GENERAL SCIENCE

Partners in Progress

Man in this age of technological progress must take a new and broader outlook toward the future and not neglect the needs of the individual human being

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➤ SPEAKING before a U.S. congressional panel earlier this year, C. P. Snow, the eminent British writer and scientist, stated in a discussion of the role of science in society: "I would far rather have choices made by wise men who are not scientifically educated than by unwise men who are." I am not sure into which category most of us here tonight fall, but I would think, or at least hope, that the majority of us could claim both some degree of wisdom and some scientific knowledge, because Lord Snow also went on to point out in his talk the importance of being scientifically informed and of having scientifically informed people in public life.

I bring up C. P. Snow at this time because the arguments resulting from the thesis he so effectively presented in his essays "Two Cultures" many years ago are still continuing. In fact, discussion of the roles of science and the humanities and arts and their degree of influence in our country has been somewhat intensified recently because of the role that the Federal Government is now playing in these areas.

Tonight I would like to spend some time discussing the relationship of science and the humanities and arts, their influences on each other and society, and what bearing government interest and support have upon all of them. This may seem like a lot of ground to cover in one talk, but I think there is a focal point we can use. It is the quality of life we expect our civilization to provide in the years ahead.

Two Major Points

In pursuing this theme I would like to make and expand on two major points: The first is that man's growing domination of his environment today demands that we take a new and broader outlook toward our future development. Secondly, in dealing with mankind's physical growth, with the mass society in a world of growing population, we must not neglect the individual human being and his basic need for a more satisfying, purposeful life.

One of the most significant phenomena taking place in our society today is our recognition of change—the extent and the rate of change occurring in this scientific-technological era, this Nuclear-Space Age. This Age is a relatively new era in history. It was born some 20-odd years ago and has been growing rapidly ever since in its scope and impact. But it is only within the past few years that there seems to have appeared an overwhelming awareness of the implications of the ascendancy of science and technology, of their present effects and those possible in the future.

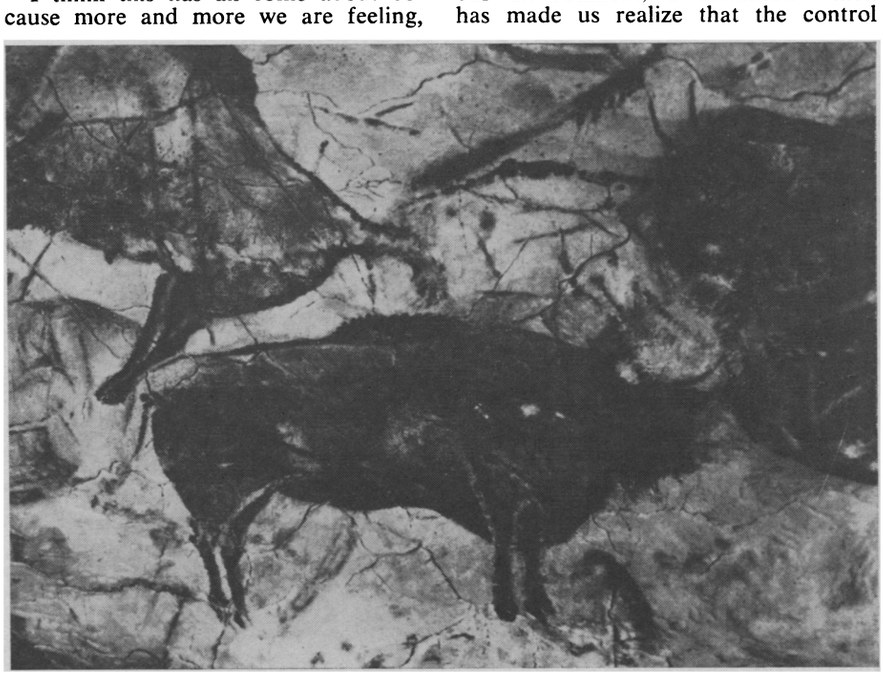
Science and Society

Now it seems that nearly everyone is rushing off to conferences on technological change, the whole relationship between science and society is a subject of symposia and seminars, and a flood of books and articles is appearing on the topic, almost all of which are in essence asking the same questions—"Where are our science and technology taking us?", "What does this mean?", "What can we do about it?"—and apprehensively recognizing the rate of change, the word "explosion" is becoming one of the most overworked in our vocabulary.

