and next to last in percentage gain in output growth. It is the belief of the business community and many economists that investment has lagged because the real after-tax return on investment for non-financial corporations (adjusted for inflation) has declined from 7.3% in 1955, and 9.9% in 1965, to only about 4% in 1976.[15] This is the real message of Wall Street, according to Dr. Arthur Burns, for a long time Chairman of the Federal Reserve Board.[16]

*Securities and Exchange Commission.

These figures are based on using replacement capital costs in computing return on investment. While this is a legitimate attempt to correct for inflation, there is some disagreement whether such a calculation is the best way to express it. In particular, it is clear to a technologist that most plants, if replaced today, would not involve the same technology or scale, so that any precise estimate of the effects of inflation by these types of calculations is unattainable. Far more important in the plans of investors and business are the calculations regarding the profitability of *future* investments, and these are further discussed below. Nevertheless, businessmen do make their forward investment plans in the light of past experience, and there is considerable evidence that profitability has lagged in recent years[17] and that the capital requirements of this country in the near future will require a substantially higher level of investment.[18]

The recently concluded report by the National Academy of Engineering on technology and foreign trade[19] stresses as a basic conclusion that the US must examine its capital formation and productivity processes so as to improve its innovative capacity. As a participant in this study it seemed logical to me to start doing just that in this article.

The annual productivity growth rate of the American economy fell from 2.4% in 1965-70 to 1.0% in 1970-75.[20] There are many reasons for this drop, such as the deficiencies in the capital formation process described herein; social attitude changes; union restrictions; the increase in the proportion of the GNP represented by government at all levels; and increase of the service sector at the expense of the productive sector—the service area being notoriously a difficult one in which to increase productivity, let alone maintain it. *Fortune* calls all these factors "social drag".[21]

Yet, without a productivity increase of an adequate amount each year, our regularly escalating wage demands, farm price supports, higher overhead costs such as more services, military, health, pollution control, education and other social expenditures, etc., must result in inflation. At the same time the balance of payments problems likewise become enlarged. An extraordinarily perceptive analysis of these worldwide trends is contained in a speech given recently by J. A. Boeckh.[22] As the late Philip Sporn said,[23] "Everything, everything in the way of improvement in human society that came about within the 200 years that we've had since the start of the Industrial Revolution in England, *everything* has come out from only one source and that is increased productivity of the human being."

It follows, therefore, with political and governmental realities as they are, that only major improvements in the productivity of the private sector can hope to offset inflation and ultimately unemployment (or to pay the cost of the latter). This, of course, is partially possible by conventional capital

investment to improve labor productivity, but even if the present inhibitions regarding capital formation are ameliorated, this effect is still low relative to the need. Most industries–such as steel, textile fibers, cement, housing, autos, wood products, etc.–are mature in the sense of requiring a lot of capital for even small increases in productivity, not to mention capacity. But the return on this capital under present conditions cannot be expected to induce risk-taking or indeed any new investment in most cases.

While not neglecting existing older industries, clearly what is most needed for the economy as a whole is a greatly increased capital investment in the *newer* industries, particularly those having a high technological component, with, if possible, a lead over other countries in the world. This happened after World War II, with the burgeoning of chemicals and pharmaceuticals, and the creation of new technological industries like computers, modern agriculture, instant reproduction, telecommunications, jet transport, transistors and silicone chip systems, electronics, nuclear systems, aerospace, fast foods, etc. These are now also approaching relative maturity, so that we need more new ideas and enterprises. Furthermore, it is well documented that big companies do not create such new technology as frequently, but generally tend to improvement of the old, although there are many advances which cost so much that only big companies can participate in such projects. Also, smaller companies tend to provide more employment; large companies, it is well known, can often expand by better usage of their existing employees. We need companies and industries with radical new ideas and technology, and the infusion of new technology even into the older industries such as steel, copper, aluminum, energy production and consumption, agriculture, airlines, etc. All of this takes a lot of encouragement in capital formation, and entrepreneurial growth. Government cannot do the job of the private sector, but it can create the climate which will be required.

Technology is also a key factor in improving the environmental and safety aspects of our society. In our industry, and indeed directly in our own discoveries, more efficient processes are also the ones that pollute the least and are the most energy-efficient, and as described above, some of these replaced toxic oxidants with either air or oxygen. Generally, it is the older industrial establishments which have the greatest environmental and energy problems and the solution to these (often a very costly one, as in steel) also requires more capital formation and higher technology. But here, also, we see the contradictory effects of different regulations and policies as inhibitors of progress. The current clean air "offset" requirements that "old pollution" be reduced before new plants can be built in the area means that "old polluters" have been granted a high value by the law, under a sort of grandfather clause, whereas the new, efficient, less polluting plants (such as those

I mentioned above) cannot easily be built, except in remote locations far from the existing infrastructure such as modern industry demands. This further penalizes the economies of our larger cities and industrialized areas. Since these new plants also require much more capital than the depreciated older plants, it is difficult for business or investors to justify so long-term a risk as these new technologies represent. With energy, the environmental regulations have a different but no less stultifying effect: substitution of "clean oil" by "dirty coal", which the nation's economy requires, is retarded.

The relationships are complex indeed, but the overall conclusion is clear to me. There has to be a recognition at the highest levels in the United States that a trade-off is necessary between encouraging new risk-taking wealth among corporations and individuals—wealth that will translate into investment—and the desire for equity and redistribution of income. Considering the great need for break-throughs, this trade-off will have to be settled largely in the direction of wealth creation and new entrepreneurial incentives by tax reduction and regulatory reasonableness. *Nothing else will realistically work.* This wealth formation is not being encouraged for its own sake, but because it is the only way the country's economic and social welfare can be improved—for all the people—in a free society. Dr. Schultze has also said this eloquently in other words:[24]

> The final virtue of market-like arrangements that I wish to stress is their potential ability to direct innovation into socially desirable directions. While the formal economic theory of the market emphasizes its ability to get the most out of existing resources and technology, what is more important is its apparent capacity to stimulate and take advantage of advancing technology. Living standards in modern Western countries are, by orders of magnitude, superior to those of the early seventeenth century. Had the triumph of the market meant only a more efficient use of the technologies and resources then available, the gains in living standards would have been minuscule by comparison. What made the difference was the stimulation and harnessing of new technologies and resources.

There is a growing recognition of the validity of these interrelationships. One recent example is the policy paper by the NAACP* which supports energy growth and the application of technology thereto because of the clear recognition that only in a growing economy amply supplied with energy can jobs be found, particularly for their own constituency which has very high unemployment, and also for others of the American working population.

Another example appears in an interview given by the newly appointed

*National Association for the Advancement of Colored People.

Chairman of the Federal Reserve Board, Mr. G. William Miller, to *The New York Times* on January 8, 1978:

> Last January, I noted . . . that one of the best places to stimulate the economy is in capital spending, and I pointed out that one of the larger capital spending periods in our history came in the early 1960s, when capacity utilization was quite low. I argued that low capacity utilization was not necessarily a barrier to creating conditions that would stimulate capital spending. Our plant and equipment in this country is 'way out of date in comparison with some other leading nations . . . I still feel the same today. One of the soundest approaches to continued expansion and job creation, which would not generate inflation, would be to create those kinds of conditions that would encourage business enterprises to expand their capital spending.

