seeking or applying scientific truths should engender habits of faithful thinking. In this respect there is encouragement in the belief that the tendency of the present engineering age is, on the whole, towards accuracy of reasoning and precision of thought. Scientific ideas may tend slowly to dominate over irrational and irregular thinking. A casual review of general literature over long periods of time seems to show that as science has advanced irrational and superstitious ideas have dwindled. The concomitant danger, however, lies in the occasional ravages of erroneous pseudo-scientific doctrines. A plausible but false doctrine, that masquerades as a scientific proposition, may produce more harm in a scientifically disposed world than a flagrantly immoral popular belief of a clearly irrational character. The responsibility for making unguarded statements that are unsupported scientifically thus rests increasingly upon all speakers and writers.

In the development of the applied sciences, a constantly increasing demand devolves upon the underlying basic sciences. In the prehistoric times of primitive engineering only the simple rudiments of the underlying sciences may have been involved. In the ancient Egyptian and Roman days, engineering must have demanded a closer study of mathematics and physics for support. Since, however, the dawn of the present engineering age, much more knowledge and research have been demanded in a long list of the branches of basic science. Invention is always needed. But whereas in past times, inventors, if they had the requisite talents, did not need much scientific knowledge, at the present time, the successful inventor has not only to be endowed with inventive ability, but he must also be well versed in basic science. It appears that in the future this demand for basic scientific knowledge, as a prerequisite to applied-science progress, will continually increase.

The leadership of the ancient world rested mainly upon physical force. The trend of the more recent past through the present, towards the future, is for world leadership among the nations to rest mainly upon science and its applications. Already the progress of engineering is hampered and thwarted in many directions by lack of advance in the basic sciences. It is to these that national attention should be directed, for the progress of knowledge that benefits first the nation in which it is made, and later all the other nations. If only in the interests of applied science, the advancement of basic science in America should be stimulated and fostered. Support for applied science is likely to be forthcoming from the industries themselves; but support for basic science is more difficult to secure. The national importance of this is so great that the need should be made widely known. An effective way to stimulate advance in the science in this country would be to secure permanent endowment for a suitable annual prize, to the most notable contribution each year, in each section of the American Association for the Advancement of Science. This official recognition of scientific achievement would stimulate and encourage researches in all sections. There is no reason to fear that such scientific progress might be practically valueless. Useless scientific knowledge is now a contradiction in terms. Moreover, aside from the question of immediate versus future application, the patient earnest study of truth, in those parts of the universe that are attainable to us mortals, constitutes the noblest quest with which we are yet acquainted.

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SOME PSYCHOLOGICAL EXPERIMENTS[1]

II

THE age curve is of fundamental interest for psychology. Thus, for example, a child can learn to pronounce his own or a foreign language best at the age of about three years; there is then a drop and after about twelve years he can not learn correct enunciation. Perhaps a boy can learn to ride a bicycle best at the average age of ten, to drive a motor car at the age of sixteen. Our most original ideas probably come in the early twenties. Some of us may hope that the curve for forming correct judgments rises at least to the age of sixty-five. Our primary school system consists largely in trying to teach children, with much labor and resulting stupidity on the part of both teacher and pupils, mathematical relations a couple of years before the organism is ready and could respond to them without effort. Then, as this is the easiest subject in which to examine children, they are promoted from grade to grade mainly on performance in arithmetic without regard to individual differences in other kinds of work.

The Binet-Simon scale, first used in 1905 to diagnose subnormal children and in 1908 to measure the mental age of children, developed in this country by Dr. Goddard, Professor Yerkes, Professor Terman and many others, together with the group tests that we owe to Mr. Rice, Dr. Courtis, Professor Thorndike and many others, have been of untold value to our schools and to the children who are the ultimate

[1] Address of the retiring president of the American Association for the Advancement of Science, given at Kansas City on December 28, 1925.

origin and end of all our efforts. Even more important than the segregation of backward children is the giving of opportunity to children of promise and of genius, which should perhaps be the principal concern of a democracy. In describing experiments on this subject in 1896 I wrote: "We consequently need to study methods which will discover individual differences early in the life of the child. Education may properly be devoted to overcoming defects which would interfere with usefulness, but perhaps its most important function is to strengthen qualities which the individual possesses and which may be developed so as to serve his welfare and that of society. From the point of view of science, private benevolence and state aid should be directed less to supplying the cripples with crutches than to supplying the agile with ladders. For this purpose it is evidently important to devise tests which will demonstrate natural aptitudes while the child is very young."

The upper end of the age curve is of special interest to some of us. For example, we do not know at what age university professors should be retired from active service, but, if it is sixty-five, then it should be not the calendar but the physiological and psychological age of sixty-five. The average variation in mental age from the chronological age of children of ten is about one year, whereas after middle life it is much greater, increasing perhaps as the square root of the age. Some men at sixty-five are really younger than the average man of sixty and some older than the average man of seventy. Most people complain of their memory; they seldom admit that they have bad judgment. We can measure both and determine how an individual departs from the average and how this departure varies with age.