I think this has all come about because more and more we are feeling, or being made aware of, some of the problems growing out of what in the past many of us have viewed as unmixed blessings. Improved medical science has brought better health and a longer life span but also an expanded population growth. More automobiles and better roads have brought speed and convenience but also traffic congested streets and an accident rate of epidemic proportions. More efficient agriculture has allowed the increased production of food by fewer farmers, but as rural population has declined, urban areas have grown rapidly, causing a multitude of economic, social, moral and political changes in our cities.

Greater Efficiency

New technologies in business and industry provide greater efficiency of operation, but demand the reeducation and retraining of workers as certain human tasks and skills become obsolete. And as our industries have produced more and better products, so also have many of them—both producers and their products—contributed to the alarming pollution of our environment, a condition which has made us realize that the control



Dow Corning

'TWO CULTURES'—Links between the humanities and science, and ancient and modern man are represented by this cave painting in Altamira, Spain, that has been reproduced exactly by artists using a mold of silicone rubber made by the Dow Corning Corporation, Midland, Mich.

and recycling of waste may be a major human problem from now on.

To add to these problems and pressures rising from "normal" growth and progress, we face other mixed blessings of potentially enormous consequences —potentially good or bad—rising from the development of new technologies whose full influence in either direction we have yet to feel. In this case, I refer to the use of nuclear energy and the technology of space. Naturally, we hope and we work toward making these outgrowths of our scientific age serve us beneficially (and I think, we are making great progress in that direction); nevertheless, they add to the total picture of change and dramatically call our attention to it.

Totality of Change

Another factor of which we have become increasingly aware is the totality of change and the influence and interrelationship of all the scientific and sociological forces producing change today.

We see quite vividly, in our modern world, not only the interdependence of man as brought about by the web of specializations in a global civilization —one we have created by modern communication and transportation— but also man's ascendancy over his environment, now reaching the point where certain changes by man can have widespread, perhaps devastating, effects on our planet.

Having recognized the problems and complexities of the rapid change of our time, we realize that planned action is called for in order to control and direct it toward our needs and benefit. We are intrigued with our new-found power but we are also aware of its possible consequences and pressed by a growing sense of responsibility.

We realize that mistakes made today are apt to be big ones and costly ones, and that even apparently small mistakes may have large and important consequences in terms of future generations. But at the same time the demands and dynamics of the times call for decisions. In most cases inaction means retrogression—and a type of retrogression which, because of the pressures of growth, may be catastrophic.

Important Questions

All these factors—a recognition of the rate of change, its totality, and the fact that we can exercise some control over it through planning—lead to some of the most important questions facing the American people today. And they are questions not alone concerned with controlling physical change. For we have come to realize that in planning and working for the future, we must also reevaluate our goals. We must temper, adapt and redirect the enormous technological forces we have created to the end of serving the individual human being—an end for which the forces were created but which has begun to elude us as we have become more and more taken with the power, the momentum and the "open sesame" fascination that our modern science and technology have provided.

In a democratic society, the underlying quality of life for which we strive is represented not by total economic and social change but by the welfare— the well-being—of the individual in society. Maintaining a maximum of freedom and opportunity for growth for the individual in a world of overwhelming technological forces and growing social interdependence and responsibility is a major challenge of our times. And it is a challenge which many feel cannot be met fully without a more meaningful interplay between the sciences, the humanities and arts, and government—forces which up to now have acted to a great degree separately, and sometimes at odds, in our society.