In this succinct statement he refutes effectively the arguments of some academic economists (like Lester Thurow in *The Economist* of December 24, 1977) who forget the role of technology and international competition, and believe our existing idle capacity requires no urgency of capital formation. Nevertheless, it is important that businessmen and economists learn from one another, and engage in more such extensive investigation of the realities of our technological age and of our free enterprise society.

My experience and observations, as summarized in this paper, clearly support Mr. Miller's thesis. Efforts at equity for those able to work should be largely concentrated on structural problems for the next 10 years, such as on the hard-core unemployment situation, remedial education and assistance in labor adjustment and retraining of displaced workers, without major new general spending programs. The reward system all the way up the ladder must be intensified. And the growth in government spending (which has contributed to the decline in productivity growth as mentioned above) must be steadily but not suddenly reined in, not only to make possible the necessary tax reductions but also to remove the inflation effects of chronic budget deficits, while the productive private sector of the economy recovers its dynamism. A convincing comparison of the productivity of state employees in the UK and the US versus those in private enterprise was recently made in England.[25] Another such study which deals directly with this issue and the impact thereon of technology was also published recently in London.[26] In a review by *The Economist*[27] of this book, two very important points are made:

> . . . Mr. Harlow only skirts the most important question of all: if the growth in productivity depends on technical change rather than capital intensity,

on the quality of investment rather than its quantity, why create state monopolies which can stimulate growth only if they can reproduce the conditions of competition by their own volition? Surely there must be an easier way.

Indeed there is, and it is the American system thus far, if we will only have the insights to improve and protect it!

If one estimates that the average GNP growth in real terms over the last decades has been perhaps 3.5% per year, technology has contributed somewhere between 25-50% of this growth. The effect of technology on productivity growth is treated as a "residual" by economists after calculating labor and capital factors.[28] Notwithstanding the general inability of econometricians to measure this factor with precision, it is clear that technology advances are a key element of healthy, sustainable growth.[29] Indeed, this matter is of such importance that I feel one or more of our leading universities should seek to set up professorships and programs in the *economics of technology*. For example, how much of our postwar GNP growth is due to the computer? The scholars who can answer such questions, and develop the intellectual framework for the subject, would surely merit a Nobel Prize or two!

It is also a fact that consistently about three-fourths of our manufactured goods exports have been technologically intensive while roughly half of our manufactured imports are in this category.[30] If agricultural products are counted as technologically intensive, and in my judgment they surely qualify, then obviously the impact of technology on our exports is substantially greater than 75%.

In my opinion, it is unassailable that technology is at the heart of our national dilemma, and that money in the private sector (capital and incentives for its formation) is the key to unleashing it. This in no way denies that there is great need for general national support of research and development, both basic and applied, from which the new technology will come. Nevertheless, it is my long-term experience that leads me to state unequivocally that technology and its interface with government policy (e.g., taxation and regulation, including anti-trust), require an urgent change in approach, with the creation of new and greater financial and tax incentives, and with more reasoned government intervention. A recent National Science Foundation Symposium[31] has focused extensively on the improvement of our research and development efforts, and the role that government policy might play in bringing this about. Its head, Dr. Richard Atkinson, recently estimated that perhaps 40-50% of our growth in GNP comes from R&D.[32] If he is right, the urgency of really understanding the economics of technology is underlined. In any event, it is my observation that the best way to increase private R&D spending is to allow an increase in profitability of the private sector, so that

even if the percentage of profits for R&D spending remains constant, the absolute amount will rise. With higher profitability, the fruits of R&D will be more quickly realized, and new investment in such technology will also become easier to justify.

It is certainly true that some of the new wealth that would be created by the tax relief measures I will propose might turn out to be employed in less useful investments than would be optimal, but this is an inevitable consequence of the alteration in economic climate. Old wealth tends to be conservative and non-risk-taking; new wealth tends to support new ventures, growth stocks of the riskier types and new technology investment. A healthy stock market would be a reflection of such underlying changes.

I am not a tax expert *per se,* although an expert in paying taxes! However, here are some ideas that make sense to me in implementing the foregoing considerations, based on my experience, and I think they at least deserve some serious debate:

a. We should stop applying the corporate income tax to profits that really aren't profits at all. For example, depreciation allowances usually don't generate enough cash flow even to replace existing facilities, let alone construct better ones. There are various ways of taking care of this matter—faster writeoffs, indexing depreciation schedules to inflation and others—but whatever the technique, that problem must be solved.
b. We have been hearing a lot about getting rid of double taxation of corporate profits through "integration", etc. This is a very complicated issue,[33] and there may be some real mine fields in how financial markets would actually respond. But, at the very least, it would make sense to reduce the corporate tax rate substantially while the whole integration idea is being thrashed out. After all, the lower that tax, the lower the doubling effect.
c. It should finally be recognized that there are legitimate reasons to tax long-term investment income differently from earnings realized every year. The patient risk should be rewarded, and at the very least, the fact that because of inflation the dollars received on sale of the investment won't buy as much as the dollars invested and reinvested over the years, should be taken into account. Maybe what we need is to get rid of the term "capital gains treatment", and substitute something like "AFRAI", meaning "Adjustment for Risk And Inflation". It is not too well known yet that the Revenue Acts of 1969 and 1976 have raised the capital gains tax maximum rate from 25% to over 49%, which applies to many transactions of this kind. Taking into account the patient risk, inflation and lack of yield before sale which an investor in a new or growing enterprise must face, this

tax level is a capital levy of a confiscatory nature, and is a gun pointed right at the head of such enterprises. While this trend in taxation may not be directly coupled with the decline in new equity issues since 1969, as the following table[34] shows, there is no question that there is a close relationship:

Year	New Issues
1969	1298
1975	24
1976	50
1977	25 (to mid-year)

The total value for these 1977 issues was $230 million, compared to $3.3 billion in 1972, and much more in the '60s. This poses severe problems in the venture capital field.[35]

A further example of the steady deterioration in venture capital investment is seen in the fact that in 1972 there were 418 underwritings for companies with a net worth of less than $5 million, and which raised $918 million; in 1975 there were four such underwritings totaling $16 million. Over the same period of time similar offerings under the SEC Regulation A fell from $256 million to $49 million, and many of these were unsuccessful.[36] I understand that leading investment bankers today won't touch a public issue unless the company has had earnings over $2.5 million per year for the last seven years. What fledgling enterprise can expect to show that kind of record for many years? Some investment advisers tell their readers "stay out of new issues altogether".[37] To be sure, there are potential sources of capital available to the venturer other than Wall Street, such as a few large companies which have policies supporting venture capital subsidiaries, and other venture capital organizations (many of which have become bureaucratized), but it is the general climate in the largest risk-taking capital market which fundamentally sets the tone of the venture capital markets as a whole. And the basic liquidity which every venture capitalist ultimately seeks can only be found on the Wall Street markets, or by a sell-out to large companies.

