*Keynote Address**

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Mr. President and members of the American Congress on Surveying and Mapping and of the American Society of Photogrammetry.

Your Chairman has said that my purpose here is to inform and entertain. I know that the best way to inform is to disguise the information as entertainment. But I am here for another reason. I am a geologist and am concerned with the kind of things you people do. In the course of my geological career I have done a great deal of mapping. Back in 1928 I mapped a piece of the west coast of Baffin Island and thereby cartographically sank an area as big as the State of Connecticut, which didn't exist at all but which had been on all maps up until that time. In a shrinking world, I am not sure that this is a desirable kind of an achievement, but I wanted you to know I am not unsympathetic with what you are doing and am not unfamiliar with it.

DR. LAURENCE GOULD

I do not have a manuscript because I have never been able to write a speech and read it. You may, therefore, be a little concerned when you notice that I take 256 cards out of my pocket. But actually these cards are a measure of brevity which might not otherwise occur. I shall take the cards from this pile and put them over here. When this pile is gone, you and I will know that the end has been reached.

Besides, I never have been able to read a speech. Reading a speech is like giving a kiss over the telephone. It is, by all odds the safest way, but certainly not the most exciting.

I have placed my watch in front of me. This gesture, which always reassures me when I am a listener, is one which I learned from the preachers. From it you may derive such comfort, as you wish.

You have a busy schedule and your program, calls for the closing this session at 11:50. Probably you will close about then. I will talk approximately half an hour. My friend Warren Weaver says approximately means plus or minus $33\frac{1}{3}$ per cent.

I assume you have invited me to speak primarily to inform rather than to entertain, and I remind myself, as I begin of my favorite precept; it is an old Arabian proverb that says wisdom consists of 10 parts, 9 of which are silence and one is bravery.

I will mention a few of the highlights of the organization of the International Geophysical Year, but I want to talk technically about the part for which I am responsible. I am Director of the U. S. IGY Antarctic Program. I have been down in the Antarctic twice during the past year, and I hope to go there many times more.

Geophysics as you know, is simply the

* Presented at the ACSM-ASP General Assembly on March 26, 1958, Consecutive Meetings of the two societies, Hotel Shoreham, Washington, D. C.

study of the behavior of the Earth, and it's had a very long period of incubation. The geophysical sciences are the oldest of all of the sciences known by man. When he got up off his front feet and began to inspect the world around about him, he began to record data about his climate, his oceans, and the other things that constitute his environment.

Even so, it is amazing that the records of the geophysical sciences are so incomplete and fragmentary. One of the reasons derives from the fact that no single one can proceed indefinitely without regard to the rest, because they are all related. In turn, to state it another way, geophysics is the application of the tools of physics to the study of man's environment. Accordingly the geophysical sciences had to wait for the development of the tools which are now provided by the physicists and the engineers. Such advances have been made in the related sciences and so great are the possibilities of the electronic computers now available that the present effort was possible. It could not have been made even 15 or 25 years ago.

Archimedes is quoted as having said: "Give me where to stand and I will move the world."

We geophysicists do not intend to move the world—we like the location of it quite well as it is—but it does suggest the global character of the concept which lies behind the International Geophysical Year, because this is the first time in man's whole history that he has attempted a total study of his environment. It is the most comprehensive scientific program man has ever undertaken and it is a program of basic scientific research which is immediately applicable.

There is no sharp line between basic and applied research. Indeed, as a scientist, I deplore the tendency of many people to try to draw lines between the two. One merges into the other, and I challenge you to find any great theoretical discovery which has not eventually flowered into practical application.

Geophysics touches the lives of everyone who lives—everything is involved in it—agriculture and transportation and communication—all of these things are inseparably bound up with the geophysical sciences, and our long-continued occupation of this world depends upon a more sharply defined knowledge of the environment in which your children and your grandchildren are going to operate.

The International Geophysical Year, therefore, is not just a program that a bunch of scientists got together and dreamed up and said, "Wouldn't this be fun? Isn't it time we did this?" Fundamentally it is a result of the pressure deriving from man's increased mobility. Every time man discovers some new source of power, some new kind of energy that enables him to travel faster, to fly higher, he's got to have more detailed, more precise information about the environment in which he is going to operate. For safety on land, sea and air, we need better knowledge for forecasting the weather, better knowledge of useable radio frequencies and better knowledge of the upper air for transportation and guided missile flight.

