RESEARCH ADVANTAGE

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When Bill Stanley invited me to give this talk I wondered at first as a wool man whether perhaps it was toward possible uses of peach fuzz that my research remarks were to be directed.

Then the thought occurred that maybe it was wrinkle resistant prunes that were desired.

But when your chairman brought up the matter on my Minnesota background, I got a better idea of what my contribution should be -- Swedish story on the importance of paper.

Man's need for paper provides illustration of the opportunity -- that is, the advantage that can be opened through research.

For centuries primitive man carved his symbols on stone, clay tablets, wax, animal skins and metal plates.

In 105 A.D. there appeared a man with real scientific curiosity -- the most essential quality for research. This man was Tsai Lun, a Chinese minister. He was intrigued by hornets. He studied their nests. He was intrigued by the paper they made and with which they constructed their nests. Relatively durable, this paper was able to withstand wind and rain.

Tsai Lun was a man of vision. He started applied research and found he could duplicate the hornets activity by disintegrating wool cellulose and then reconstructing it as paper.

The paper he made provided him with a means of communicating his experiment to others. But because communication in those days between China and Europe did not exist, paper did not reach Europe until about the 12th Century.

After the invention of movable type in 1450 the printing on paper spread rapidly over Europe. Books, learning and research were on the march.

Today our domestic paper industry consumes about 45 million cords of wool annually. Out of this wool comes our books, newspapers, manuscripts, reports, manuals, roadside advertisements and what not. Paper provides man with one of his most important needs - a means of communication.

It is interesting to note that presently manufactured paper is not as good as that made 100 years ago. Most books 20 to 30 years old are beginning to deteriorate, whereas books over 100 years old are frequently in good condition.

A recent research report claims that improvements in manufacture may result in paper that will last 300 years or more.

Paper made from plastics is a possibility. For example, in the course of mill development studies of a new process for making ultrathin nylon film on each fiber in a wool fabric, we have accidentally produced a nylon paper on the machine rolls when the chemical control was not appropriate for treating the wool. Coincidently, this nylon paper resembles in color and texture and water resistance the paper made from cellulose by the hornet. But I'm not recommending synthetic hornets nests.

The primary incentive to all research is need. The industry that aims to grow and to meet the challenges of competition and changing circumstances must analyze its needs. It must know the limitations and requirements of research.

Research is big because it is proving worthwhile.

In 1955 this country spent $6.4 billion for research and development, in 1960, $13 billion, and in 1964 it is estimated we will spend $20 billion. Of this $20 billion, $14.65 billion is being done or supported by industry, $2.65 billion by federal laboratories, $2.0 billion by colleges and universities, and $.7 billion by other nonprofit institutions.

Of the $20 billion, $4.2 billion is for aircraft and missiles compared with $108 million for food and related products.

The opportunities for new advances from research are unprecedented. Cummulating is new basic understanding of biological as well as non-biological systems. We are learning more about the requirements for life and its well-being. We are learning more about aging and disease.

New and improved instruments and techniques are being discovered and developed. For example, new opportunities for studying flavors and odors are being opened through latest techniques of chromatography, mass spectroscopy, and nuclear magnetic resonance.

The new understanding and applications of radiations, aerodynamics, electrostatics, hydrodynamics, ultrasonics, promise to revolutionize processing methods.

New and improved chemical agents are appearing. For example, better anti-foamers and anti-oxidants, new plastics and bio-degradable detergents.

Research is an investment in the future. There is no telling what benefits can come from continued research on disease, aging, and the requirements in foods for health.

Our bodies are woven and unwoven by molecules that shuttle back and forth. There is much yet that we don't know about the chemical details. Much yet needs to be learned of trace constituents in foods necessary for our well-being and of the agents and conditions responsible for flavor, taste, texture and stability. Continued research coupled with the rapidly increasing population and the demands for easier living may lead to entirely new food habits.

Maximum research advantage requires a proper balance be placed on pure and applied research. The pure research was carried out by Tsai Lun when he studied hornets behavior. It started as pure curiosity with no practical objective. Pure research was similarly done by Pasteur when he studied the habits of bacteria.

Out of Pasteur's findings came aseptic surgery, antibiotics, pasturization and other important developments.

It is interesting to note that pasturization was recommended in this country in 1878 but, on account of natural resistance by people to accepting something new, it was not generally adopted until about 1910.

The scientist is constantly learning from nature. It is not inconceivable for example, that further study of the life cycle of the hornet might lead to more effective biological control of insect pests.

In many mills chemical control is now done automatically. This saves hundreds of hours of valuable technical time. Freed from such routine tasks, scientists can now devote their technical background to more creative work.

Operations research is example of work being done by modern machine computers. This involves analyzing a system in detail, describing it in terms that are amenable to mathematical treatment, performing experiments that prove or disprove the validity of the mathematical treatment, and finally making predictions about the system under various considerations.

Computers are coming into use in diagnosing a problem from the symptoms and in scheduling work programs.

Computers have only started assisting man in formulating the most efficient patterns to follow.

