February 1934

TECHNOLOGY REVIEW

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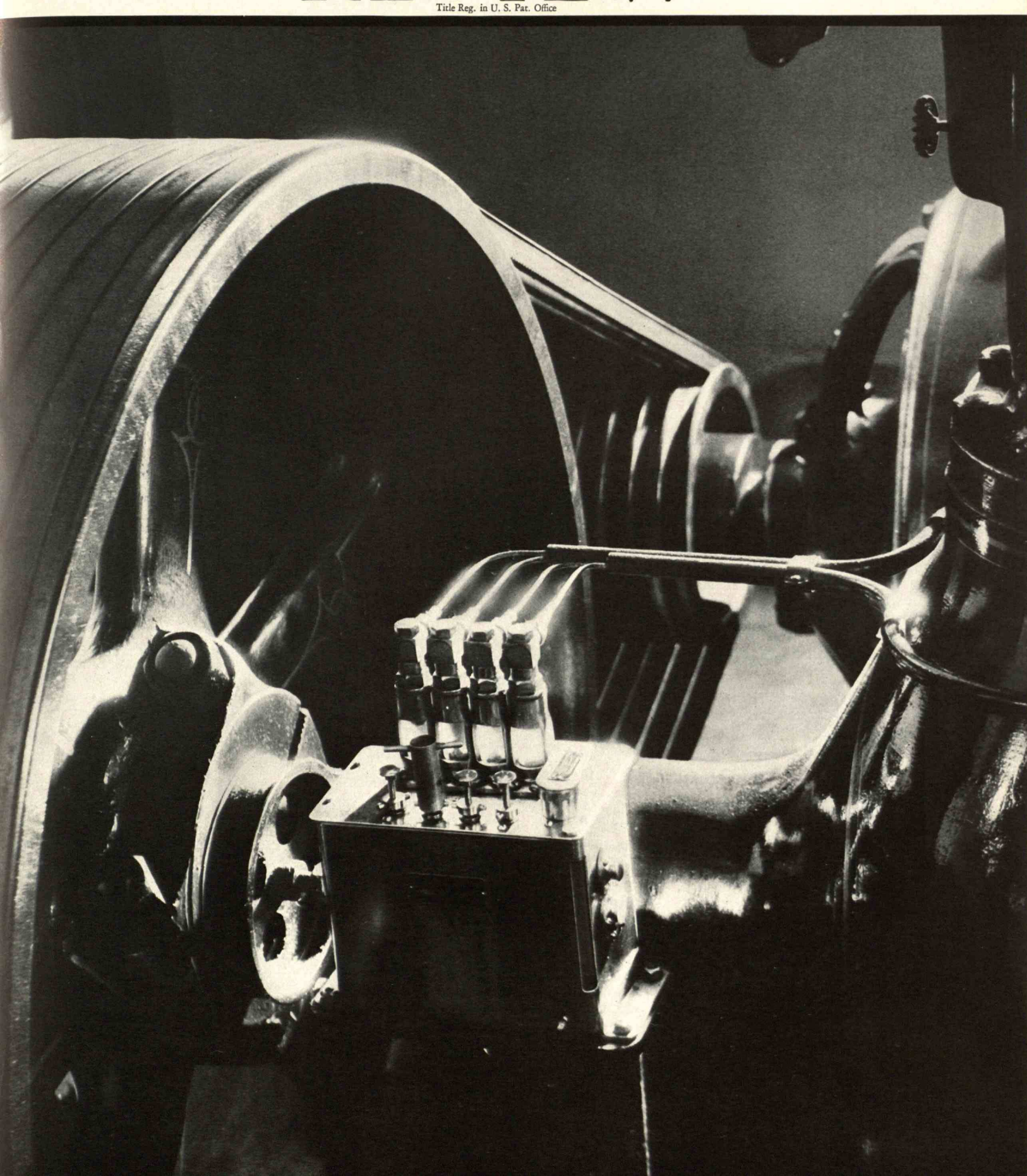