Geophysics is unlike the "physics" that we think of when we use the word. The nuclear physicist can go into his laboratory and split his atoms whenever he pleases and observe the results. In the geophysical sciences nature performs the experiments and man is the observer. Therefore, he will select the time when nature is at its best, from his standpoint. That is the reason why 1957–58 was selected for the International Geophysical Year. You have noticed, of course, that instead of 12 months the geophysical year is 18 months long—July 1, 1957 through December 31, 1958—18 months—because we wanted to be sure of having a continuous period of 12 months observation from all of the thousands of stations that blanket the globe.

We expect some major results, even from so brief a period of observation. We expect the accumulation of data which already are flowing into the world data centers to provide reservoirs of research material for scholars for a long time to come.

One of the great things about this whole program is that it is free to all men everywhere. There is no classified material in it; all of the data are available to everyone who will make use of them. We expect break-throughs in such areas as ionospheric physics, meteorology and many other aspects of man's environment. We are studying the shape and the structure and the interior of the earth by gravity, seismology and longitude and latitude; by meteorology, oceanography and glaciology; we are studying the earth's heat and water budget; and by solar studies, ionospheric physics, aurora and air glow, geomagnetism and cosmic rays, we are studying the physics and chemistry of the upper air. We have sent up nearly a hundred rockets, and, believe it or not, we are going to send up all of the satellites we planned.

Even the listing of these disciplines suggests the relation that many of them have to photogrammetry, to mapping and surveying; for instance, this afternoon, in one of your programs, you will hear about earth satellite photogrammetry. There isn't time this morning for me to talk about the relationship between these programs and the things that immediately concern you.

Each one of these fields that I have mentioned is characterized by its global nature and by its relation to solar activity, because the sun, by electromagnetic ray and particle form, is the source of all of the energy and, therefore, all of the life that we know.

There is time for only the briefest comments about a few aspects of the program —meteorology, oceanography, glaciology—the heat and the water budget of the earth.

We know, of course, that carbon dioxide and water make it possible for us to live and that the atmosphere acts as a blanket, protecting us from the lethal rays from the sun and outer space that might otherwise destroy us. Many of us don't realize, however, that the most important aspect of the atmosphere is its circulation. If the wind were to cease for two weeks, life would soon become intolerable. We know that the atmosphere behaves like the fluid of a great heat engine, picking up heat in the tropics and discharging in the polar regions. But we don't know too much about the manner in which these great masses of air are exchanged. We are now learning much from our work in Antarctica; there is still much to be learned.

For the first time it is possible, because of our observations in Antarctica, to follow the great air masses that have their origins over that vast continent covered with ice. We have learned much about ozone. We are startled to discover that there is 25 per cent more ozone at Little America in Antarctica than there is in New Mexico. People who study these things believe that the ozone plays a very important part in the circulation of the higher atmosphere because of the energy it can absorb and release.

Oceanography is second only to meteorology in the light it throws upon weather and climate. Many students believe that the deep sea currents of the seas are among the fundamental factors involved in meteorology and climatology. Today, we know next to nothing about these deep currents. Likewise for the first time, we are making simultaneous measurements of fluctuations in the sea level, which seems to be the most effective method for studying the weather of the ocean. We are much concerned with the carbon dioxide in the atmosphere—whether the oceans and plant life are going to absorb it fast enough, also use it. When I say fast enough, I remind you that carbon dioxide is a normal product of combustion; at the present rate of combustion of our fossil fuels, of coal, oil and gas, the amount of carbon dioxide in the atmosphere might be doubled in 50 to 75 years.

Carbon dioxide is one of the most important items in the atmosphere in absorbing and retaining the heat radiation of the sun. If the amount of carbon dioxide in the atmosphere were doubled, magnolias would bloom in Greenland again! But we don't know whether that will happen because we don't know how fast the carbon dioxide is taken back into the sea and how fast it is absorbed by the great masses of ice, particularly that in Antarctica.

Here's an aspect of oceanography, then, full of interest to us. One of the puzzling things about this carbon dioxide is that we find just as much of it over the Antarctic continent as we do over the inhabited parts of the world, except for the highly industrialized regions.

Of the 3 fields involving studies of the heat and water budget of the earth, only one—glaciology—provides any record of the past. One of the most important aspects of our present program in glaciology in Antarctica concerns an attempt to interpret the conditions under which the ice formed. We have but recently drilled a hole, making a 4 inch core, more than a thousand feet into the ice at Byrd Station. That core has been refrigerated; it's on its way back to the Snow, Ice and Permafrost Laboratory near Chicago, Illinois. Perhaps from it we shall discover what the climate has been for the past few centuries—interesting in itself and of enormous practical application as the tool it gives to think more accurately about long range forecasting. For the first time we are able to get a world-wide study of the variation of glaciers. This has never before been possible. We have known that the ice in the Arctic Ocean, and in the areas generally associated with it, has been melting at an accelerated rate since about 1900—a rate so rapid that if it continues to the end of the century, ships will easily navigate the Arctic Ocean again. We have not been sure whether this same correlative operation in Antarctica is continuing. We still are not quite sure, but we feel that it is.