Some very significant reduction in the effective tax on sales of assets held for true investment over a longer period of time is required, such as a declining rate scale on a sliding basis with length of holding. This distinguishes between profits made in short-term trading of securities, and true longer-term risk-taking investment. Other ways can no doubt be found to accomplish the same end-result. The US, that bastion of free enterprise, taxes "capital gains" at the highest rate among industrial powers. For example, West Germany and Japan have none; the French and British are much lower; the Swedes have no tax when property is

held longer than five years. Obviously, other features of the economies of these countries may well provide countervailing negative influences–but there is no ideological or practical reason why the US cannot adopt good ideas from any source–and certainly these countries have concluded that lower capital gains taxation is beneficial. One reason may be their greater experience than we have had with inflation and higher personal income taxation brought about by social policy, which makes them more conscious of the patient investor's need for incentives to invest at all.

d. Next, let's get rid of the term "unearned income". I'll make no bones about it: I think anybody who saves and invests "earns" his income from those savings. If there is outrage that by investing in tax-free bonds for schools and housing projects for the poor, by charitable giving, by investing in dry holes, etc., a small number of wealthy people (for those with incomes over $30,000 in 1975–perhaps 19,000 out of, say, 82,000,000 individuals who file tax returns or 0.09% and some 61,000,000 who pay some tax!) end up paying no federal income taxes, then so be it. Impose some minimum income tax on them. But, let's not tax income from an investment differently from income from daily labors on some theory that investments are not as important as daily work; both are vital. Progressivity? Sure, but do it through the tax tables, not by pretending the yield on investments, whether interest, dividends, royalties or rents, deserves to be hit harder.

Yet, it should not take great imagination to visualize that a tax structure which taxes so-called "unearned" income the same as "earned" income but gives no tax advantage to "capital gains" as opposed to other kinds of income, will result in a total destruction of the riskier growth stocks (perhaps not of the IBM's which can be safely bought by institutions). It is obvious that investors confronted with these ground rules would gravitate strongly toward high-yield safe securities, mostly bonds or other debt instruments, and not stocks–particularly stocks of risky new technological enterprises. The incentives to take risks would simply evaporate, and that is why there is and would be a dearth of risk capital. The most important single point in all this is that, whether the government tax experts agree with this assessment or not, it is nevertheless what the investor will perceive, or be advised–and in Wall Street it is the perception that counts, not necessarily the underlying reality, as so many frustrated investors know to their sorrow. An example of only one among many market letters which are passing out such advice to the public is given in McGraw Hill's *Personal Finance Letter* (PFL) of September 5, 1977:

. . . What's more, Carter's new tax package, which might end the preferential tax treatment of long-term capital gains, would make bonds even more

attractive [emphasis in original]. Under the Carter tax proposals [then under consideration within the Administration],* capital appreciation in a stock, which historically accounts for a hefty chunk of an investor's total return, would be taxed at the same rate as interest income (PFL, August 22, 1977). That would kill much of the incentive to take risks in the stock market. Hence, investors will probably turn to bonds because they're not as risky as stocks and generally have a higher yield. And that's already the name of the game. The promise of future earnings increases or capital gains no longer carries much weight.

e. Stock options, *per se*, have for a long time ceased to have much incentive for most company employees and managers because of the unfavorable trends in capital gains and other taxation as well as the decline of the Wall Street markets generally. Recent trends to treat the appreciation in the stock as earned income have renewed interest in such arrangements, but the absence of a healthy equities market for the companies' stocks is still a serious obstacle. Yet, a new entrepreneurial company needs stock options, stock sales or the equivalent to attract able personnel in the absence of ability to pay high salaries, pensions and other perquisites.
f. We need to expand the provisions that allow ordinary loss if an investment goes sour. This is vital to the entrepreneur, and he needs special help.
g. And let's stop talking about "loopholes". One person's loophole is another person's "social incentive". Let's look at the host of these incentives on the books. If some have seen their day and are no longer needed to foster this or that economic or social goal, then let's get rid of them. But if they are needed—or indeed need enlarging—to meet current goals (and that includes more capital formation in the private sector and especially more help to the budding entrepreneur), then let's not be afraid to provide those "loopholes", those incentives that will get the job done. As *Barron's* points out,[38] the US government has steadily widened the greatest tax "loophole" of all, the personal exemption and the standard deduction, expanding thereby the number of those who pay no levy to Uncle Sam (now including the approximately 20,000,000 who file but pay no tax at all). This increases what *Barron's* also says has been called "representation without taxation"! Why should there not be, perhaps, some kind of a small minimum federal tax on all citizens, also, so that they too make a contribution to the cost of their government? Perhaps a better system would be a lower ceiling on

*These were widely discussed at the time the advice was published. More recently, the Administration has been signaling a change in its tax proposals for 1978, but this does not affect the point that what the investor perceives must be carefully studied; and the past damage to capital gains taxation as well as proposals to end its remaining preferential treatment were facts when the advice cited was published.

all taxation coupled with a negative income tax, which would reduce much of the welfare and unemployment still unfortunately too widespread in this country.

C. INFLATION

Wall Street is now increasingly an institutionalized market because our tax structure in an inflationary era is inimical to individual investment in equities. As *Business Week*[39] put it:

> Before secular inflation took hold in the 1960s, the total return on stocks had averaged 9% a year over 40 years, and AAA bonds, while infinitely safer, had hardly ever paid more than 5%. Now, with secular inflation in the saddle, the situation is reversed. The annual total return on stocks over the last two market cycles averaged less than 1%. AAA utility bonds–still infinitely safer–yield more than 8%.
>
> Seeing the writing on the wall, in fact, individual investors have been bailing out of stocks and getting into safer securities. Even with a rally as strong as last year's, figures compiled by Merrill Lynch, Pierce, Fenner & Smith Inc. show that individuals continued to take their money out of the market. Since 1969 they have taken $79 billion in cash out of the stock market. Since 1973 more than 7 million individual shareholders have ceased to 'own a share of American business.' . . . Institutional investors, by contrast, have stayed with stocks. . .

Whereas years before, individuals accounted for about 70% of the trading in securities, financial institutional trading is now 54.7%,[40] and is growing at the expense of individuals, who were responsible for only 23.1% in 1976 (the remainder was by Wall Street member firms, not strictly speaking investors, trading for their own accounts); yet it is individuals who are most likely to take the risk in financing new entrepreneurial companies. Of the $230.4 billion of primary debt and equity issued in 1976, five out of every six invested dollars were institutional.[41] Institutions are not only bureaucratized, they are bound by ERISA rules and others to invest very cautiously. But the personal income of the individuals who used to be so active in the stock market continues to be taxed at highly graduated rates, and this, coupled with other factors such as those discussed in this paper, largely accounts for the foregoing shift in trading patterns. Thus, the Tax Foundation surveyed 1975 tax returns and found that the highest 10% of the taxpayers, earning $23,420 and over, paid nearly 50% of the total federal income tax bill to individuals. Five percent of the taxpayers, earning $29,272 and over (and it is this category which was most likely in the past to invest in riskier equities)

paid more than one-third of the revenue, while the lowest 50% of taxpayers accounted for only 7%, as an expert on capital formation for new ventures, Alvin Zises, pointed out in *The New York Times* of November 13, 1977. It is also interesting to note that whereas for all taxpayers the percent of adjusted gross income which was paid in taxes was slightly under 14%, this number rises rapidly until above $100,000/year adjusted gross income it becomes just under 40%, and in the higher brackets just under 50%, even with all the deductions and incentives the present tax code permits in order to increase our economic efficiency.

There is certainly a close relationship between the better entrepreneurial record of the US versus Western Europe and Japan, and the relatively better control we have had until recently over inflation. It's tough enough to face the uncertainty, the inherent risks, of new products, new processes, and new plants, even in the best of economic climates; today's is very far from ideal! But we must take further steps to ensure that the proper conditions for risk-taking will prevail in the future.

