GENERAL SCIENCE

The Talented Mind

The young people of today can be pioneers in the world of science, helping to replace the nation's diminishing natural resources with intellectual resources.

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An address at the awards banquet of the Sixteenth Annual Science Talent Search, in Washington, March 11.

➤ AS I LOOK at the bright faces of the young men and women whose achievement we have come here to honor, I am impressed with the thought: How fortunate are these young people! Fortunate, in that God has blessed you with an endowment which is priceless. What has been given all of you—the 40 winners, as well as the 260 runners-up—is the most lasting, the most persistently satisfying, the most all-around useful of natural endowments—a really good mind.

I trust that you will not let yourselves be proud of this gift. It reflects no particular credit on you. Nor is it a guarantee of success in life. Rather does it resemble a vein of precious metal imbedded in rock—valuable only when it has been mined intelligently and laboriously. But with it, an unusual opportunity is granted you to develop yourselves into successful human beings in a field of activity where success must always be rare and difficult.

First Step to Success

You are here tonight because you have already taken the first step towards making use of your good fortune. You have given that good mind of yours what it most needs —exercise in meeting an intellectual challenge. In doing this you have shown yourselves worthy of the endowment with which you have been blessed. You have demonstrated that you can marshal the ambition and stick-to-itiveness which a good mind demands. You have taken the first step towards success in your chosen fields, but only the first.

Like most of today's youth, you must at times have felt that you missed something exciting and important because you were born in the 20th century, at a time when almost all frontier areas of this country had disappeared and with them the adventure formerly enjoyed by many a young man and woman, of hewing out their destiny, dependent on no power on earth but their own will and ability. Today there is hardly a spot on this globe which has not been discovered and mapped. For most people, life, while doubtless more comfortable, lacks the spice of discovery and adventure so dear to young spirits.

Yet it is precisely in this respect that your good fortune manifests itself most dramatically, for you carry in your own minds potentialities for adventure and discovery not shared by most of your contemporaries. You have as many opportunities for exciting living as people born a hundred or more years ago; different in kind, perhaps, but opportunities not one wit less exciting and rewarding than those which vanished at the turn of this century.

Scientific Pioneers

Capable and ambitious young people could once fashion their lives by their own efforts in wild and unmapped areas of the physical world; you can be pioneers today in the wild and unmapped world of science. In the short span of three centuries, since man first learned to think and experiment scientifically, enormous advances have been made. But enough remains to be discovered and mapped to guarantee excitement and adventure to more young scientists and engineers than we are likely to have for many years to come.

I recommend that you make your life an adventure of the mind. This will at times be hard, but always deeply rewarding. When you reap the fruits of your own intellectual labor you will experience the satisfaction of having proved yourselves good cultivators of the talents given you by Providence. Over and above all this, you will know that yours is a kind of pioneering which yields not alone personal gain and satisfaction, but it also contributes significantly to the economic and hence the political strength and security of our country. This you will find the greatest reward of all.

Need for Talented Youth

There never has been a time in the history of our country when it so greatly needed the services of its talented youth. One hundred and eighty years ago, this nation was born on a new continent, sparsely populated by four million people. Seldom has a new nation started life under such favorable circumstances. Not the least of these was the political inheritance which enabled the founding fathers to devise a form of government marvelously suited to a vast land with fabulous natural resources which had to be developed by a small population. The Constitution insured fullest scope for each individual's abilities. Moreover, our continuing scarcity of labor helped us to hold fast to that basic respect of the individual which the first settlers brought with them from England, and which is the foundation of our democratic way of life.

The open frontier kept us socially mobile and therefore checked any tendency towards the class barriers which are so apt to accompany advances in civilization, and which are characteristic of most highly civilized but static societies. Respect for the individual, full opportunities for all, abundance of land and natural resources, and a government eminently suited to our particular needs built this nation into the formidable giant it is today.