Insight Into Challenge

In bringing up the influences and interplay of these forces in a nation, and to gain some insight on the growth of the challenge facing us, we must take into account several factors which had an important bearing on our early development. The pragmatic spirit of our early settlers and our first citizens was of prime importance in shaping our entire destiny. From its birth ours was a nation of opportunity, of action and of mobility. The need for movement and growth was characteristic of America from its beginning.

Fortunately, we were blessed with a land of vast natural resources, a growing population of vigorous people from a variety of cultural backgrounds, and, most fortunately, our early years coincided roughly with the beginning of the Industrial Revolution. All these circumstances combined to allow us to grow and prosper rapidly.

From our earliest times it was the Federal Government's responsibility to minister to the needs of the people, but to do so only when those needs were considered national and federal action did not conflict with individual and states' rights. This was evident in the Federal Government's early role in science and technology—in its support of such a scientific venture as the Lewis and Clark expedition and its establishment of our first federal scientific agencies, the Geological Survey, the Naval Observatory and the Coast and Geodetic Survey. Other federal organizations of a scientific and technological nature were ushered into being as their need became apparent.

But it was not until the 1900s, the period after the first World War, and particularly after World War II, that large-scale federal involvement in science evolved. It was during this era when the chemical industry saw the beginning of rapid growth based on new discovery and innovation, and when in physics, as Robert Oppenheimer characterizes it, we shook the tree of earlier theoretical science and applied the knowledge we gathered to help us develop new and potent technologies to help us foster the scientific revolution, the tremendous effects of which we are experiencing today.

People 'Discover' Science

This scientific revolution, since the birth of the Atomic Age—and particularly since the challenge of Sputnik —has had a pervasive influence throughout our society. It has led many people to "discover" science; that is, to realize its power to produce substantial material gains when its methods and knowledge are put to use by modern technology.

But what has been most notable about this scientific revolution—and probably what characterizes it as a revolution—has been the increasing speed with which theoretical discovery has found its way to practical application. And today as the time gap between discovery and application continues to narrow, so does the social impact of science grow with an almost exponential force.

There is no need to go into detail about the government's role in this revolution and the combined effect on our society. Its overwhelming influence in most aspects of our national life is, of course, obvious. It has continued to shape our national personality along the pragmatic lines of our formative years— and I do not say this disparagingly, as we have accomplished a great deal in bringing a better standard of living to our people in our relatively short history.

Other Side of Coin

But what of the other side of the coin? As opposed to our technological know-how, how have we developed "value-wise," "culture-wise," or even "wise-wise"? If we view America in terms of its intellectual and cultural growth we see that we arrive at a problem when we compare this with our "scientific explosion" of recent decades.

As I mentioned last year while testifying before a Senate Subcommittee in support of a National Humanities and Arts Foundation, I feel we are developing an imbalance in our national personality, one which is arising from a well-intentioned emphasis on technological gain but one which is weakening our framework of values nevertheless. Among the elements which characterize this imbalance is a strong desire to satisfy material needs—some of which we create artificially—at the expense of satisfying some very important psychological and spiritual needs.

Today our concern with efficiency and economy, with power and production—with our overall desire to "do the job"—dominates our reasons for doing the job. In our preoccupation with "means" we have lost sight of many of the "ends."

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We set more production goals but fewer human goals. We think more of developing "systems" and less of developing individuals. We chart the course of our businesses and our economy but not the measure of our success or failure in providing human fulfillment. Granted there is no equivalent to the gross national product in the fulfillment of human values, we seem to give the former far more thought and concern than the latter.