The day is foreseen when computer programmers, using computer language, will talk their instructions into the computer. It is predicted that programming will be taught in high schools like typewriting.

Although the use of machines is bound to increase tremendously, for storing knowledge and for calculating, correlating, and predicting results, the vital element behind research is the research man himself. He is frequently the forgotten and misunderstood man.

It is important that industry understand him.

C.F. Kettering, formerly top executive of General Motors, once said,"The opportunities in this world are just as great as we have the imagination to create." Many people think of research men as high brows or nuts, and that research itself is long hair. On the last point Kettering had this to say, "Research is a high-hat word that scares many people. It needn't. It is rather simple. Essentially it is nothing but a state of mind -- a friendly welcoming attitude toward change."

The research man is motivated by the need to satisfy his curiosity. This is the reason he chose research as a profession. He likes to ask questions: Why did this occur? What would happen if it went this way? He is alert for and seizes unexpected opportunities. To him the joy

of discovery and the satisfaction of his creative instinct offsets untold frustrations in trying to solve a problem. His success in solving a problem helps to satisfy his desire for feeling important -- in justifying himself. He wants recognition.

The scientist is a craftsman in scientific ideas. Craftsmanship is something which most people find psycologically satisfying. Solving problems, finding patterns of behavior, creating and building new things bring psycological fulfillment. Most people like to create. Incidently, the mechanization of industry has deprived millions of the opportunity to practice craftsmanship. Here alone is an area for social research.

Man's early research was empirical -- a fumbling -- a try-every-bottle-on-the-shelf type of work. Reasoning played only a minor part.

Trial and error incidently is the way in which mother nature herself does "research". Although this process is slow -- nature is in no hurry -- some of the most important developments have come by this method. Let's not forget that sex was evolved by nature to enable survival (lucky for man that there's an opposite one!)

Given sufficient time nature can come up with machines adapted to widely different requirements. The blue whale, weighing 200,000 pounds, has the same chemical servo mechanism for milk production as the masked shrew weighing only one-seventh of an ounce.

The modern scientist has received specialized training and discipline which has developed his power of observing certain kinds of things, and of correlating facts and developing ideas. He is often trained in the use of specialized instruments to help him gather and analyze his facts.

Proper planning of modern research requires attention be given to the needs and problems of importance, and to coordinating efforts to attain satisfaction of these needs. In contrast to the trial and error method, the proper planning accelerates attainment of full research advantage.

Proper planning also means selecting the right men, putting them together, inspiring them and then turning them loose on the problem, but yet coordinating their activities toward the ultimate objective. The right men are men of good learning and strong imagination -- creative people who want to satisfy their curiosity.

It is valuable to understand how a research man operates. First of all he needs inspiration. Volumes have been written about Thomas Edison and on inspirations for inventions, but I think a most illuminating biography of Edison was that written by a small girl -- She wrote:

"He was born in Ohio,
He traveled to Michigan,
He met a lady on the street.
She laughed at him,
He married her and discovered the light bulb."

One never knows when and where research ideas will strike. Newton got his under an apple tree and Archimedes his in a bath tub. But I am not necessarily suggesting broader fringe benefits for scientists. I am suggesting that greater attention be paid to scientists' needs and to providing the environment which will permit creative individuals to apply their knowledge and ability to the fullest extent possible.

The prevailing notion is that where equipment and facilities are the best money can buy, and where working conditions are relaxed and the researcher is given freedom to find his own way, and where salaries meet or exceed those of competitors, that the success of the laboratory productivity is insured.

This is surprisingly not the case. In a survey of 3500 research and development people it was discovered that the number one problem of concern to these men was the lack of proper communication with those who should be interested in their results. That's why I am glad to see meetings of this kind -- where those interested hear directly from the scientists the results from the laboratory.

The research man needs and wants to get proper attention to his ideas and, if they have potential use, he wants to see them adopted.

Because truly creative research is an art, it is often difficult to predict when answers will come. Sometimes management gets impatient. And in some quarters there is the tendency

to think of the scientist as a magician who can pull the answers from the hat. Obviously creative research cannot be done under such atmosphere.

Some companies turn off research when profits tumble and problems multiply. This recalls the old Chinese proverb, "It doesn't pay to go to bed early to save electricity if the result is twins."

Research can't be turned off and on like electricity. Research ideally should be intensified when times are bad.

In conclusion, the future well being -- that is the research advantage, which any industry can get comes not only from the scientists but also from the leaders who call attention to research needs, and who inspire scientists to the unusual rather than perfunctory effort, who provide the proper atmosphere and incentive, and who follow up significant research findings.

Just as productive research requires research men of superior creativity, it requires that those interested in their research be men of vision to see the significance of results, with judgment to decide what's important, with courage to act, but with patient understanding.

Greatest research advantage can come from proper investment in human creativity and proper understanding of the nature and limitations of research and research men, and of the atmosphere for bringing out greatest creativity.

Small companies may not be able to afford the luxury of large, balanced research laboratories, but as a part of an association they can help promote the welfare of their industry through encouraging research and providing proper incentives and communications.

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