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THE TABULAR VIEW

PAGES 177 to 189 of this issue are given over to a symposium on Industrial Problems under the National Recovery Act. The Review does not often devote so much space to one topic, but so much interest was aroused at the Economic Conference at which these papers were originally presented that it would seem to be a public service to put them in permanently available form. Each of the four contributors is identified at the beginning of his paper, but it is appropriate here to give further information. ¶ WILSON COMPTON, brother of President Compton of the Institute, will be recalled by Review readers as the author of the article "Opportunities for Technically Trained Men in the Wood Industries," published in The Review for November, 1931. Dr. Compton has made the National Lumber Manufacturers Association one of the most forward-looking and important trade associations in the country. ¶ ROBERT F. ELDER is a graduate of Harvard University. In March, 1932, he contributed to The Review an article entitled "Industrial Equilibrium." In 1928 he won the Alvan T. Simonds prize for a paper on "Reducing the Cost of Distribution." ¶ FLOYD E. ARMSTRONG holds two degrees from the University of Michigan and has been a member of the Department of Economics at the Institute since 1916. ¶ ERWIN H. SCHELL, '12, in addition to being Head of the Department which sponsored the Economic Conference New Year's Day, is Professor of Business Management, M. I. T., a member of the Corporation of Simmons College, and a former Professor of Industrial Management at the Graduate School of Business Administration, Harvard University.

ONE of the outstanding papers at the recent meeting of the American Association for the Advancement of Science was given by WALLACE B. DONHAM, Dean of the Graduate School of Business Administration, Harvard University. His address was the opening one at a symposium, entitled "The Chemical Revolution," over which he presided. On page 165 The Review presents this address in full. Dean Donham is the author of "Business Looks at the Unforeseen" and "Business Adrift." In its March issue The Review will present another important paper which was presented at this symposium—the one on "Plastics" by Dr. A. D. Little, '85. ¶ E. C. CROCKER, '14, and L. F. HENDERSON are members of the staff of Arthur D. Little, Inc. While in the Chemical Warfare Service, they became interested in odors and have been working together on the subject in the Little Laboratories for over eight years. During this time they have worked on problems relating to perfumes and flavors of all types. They report that liquors have lately come within their scope and interest (in a purely academic way!). ¶ The Review acknowledges with appreciation the assistance given by HORACE FORD, Bursar of the Institute, in the preparation of the article entitled "Everett Morss and the Institute" on page 190. ¶ The information and pictures on page 170 relating to Culture Pearls were supplied by CHARLES H. BAKER, JR.

He cut the Belt to pieces before our very eyes, and this is what he said:

Made by the
Makers of GOODYEAR TIRES

HE IS an eminent engineer, and an eminently practical one, too.

His projects, and the installations which he has supervised, are conceded to be the models for the entire industry in which he works.

Talking about conveyor belts, he reached into a drawer, took out an old section of Goodyear Belt that had carried 24,000,000 tons, and with his strong-jawed pliers and might and main (and the aid of a couple of bystanders) tore its plies apart.

You could see and feel and hear the friction rubber between those cotton cord plies holding fast and stretching and finally giving way. He tossed the torn belt section onto the desk, saying:

"I would rather have this old belt right now than many a new one

"THAT'S what you ought to tell the world about Goodyear Belts! Goodyear knows how to send the friction through the fabric so that every individual thread of every cord is impregnated with rubber, so that the carcass never separates and every individual cord carries its full share of the load.

"This section is from a Goodyear Conveyor Belt that has seen seven years of service and carried 24,000,000 tons. Right now it is as good today as many a new belt of ordinary construction, and I'd rather have it."

Goodyear Mechanical Rubber Goods are accurately specified to the job by the G.T.M.—Goodyear Technical Man. They do better work, save money, make money for their users. Why not talk with the G.T.M.? Communicate with Goodyear, Akron, Ohio, or Los Angeles, California, or your nearest Goodyear Mechanical Rubber Goods Distributor.