Inflation is now a major concern of the accounting profession, with unpredictable results. For example, the recent attention to unfunded pension liabilities will result in due course in further incentives to limit employment and declines in stock market values as investors realize the potentially large magnitudes of these liabilities. As a result of inflation, these are almost equal to corporate net worth in many cases, and may exceed market value of the stocks by several fold.[42] The burden of these liabilities has been placed on the shareholders by ERISA.

Inflation can only be solved by governmental action that creates a favorable climate for new investment to produce more and better goods and services and that gets rid of large government deficit financing as a way of life. Indeed, Ambassador Kingman Brewster, former President of Yale, puts it even more bluntly:[43] "The inflationary bias of representative government seems to be the greatest threat to the survival of a democratic political economy." So we are back to the other parts of this section, and the vital importance of encouraging capital formation in freedom. Again looking abroad, we find that while Britain makes it almost impossible to become rich out of income, West Germany allows people to become rich only to discourage them from using that money creatively to set up new companies.[44] In fact, the German equity market is largely dominated by a few large banks, a situation which is not permitted in the US. Herein lies the American opportunity!

D. UNCERTAINTY

Perhaps above all else, business (large and small, but particularly the entrepreneur) needs a higher degree of certainty by way of general economic and

legal climate than we have seen over recent years—e.g., price and wage controls, changing energy rules, changing tax laws (usually for the worse), increasing opportunities for time-consuming (and often unfounded) litigation, overlapping and frequently contradictory regulatory rulings by different federal agencies and changing accounting principles. The only exception I can see to this need for certainty is inflation, where the problem is too much certainty—growing feelings that inflation is here to stay. As George Will has said,[45] "It is said business is reluctant to invest because of 'uncertainty'. Actually, business reluctance reflects the virtual certainty that inflation will remain intolerably high and that government will require corporations to devote more resources to environmental and other social purposes."

No democratic government can or should try to iron out all of the bumps in the economic road. There will be periods that are better than others and that's a risk that has to be taken. But a free-enterprise democratic government does have the responsibility of not moving in fits and starts, by applying short-term fixes to long-term problems, changing direction like a broken field runner. The proposed Congressional solution to the saccharin problem mentioned above seems to be an 18-month postponement in lieu of tackling head-on the totally unscientific Delaney Amendment. The government should confine itself primarily to the macroeconomic sector and the correct policies to aid the supply side of the economy, and leave the detailed decisions—the fine tuning—ranging from such minutiae as OSHA's design for safe lavatories (now mostly rescinded) to wage and price controls for thousands of firms (abandoned not long ago) to the pluralistic wisdom of the market and the individual enterprises. As Tom Wicker describes it so well in *The New York Times* of November 13, 1977,

> . . . a businessman trying to make his investment and spending plans at this point does not know whether to expect tax reduction or tax reform—with all its uncertainties—or how much of either. He does know he faces a big Social Security payroll tax increase, higher minimum wages and probably some form of new energy tax. All three will have inflationary effect, and the prospect also is for somewhat higher interest rates. . . No wonder business is looking for a Carter economic policy that it can count on.

An insightful analysis of the secular and cyclical changes which have taken place in the investment climate is given in a recent study by a prominent Wall Street firm.[46] They point out that in recent years investors in stocks have come to demand a higher risk premium over bond yields, citing such factors as inflation, the strains on the international lending institutions and on trade, the rising tax burden on the productive sector of the economy, the decline in the quality of earnings and assets brought about by the rapid buildup in un-

funded corporate pension fund liabilities, the problems of the Wall Street firms themselves, etc. Thus, investors today are emphasizing risk and return, rather than return exclusively. And if the risk premium is unusually great for investment in large companies, then it must become astronomically high for new risky enterprises, and this is why so few can "make it" or even get started today.

The former Chairman of the Council of Economic Advisers, Alan Greenspan, has also written about investment risk assessment by business today.[47] He says, "Thus, the critical focus of economic policy in the western world has got to be to reduce these abnormally high risk premiums. They have created a private decision-making atmosphere which gives short shrift to long-term benefits and costs and undue emphasis to the short run." He stresses that because most Western governments have been activist in policy and will not reduce such intervention overnight, it is all the more important to lower taxes on business and capital. These cuts, he says, are not a "permanent substitute for lowering risk, but to the extent that after-tax returns to capital are increased, they will offset some of the high-risk (discount) in the investment process . . .There is no substitute for a non-inflationary environment if prosperity is our goal." Another expression of this viewpoint was also contained in the *1977 Economic Report of the President* (p. 28).

I have been and am involved with many such investment decisions both as a shareholder and as a chief executive officer, and I can only confirm the truth spoken by these authorities on the subject. Entrepreneurial risks require a longer time horizon than is currently demanded by investment and uncertainty conditions today—about a four-year span, which accounts for the currently low price/earnings multiples. In a recent speech in Vienna[48] I amplified some of these subjects as they affect the international chemical industry investment patterns. Another example from current industrial real-life situations may be found in the aluminum industry. It is no secret that new technology is within reach to permit utilization of the abundant domestic clay resources instead of imported bauxite, which therefore would contribute greatly both to national security and the balance of payments. But the inflationary bias of our economy is reflected most acutely in the rapidly escalating costs of building new and risky capital projects of this kind. In addition, the long range policy of the US with regard to the structure of power costs and pricing, choice of fuels, environmental restrictions, forced recycling, etc., is undecided if not contradictory. Any such conversion of the aluminum industry to domestic raw materials requires not only adequate profitability expectations such as a closer approach to replacement pricing (taking the competition from other materials into account) but a reduction in the uncertainty levels so that longer range earnings need not be so heavily discounted as at present. There are examples like this throughout the US, in old as well as new enterprises.

Organization for Innovation

I am convinced organization has a great deal to do with the way any company can succeed in innovation. The top management should be actively and personally involved in the business, *and* the technological leadership and planning. Professor Bradbury put it very well in his paper, *Constraints to Innovation:*[49] "Effective leadership today demands not the good practical man, but the well-trained and broadly trained professional."

From the very beginning, Halcon was managed primarily by technically trained people, chemists and chemical engineers. Our CEO is the man in charge of strategic planning, but we have chemical engineers right in the laboratory, working with our chemists at every stage of process development. Again, to cite Bradbury, "Without an explicit strategy, well understood at the laboratory bench as well as in the board room, the failure rate in innovation may be unacceptably high and ruinously expensive." We have followed this concept from our inception. When you are under-financed, as we were for so many years, you really have no choice. But even now it is part of our fundamental thinking, and we are organized so that our entire top management constitutes our entrepreneurial core, mostly freed from daily operating responsibilities. Where this structure differs from many larger companies is that we control the R&D directly, for the company as a whole, together with the more conventional control over our cash flow. This permits us to deploy all our strengths rapidly, in accordance with the market, existing and potential, with the most effective feedback possible. The Oxirane group is similarly organized, and as mentioned, Halcon Chemical is still another entrepreneurial center. All this is based on our experience that even the larger companies, if they are to be successful in new venture strategy, must imitate the strengths of small company technical entrepreneurship, as Professor Roberts also points out.[50]

The link between size of enterprise and entrepreneurial innovation has been cited frequently in the literature. All the more reason, therefore, to change our tax laws, especially the capital gains section, as mentioned above, so that young companies need not be so frequently gobbled up by larger companies (using the tax-free reorganization devices, for example)[51] but rather have a market for their securities as independent companies.[52]

I feel that we have achieved a very successful mode of continuing innovation, despite the fact that we are much larger than we had originally expected. In this context we have paid close attention to management development. For many years we have had a flow of the brightest young people into all aspects of our work, and we are very strong in the younger generation of management. As mentioned above, many young people prefer an entrepreneurial organization in a way which is most heart-warming to us.