Nation of Individuals

Being a nation founded on concern for the individual—his freedom, his welfare and his pursuit of happiness—it is all the more ironic that today our concern with the techniques for achieving many of these goals has somehow pushed the individual into the background. At times he feels sorely neglected as a human being. This is becoming more evident on our college campuses, in our big cities and in our industries, where people, living and working together in large numbers, are reacting to the strange combination of the pressure of competition and yet the lack of meaningful human contact. It is evident in much of our current social behavior—in the pursuit of some of our more exotic fads and cults, in an excess of hero worship, in some rebellion only for its own sake, and even in conformity to non-conformity.

But most of this behavior has some constructive meaning. It acts as a form of release and fills certain superficial needs of the times. More importantly though, it calls our attention to needs which are being overshadowed in today's technological society—the basic needs of a person to have an individual identity, a sense of purpose and accomplishment in his life, and outlets for his physical and creative energy.

In today's restlessness and rebellion, once again we are made aware of change and of the need for action to deal with it. Within the context of the total change I spoke of before, I believe we can deal effectively with our social and psychological needs—as well as our technological and economic ones. I believe we can deal with them by emphasizing in our plans and work the human values which we have had for ages, but many of which in recent times have been overshadowed, overlooked or inadvertently bulldozed aside by the momentum of a benign but often bumbling technology.

Man's Role Reemphasized

In the light of recent events I think we have begun this reemphasis on man's role in the scientific age, or at least are at the point of beginning it. I feel that perhaps we are now at a time in our history where, breathless from a headlong pursuit of material gains, we have paused to look around and reflect, and this has engendered in us a new awareness of the total condition of our lives and a broader outlook of the future.

During our reflection we have arrived at some badly needed insight into significant needs. And, among other things, this is leading to some important national planning toward preserving the natural beauty and resources of our land, toward "beautification," toward fulfilling some of the obligations of our heritage which we have bypassed in our rapid growth. Who can doubt that these also are major goals of a truly Great Society, the pursuit of which deserves our firm support?

Today with our new awareness of change and our realization that we can and must be the master of that change, we are also taking a more positive attitude toward emphasizing and cultivating human and aesthetic values.

Most recently this attitude has resulted in some important new action taken by the government which has long remained at some distance from any direct interest in or support of our humanistic and cultural growth, although it may have realized the importance of those values to us as a nation. There have been many reasons for federal inactivity in these areas.

The primary one parallels what has taken place in our scientific development and also grows out of our basic philosophy of a minimum of government interference in all segments of life. As I pointed out in discussing the relationship of science and government in our history, the government's role

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developed basically along the needs of the country.

Unfortunately—or, in some respects, perhaps fortunately—wars and national crises have not demanded government support of the humanities and cultural pursuits. With the exception of some Federal support of the arts by WPA projects in the depression years, scholars and artists have continued on their own during these periods when vast sums of money went to support science and technology.

Also, it has been traditional in our society to view scholars and artists as people who need no public support, who work best on their own; who, in fact, derive some kind of inspiration from their isolation if not their poverty. Considering the arts, most people who have this attitude conveniently overlook the fact that many of the world's great masterpieces were commissioned—masterpieces which may never have been created but for the support of a patron.

Great Patrons of Art

America has had its great sponsors of intellectual growth and patrons of the arts in the past, and today we have numerous individuals, foundations and business organizations that are helping to support a substantial segment of the scholastic and cultural community. But private support only begins to meet the needs being generated today.

Finally, there has been the attitude in America that government support of any educational or creative process would lead to its control by that government and to dangerous interferences with our most basic freedoms. Many have used as an example of this sort of culture-control the book-burning tyranny of Nazi Germany or the directing of the arts toward propaganda in Communist countries. But it does not follow that governmental support of creative or scholarly pursuits necessarily leads to controls.

I think that what transpires in this relationship between support and control depends on the basic philosophy of the nation. And within the American framework of thought and action it seems highly unlikely that government control of the arts would evolve here.

Support for Humanities

It is of greater concern today to find ways to support the humanities and arts so that they can have the economic freedom to reflect some of the truths that a nation needs to have revealed to itself. Through this process we can maintain and develop further the values and outlook that we so crucially need to guide our technological society, to assure its growth and development as a human society as well.