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The Technology Review

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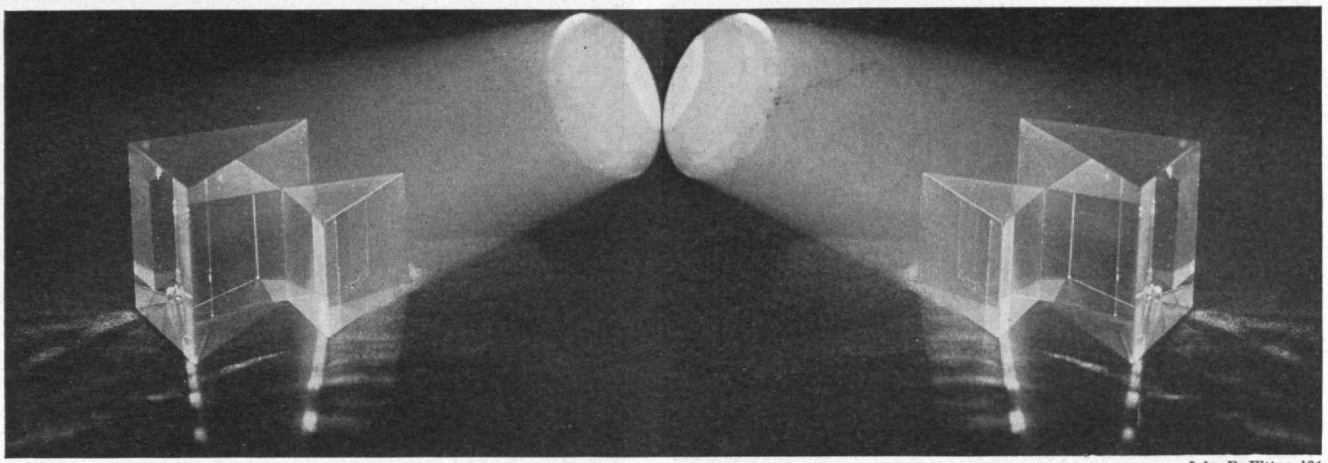