The Need for Innovation

There is still a continuing great need for innovation in chemical technology. My friend, Robert Malpas, an executive director of ICI and former Chairman of ICI Europa, has written a paper recently on this topic, which he called *Chemical Technology–Scaling Greater Heights in the Next Ten Years?*[53] It is a very thought-provoking account of both the difficulties and the needs for chemical innovation. There are two charts he shows to illustrate some of his points, and I take the liberty of reproducing them (with permission). It is no coincidence, I feel, that Halcon is not only mentioned therein, but the second chart on "disinventing" seems to have been drawn with us in mind! He, too, addresses the organizational question, saying,

> . . . organizations must cater both for the optimization of existing assets and fundamental change. They probably need two different cultures existing within the same organization, staffed by different types of people. There must not be a conflict between the full utilization and improvement of existing technology and the creation of new. The first must finance the second, and the second is needed to remain profitable in the long run.

I agree with the conclusion contained in the final paragraphs of Mr. Malpas's

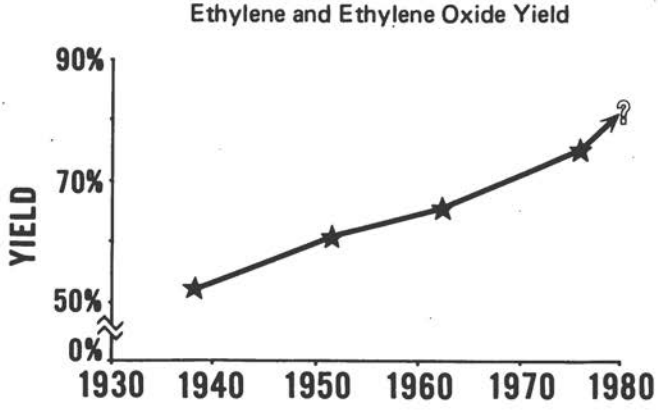

FIGURE 1 Ethylene oxide yields have improved greatly over the years, and they are still improving through better catalysts. Now Halcon International have proposed an alternative route through to ethylene glycol with even higher yields.

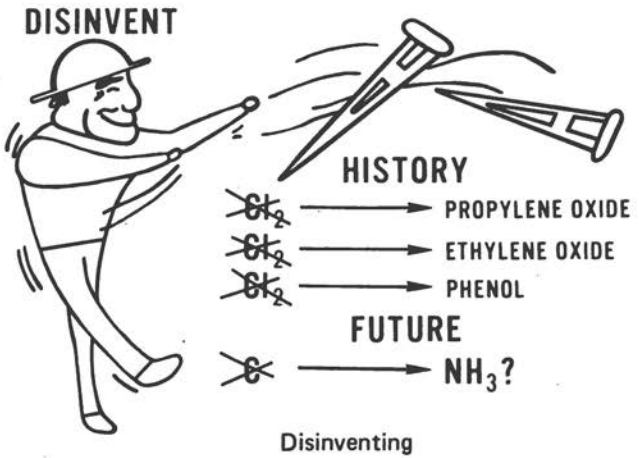

FIGURE 2 Ethylene oxide, propylene oxide and phenol processes all progressed through discarding the use of chlorine. Chlorine is an excellent chemical but it does not appear in the final molecule of the products and hence is a chemical "crutch". Dr. Duncan Davies called it "The Need to Disinvent" at the Brussels Sci in 1974. Throw away the crutches.

stimulating paper, and I will once again use his words, which say what I would have wished, but better:

> . . . the chemical industry has a technological challenge over the next decade of major proportion. Slow growth, expensive resources, high entry fees, must not weaken the resolve to scale even greater technological heights in the next decade. It needs to do so to avoid the failures that have befallen other industries such as the railways since 1860, and cotton since 1900. Technological change in a slow-growth era needs to be selective and sophisticated, and is the only way to ensure a profitable future. From the industry's position of health and strength it can, and I believe will, be done.

I believe in the vital necessity for growth, since without it our free society and solutions to our economic and social problems are doomed. No one can hope to freeze the status quo without dictatorship. A declining economy, needless to say, is unthinkable in a democracy. I have previously written about the debate in this country over the desirability or lack of it for growth,[54] with a concomitant discussion of egalitarianism, which is fundamentally inimical to technology, freedom and morality. (It has been aptly noted in this context

that political freedom exists only in free-enterprise countries which are also countries that lead in technology, although all capitalist countries are not free.[55]) The present article has implicit throughout it my firm conviction that our Western industrial world and especially the US cannot retain their freedom without growth, and that such growth must, as in the past, be based on technology.

While I do not feel it appropriate to address such a major question in greater detail herein, I think a recent quotation from Richard Rovere,[56] a well known writer for *The New Yorker* and one who is by no means a conservative, is especially relevant. He speaks of the voices raised in recent years against further industrialization and bigness, including many who "would like to go at least part of the way back to the world of cottage industry, to the vision eloquently set forth by the late E. F. Schumacher in his 1973 book, *Small is Beautiful.*" He then goes on to say,

> Advocates of the small-is-beautiful view make many telling points . . . But for most people in most societies, growth is the way out of such miseries as hunger, severe heat and cold, disease, illiteracy and wars undertaken for plunder. Mere growth cannot alleviate suffering, but it can provide the necessary condition—capital, infrastructure, employment—for a social approach to alleviation. Growth in itself cannot bring abundance, leisure and convenience, but they are seldom to be had without it, and to oppose growth on the ground that it is aesthetically offensive or that we would all be better off leading simpler lives is to take a rather callous view of the human condition in those parts of the world—including sections of this country—where life tends to be simple indeed . . . To ask the poorer countries to conserve oil and to eschew nuclear energy is to ask them to accept continued poverty as a condition of their existence. To ask Americans to mark time until solar energy comes into our homes and factories is to resign ourselves to a rate of unemployment higher than the seven percent—far higher in some places and categories—that most find intolerable. (The prospect that such a proposal offers is of a society in which by the end of the century almost the entire industrial labor force is idle and the engines of agriculture are men and horses.)

Karl Deutsch, Professor of Peace at Harvard, puts the same thought this way:[57]

> . . . in order to keep life tolerable, we must continue to grow economically in the highly developed countries . . . The doctrine of ending growth here and now is a doctrine of civil war within most countries, and a doctrine of international war . . . The politics of the next 35 years will be, in sig-

nificant part, the politics of capital formation and allocation of capital investment. Even more, we need more innovations.

But if I believe growth and increased productivity are essential, I also have tried to underline in this article that encouraging entrepreneurship and entrepreneurs is the best way to retain something of the small-is-beautiful concept, rather than force the burden of all economic activity into increasingly larger existing corporations, or what would be even more counter-productive, into the hands of government.

We must put our American ingenuity, technology and market system to better use to permit growth while solving the historical negatives of growth, such as pollution, unsafe conditions, and the like.[58] In short, I know would-be entrepreneurs are still all around us, but will we permit entrepreneurship, risk-taking and innovation to flourish, for the sake of our economy, for the sake of *all* our people, even though some will end up with more than others?