In recent years, however, some of the foundations upon which we have built in the past have begun to crumble or have vanished altogether. Instead of four million people, lost in a vast wilderness hardly touched by man, we now have 170 million, increasing annually by three million, or almost as many new Americans as lived here on the eve of the Revolution. In fact, we may soon reach a density of population close to that of the old countries of Europe. Virtually no good free land is left; much of the wilderness which nurtured the free spirit of earlier Americans has all but been buried under factories, cities, and suburban developments. And, where even as recently as 50 years ago, we exported 15% of our raw materials, we now depend on the rest of the world for 10% of our raw material needs.

U. S. Demand for Imports

The turning point occurred only a few years ago. Today our consumption of raw materials grows at a compound rate. If

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we continued to expand our consumption at this same pace for the next 25 years, our needs would reach a fantastic 80% of total world production, leaving only 20% for all other countries. Let me illustrate with a few figures what this momentous change in our raw materials position, from a resources-exporting to a resources-importing country, portends for our economic health and political strength.

Advances in medicine and public sanitation have quadrupled the world's population since the middle of the 18th century, and population is increasing at a geometrical rate. Our own country has the highest percentage of natural increases in population of the large industrial nations of the world —an increase which is higher even than the increases in Japan and Italy. Scientific calculations give us the astonishing estimate that one out of every 20 human beings who have ever trod this earth is alive today.

Heritage Squandered

This enormous and ever-growing population must now be fed, clothed, and housed by cultivating land which over vast areas has become depleted through erosion and faulty agriculture; by harvesting the products of the sea and of inland waters which likewise have become depleted by unintelligent overfishing and by pollution; and by consuming irreplaceable mineral and fuel resources. The United States alone, for example, has consumed as much in irreplaceable mineral and fuel resources since 1914 as had then been used by all the world in all of the 5,000 years of history since man first discovered bronze. And much of this priceless heritage has been and is being squandered in an appallingly wasteful manner.

From a scarcely populated, fabulously resources-rich country 180 years ago we have changed to a densely populated, resources-poor country today. We are, of course, not as poor in resources nor as heavily populated as most of the industrial powers of the world. We are still rich compared to such countries as Britain or Italy. In fact, with but 10% of the population of the free world and 8% of its land area, we consume close to half the free world's volume of materials. These figures are frequently used to illustrate that we have the highest standard of living in the world. What seems more significant to me, however, is that these figures also indicate our increasing dependence on foreign countries for vitally needed minerals and fuels. At present, we are truly independent only in two metals: molybdenum and magnesium. When measured with our wealth of but a few short years ago, we are therefore poor, and we are poorer still when measured against our future needs.

U. S. Dependent on Others

The shrinking of the once broad materials base of our industrial civilization makes us for the first time in our history dependent on foreign countries for materials basic to our technical organization. So far we have had no difficulty buying what we need abroad. We may, indeed, never have to face the disaster which threatened Europe's economic life when the flow of Mid-East oil was cut off for political reasons. But it would not be wise to count on this. We shall not remain truly free and powerful unless we compensate, to the fullest possible extent, for lack of materials resources within our own borders. There is one way, and only one way, that this can be done. It is by using far more effectively than heretofore our natural resources in brain power; we must substitute intellectual resources for diminishing materials resources.

Applied to this problem, brain power can devise ways of extracting at reasonable cost the considerable store of low-grade minerals and fuels still remaining to us which we are not utilizing today because of excessive cost in time and labor—thus taconite and shale oil may in time make up for the threatened deficit in high-grade ores and oil. It can discover ways of replacing scarce materials with plentiful materials heretofore considered unusable, as aluminum is replacing scarcer copper. Trained minds may be able to relieve shortages of natural minerals and fuels by creating man-made substitutes as plastics and synthetic rubber have reduced our dependence on imported tin and natural rubber, or as atomic power may replace coal and oil. Similarly, synthetic products made from renewable resources may serve as substitutes for irreplaceable materials.

Folly of Using up Reserves

Perhaps we need brain power most to teach us the folly of needlessly wasting the inheritance of our children. Using irreplaceable materials resources is like using up your capital instead of learning to live on your interest or earnings. No matter how slowly we deplete capital, the day must come when we have nothing to leave our descendants. For almost two centuries we have been wasteful because we thought our natural resources were inexhaustible.