John P. Elting, '31

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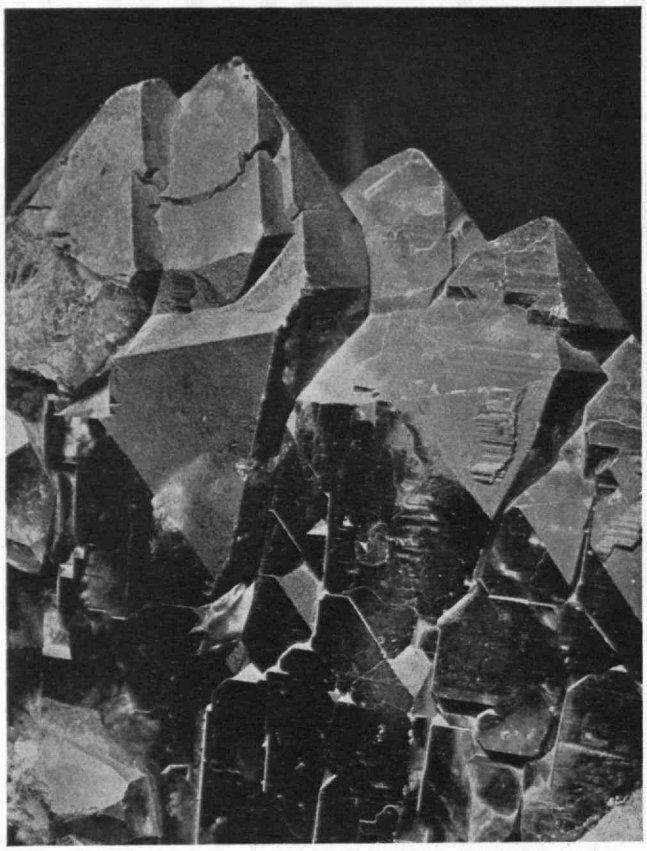
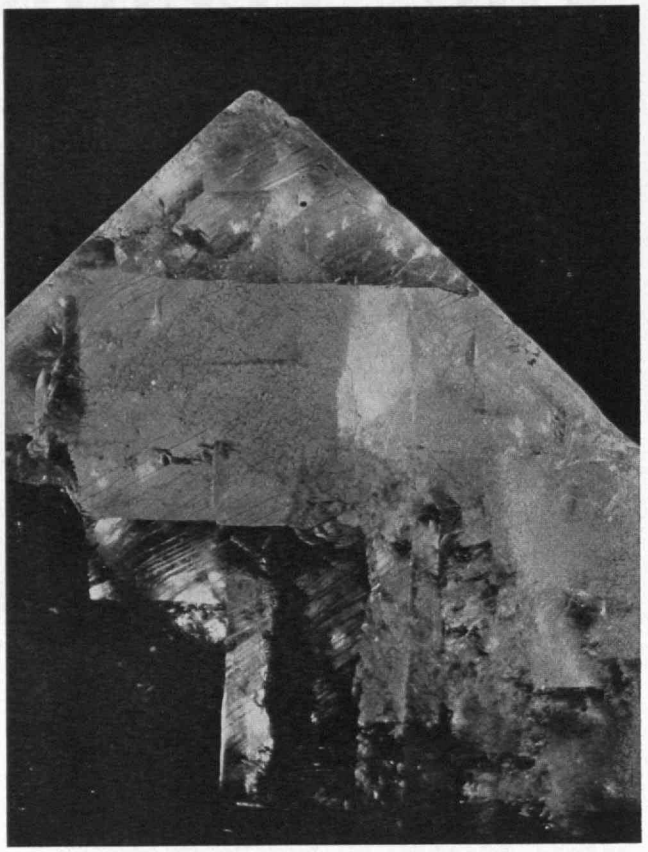
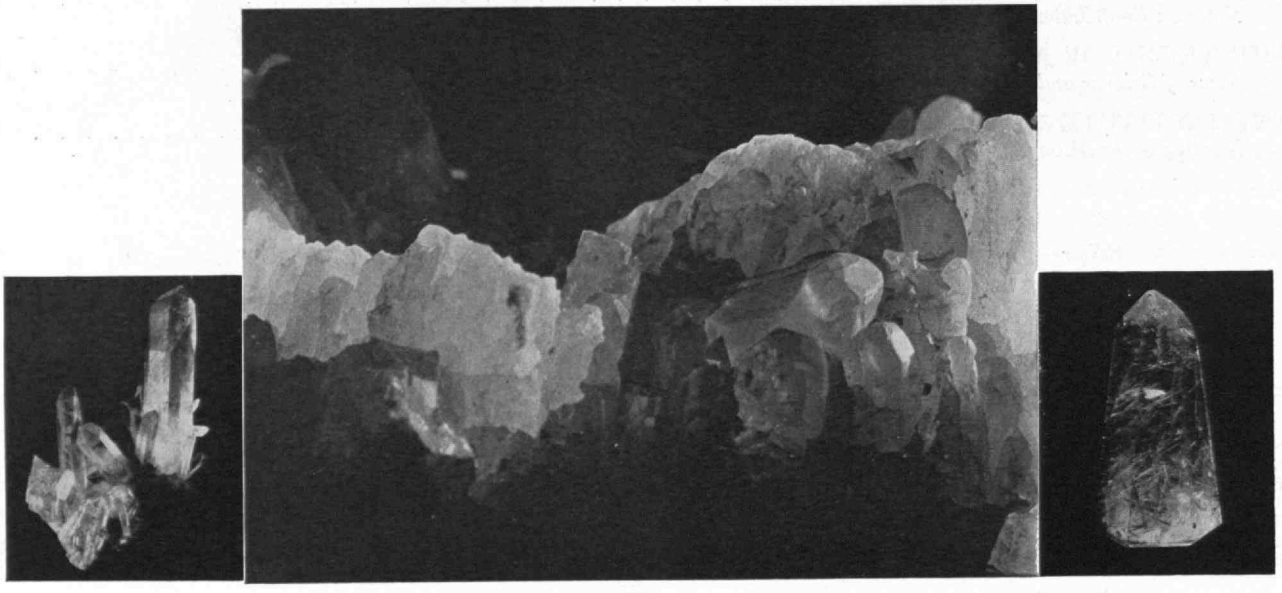




In the High Sierras of Crystal Land

Crystal Formations (Mostly Quartz) from the Economic Geology Collection at M. I. T.

PHOTOGRAPHED BY JOHN M. SLATER, '32



THE
TECHNOLOGY
REVIEW

Vol. 36, No. 5 February, 1934

Science in the World It Changes

Security vs. Progress

By Wallace B. Donham

THREE REVOLUTIONS AND THEIR SOCIAL CONSEQUENCES — SCIENCE, THE CONQUEROR — THE IMPORTANCE OF NONSENSE — SLOW PROGRESS OF SOCIAL SCIENCE — NEED OF DIRECTING SCIENCE TOWARD SOCIAL OBJECTIVES—SUGGESTIONS FOR RESEARCH PROJECTS

IT IS a commonplace that the phenomena grouped by economists and students of business under the Industrial Revolution deal, not with a short period of time in the first half of the last century, but with changes which began about a century and a half ago, continue now, and project themselves into the future. The situations which we group in this way are a result of great accomplishments in natural science. They have always been dominated by progress in applied science which, in turn, depends on pure science. For some purposes it is helpful to subdivide this Industrial Revolution into three revolutions in applied science, originating or gaining momentum at different times and presenting different characteristics and results.