Learning and practice can be studied to special advantage with the lower animals. The fundamental work in Dr. Thorndike's Columbia dissertation of 1898, placing the study of animal behavior on an experimental basis, has developed into a branch of our science. Dr. Bagg, in his dissertation on individual differences and family resemblances in animal behavior, found that strains differed, but there was no measurable resemblance among young of the same parents. He found a lack of correlation in different kinds of performance, the difficulty appearing to be that our present maze and discrimination tests do not adequately measure variations of individual ability. Such experiments are in a class very different from the queer results recently announced by Professor Pavlov on the inheritance of the conditioned reflex.

There was published in 1890 in *Mind* an article entitled "Mental Tests and Measurements," and in 1896 in *The Psychological Review,* established in the meanwhile in cooperation with Professor Baldwin, an article entitled "Physical and Mental Measurements of the Students of Columbia University." This was the first series of tests used with a large number of individuals and it still remains the most extensive undertaking of this character. The students were tested at the beginning of the freshman and the end of the senior year, the women of Barnard College as well as the men of Columbia College.

About an hour was given to the examination of each student and some thirty measurements were made ranging from height, weight and lung capacity, through keenness of sight, discrimination of pitch and reaction time, to memory, imagery and association. In addition some forty records and observations were made, ranging from color of eyes and hair to an estimation of intelligence and straightforwardness. Further the student at home filled in a blank answering some eighty questions ranging from the ages, and, if deceased, cause of death of his grandparents, to what profession or business he proposed to follow and in what calling he would prefer to succeed if he had his choice. Other information was also available including class standing in different subjects, success in athletics and social interests. It is possible to follow the careers of alumni in after life and to measure their children when they in turn come to college at about the same age. In addition to the Columbia students these tests were made on members of the American Association for the Advancement of Science at three annual meetings, measurements having been obtained of men so distinguished as Simon Newcomb and William James. At the St. Louis Exposition of 1904 a laboratory was set up and tests were made by Professor Woodworth and Dr. Bruner, both on the visitors and on the racial groups that were represented.

In working over the tests, Dr. Wissler used for the first time in psychology the methods of correlation developed by Francis Galton and Professor Pearson. The correlations among the grades in different studies were significant and have been the basis of many subsequent studies. The lack of correlations among the measurements was at the time disappointing. It is due in part to the attenuation from measurements that are only accurate when deduced from averages, in part to a real lack of correlation in different traits. For example, a student who is accurate may be as likely to be quick or slow as one who is inaccurate. There is no correlation, but one fourth of all students will be above the median, one in a hundred in the first tenth, in both accuracy and quickness and will have a great advantage. The correlations—due to the circumstance that the same abilities and training are involved—discovered among complicated performances, such as class work and intelligence tests, have led to their cultivation and to the neglect of the simpler measurements. The cultivation is desirable, the neglect unfortunate. It is of interest to any one to know where he stands among others in these traits and determinations; some of them, such as color blindness or acuity of hearing, which can be measured in a couple of minutes, may be of real use. It is also the scientific method to be followed in analyzing the more complicated processes, such as those going under a term so ambiguous as general intelligence.

Estimates of character and of other psychological traits are difficult and unreliable. No correlation has been found in the Columbia laboratory between size or shape of head and ability of any sort. There is no known relation between complexion, forehead, nose, chin, or other features and psychological traits. The reading of character by physiognomy or graphology is the occupation of charlatans. It is difficult or impossible to tell even the sex of the individual from the features of the face or from the handwriting. These are, of course, legitimate subjects of study. The full and side face have been photographed through a centimeter netting with a long focus lens, thus obtaining in a moment a large number of determinations, which are on the average as exact as can be got by direct measurement. The method can be used to advantage with children or savages, who do not like to be measured, and it is useful in recording and preserving a large number of determinations, some of which may prove to be of unexpected value. Photographs of the face were cut in parts to determine by what features we recognize the individual, and estimate the age, sex, etc. A study was also made in which individuals were judged first from a photograph, later after a five-minute interview, and then by individuals who knew them well.