Today, recognizing the desire of our people for a more meaningful life—for fulfillment beyond that of the materialistic life—has come a response from government. The response is taking place on local, state and federal levels, and in many forms. There is not time to go into all of the work being done or planned, but for a few minutes I would like to touch on some of it being carried out by the Federal Government, particularly by the newly created National Foundation on the Arts and Humanities.

This Foundation, created by a bill signed into law last September is comprised of a Federal Council on the Arts and Humanities, a National Endowment for the Arts, a National Arts and the Humanities, and National Councils on the Arts and the Humanities. Its purpose is to help support and encourage literary and scholarly pursuits and creative arts of the highest caliber.

Varied Interests in Arts

In the arts, its interests include (but are not limited to) music, dance, drama, architecture, painting, sculpture, photography, graphic and crafts arts, industrial design, fashion design, motion pictures, television, radio, tape recording and all the other arts related to the preservation, performance, execution and exhibition of these major art forms.

In the humanities, it is concerned with our knowledge and understanding of literature, language, archaeology, history, the classics, religion, philosophy and the preservation of our heritage in all these fields. This is indeed a lot of ground to cover, but the range of interests indicates, I think, the thoroughness of consideration that went into the planning of the Foundation and its activities. It has carefully con-

sidered the complex needs of our creative and intellectual life. What are some of the ways it plans to help fulfill these needs?

As many of you probably know, Roger L. Stevens, who was formerly the President's Special Assistant on the Arts, was designated as Chairman of the National Endowment for the Arts, and the National Council on the Arts which advises the Endowment. Mr. Stevens, who has combined a highly successful career in business and finance with an equally successful one in the world of art, recently elaborated on some of the plans of the Arts Council. And I would like to mention a few of them now just to bring out some of the areas of work involved in supporting our cultural growth. I think you will find many of them as surprising as I did, particularly in the very practical and far-reaching way they will help the arts—and without regimenting or controlling them. Not all of the plans involve direct financial support, but some, because of their widespread effect, may be more significant than direct financial support.

For example, Mr. Stevens points out that there is already an Executive Order in effect that calls for the expenditure of one percent of total construction costs for art in all federal buildings, but that this is the first item cut in a building's budget when the money starts to run out. The average expenditure for government buildings runs about $600 million to a billion dollars a year. Stevens argues that if the one percent figure could be made mandatory it could create a market for the purchase of art of about five to ten million dollars annually.

A similar situation exists under FHA regulations which, in view of FHA's annual expenditure of about $5 billion, might account for another 40 to 50 million dollars worth of sculpture and painting. Aside from the support this could lend to American artists, think of what it would mean to the beauty of the buildings and the enrichment of the lives of the people working and living in them.

The Arts Council further suggests that there is no reason why the immense number of government-owned buildings throughout the country cannot to some extent be used for art exhibits, particularly in cities that do not have museums.

Paralleling these suggestions, Mr. Stevens points out that through National Park Service receipts controlled by the Department of the Interior it may be possible to support many cultural activities such as the theater, concerts and museums in our national parks, thus providing an excellent medium for the work of actors and musicians.

Another very practical recommendation involves making available government surplus property construction materials to museums, theaters and cultural centers for building or adding to existing facilites.

The Council recommended that direct aid to artists be made not only in the form of grants and commissions but in such minor but important matters as providing money for crating and shipping works to an exhibition—a matter perhaps trivial to us but quite important to the artist.

Another problem artists face is finding a place where they can afford to live and work, especially in large cities where building costs are high. Many are willing to fix up older buildings, and the Arts Endowment has arranged for a number of FHA loans for this purpose. It has also established a revolving fund of $100,000 for an artists' housing project, with studios and living quarters for painters and sculptors.