The power revolution which began at the end of the Eighteenth Century substituted indefinitely expansive steam power for small-scale, inefficient, local water powers. It stimulated mechanical invention, enlarged the factory system, made possible steamships and railroads, radically changed the relationship of agriculture to other social functions. It created vast division of labor among the nations of the earth. By offering new personal opportunity to men, it redistributed a multitude of people over the earth's surface, increased the points of contact among nations, brought about new relations between tropic and temperate zones which increased the wealth of both, and stimulated the growth of powerful empires. When internal combustion engines arrived, this power revolution displaced animal power by small, mobile power units and gave new freedom of movement to individual men. It brought still further improvements in agriculture and completely changed the highway systems of the civilized world.

On this revolution was imposed an electrical revolution, which facilitated the growth of efficient steam power plants, reëstablished waterpower, made possible wide distribution of power from central plants, and affected agriculture by stimulating great irrigation projects. Beside lighting the world, it gave instantaneous communication by telegraph, telephone, and radio.

Deep in its roots, but more recent in its spectacular effects is the chemical revolution. In its childhood it was principally effective as it revolutionized warfare and, through metallurgy, helped make possible the power and electrical revolutions. Now it uses great quantities of power and electricity in a vast range of processes and products known to you all. In America this chemical revolution, hardly 15 years out of infancy, introduces new processes and products into our industrial structure on a scale which may soon enlarge the material options of mankind faster than either of the other two developments.

Dynamics — Gerald Young

All of these accomplishments represent amazing progress in the effective control of nature for mankind. One collateral thing they have in common. Through changes in material things, they change constantly the habits of living, environment, modes of thought and action of countless people. Collectively, they have brought about a higher standard of living for great masses of men than ever before known. They have put within the reach of well-located industrial nations the abolition of hunger and thirst; adequate provision for raiment and shelter, in old age as well as in maturity. Provided only we can make wise use of the enormous powers placed in our hands, we shall be freed from those great consuming fears which have obsessed mankind since the dawn of consciousness.

But there are other consequences of this advance which illustrate the age-long conflict between progress and security and the difficulty of maintaining social equilibrium in periods of rapid material progress. The power revolution was felt first in England, where it ushered in a century of material progress. Unfortunately, this progress brought great social stresses. A generation of men, without understanding or sense of social responsibility, abused their suddenly attained power. England still suffers from these strains. We avoided the worst consequences of this period because alternative opportunities in an uncharted continent compelled more humane handling of labor. Nevertheless, we, too, still suffer from the disorganizing effects these early changes imposed on a society which could have no understanding of their significance.

These revolutions in their social effects go far beyond the factory system. They accelerated the movement of farms to the West and made cotton King in the South. They gave the Northeast substitute occupations when agriculture in that rockbound and hilly area could no longer compete with the great plains. They increased the wealth of the nation, but in doing these things they separated the farmer from his market, made an uncertain business out of a solid way of living, and tangled him in the complex skein of international trade. They kept industry out of the South, complicated the slave question, and increased the difficulties of the negro problem.

By making skills progressively less important, they created an almost continuous shortage of cheap labor and brought on the heterogeneous immigration of races, creeds, and cultures which became so imposing in the last 50 years. The efflorescence of commerce and industry concentrated these new groups in cities. Segments of many peoples mobilized from the ends of the earth, continually shuffled and reshuffled, were given no chance to become one people with normal social contacts. Far too many of our newer immigrants, even to the second and third generation, never secure a real social integration in community life. Indeed, for them there may be no community life. Even in our middle classes it is becoming normal to be born in a hospital; to be educated in many schools with changing associates; to live in a succession of apartments in a variety of cities, never tasting the values of life in a home fixed to land and to neighbors; only to die in a hospital and be buried in a grave unknown to and unoccupied by their ancestors. The neighborhood is destroyed as a social unit. Old social controls break down. If immigration had come more slowly or if our communities had stayed smaller, we might have preserved the integrity of existing social groups and controls while processes of assimilation could go on, but change was too rapid. The older groups in the cities are overwhelmed with numbers and our cities are agglomerations rather than societies.

