activities which literally from day to day are conquering new domains and adding them to the imperial realm of human knowledge. The future of civilization is well nigh in your hands. You are the wonder workers of all the ages. The marvels of discovery and progress have become commonplaces, simply because their number has paralyzed the capacity of the mind for wonderment. Those of us who represent social organization and political institutions look upon you with a feeling that includes much of awe and something of fear, as we ask ourselves to what revolution you will next require us to adapt our scheme of human relations.

But we know that you are animated by a profound purpose to better the estate of men. We are confident that society will somehow devise institutions capable of adaptation to the changed circumstances with which you are surrounding the business of living in our world. We trust ourselves to you perhaps with some doubt as to what you may finally do with us and to us, but at least with firm convictions that your activities will save life from becoming very monotonous. And, besides, we realize that if we did not give you our confidence you would go ahead without it.

It is a wonderful thing to live in a time when the search for truth is the foremost interest of the race. It has taken endless ages to create in men the courage that will accept the truth simply because it is the truth. Ours is a generation of pioneers in this new faith. Not many of us are endowed with the kind of mental equipment that can employ the scientific method in seeking for the truth. But we have advanced so far that we do not fear the results of that process. We ask no recantations from honesty and candor. We know that we need truth; and we turn to you men of science and of faith, eager to give you all encouragement in your quest for it.

CALVIN COOLIDGE

SOME ASPECTS OF INTERNATIONAL COOPERATION[1]

IT would be superfluous to address to you words of welcome. Washington is yours; you have made it what it is. You represent the aristocracy of effort without which democracy would be arid and fruitless. We who greet you come out of the struggle to hold what has been won; to protect the gains of the past from reckless squandering; to provide educational facilities so that the heirs of all the ages may be able to enjoy a reasonable portion of their inheritance; to make it possible for men to live together without seeking to destroy each other; in short, the never-ending task of getting the best out of things as we already know them. But you hold the promise of additions to the resources of humanity, the staking out of new possessions in the unseen world; of fresh discoveries and a richer life. If civilization is to advance it will be your doing, and the best we can hope of governments is that they will not stand too much in your way.

We are deeply interested in the promotion of peace. But there are only two methods by which we really may assure peace. The one is the long and difficult process of drying up the sources of controversy, of getting rid in some amicable fashion of actual causes of difference. The other is by developing new and enlarged conceptions of national interests and thus avoiding the strife due to narrow and artificial concepts, by mutual appreciation of the advantages which will accrue by pursuing paths of peace and by an adjustment of our international relations more in harmony with the methods and revelations of science. When difficulties are emphasized, we have a demonstration at hand. What may be done in conceiving national interest in terms of peace is happily illustrated in our relations with Canada, an object lesson not only to other peoples but to our own people in dealing with others. There are no two peoples anywhere, whatever historic antagonism may exist between them, however lavishly the seeds of distrust have been sown in valiant hearts ever ready to defend their country's honor, but would find on even a brief, if dispassionate, examination guided by the dictates of reason, that they had much more to gain by a well-directed cooperation than by pursuing the illusion of the gains of force. I am in hearty sympathy with those who would make aggressive war a defined crime, but such definitions, like other legal concepts, in order to be effective, must be sustained adequately by sentiment and we make the most rapid progress as we convince the practical judgment that unnecessary resort to force is a stupid blunder. It is your work that points to the benefits of peaceful cooperation that are within our grasp. Science, it is true, forges the weapons of war and constantly develops new and more terrible instruments of destruction. But she is far more eloquent as she points to the wastes of strife, the retarding of progress, and the vast opportunities which are open to industrious peoples if they are able to abandon their mutual fears and destroy the artificial barriers to community of enterprise. We wish no lowering of the standards of patriotism, no lessening of

[1] Address of Charles E. Hughes, Secretary of State, at the opening meeting of the American Association for the Advancement of Science at the Memorial Continental Hall, Washington, on the evening of Monday, December 29, 1924.

patriotic ardor, no weakening of the fiber of men and women ready at any cost to defend their country against attack upon its liberties, but rather a more enlightened patriotism, a more intelligent appreciation of what love of country demands, a desire to make friends and to find means to stifle distrust and to encourage confidence. To assure peace, this disposition must be found in other countries as well as in our own, but we should leave no doubt in word or deed of our own sentiment.

We should think in terms of the cooperation of peoples and not simply of governments. Science knows no political boundaries; she recruits her conquering chieftains from all climes and races. It may be an Austrian monk, revealing the secrets of plant inheritance; or a New Hampshire farmer's boy who learns to fashion instruments of the utmost delicacy and precision; or a Serbian herdsman taking youthful lessons in communication by listening through the ground; or a Japanese devotee of medical research isolating and cultivating microorganisms. In this field all are coworkers and pride is not of race or of tradition, but of achievement in the interest of humanity.

You have properly and insistently urged that international cooperation in scientific research is not only desirable, but absolutely necessary. There are most important enterprises which, if undertaken at all, must be conducted by international collaboration. Take, for example, the world-wide study of earthquakes and of various astronomical phenomena. In history, archeology, zoology, botany, geology and in any other of what are called the natural history or historical sciences little progress can be made in the study of what is fundamental unless there is opportunity to examine all the parts and aspects of the earth. Thus it is manifest, as has well been said, that considered as a local science geology gave only fragments of the earth's history, these partial records being separated in such a way as to suggest intervening periods of cataclysm or destruction. This was the natural interpretation of early investigators, but to-day with a knowledge of a large part of the earth's surface these gaps have been filled and a continuous history is available. It is not possible to have a complete history of life if you have an interrupted geological record, and yet this history is the world's most important story and the foundation of philosophy. You can not have an adequate history of peoples, or even of governments, if you rely exclusively upon data which are obtained in any one nation. And when we come to the enlargement of our knowledge of the universe, whatever may be the value of the discoveries and interpretations made in any one observatory, it is obvious that there can be little progress unless there are stations widely scattered over the earth and the bits of knowledge thus acquired are pieced together.