In the area of the performing arts, the Arts Council has been even more active than in the creative arts. Among the many things they have done is to recommend the setting up of four Youth Symphony Orchestras in four sections of the country where there is no strong local symphony. The Arts Endowment would sponsor these with the idea that eventually they would support a National Youth Symphony made up of the best instrumentalists.

The Council is also interested in setting up repertory theaters, "of the highest professional quality," in different parts of the country, and the Arts Endowment has set aside $500,000 to help found three such companies. These funds would be augmented by local school authorities and the U.S. Office of Education.

Underwriter Experimental Theater

In addition to these, the Endowment plans to underwrite a playwrights' experimental theater for $250,000, the purpose of which would be primarily to present plays "that cannot be produced under economic conditions facing Broadway today." Many will argue that all these funds and plans represent an infinitesimal amount of financing and effort as compared to government support of science and technology.

Nevertheless, this action is an important first step in direct government participation in our cultural life, participation which certainly will be increased as it proves successful.

Up to this point I have been speaking of the plans of the Arts Council and Arts Endowment, but what of the work of the National Council on the Humanities and National Endowment for the Humanities, also created by the same bill? The chairman of these new Federal organizations happens to be the president of our American Philosophical Society, Dr. Henry Allen Moe. It is in the fortunate interest of the Government to have someone of Dr. Moe's standing serving in all these capacities. Dr. Moe recently reviewed some of the plans of the Humanities Endowment, and once again it is interesting to see the extent and the scope of work anticipated.

Grants for Scholars

To further individual work in the humanities, the Endowment will support scholars with several types of grants. Among these are Summer Fellowships to teacher-scholars, Fall Fellowships to support significant humanistic scholarly efforts, and Advanced Study Grants for those who, working within the university or outside, "are on the edge of seizing truth—historic truth, philosophic truth, aesthetic truth."

The Humanities Endowment plans to aid archaeological-historical studies by supporting a number of excavations in both domestic and foreign territories, and such excavations and stud-

ies will reveal important new knowledge for scholars and historians.

Support will also be given by the Endowment to local archaeological and historical museums—to their staffing, cataloguing, exhibits and publications.

A most interesting area, which brings out the valuable partnership between science and the humanities, is the field of computer-oriented humanistic research. And this is an area in which the Endowment has great interest.

In addition to those activities mentioned, the Humanities Endowment will also be active in and lend assistance to such interests as the study of classical languages and cultures, the support and training of critics of the arts and humanities, the study of the educational uses of radio and television, the recording of literature, the support of American historical studies and the rediscovery and preservation of American literature.

I could go on to mention other plans of the Arts and Humanities Endowments which will lend support and encouragement to ventures ranging from performances of the classics to the creating of avant-garde films and electronic music, but I think you will see at this point that a new source of support for our cultural life has come into being, and it is one which will be taking encouraging and effective action. Of course sufficient financing of these efforts is essential but has not yet been forthcoming.

Important Results Seen

If Congress is as generous in providing funds for these Endowments as it was wise in legislating them into existence, I believe we can look forward to seeing some interesting and important results from this new venture of the Federal Government into the neglected one of the Two Cultures.

Foremost among these results will be refocusing on those values which give our lives purpose and direction. As I indicated before, we have entered an era in which mankind—and particularly individual man—will have a growing need for an inner strength, for a feeling of worth and fulfillment, and for an appreciation of the things in life which, shared or experienced alone, make life worth living. The arts and the humanities offer many of these more evasive necessities of life, supplementing those others supplied more abundantly today by science and technology.

The new support of the arts and humanities by the Federal Government should help break down some of the artificial barriers we have created between the world of science and technology and that of the arts and humanities. I call them artificial because I think we have created them to some extent only by our words and deeds and can remove them by new outlooks and attitudes.

I believe these barriers are partly the result of our desire to conveniently

categorize and catalogue our ideas and activities. But though science may have a pervading and ascending influence in our lives today, there cannot be any clearcut division between science and nonscience in interdisciplinary civilization which a liveable future world will require.