Meantime, great inventions save human labor on a scale which creates a new type of technological unemployment and intensifies all unemployment problems. Instead of realizing security as the fruit of progress, the most ancient fears of mankind revive. Countless individuals have lost social stability and a normal social life. The fear of hell fire and damnation in the world to come no longer dominates mankind, but insecurity and loneliness make the world a living hell for increasing numbers. Multitudes have lost faith and with it a sense of purpose in life.

The impact of material progress has lessened, destroyed, or prevented the development of social customs and controls which alone enable mankind to live as a social animal. Our researches in industrial relations indicate the serious effects on both production and morale which follow on such simple things as changing the seating in a room and thereby breaking down the accustomed social contacts among individuals at work. We have moved millions into the unknown without reëstablishing them in social units. Is it any wonder we miss individual thrift and piety, neighborhood interest and responsibility, old-fashioned personal stability?

In efforts to secure substitutes for neighborhood responsibility and social organization, we are driven more and more into centralized political controls. As these problems are forced on central governments, international efforts for peace and harmony break down. Instantaneous communication causes more friction than it stops. Efforts to confine problems within national borders increase. National loyalties grow of necessity, for the only hope of securing a degree of social stability compatible with continued progress is through national efforts at self-control. Here is one of the greatest reasons for the growth of economic nationalism so deeply deplored at Geneva.

Can these rapid processes of change be kept from upsetting our whole structure? If so, science gives complete assurance of continued progress in material things and of the leisure out of which we may develop a great civilization.

Conflicts between security and progress are always present. The point is that less than 200 years of applied science, just because they brought great progress, have brought great instability. This instability threatens to destroy civilization. It is not a time for despair, nor is it time to stop the quest for knowledge. Rather is it time for sober thought and plain speaking; for wise direction of progress toward increased knowledge. We need the combined efforts of many groups, particularly in the universities, to bring about social and economic stability. Otherwise our unplanned activities will increase the stresses and strains on an already unstable nation and civilization.

If I appear to emphasize the disturbing consequences of scientific progress, I beg that you credit me with the intention of being constructive. If later I emphasize the responsibility of the scientist, you will find reason for this emphasis in the fact that I am addressing scientists and engineers and not assume that I seek an alibi for the group to which I personally belong. In an address* last year I dealt with the collapse of business leadership and the responsibility of universities for this collapse. I assure you I was no less frank and rather more critical in that address than I am now.

WHITEHEAD, in "Science and the Modern World," ends his epic story of a great adventure in thought with these words:

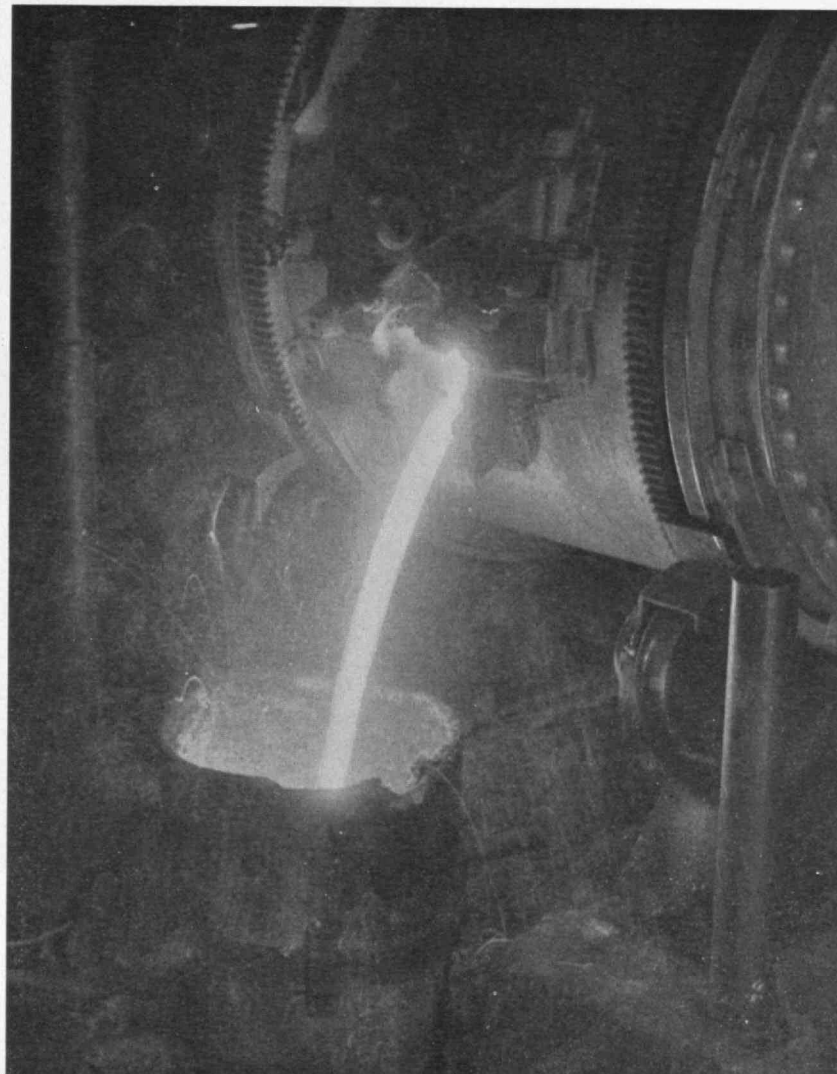
> The great conquerors, from Alexander to Caesar, and from Caesar to Napoleon, influenced profoundly the lives of subsequent generations. But the total effect of this influence shrinks to insignificance, if compared to the entire transformation of human habits and human mentality produced by the long line of men of thought from Thales to the present day, men individually powerless, but ultimately the rulers of the world.