At Little America, which was established in 1928 and where there have been four subsequent establishments, we find from preliminary observations just now available that between 1928 and 1958 the temperature seems to have increased six degrees. That is almost too much to believe, but it shows that the general warming up which we find in the Arctic is paralleled in Antarctica.

Now, a brief comment or two about some upper atmospheric phenomena. We find for the first time that the aurora borealis and the aurora australis are displayed simultaneously. We have secured a lot of new information about the ionosphere from the study of whistlers. These are whistle-like sounds that are detected by low radio frequencies. They have their origin in lightning flashes and then follow magnetic meridians swinging far away from the earth to return in the opposite polar hemisphere. They have told us that our atmosphere extends much higher than we had supposed, that actually our earth is within the corona of the sun itself.

The ionosphere is that portion of the atmosphere 50 to 250 miles above us, which acts somewhat like a mirror, reflecting radio waves and making possible all phenomena related to them. The normal variations in ionization are diurnal—that is between day and night—more in the daytime and less at night because the ultraviolet light from the sun is supposed to be solely responsible for the ionization.

One of the most important things to be observed in our Antarctic program was the behavior of the ionosphere over the South Pole, where there is no sun for 6 months. We thought the ionosphere would thin out and perhaps disappear, but preliminary results reveal that this did not happen.

Of all parts of the earth, Antarctica was most neglected until the International Geophysical Year came along. Much of the rest of the earth had been blanketed with stations of one sort or another. But when we contemplated the present operation, it was obvious that Antarctica would occupy a major part of our attention. There isn't a single one of the disciplines I have mentioned which does not demand for its completeness data which can come only from Antarctica. It represents the biggest blank space in our geophysical knowledge. It is the only polar continent: it is the highest and coldest of all, and is the only isolated one. It's the only one that's never been the home of man. It's the world's greatest desert. Today there are 12 nations with 48 stations around the margin and in the interior of the continent carrying out the program of the International Geophysical Year.

When the American Association for the Advancement of Science listed the 10 major scientific achievements for 1957, it included the IGY occupation of Antarctica as one of the ten.

We were supported in the operation in Antarctica by Task Force 43 of the Navy. The whole program rests upon 3 legs of a tripod. The scientific program is under the aegis of the National Academy of Sciences. The fiscal agent is the National Science Foundation and the logistics are in charge of the Department of Defense and delegated to Navy Task Force 43, under command of Admiral Dufek. The relationship has been very successful. Indeed it is one of the more wonderful achievements in the history of American science, both for the results that will come and for the record of what can be done among people of good will when they are devoted to high objectives. Even though photogrammetry, mapping and surveying are not parts of our IGY program as such, much new information in these areas has been secured. Task Force 43 has taken hundreds of aerial photographs of the various bases, and a good deal of mapping has been done in that connection. We have had three major glaciological traverses, making seismic soundings, thus giving us our first knowledge of the terrain beneath the great ice cap.

A wealth of new meteorological data is coming from Antarctica for this is the most comprehensive of all our programs.

Certainly Antarctica is the world's greatest cold weather factory. We know that great masses of cold air form over the continent and move toward the north. How far do they go? Do they go into the Northern Hemisphere? It begins to look as if they do. It begins to look as if the exchange of air in the atmosphere is much more rapid than we had supposed. We forget sometimes that our atmosphere is a closed system and that we are breathing the same air that Moses and St. Paul and Darwin and Roosevelt and everybody else before us has breathed.

At Little America, which is our main scientific station, we have a weather center into which all of the other nations have been feeding their data. We put it together and for the first time we have been able to make a weather map of Antarctica which, added to what we know about the rest of the world, enables us for the first time to make a weather map of the whole world at any one time. This is an amazingly important step as we move into the speeded up method of transportation of the jet age and into space flight. Already the data coming out of this little operation in Antarctica has immensely increased the efficiency of weather forecasting in the Southern Hemisphere.

I have told you about the glaciology traverses we have made in which we have learned about the thickness of the ice. Father Linehan took one sounding at the South Pole and discovered it to be 8,200 feet thick with the land underneath at least 1,600 feet above sea level. At Byrd Station it was discovered that the ice was 10,000 feet thick, interesting because Byrd Station is only 5,000 feet above sea level, which means the rock which supports the ice is 5,000 feet below sea level. Now, that does not mean that the ice accumulated 5,000 feet below sea level. Ice doesn't do that. Ice accumulated on the land over hundreds, thousands—we do not know—perhaps millions of years. The weight of the ice slowly pushed down the flexible crust of the earth; were the ice to melt slowly, I suspect the crust of the earth would respond accordingly.