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The Changing National Environment for Innovation

RICHARD S. MORSE

The process of technological innovation and the ability of industry to commercialize the results of research and development activities are fundamental aspects of the American economy. Our past position as a leading industrialized nation and exporter of high technology products has been directly dependent upon the concept of rapid exploitation of innovative technology. The creation of new employment opportunities and the generation of *new* technical enterprises depend upon our continued ability to commercialize the results of R&D activities, and the availability of management talent, entrepreneurs and risk capital.

There is also ample evidence that a disproportionate number of innovative ideas emanate from our smaller technically based corporations.[1] It is the growth of these smaller companies which is so essential to counteract the relative loss of employment in many of our older and more mature industries. A recent study[2] by the Commerce Technical Advisory Board, for example, showed that over a five year period, five high technology companies–only six to 14 years old–created 35,000 new jobs. These 35,000 jobs were direct employment with the companies and did not include the additional jobs associated with such corporate activities.

For a similar period six mature companies such as du Pont, Bethlehem Steel and General Electric, with combined sales of $36 billion, had a gain of only 25,000 jobs. If this country wants to *create* jobs, lets *create* a national environment in which our great human, technological and financial resources can be more effectively employed.

Many factors in our national environment–within the government and industrial sectors, and probably the academic community–have now changed. These changes appear to militate against the continuing role of technological innovation and the generation of new technically-based enterprise. The United States has a unique position of technological superiority in an ever decreasing number of commercial areas. American industry also does not enjoy the effective cooperation of government, particularly in the areas of finance and regu-

lation, to insure our ability to compete in the world markets against other rapidly developing industrial nations.

The role of innovation and the factors that influence its environment are not always understood. In 1976, the Office of Federal Procurement Policy, Office of Management and Budget, of the Executive Office of the President, sent a draft memo for comment to all heads of executive departments and agencies which stated the need for recognizing the importance of "innovation". In part this stated:

> The government directly sponsors research and development through the government in-house technical and laboratory activities and through procurement actions with non-government organizations. Additionally, it is the government's responsibility to ensure that its policies and programs stimulate private investments in research and development and to encourage innovation in all sectors of the economy. Acquisition policies for research and development are intended to support these objectives.
>
> In the United States' competitive economic system, the role of industry in research and development is particularly important. Industry transforms new ideas from laboratories into new and improved products and services and brings them to the marketplace for the nation's consumers, including the federal government. Industry has built successfully on advanced developments of the past and provided new products and services of great economic and social value to the nation. This has been demonstrated in many areas, including electronics, computers, aircraft, communications and medical services.

This initial attempt to stimulate interest and action at the highest levels of government was never concluded, but hopefully the current administration will move forward in such a direction.

Government R&D

Government R&D funding has in the past served as a very useful mechanism for the support of high risk research programs and advanced technology. The so called "unsolicited proposal" concept for R&D funding is no longer generally available, and the cost and time required for obtaining R&D support has increased substantially. It is not unusual for the government decision process now to take nine months or a year to fund a research proposal and initiate work even after responsible people agree it should be done. One recently reorganized government agency has been structured to require 17

different approvals prior to the start of a research contract. Government regulations and the program, technical and management control systems introduced by the government bureaucracy have now reached the point where many small companies as well as larger ones have elected to go out of the government R&D business–some of our more innovative and better managed organizations are no longer available as support for important government programs.

This country has now developed a very large "in-house" component of our national R&D effort which consists of the defense/aerospace industry, government laboratories and a variety of profit and nonprofit institutions, whose "business" depends exclusively on funding by the federal government.[3] In general, these organizations do not have the ability or experience to commercialize the results of their research, and the all important "coupling to the marketplace" factor found in a well run R&D program, is missing.

Because of their size and experience in dealing with the government, larger companies have a substantial advantage over any small technical company. In fact there is reason to believe that there is a critical corporate size below which it is rather impractical for a technical company to seek effectively government contracts for support of new technology.

With creation of the Energy Research and Development Administration, and now the Department of Energy, we have an urgent need to develop a better working relationship with our more innovative large and small technically based industrial companies. Now for the first time we have a tremendous new department with the sole objective of commercializing its R&D programs. This objective is quite different from that of the National Aeronautics and Space Administration or the Department of Defense. No national R&D effort has been launched on such a scale whose success is solely dependent upon public acceptance of new products and processes and ultimate industrial participation in the market place with private capital.

The responsibility for technical and program management, and financial control of contracts in the energy field are now delegated to in-house laboratories and/or non-profit institutions. These same laboratories and non-profit institutions are also often in direct competition with industry for funds to maintain or expand in-house staff and programs. Current government policy permits R&D funds to be transferred to government laboratories, or contracts made with non-profit institutions, much easier and faster than a contract can be given to industry. This factor is often responsible for the support of government labs and non-profit institutions even when such work might be more effectively performed by large or small industrial organizations.

Government employee salaries are now often higher than industry, and the industrial experience, knowledge and ability to commercialize R&D results is not available in this government lab/non-profit sector. These institutions are a great national asset and their unique expertise and resources should be per-

served. However, the current trend towards the involvement of such institutions in the commercialization of science and technology is not in the best interests of the country.

New Enterprise Generation

New technical enterprises have been a unique source of technological innovation, and of a large number of this country's array of new technically based products. The environment for new enterprise generation has deteriorated substantially in recent years, and neither the role of the small company nor the problems associated with new company generation has ever really been understood by the executive or legislative branches of government. Neither has this country ever had a spokesman on the Washington scene for this important sector of the economy.

In recent years, incentives for both the investor and the entrepreneur have been reduced as a result of Congressional action. Qualified stock options for example, are now no longer available for key management personnel—an important incentive for the small, high risk company which normally has no pension fund or real employment security. Government over-regulation has made the life of the small company manager—and of the entrepreneur—extremely difficult, and the relative costs and executive time associated with such regulatory activities are tremendous. Changes in the personal income tax structure have now reduced the potential advantages of capital gains to the investor and entrepreneur, and the 1976 Tax Reform Act now has a significant impact on the potential long-term benefits to both investors and entrepreneurs involved with successful business ventures in terms of their estate. The cost of financing start-up companies has substantially increased and the prospect of early financial rewards for the investor are greatly tempered by the decreased liquidity of investment.

In spite of these adverse changes in the business environment for new enterprise generation, venture capital is still available even for start-up situations, but the requirements established by the capital sources, which have now become "professionalized", are very exacting. New technical ventures, however, *are* being funded by a variety of venture capital sources—corporate, private, financial institutions and even some universities.

The Industrial Environment

There is reason to believe that the current industrial environment, under which most large corporations now operate, tends to restrict "risk taking"

and the commercialization of innovative new technology. The very size alone of our major corporations, with the attendent rigid structure and necessity for long range planning and financial control, creates an atmosphere that is not attractive to the entrepreneur or innovator. Our national preoccupation with large "systems" and the never ending repetitive systems analyses, economic and engineering studies and computer modeling leave no room for an innovative scientist or engineer to develop something new to meet an unknown market.

Most large industrial companies now operate on the principle of "Management by Objectives", are organized on a group or division basis by market area and have well conceived executive incentive plans based on performance. Unless appropriate mechanisms are provided, some management incentive plans may overemphasize short-term financial results at the expense of taking technological risks and long-term research programs that may be essential for *future* corporate growth and even greater ultimate profitability. The increased cost of capital and executive empahsis on "Return on Investment" (ROI) now tends to place greater emphasis on cash management and the financing of programs associated with cost reduction and the purchase of fixed assets that can demonstrate a known ROI.