Should we not inquire why the great conquerors failed to do more? It is characteristic of conquests that, despite every effort of the conqueror to assure the permanency of his accomplishments, his direct objective even when attained is quickly overthrown. Only indirect and secondary effects have permanent importance. Yet it is characteristic of conquerors that they start out to accomplish things worth while in the general interest. Napoleon's empire fell during his lifetime, but his social programs still color the whole organization of France. Unfortunately as success gives assurance and power stifles criticism, the Alexanders, Caesars, and Napoleons become more and more self-centered, more and more oblivious of the position and interests of other individuals, social groups, and nations. Despite the fact that no man can for long wield great autocratic power with balanced social wisdom, Power becomes their God. Thus, they bring their own destruction. The defeat of their dearest ambitions comes through the opposition of individuals and groups of segments of their own followers as well as of conquered peoples. No one likes to have modes of thought and habits of living imposed from without. Alogical and nonlogical sentiments upset the most carefully conceived plans of empire.

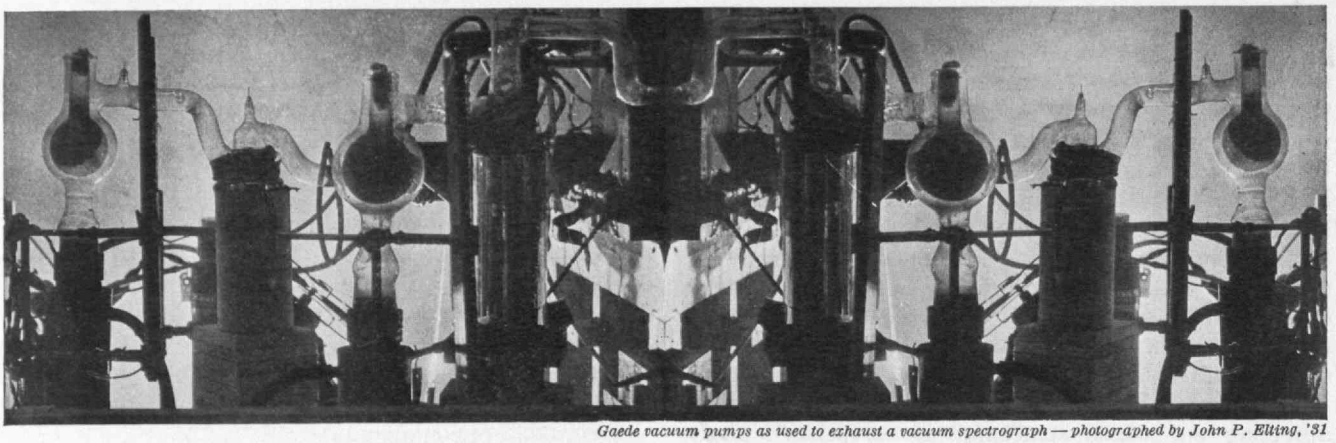
Such conquests are always followed by long periods of readjustment. The social forces let loose by the conqueror settle slowly into some new moving equilibrium with other social forces in the society affected.