In truth, scientific achievement is not individualistic, but is the work of groups either consciously formed or produced by the essential correlation of effort. This essential cooperation has recently been described to me in this picturesque manner: "It grows like a building. One man may lay the capstone and get the credit, say an American scientist, but the stone may be laid upon a brick put into place by a Japanese and another by a German, and all may be held in place by the generalization of a Frenchman or a Scandinavian. A scientific problem is like a crossword puzzle worked out in a family circle. The solution may be held up until someone, perhaps accidentally, supplies the keyword that interlocks the rest." It may be added that in science we have a puzzle that is never solved; rather, a succession of puzzles, each answer raising new questions for which there must be a fresh collaboration.

It must be recognized that effective international cooperation depends quite as much on national organization and on appropriate interchanges as upon the creation of distinctive international bodies. There are national obligations which must be met and which can be made adequately only by the aid of governments.

The place of scientific research in our governmental economy should have more appropriate recognition. We develop bureaus, but with all our indebtedness to investigation we are still lacking in proper appreciation of scientific work. It is not comforting to our pride to think of the eminent scientists who are serving our government without adequate recompense or the losses in personnel we sustain by lack of appropriate provision for those who would be our greatest benefactors. If the test of civilization is in the sense of values there is little room as yet for boasting. The most competent organization of national scientific work which will seek, hold and suitably reward investigators of the highest rank is the fundamental requirement.

Then there is the responsibility which each nation should assume of properly assembling, arranging and safeguarding all data and records within the limits of its territory. Each nation should consider itself a trustee in the interest of humanity of all the results of researches in matters either touching itself directly or related to general questions dealing with wider regions. This safeguarding of data and records should be supplemented by coordination of effort and an assembling of results which will make it possible readily to command whatever may be found in any department as to any subject. The tendency

is strong among departments to treat themselves as little separate governments, but, whatever distribution of endeavor may be necessary for convenience or economy, government in its relation to its guardianship of scientific data should recognize its undivided responsibility.

Each nation should also acknowledge its obligation in the interest of necessary international cooperation to make readily available to other nations its assembled data and records. The mutual understanding and support of all peoples relating to any subject of research will give ultimately to each investigation and to each separate locality the largest possible measure of result. This sense of mutual interest and obligation will be of especial importance in opening opportunities throughout the world for archeological inquiries. We deprecate all suggestions of the monopolizing of such researches or their results to the prejudice of reasonable requests to prosecute investigations on fair terms. We trust that our scholars and the representatives of our museums and scientific institutions will receive a cordial welcome wherever they go throughout the world, in the realization that they are not serving selfish interests but seeking to advance the knowledge of mankind.

It is fitting that we should recognize what has already been achieved in the line of competent organization. This effort was stimulated by the great war, the conduct of which was largely based on a knowledge of science and its applications. I am informed that at the beginning of the war the Germans showed an ability "to mobilize science in a national emergency" beyond that of other nations at that time, and that since then, and in part because of that fact, the leading nations have taken definite steps towards the encouragement and support of scientific investigations. England has set up a special government Department of Scientific and Industrial Research. In the United States a National Research Council has been organized by the National Academy of Sciences. Japan and Australia have recently set up national research councils. Canada, I am told, has a similar undertaking, and in two or three European countries new scientific enterprises of similar character have been developed. Then there is the federating effort of the International Research Council which has established a number of affiliated international unions covering special fields of science, as the International Astronomical Union, an International Union of Pure and Applied Chemistry; an International Mathematical Union, an International Union of Pure and Applied Physics; an International Union of Scientific Radiotelegraphy. These organizations naturally lead to arrangements for special international scientific conferences. Thus we are at the threshold of a new era of international cooperation in the scientific field. This can not fail to add strength to the influences which make for better understandings between peoples and for a desire to adjust their differences so that they may enjoy the fruits of peace.

We should make acknowledgment to you for the benefit of the by-products of your labors. If to an increasing degree we have the security of sound public opinion, if the extravagances and diatribes of political appeals fail of their object, and if, notwithstanding the apparent confusion and welter of our life, we are able to find a steadiness of purpose and a quiet dominating intelligence, it is largely because of the multitude of our people who have been trained to a considerable extent in scientific method, who look for facts, who have cultivated the habit of inquiry and in a thousand callings face the tests of definite investigations. With scientific applications on every hand, the American people are daily winning their escape from the danger of being fooled. There are, it is true, many false prophets who are active in those areas of exertion where patient inquiry and regard for facts are not prized, but their following, while strident, is apparently not increasing.

We need your method in government; we need it in law-making and in law-administering. We need your interest in knowledge for its own sake; the self-sacrificing ardor of your leaders; your ceaseless search for truth; your distrust of phrases and catchwords; your rejection of every plausible counterfeit; your willingness to discard every disproved theory however honored by tradition, while you jealously conserve every gain of the past against madcap assault; your quiet temper, and, above all, your faith in humanity and your zeal to promote the social welfare. We need your horizon; your outlook on the world. We need the international cooperation which makes more effective the essential national endeavor and brings us nearer together as members of one human family, who in the presence of science can not remain estranged, but must find means of reconciling their several interests in the harmony of their common aspirations and for the common good.

CHARLES E. HUGHES

THE MEANING OF SCIENTIFIC RESEARCH[1]

I HAVE been assigned the task of speaking upon the meaning of scientific research. Some of you will say,

[1] Lecture delivered before the Sigma Xi Club of New York University, Tuesday, November 25, 1924.