The very magnitude and length of the R&D cycle of most government, and many industrial development programs, leaves little room for the entrepreneur or really innovative individual. It's hard to visualize just how an Edison or Land could contribute effectively to multi-billion dollar, 20-year programs such as the B-1 bomber or the breeder reactor program of the Department of Energy. Inventors and entrepreneurs are unique individuals. They do not usually "fit" into structured organizations. They are impatient and want to see early *results* of their endeavors. Few real innovators would put up with the ever increasing analytical studies, economic analyses and now so-called "risk analysis" programs associated with highly structured R&D. Very few of our truly innovative ideas would ever pass through the types of analytical filters being imposed by the decision makers–who usually never have been involved in real hardware research, and falsely assume you can schedule creativity.

There is a great difference between conducting large development programs associated with known technical objectives and the environment in which a real entrepreneur or innovator will operate. The incentives for "high risk" ventures in areas of uncertain markets and unproven technology are hard to sell to management in many industries in the current business environment, particularly those which require heavy capital investment.

In an effort to obtain some current thinking on these subjects, an opinion survey was mailed to the principal executives of our major corporations, their directors of research, selected small high technology companies and venture

FIGURE 1 Ability to commercialize innovative technology *today* vs *10 years* ago (132 corporations).

	Much Less	Equal	Much Greater
R&D Directors	15.2%	68.9%	15.9%
CEO	18.1%	52.4%	29.5%

capital organizations. The relatively high response level to this survey suggests a growing natural interest and concern with the subject of technological innovation. While a wide range of opinions was observed, it is clear that the climate for innovation is changing. Most corporations, however, believe they are still innovative and that venture capital is still available for new technical enterprises. Figures 1-9 summarize some of the attitudes of major corporations on these and other pertinent questions, based on the responses to the survey.

Attitudes: Major Corporations. R&D directors of the large corporations surveyed believed that their ability to commercialize innovative technology is about the same today as it was 10 years ago. Nearly twice as many of the chief executives, however, thought their companies are much better in this regard (Figure 1).

When asked to list the relative importance of factors influencing the funding of technical programs, executives and research directors of major corporations agreed that government regulation is the number one problem and that Return on Investment is now the second consideration as compared with the situation 10 years ago (Figure 2). These appear to be new factors that may well have a substantial impact on future innovative programs. The executives and directors also agreed that the following factors influence their reluctance to perform government R&D: opportunity cost; government bureaucracy; know-how disclosure; government patent policy (Figure 3).

FIGURE 2 R&D Directors and CEOs: Significant factors influencing funding of technical programs *today* vs *10 years* ago.

1	Government Regulations	Much More Important
2	ROI	More Important
	Anti-Trust	No Change
	Personnel	No Change
	Management	No Change
	NIH, etc.	No Change

FIGURE 3 R&D Directors and Executives: Relative factors influencing reluctance to perform government R&D.

1. Opportunity Cost
2. Government Bureaucracy
3. Know-how Disclosure
4. Government Patent Policy

One hundred twenty-five directors of research rated their corporations relative to other industrial organizations in terms of their relative ability to commercialize innovative technology (Figure 4). Less than 5% of the research directors believed that their companies were better than Xerox, IBM, Sony and Hitachi; and 55-66% felt they were much less innovative than these groups. Nearly 48% of these directors said they were much *more* innovative than US or Bethlehem Steel.

These answers are in general agreement with early studies at the Sloan School at MIT which indicate that our more mature industries such as steel and automobile are *considered* to be far less innovative than our newer industry groups which have been developed on the basis of recent advanced technology, and maybe are not so dependent on large capital expenditures and labor costs.

Corporate Environment. Thirty-two corporate executives reported that their time spent on government regulation had increased 17.8% in the past 10 years. The average cost of legal-accounting expenses of 41 companies is up 260% (Figure 5).

This information is not entirely unexpected in view of the current trend of affairs in this country. While the impact of the executive time devoted to government regulations and the corporate expense are important, such factors are having a tremendous influence on the small company community.

FIGURE 4 Ability to commercialize innovative technology (125 R&D Directors).

Relative to	Much Less	Equal	Much Greater
Xerox, IBM	66.4%	31.3%	2.3%
Sony, Hitachi	54.5%	40.6%	4.9%
GE, West., RCA	32.6%	58.1%	9.3%
US, Beth. Steel	9.4%	42.9%	47.7%

FIGURE 5 Corporate environment.

	10 Years	Today	Change	Companies
Exec. Time Gov. Regs.	8.2%	25.8%	+ 17.8%	32
Innovative Programs	41.4%	58.6%	+ 17.2%	58
Legal, Acct. Expenses			+260 %	41

New ventures are usually successful because of the one entrepreneur who dominates the business activities. There is no more difficult or demanding job than running a new technical enterprise. The added load of government regulations and associated costs can be fatal to a new venture that does not have the management staff or resources of a major corporation.

The Product Development Cycle. The directors of research of 125 major corporations agreed (Figure 6) that the product development cycle for technical products has increased 25% in the last 10 years, although 50 chief executives seem to think the time increase is only 10%. As noted in Figure 1 the directors of research appear to have a different viewpoint than their chief executives—or perhaps they are a little more realistic.

Venture Capital Environment and Attitudes. The venture capital community was asked to rate the factors that influence the financing of new venture (Figure 7). The two considered most important were investment liquidity and increased capital gains tax. Lack of entrepreneurs and the impact of government R&D procedures were not important considerations.

The relative importance of reasons for the failure of small technical companies were submitted by 50 professional venture capital organizations (Figure 8). Management ability was listed the number one factor contributing to the success or failure of a new business, with such items as

FIGURE 6 The product development cycle.

	10 Years Ago	Today	Change
125 R&D Directors	4 Years	5 Years	+1 Year +25%
50 CEOs	3 Years	3.3 Years	+3 Years + 10%

FIGURE 7 Factors which influence financing new enterprises.

		Relative* Importance
1	Investment Liquidity	9.2
2	Increased Capital Gains Tax	7.6
3	Reduced Management Incentives	7.2
4	Increase in Business Risk	7.2
5	Larger Capital Requirement	6.4
6	Fewer Entrepreneurs	5.6
7	Government R&D Procedures	3.4

*10–Very Important

patentability and the difficulties of government R&D considered of minor interest.

These results are consistent with the views of almost all of the venture capital community. A recent review of early records of two of the country's largest venture capital organizations showed that not one single company founder had survived in the chief executive position after his company was

FIGURE 8 Relative importance of factors relating to failure of small technical companies (50).