Is is worth mentioning these characteristics of great conquerors, for if Whitehead's summary approximates truth, science — meaning thereby the natural sciences — is the present day conqueror. There is imperative need that this new conqueror avoid the errors of great conquerors of the past. Like human conquerors, natural science has by its own success become self-assured and self-confident. Science is the conqueror; its God, The Increase of Human Knowledge.

Pouring a Heat — Gerald Young



*The Failure of Business Leadership and the Responsibility of the Universities, *Harvard Business Review*, July, 1933.



Gaede vacuum pumps as used to exhaust a vacuum spectrograph — photographed by John P. Elting, '31

Most scientists assume that increase in knowledge is intrinsically and inevitably good. Others, a little more objective but still without vision or understanding of the complexity of social problems, conclude that failure to keep it good is the fault of personal devils outside the scientific group. Usually they blame business men or politicians, believing that they should and in time will be exorcised by the incantations of the high priests of pure science and the vast chorus of the faithful in applied science and technology. Natural science prides itself on the impersonal and objective nature of the Increase of Human Knowledge and as a consequence makes little effort to study the hopes, fears, and needs of humanity. It does its duty, as it sees it, when it adds to our grasp of natural laws and multiplies the options open to mankind in the use of material things. It forgets that at least in the western world the God of the Multitude must always be a personal God, responsive to the hopes and fears of His people. The case for the goodness of Human Knowledge Increased through the natural sciences is far from established. In my opinion, it is unlikely to be established unless the search for knowledge is socialized, much as the Jehovah of the old testament was humanized by Christianity.

Science looks at its vast accomplishments and at huge, unconquered areas ahead. It recognizes that what has been done is a small beginning. Scientists are humble before the great God of Knowledge. So long as they leave untouched the great questions arising out of the impact of scientific accomplishment on the social organization of civilization, do they not by that fact arrogantly assert that there is no God but Knowledge and that science is Its handmaid?

Science is self-centered. Too often it assumes that the logic of natural science is the universal logic. One sees repeated statements that social jobs would be done better if left to engineers, that leaders in other social groups are incompetents who do their tasks on a reprehensibly low level.

Science assumes that social science could, if it would, progress by building brick on brick. The quicksand of uncertainty in the world of social relationships is forgotten. There is little realization that scientific logics developed under conditions which allow isolation and control of individual variables furnish no foundation for social sciences. There is no general understanding of the logical and practical limits within which we must approach deep sentiments and emotions. It is forgotten that the human race evolved without a logic for countless years and that since systematic thought began, it has used its logics mainly to rationalize hopes, fears, loves, and hungers; its social forms as modes of achieving the good and exorcising the evil.

The failure of science to take into account these deep-seated emotions, indeed its habit of brushing them aside as on a lower level of activity; its failure, in a scientific colleague's phrase, to understand the value and importance of nonsense is amazing lack of perspective.

One hundred and fifty years of science has introduced new variables into our western society more revolutionary in its effects on individual men than everything since the establishment of Christianity. Nothing in the history of the race equips it for dealing with change on this scale of time and magnitude. We forget that the limitations on human capacity, the emotions, the sentiments, and the habit of rationalizing logics which enable men to live socially do not change in any such moment of time as 150 years. The great conquests of the past have been followed by long periods of adjustment in which the world sought new balance. Just so, unless science, the conqueror, with greater wisdom than the conquerors of history, definitely does its part with other social groups in seeking balance now, a like period of rest from the conqueror and slow adjustment will be essential. During such a period, science will be dethroned and imprisoned. Science cannot wait for its conquest to be complete. It must adjust itself to human nature.

IN ITS impatience at the failure of social scientists and practical administrators to make faster progress, science forgets the long centuries between Plato and the Seventeenth Century, when scientific progress was dependent on a handful of geniuses like Aristotle, Galen, and Copernicus and wholly lacked continuity. It overlooks the many years when the concept of perfection with its corollary acceptance of the circle, stopped observation and progress in astronomy. Chemistry forgets that the accidental observations of alchemy turned into organized progress 150 years later than a corresponding beginning was made in physics; that it waited those long years for a technique of isolating and studying quantitatively the characteristics and behavior of gases. Social science may never learn, as a