had long protested that my name should not be given to any endowment of anything that I might ever make; I protested against the use of it on this laboratory building; and the arguments of members of the Board and other friends, including the Director of the Laboratory himself, failed to move me in this particular—until I found that the vital member of my own household, who had for half a lifetime helped toward this opportunity, was in league with these people—then I surrendered. And I am ready now to confess to one comfort in seeing my name chiseled over the chief portal: it ought to tend toward discouraging the public from longer trying to impose on my name a final *S* and a middle initial!

As to the material contributions toward the building, they are made with utter gladness, with the knowledge that here shall develop a great center of education and resarch that will give the start and found the careers of many of the scholars and super-engineers of the future —and make life easier and more joyful, as well as more worth living, to vast numbers of people —for the men who are graduated here will carry the torch to others, and they to still others, on through an endless succession. Certainly no gift of mine already made, or that shall hereafter be made here, can possibly be a measure of my faith in this institution, and I have not for years had any official connection with it. My faith in it is greater than if I had a hand in its management.

Finally now, and in behalf of the donors and all the friends who have encouraged this consummation—those who have hoped and prayed for it; those who have planned and designed it and watched its growth; and those who have devised and furnished the sinews of construction that have made its walls arise into being—in behalf of all these and in their name, I commend and present this Laboratory of Physics—the last and best word in a modern workshop of nature's philosophy, to this corporation, and to you, Dr. Millikan, its Director—to you, Sir, who embody in your person the new spiritual and intellectual gift that comes with the Laboratory. And you are the hope and sure promise of the future!

ADDRESS OF ACCEPTANCE OF THE NORMAN BRIDGE LABORATORY OF PHYSICS

IN accepting in the name of American physics this beautiful and well-appointed laboratory, I wish first to express on behalf of my colleagues and myself the appreciation and gratitude which we feel because of the opportunity which you, Mr. Fleming, and you, Dr. Bridge, have jointly opened up to us, not only of devoting ourselves to the intensive pursuit of the science which we love, but also of assisting in the solution of the fascinating and vitally important problems which the extraordinary developments in physics during the past two decades have pushed to the forefront of the world's needs to-day.

In the second place, I wish to accept this gift on behalf of the California Institute of Technology, with which I now have the honor to be connected, and to express its gratitude for the opportunity which is thus afforded it of taking another long stride forward toward the realization of the ideal which the far-visioned men who constitute the Board of Trustees have had from the beginning—an ideal not very common in American educational institutions, an ideal not of large growth in numbers, nor of the extension of the field of study over a large range of subjects, but rather the ideal of doing work of superlative quality in the chosen and relatively limited field of the Institute's activities—*the cultivation of the mathematical and physical sciences and their applications.*

In the third place, I wish to accept this gift on behalf of all those who, like myself, believe that the private educational institution still has a very vital role to play in the development of American civilization. I am no opponent of state education. From the common school up it represents one of America's most important contributions to modern life, and that contribution should be greater in the future than it has been in the past. But state-education is not all that is needed in this country. It can do something but not everything. Indeed, one of the most dangerous tendencies which confronts America to-day is the apparently growing tendency of her people to get

into the habit of calling upon the state to meet all their wants. The genius of the Anglo-Saxon race has in the past lain in the development of individual initiative, and if we lose that we shall lose our most priceless heritage. Even in the field of education the greatest and most distinctive contributions which our race has made thus far have been made through private institutions like Oxford, Harvard, and Chicago—institutions which are supported by men whom it has been our glory to develop in numbers found nowhere else in the world—*men who have treated their wealth and their talents as public trusts and have voluntarily devoted them to public ends.* I, for one, believe that some, at least, of our most important future contributions are going to come because we continue to develop such men and to preserve such ideals.

In the fourth place, I wish to accept this gift on behalf of American education, to which this institution hopes to contribute by its example an important element. We have succeeded in this country marvelously well in quantity or mass-education, as we have in quantity production. We have not as yet succeeded as well as have a number of other countries in quality education. We have not produced one-half as many—I think I may say one-fifth as many outstanding scientific and technical men in proportion to our population as have Holland, England, Germany, or France. The English honor system, to take but one example, has selected and trained the exceptional man in England and Canada as nothing in this country has thus far done, and after all the progress of civilization is determined by the very few men of vision and capacity which each age develops. There is then not only a place, but there is tremendous need in the United States for some schools which are designed to furnish exceptional opportunities and to give exceptional training to exceptional men. This has been the aim of the trustees of this Institute from the start. This is why the first step taken in the initiation of the work of the Norman Bridge Laboratory has been to provide something rare in America but something which the Institute already has, namely, an unexcelled staff in mathematical physics. Four-fifths of all teaching is the teaching of example. Creative men arise spontaneously in an atmosphere in which creative men exist and in general nowhere else.