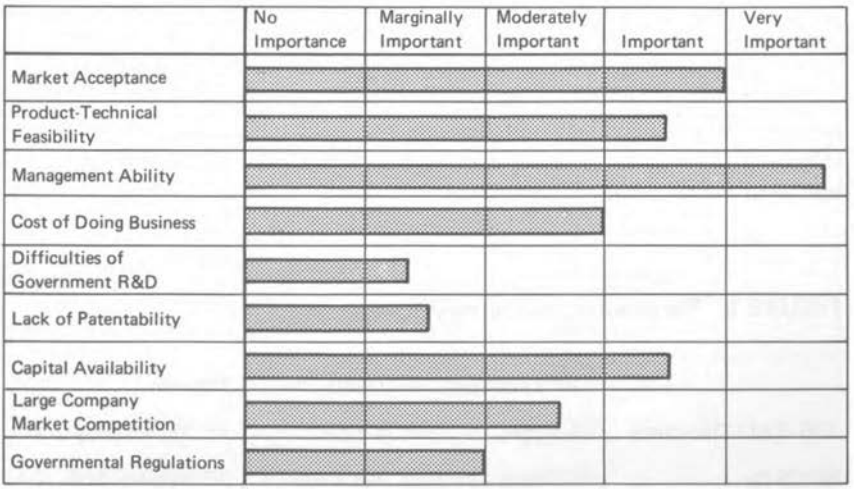

FIGURE 9 Financing new enterprises by venture capital sources: average data for venture capital organizations reporting.

	10 Years Ago	Today	Companies Reporting
Start-Up Capital Requests	232/Year	114/Year	29
Average Capital Requested—Dollars	420,000	500,000	27
Capital Devoted to Start-Ups	32%	25%	14

commercially successful. The initial entrepreneur in a new technical enterprise seldom has the management ability—or often the interest—to run a large business.

In the areas of capital availability it appears that the number of requests for the financing of "start-up" companies is half what it was 10 years ago (see Figure 9). Some 14 venture capital organizations say they now invest 25% less of their available funds in "start-up" ventures.

In recent months we have seen evidence of renewed activity in the venture capital business, including some newly formed organizations with substantial financing. Some universities are even getting involved with the venture capital business, from an investment viewpoint. The corporate policy of our larger companies regarding venture capital, dealing with outside entrepreneurs and creating new enterprises appears to be subject to a variety of changes. Some major corporations have activated venture capital programs as a means of seeking new opportunities outside the firms; others are now either less active than five years ago, or have changed their investment policy with respect to the types of mechanisms employed in dealing with new enterprise situations.

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The Entrepreneur: An Endangered Species

KENNETH H. OLSEN

I will not continue the lambasting of the government, at least not very much. Many people lament the passing of the entrepreneurs and blame the government for their extinction. Instead, I'm going to attempt to put the current condition of the entrepreneurial spirit into some perspective for you. To do that, I would like to start with three basic points:

First, "the good old days" of twenty or thirty years ago were not times when it was easy to start a company.

Second, the period of the late '60s and early '70s, which saw a flurry of new business start-ups, was not a norm but a spurt, and should not be considered the point of reference. At that time many private investors, including some very conservative endowment funds, decided to invest recklessly; at the same time the government joined the act and decided to encourage aggressively new businesses with the formation of Small Business Investment Corporations.

Third, we probably have more entrepreneurial spirit and activity today than at any other time in our history, except for that time in the late '60s, but we must be careful that we don't stifle that spirit and lose the advantages that come with it.

I can tell you a little bit more about what it was like to start a technical company in "the good old days" of just 20 years ago. Several of us were making transistor computers at MIT. The world laughed at us and said that what we were doing wasn't useful because we were academics. We felt we had to show them that high-speed transistor computers were simple, inexpensive and reliable, so we started a company.

We had no money, so we went to American Research and Development (AR&D) Corporation, a risk capital company, and proposed our idea to make computers. The Korean War was over and a recession had started and the people at AR&D were a little nervous. But they were fascinated enough to send us to their Board of Directors armed with three bits of advice. They told

us, "don't use the word 'computer'. *Fortune* magazine says no one has yet made any money with computers and they aren't about to make any money", so we took that word out of our proposal. They also said, "5% profit isn't enough to promise if you're asking someone to risk money on you". So we promised 10%. And finally they said, "most of the Board is over 80, so promise fast results". So we promised to make a profit in one year. They bought our proposal but gave us only $70,000 in capital, which we used very frugally.

We did everything ourselves: we cleaned the johns and swept the floors. We did the photography in my basement; made our printed circuit boards with real silk on wooden frames; we etched them in aquarium tanks. Since I was the closest thing we had to a tool maker, I made the tools. Every now and then, while hardening some tools, I'd leave them to answer the 'phone, only to come back and find the tools burned. We learned a lot about all aspects of business.

Now, to the question of what happened to entrepreneurship. As I said earlier, I think we should skip the period of time in the '60s. It was a short interval in the history of business. Things were very unusual. Everybody wanted to invest. There was competition to invest. I was on the board of a risk capital company at that time and there were very few investments we could make. Others were pouring money into new businesses with reckless abandon and there were few opportunities for a careful investor.

What it did to engineers, I think, was not very healthy. Everybody wanted to start a business. Wives were embarrassed to tell other wives that their husband was already 32 and wasn't starting a business. One bank counted *64* firms in the minicomputer business! I think it was closer to 264.

This period of irresponsible investing came to an end in the early 1970s, and the stock market hasn't recovered from it yet. However, the entrepreneurial spirit continued, and there probably have been more new entrepreneurial and technical organizations started in the last few years than during any other period of our history—except for that period in the 1960s.

Sometimes we do not notice today's entrepreneurs because when we look at new companies we often don't see products that will be significant in the future. We forget that those products which are obviously going to be significant in the future will be started by the established companies, whereas those that need entrepreneurs to start are ones that are not immediately obvious to the rest of us.

Sometimes, also, we despair because the entrepreneur cannot start readily in the same fields that people started in 10, 20 and 30 years ago. This should be obvious too. The industries that started at that time are now mature and it takes vast amounts of capital and research to compete. It is hard to get into the business of building jet airplanes or automobiles or even semiconductors.

The place for the entrepreneur is not in the industries that have been established, but rather those that still have to be proven.

The role of the entrepreneur in our society is to do those things which the larger, established company cannot or will not do. The entrepreneur has the drive and the spirit the established company cannot buy with just salary. The entrepreneur can and will take risks that the larger company cannot. When the entrepreneur fails he just disappears. When the large company fails on a project, it has to pay dearly to recover and take care of its customers. The large number of entrepreneurs can try an infinite number of ideas. I propose that we need entrepreneurs and I propose that society and government should encourage and promote the entrepreneurial spirit.

In our society we discourage entrepreneurship by giving more value to the individual who criticizes than on the organization that does things. Most people want to be on the side of the "hassl*ers*" and not the "hassl*ees*". Not long ago, it was very hard to find a president or a dean for a college. If you were a college professor, you made points with your social group by hassling the dean and the president. No one wanted to be the hasslee.

For example, we as a society are very interested in protecting the privacy of the individual, particularly if he or she has some criminal history. There is no privacy at all for someone in business. The government can ask for your personal check stubs for the last 10 years or all your files, your correspondence. Then, once the government has your material, it's open to everybody.

Our society holds business responsible for safety, pollution, integration, it seems; but individuals are protected from any responsibility.

What can our government do to help? I would like to propose that most important is to stop the constant changing of rules. People need a feeling of stability if they are going to invest their efforts as entrepreneurs or their money as investors. I would even suggest that they don't change the tax laws to encourage entrepreneurship. The feeling that the rules are unstable is probably the biggest discouragement to investment.

The computer industry in this country is one of the most fascinating stories in modern industry. It moved so fast in this country that the government could not catch up with it to "help" it or control it, much to the frustration of many of the bureaucrats. Many other governments worked hard to encourage and help their computer industries, yet the Americans have dominated from the start. And we'll probably continue to dominate, if the government doesn't step in to "help".