The growing overlapping of cultures becomes obvious to those who care to pause and look for it. Some people, apprehensive over the rate and degree of change brought about by our applications of science, talk of science as if it were a force apart from man. What they tend to overlook is the simple fact that science is after all a human endeavor and that it does not exist independent of man. We must not forget that in overall history science has, so far, done more to "humanize" than to "dehumanize" man.

In trying to separate science from other aspects of our lives many tend to overlook the large areas of direct interplay betwen science and technology and the humanities and arts. As most of you know, sicence has become a valuable tool of the humanities.

In the fields of history and archaeology it has provided remarkable means in helping us to discover and analyze many traces of our past. Such techniques as carbon 14 dating, the use of the proton magnetometer and neutron activation analysis are today helping to reveal much new knowledge about our ancestors and their various civilizations.

A unique new example of the symbiosis of science and the humanities may bring together, in a most unusual endeavor, the most unlikely partners, high energy physics and egyptology.

This proposed project, in which high energy physics (a field not yet having many direct practical applications) may help archaeologists, is one involving the search for a possible hidden burial chamber in Chephren's Pyramid, one of the great Egyptian Pyramids built about 4,500 years ago.

In addition to bringing together widely divergent disciplines, the project would be one of international cooperation bringing together physicists and archaeologists of the United States and the United Arab Republic. Those who would be involved are Dr. Luis Alvarez and his staff at the University of California Lawrence Radiation Laboratory at Berkeley, Dr. F. El Bedewi, nuclear physicist of Ein Shams University in Cairo, and Dr. A. Fakry, archaeologist and well-known authority on the pyramids from the UAR Department of Antiquities.

High Energy Physics Approach

In this high energy physics approach to archaeology, originally proposed by Dr. Alvarez, the plan is to use cosmic ray "muons," occurring naturally from space, and high energy particle detection equipment to literally "X-ray" the great pyramid. Through the use of a spark chamber, placed in a known subterranean burial chamber beneath the pyramid, it is possible to detect the "muons" penetrating the pyramid's walls. Any voids within the pyramid will be manifested by a greater number of "muons" being recorded by the spark chamber.

Through this method the scientists and archaeologists hope to discover and map out in a non-destructive manner the location of the hidden chamber they believe exists somewhere in the huge structure. This suggested project, I think, is an outstanding example of science in the service of the humanities, helping man to solve some of his past and present mysteries.

Of course the pyramid project is a specific, isolated example of the symbiosis I referred to earlier, but the integration of our Two Cultures is also under way in more general terms. One indication of this—oddly enough again involving high energy physics—relates to the search for a site for the AEC's proposed 200 Bev accelerator.

As you well know, the possibility of having a scientific laboratory of such importance and economic impact in their area has created keen competition among many communities across the nation. What is less well known—but has even greater significance—is the unexpected effect of this competition on the various communities.

The process of assembling informa-

tion brought together in each community an unusually broad group of local leaders, state officials, university presidents, professional men from a number of fields, and industrialists. Immediately there resulted a cross-pollination of ideas, an exchange of views, a frank discussion of problems—in short, these communities engaged in an unprecedented self-appraisal. In many cases, I think the people were led to see some of the hitherto unrecognized assets and shortcomings of their area.

As local resources were being mustered, it suddenly dawned on community leaders that the overall attractiveness of an area must be measured by factors which transcend economic considerations. Critics of intellectual and cultural activities were transformed into champions when it became evident that a strong academic base and a broad cultural environment were more highly regarded than amusement parks or dog racing.

University presidents suddenly found that their pleas for understanding of long-range goals—pleas that had long been ignored—were blossoming into legislative appropriations. In some cases for the first time in history, legislatures specifically earmarked appropriations for their university's research programs.