Now, this may sound to many of you like purely scientific observations—they are, but again, like so many other aspects of this program, they are of immense practical importance to you and me.

The removal of only a few feet of ice from Antarctica by melting would profoundly affect Washington, D. C., and if all of the ice in Antarctica were to melt, as indeed it can, then the sea levels would rise 200 and maybe 300 feet—we don't know—and then that would play havoc with all the seaports of the world and all of the heavily populated low-lying coastal areas around about.

Antarctica presents special opportunity for the study of cosmic rays. We know the magnetic field of the earth is the chief instrument for analyzing the energy of cosmic rays. The rays are bent in such a way that only the low energy rays can enter at high latitudes. Furthermore, the connections between solar effects and cosmic rays are more conspicuous for the low energy than for the high energy rays.

I have recited very quickly a few things to suggest to you why the Antarctic Program is of peculiar and specific importance. These kinds of data cannot be supplied from anywhere else in the world. I am very pleased that I can tell you that the scientific program is not to end on December 31 of this year—the terminus of IGY.

It has always seemed to me that to invest so many millions of dollars as we have in our bases in Antarctica to carry on our observations for a year and a half, then to fold up and stop, would be a great mistake indeed. We have conveyed this idea to our cooperating friends all over the world and the International Council of Scientific Unions which is responsible for the organization and the emergence of IGY. A meeting was called in Stockholm in September to consider the feasibility of continued Antarctic research. This led to the creation by the International Council of Scientific Unions of a permanent Special Committee on Antarctic Research (SCAR); it had its first meeting at The Hague February 3–6, 1958. At this meeting we drew up a program for continuing Antarctic research. I was chairman of a subcommittee to present a program for geology, geomorphology, glaciology and cartography. We placed very strong emphasis on cartography. We said that maps and charts are indispensable tools to geology and to many other fields of research in Antarctica.

Finally, one of the outstanding characteristics of the International Geophysical Year has been the extraordinary quality and completeness of cooperation amongst the participating nations. We do not have any conflicts, because the geophysicist is inevitably international—he cannot operate on any other basis; and all considerations other than purely scientific are laid aside as we go ahead and cooperate in this program.

Civilization does evolve largely on the basis of precedents, and it is my hope that this extra-curricular quality of the International Geophysical Year, this wonderful cooperation, will result in further working together of nations in other areas.

*History from the Air**

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ABSTRACT: *Nova Scotia was the scene of the earliest attempts at settlement in Canada. It was also the locale of the decisive campaign fought between the French and English for the supremacy of the continent. It is is rich in historic sites, many of which are known and marked, but about which little is known in the physical sense. Some restoration has been done but much remains to be accomplished. The present paper deals with the air photography, photo interpretation and preparation of maps by photogrammetric methods, of some of these sites. Grand Prê, the Champlain Habitation area, and Old Louisburg have been mapped. Examples of the standard annotated photos and maps of the three areas are given. At Louisburg, standard medium-altitude black and white, low level Sonne, and medium-altitude infra-red photography were used, respectively, for control, for surface detail, and for sub-surface detail. Photo interpretation of shallow water areas led to skin diving operations which produced interesting relics of ships sunk during the final siege of Louisburg. This research work is being continued. The method is suggested for all historic sites.*

INTRODUCTION

AFTER the preliminary period of exploration and skirmishing, the history of eastern North America is resolved into a struggle between England and France for the domination of what was to become Canada and the United States. The struggle was complicated by the fact that European statesmen considered the wars as mere extensions of the European struggle and were prone to trade large pieces of the New World, of unknown value, for small areas in Europe, often of only sentimental value. Louisburg, for example, was captured by a New England expedition in 1745, but was returned to France by treaty. The French Acadian settlers weathered a number of changes of sovereignty, but were finally expelled in 1755. The repercussions of these events were both immediate and long term, with echoes being heard to the present day.

The Nova Scotia-New Brunswick area, the Acadia of the French settlers, is rich in historic sites connected with the struggle for domination. The better known sites are shown in Figure 1. At Lower Granville, near Digby, Samuel De Champlain built his "Habitation," or fortified farm house, in 1605. This was the first permanent settlement attempted by white men north of the Gulf of Mexico. A few

* Published with the permission of the Nova Scotia Research Foundation. With substantially the same contents, this paper was read at the 24th Annual Meeting.