But there is a second reason for accepting this gift in behalf of American education. With the gradual disappearance of the classics and the rigid discipline which they furnished, as the basis of our higher educational system, there have been slowly creeping into it during the past two decades certain emasculating influences which need to be counteracted. There is no Elisha upon whom the mantle of the classics can fall except the mathematical and physical sciences. There is no training like that which they furnish for teaching men to apply themselves intensively, to observe carefully and correctly, to treat their data honestly and dispassionately, and to reason objectively from a given set of conditions to their inevitable consequences—in a word to see clearly and to think straight. Indeed, there is nothing else left to constitute the backbone of the training of the coming generation if it is to maintain the virility and the strength of those that have preceded. The Institute hopes to do some pioneer work in demonstrating the values of an education having the mathematical and physical sciences for its backbone. I accept this gift, then, in behalf of American education in the confident belief that the intensive training in the mathematical and physical sciences which will take place within its walls may exert a wholesome, yes, a saving influence upon American education as a whole.

In the fifth place, if I may be so presumptuous, I wish to accept this gift in the name of Southern California, of which I have been a resident for the whole of three months, for I believe that this enterprise here is not a local enterprise. I believe that there is a contribution which it can and will make to the intellectual and cultural development of this whole empire of the south, which with all that it has of stimulating climate, of enterprise, of wealth, and of business capacity, still needs throughout its length and breadth the stability and sanity—in a word the culture—which a center of rigorous, objective, scientific thinking should

help to impart to it. Nor is this enterprise one which should influence Southern California alone, for since men of affairs come to this region as to scarcely any other region in the United States, no section is more favored than is this one in its opportunity of contributing its own good things to the progress of the country as a whole.

Finally, I wish to accept this gift in the name of all those who believe, as I do and as the trustees of this institution have from the start believed, that science in itself is not the most important thing in this world, but that the salvation of the world is to be found in the cultivation of science together with the cultivation of a belief in the reality of moral and spiritual values. Science alone may destroy this world instead of saving it, but the trustees of this institution have from the start differentiated it from most technical schools in the altogether exceptional emphasis which has been laid in its curriculum upon cultural and spiritual development. One expression of this ideal is seen in the atmosphere which has been thrown about the campus by the architectural beauty of the buildings which are already found here, a beauty which the architect, Mr. Goodhue, has known how to put in exceptional degree both into the exterior and the interior of the Norman Bridge Laboratory. I accept your magnificent gift, Dr. Bridge, in the hope and the belief that it will be an important factor in the creation at the California Institute of Technology, not only of men with the highest technical skill, but of men of the finest character and of the broadest citizenship.

R. A. MILLIKAN

A JOINT INVESTIGATION OF THE CONSTITUTION OF MATTER AND THE NATURE OF RADIATION

THE establishment of the Norman Bridge Laboratory of Physics, if my estimate is correct, is an event of no small significance in the progress of science. Dr. Millikan has explained its bearing on scientific and technical education, and pointed out that research, as conducted in the Bridge Laboratory and the Gates Chemical Laboratory, accompanied by the best instruction in physics, chemistry, and mathematics, must provide the firmest of foundations for the entire superstructure of the California Institute of Technology. It remains for me to speak of a joint investigation of the constitution of matter and the nature of radiation which the organization of the Bridge and Gates Laboratories has rendered possible.

Matter occurs in nature under the widest variety of composition and form. The physicist, who approaches this complex problem by the simplest and most direct route, deals chiefly with the chemical elements, and evolves powerful methods of research which enable him to penetrate to the core of the atom, to visualize the electrons swinging in their orbits, and to remove them one by one for detailed study. The chemist, concerned primarily with the union of atoms into molecules, and the combination of molecules of one or more elements, necessarily attacks matter of greater complexity, extending all the way from the single atom of hydrogen to compounds containing hundreds of linked atoms of many kinds. The astrophysicist, permitted by his powerful telescopes to penetrate to the depths of the universe, observes matter in the state of luminous gaseous elements, associated in the cooler stars with certain chemical compounds. The cosmic crucibles in this vast laboratory of nature exhibit conditions of temperature and pressure often transcending those attainable on earth, and thus present for observation experiments on an immense scale, the interpretation of which has already added much to our knowledge of physics and chemistry. A general study of the constitution of matter should therefore approach the problem simultaneously along the converging lines of physics, chemistry, and astrophysics.

The progress of research, particularly during the last quarter century, has brought us to the present critical juncture, when the possibilities of such a joint investigation are especially favorable. In each of the branches of science involved the methods and instruments of research have advanced to a high degree of per-

[1] Address at the dedication of the Norman Bridge Laboratory.