This local self-appraisal brought a greater interest in racial harmony. It brought renewed support for education at every level. It brought a greater appreciation for the public library, the symphony and even children's ballet classes.

New Channels Opened

The very process of assembling information opened important new channels of communications within the community. And if the people can maintain their momentum, not only will the community be a better place in which to live—it will be in a stronger position to compete for other scientific or technical installations.

Our site search has, I think, helped in another way which is important to me personally. It has helped change the public image of the scientist from a cold, detached individual to that of a very human person with a deep interest in his family and in his community.

All of this indicates, then, that the 'Two Cultures' are, indeed, becoming integrated, and this will be mutually beneficial to each.

Finally, as part of the new blending of scientific, social and cultural interests which seems to be forthcoming today, and in turn influencing it, I think we may see in our country a new rise in the quality of leadership. This should come about as, in this process of better balancing human values with the growth of science and technology, we develop men and women who have both broad social outlook and the knowledge to make the practical day-to-day decisions in keeping with that outlook.

Perhaps also in a society which fosters this combination of wisdom and knowledge, and which tries to keep its focus on individual human values within an evergrowing nation, we will be able to develop some immunity to the Anti-Leadership Vaccine which John W. Gardner has described so effectively as one of today's new problems in education.

To me, all these aspects of our new awareness, and the new actions we are taking as a result of it, are signs of an important new period of maturity for our country, and I believe they will not only reflect in our building of a Great Society here but will have a profound influence in our relations throughout the world.

In October of 1963, the late President Kennedy flew to Amherst College in Massachusetts to participate in a ceremony honoring the poet Robert Frost. I think that the talk he gave at that ceremony best reflects what most Americans feel should be the goals of this country and our role in the world. And since it bears so profoundly on what I have been trying to say tonight, I would like to conclude by quoting some of this most impressive statement.

"I look forward to a great future for America, a future in which our country will match its military strength with our moral restraint, its wealth with our wisdom, its power with our purpose.

"I look forward to an America which will not be afraid of grace and beauty, which will protect the beauty of our natural environment, which will preserve the great American houses and squares and parks of our national past, and which will build handsome and balanced cities for our future. . . .

"I look forward to an America which will reward achievement in the arts as we reward achievement in business or statecraft. . . .

"I look forward to an America which commands respect throughout the world not only for its strength but for its civilization as well. And I look forward to a world which will be safe not only for democracy and diversity but also for personal distinction."

• *Science News, 89:339 May 7, 1966*

Nature Note

Iridescent Jewel: The Pearl

➤ THE PEARL, natural or cultured, is the only jewel created by a living creature.

Although every two-shelled creature can produce a pearl of some sort, the truly beautiful and valuable pearls are created only by certain oysters—the Pteriidae or pearl oyster, of the large Mollusca phylum.

During the life of an oyster, its fleshy tissue, called the mantle, secretes and lays down molecules of horny material in precise orientation to produce an outer horny shell. Next to this, calcium carbonate crystals lie in tightly packed prisms. The innermost layer, the nacre or mother-of-pearl, is secreted in extremely thin layers of limy material alternated with equally thin films of horny material. These layers provide the diffraction of light that produces beautiful iridescent colors—blue, green and pink.

Then if a grain of sand or other material gets between the mantle and the inner layer, it irritates the tissues, and the oyster secretes more mother-of-pearl to cover or wall off the foreign object. The shape of this growing pearl depends on the body zone in which it is produced. It may be spherical, or if compressed, it may be lateral or pear-shaped.

The layers of nacre are built up slowly—at a rate of about three thousandths of an inch per year. It takes an oyster about three years to make a pearl.

Natural pearls are those occurring naturally in the oysters. Cultured pearls are the products of cultivated oysters into which man has deliberately placed a foreign object. Artificial pearls have been made with spheres of thin glass filled with a special preparation of silvery scales of small fish. The cavity is then filled with white wax.

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