It will take wise and intelligent guidance to change our ways. But eventually we may learn to deny ourselves today's pleasures for the sake of leaving enough for our children to let them enjoy the blessings of civilized living. We may even learn to deny ourselves such pleasant luxuries as large, chrome-trimmed cars, powered by high octane gas which discharges thousands of tons of scarce and irreplaceable lead into the air. Changes in national outlook such as these can only be pioneered by people whose minds are able to grasp the scientific problems involved, and who can make them understood by the average citizen.

It is a truism needing no elaboration that as society becomes more complex technologically, it needs proportionately more, as well as qualitatively better, trained professionals. Thus, while the population of the United States has doubled in the last 50 years, the number of its professional men and women has quadrupled. We have today five times more engineers and ten times

more scientists than a half century ago and yet there are still not enough. To increase our national product by a given percentage annually we must increase our scientific and engineering personnel almost twice as fast. With every step forward in technological progress, the nation becomes more dependent on its trained brain power.

Must Increase Knowledge

Moreover, the closer we come to scarcity of natural materials resources, the heavier grows our demand upon the quality of our trained man power. Just as it is far easier to dig a lump of coal from a surface vein than it is to pump oil from a deep well, perhaps buried under tons of sea water, so it is more difficult to release the power locked in the atom than the power held in falling water. Substitution of man-made for natural resources, better utilization of inferior natural resources, elimination of waste —all these demand the raising of our entire body of engineering and scientific knowledge to a higher plateau. I can best illustrate this from my own experience.

A nuclear power plant consists of two distinct parts: the reactor proper; and the heat exchangers, the valves, the pumps, etc. which draw power from the reactor and transform it into electricity. When we began work on the first nuclear propulsion plant we expected that, in building the reactor, radiation hazards would present us with unusual technical problems requiring greater scientific and engineering knowledge than had up to then been needed for construction of conventional power generators. For one thing, the constant bombardment of all metal parts of the reactor by neutrons would in time make the metal itself so radioactive as to change its composition, unless we could find metals resistant to such changes. In the end we had to develop two entirely new metals for reactors—zirconium and hafnium. We had not, however, expected to meet almost as many tough problems with the conventional components of the nuclear plant. The problem here again was radiation hazards and resultant difficulty of access to all parts of a nuclear plant for inspection and repair. We spent much time and money testing each item to discover what was needed. Costly methods of trial and error had to be substituted for exact scientific knowledge, because such knowledge was not available in metallurgy. We did not know why conventional heat exchangers, pumps, valves, etc. worked with steam or hydroelectric power plants but not with nuclear plants. Before we can develop a viable and competitive nuclear industry, we must raise metallurgy from an art to an exact science, for empirical methods cannot be used indefinitely in modern technology.

In the past, man's advances in technology have been slow whenever theoretical knowledge failed to move forward. Rome, for example, had everything she needed to build structures of reinforced concrete except the necessary theoretical knowledge of stresses, thrusts, and distribution of weights. From Egypt and Greece, Rome had inherited practical knowledge in building structures based on lintel and post; from the Etruscans she had inherited the arch; and in Italy she found the raw materials from which she learned by accident to develop a hard and durable cement. Greece had already experimented with strengthening masonry by imbedding iron rods in grooves. Had Rome been able to combine these methods with theoretical knowledge, she could have built her aqueducts and pipe lines more durably and far less expensively with reinforced cement.

Nations in Scientific Race

In a sense we are today at the Roman stage as regards metallurgical science for reactor requirements. We must advance not only our knowledge of theoretical and applied nuclear physics but also our entire level of engineering and metallurgy. Similar advances in theoretical knowledge are needed throughout the entire field of science and engineering if technical civilization is to be maintained and advanced in a resources-poor world. How successfully a country manages to raise itself by its own bootstraps to ever higher stages of scientific and engineering competence will determine that country's position in the world. The fate of our country rests in the hands of those of its citizens whose natural endowments enable them to push back the boundaries of knowledge.

Intellectual Empires

You young people have the ability to grow into empire builders of the intellectual realm. I hope that you will be inspired to adventurous search beyond present boundaries. I hope that you will not let yourselves be deflected from pursuing this aim by accepting positions having less intrinsic importance but greater material rewards. I hope that you will firmly withstand the constant pressure by the advocates of the greatest of modern fallacies—that material possessions are the mark of the successful man. Man's acquisitive traits are not what make him great. Nor can true greatness be measured in dollars and cents. What money value can you assign a book on which the author has labored for years and which may inspire you to actions having incalculable effects? Is it worth only its price of three or five dollars? How would you value the piece of paper on which Einstein scribbled the simple equation which in its ultimate effects may preserve the freedom of the West by providing it with nuclear power to replace coal and oil?

Is the pay you receive to be the only measure of the value of your job? No! Nothing material can ever give the intelligent man or woman such deep satisfaction as successful solution of an intellectual problem that challenges the mind.

We are engaged in a grim duel. You are familiar with the threat to American technical supremacy which may materialize if Russia succeeds in her ambitious program of achieving world scientific and engineering supremacy by turning out vast numbers of well-trained scientists and engineers. Democracies move slower than totalitarian dictatorships. We have let our educational problem grow much too big for comfort and safety. We are beginning to see now that we must solve it without delay. Perhaps the greatest danger has been our failure to provide adequate educational opportunities for our gifted youth and, in particular, to seek out the talented at an early age and to give them an education which challenges their minds and induces them to become trained professionals. I am particularly happy, therefore, to be here tonight because the Science Talent Search sponsored by the Westinghouse Electric Corporation is exactly the sort of device we need to discover and develop our greatest national resource —the young man and woman with a really good mind.

Typical American Solution

It is a typically American device in that it represents an effort on the part of private citizens to accept responsibility for a problem usually considered to be the peculiar responsibility of government. It has ever been characteristic of Americans that when faced with a community problem we do not sit with folded hands waiting for government to solve it but pitch in ourselves. I hope more and more corporations will pitch into the problem of fostering America's wealth of young talent. And I hope that more and more talented young people will make the fullest use of their intellectual endowments. Democracy is not merely a political and social device to insure that under a popularly elected government each citizen may enjoy complete personal freedom, bounded only by the equal rights of other citizens. It is far more than that. Democracy guarantees to the individual freedom and opportunity to develop his mind and character to his maximum potential without hindrance from external sources so that he may put them to use not only for himself but for the community as well.

Democracy Entails Duties

Sometimes we forget that democracy is not a matter of rights alone; that it depends for its very life on acceptance of corollary duties. If democracy meant no more than freedom of each citizen to enjoy himself, provided in so doing he harmed no one else, it would be a shabby creed indeed for the people of a great country; an uninspiring banner under which to fight the enemies of freedom.

The men who established this nation and who devised the political institutions which have served us so well realized that democracy puts heavy obligations upon the citizen. It demands of all of us that we participate wisely in choosing the men to govern us, and it places on those who have special talents the obligation to develop these talents to their fullest, and to apply them in the service of the common good.

Science News Letter, March 16, 1957

Do You Know?

For almost 5,000 years China and Manchuria had a virtual monopoly on *soybean* cultivation.

More than a million fixed, portable and mobile radio *transmitters* are in operation in the U. S.

The *jig* used in construction of wings for a modern transport is so large that workers using the tool must communicate by telephone.

Blister rust control in 1956 involved destruction of 12,000,000 wild currant and gooseberry bushes of the ribes family which act as intermediary hosts and transmit the disease to the white pine.

Questions

ANTHROPOLOGY—California's famed Catalina Island was inhabited as early as what year? p. 169.

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CIVIL DEFENSE—What is the only known effective drug against nerve gas? p. 165.

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GENERAL SCIENCE—How can we replace the nation's diminishing natural resources? p. 170.

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NUTRITION—Of what does the Bantu diet consist? p. 163.

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OCEANOGRAPHY—Which two currents affect the southward course of icebergs? p. 163.

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● RADIO

Saturday, March 23, 1957, 1:45-2:00 p.m., EST.

"Adventures in Science" with Watson Davis, Director of Science Service, over the CBS Radio Network. Check your local CBS station.

Dr. Frederick J. Stare, professor and chairman of the department of nutrition, Harvard School of Public Health, Boston, Mass., will discuss "Fats in the American Diet."