It is possible to put judgments of character on a quantitative basis. In the earliest undertaking of this character five instructors in Columbia University were graded on a percentile scale by twelve fellow instructors and graduate students. Twenty-four traits or qualities were included, ranging from physical health to efficiency and leadership. There were used the psychological categories of intellect, emotion and will, together with the quantitative differences to which they have a certain analogy, breadth, intensity and quickness. All these qualities are useful, but it is especially desirable that a scientific man should have broad intellect, an artist intense emotions, a soldier or statesman quick will. We can fancy that these are unit characters which are combined by chance in Mendelian fashion. The probable error in position in a centile order for different traits estimated by twelve observers was only 4 places, ranging from 3 to 5.2, and apart from constant errors there is thus a close agreement. The chances, for example, are even that a man ranked 51 for integrity, with a probable error of 5, is more honest and straightforward than 45 of a hundred of all scientific men and less so than 44. A man ranked 95 for courage with a probable error of 3 is to the best of our knowledge more courageous than 9,400 of the 10,000 scientific men of the country, and the chances are even that this position is correct within 300 places. There was greater agreement on mental balance than on physical health; there was least agreement on cheerfulness, most on energy, perseverance and efficiency.

There is a certain amount of validity in judgments of personal traits, character and performance, and individual differences in the reliability of the judgments of those taking part in these experiments have been measured, showing a variation in competent observers covering a range of about two to one. It is an accepted truism that success in business and in other directions depends on the wise selection of associates and agents and on the ability to predict how others will act in given circumstances. When we learn to look upon our observations, recollections, beliefs and judgments objectively, stating in numbers the probability of their correctness, there will be an extraordinary change in our attitude in religion, politics, business and all the affairs of life.

In a study of examinations, grades and credits of the students of Columbia University it was proposed that grades be standardized on the basis of order of merit and the probability curve, that credit toward degrees be given for quality as well as for quantity of work, and that tuition fees be inversely proportional to quality. In a fivefold grading system, if half of the students are given the median grade of C, 22 per cent. B and D, 3 per cent. A and E, then the differences among the five groups are theoretically about equal; but 10 per cent. can be given honors and 10 per cent. failed if that is preferable. This plan has been largely adopted, and the grades given by different instructors become comparable and have some meaning. The giving of extra credits for good work was adopted at Columbia College in 1905 and has since been extended, though not to the extent that it should be.

Normal individuals tend to differ about as two to one, as has been indicated for a number of measurable traits. A good student can complete the work for the doctor's degree in two years about as well as a poor student can in four years. A good stenographer earns $40 a week while one who is inferior earns $20. Grades can be standardized and credits given on a scientific basis so that a student earns his degree in an equitable manner. Not only credits should be given, but tuition fees should be charged in accordance with quality of work. Thus if the annual tuition is $300, the upper 10 per cent. of the students might pay $200, the lower 10 per cent. $400, others in proportion. Such a plan would be a proper use of trust funds given to defray the cost of college education, and would make scholarship and good work a reality.

In grading class work or in estimating character, the order of merit method should be used. A grade of 60 should not mean that a student has just passed or that he has done 60 per cent. of the work, but that among a hundred students in the same group there are about 40 better in their work, about 59 not so good. The order of merit method of converting a qualitative series into a series of quantitative differences had been used earlier in laboratory experiments. Some two hundred shades of gray were made, giving approximately equal differences in illumination between white and black. In such a series the grays toward the white end appear more alike than those toward the black end, and two adjacent grays are indistinguishable. Psychologically it is a qualitative series. If now the grays are arranged in the order of brightness a number of times by the same or different observers and the average position in the series of each gray is determined, the mean variation is inversely proportional to the psychological differences between the grays. There is thus determined the quantitative difference in the perception and its relation to the physical differences between the lights. The method can to advantage be applied to the determination of individual differences in the perception of the brightness of lights or in color blindness.

In the case of intensities or of qualities, the objective stimuli can be measured and the errors of the observers determined. The method of order of merit or relative position can, however, be used when the criterion is the agreement of different observers, as in the work already described on the determination of differences in character. It has been applied in the Columbia laboratory in various directions. Professor Thorndike has used it for handwriting and composition, and these scales have proved to be of great value in school work and have been developed in many directions.

Before the selection of a thousand students of Columbia University and a thousand American scientific men, a study was made of the thousand most eminent men of history and this was the basis for the later studies by order of merit. From each of six French, German, English and American biographical dictionaries or encyclopaedias were selected about 2,000 of those allowed the longest articles. From the some 6,000 individuals so determined were taken those who appeared in at least three dictionaries and from these were selected those given the greatest average space, the several dictionaries being reduced to a common standard. Thus was obtained not only the thousand men given most attention, but also the order in which they stand. The method further permitted the assignment of a probable error of position, which can be used as a measure of differences in eminence, and, if we assume the distribution of the probability curve, the differences between eminent men and average individuals.

Curves may be drawn showing the historical distribution of eminent men by nationality and by performance. After the Greco-Roman period and the so-called dark ages, there is a rise in numbers from the tenth century onwards, but with definite fluctuations in productivity. In the fifteenth century, Italy, England, France and Germany had nearly the same number of eminent men. Italy was in the lead, but then falls, as does Germany, while England and France rise, their curves crossing through the centuries with nearly an equal number of distinguished men, England surpassing in the number of highest eminence. France reaches its culmination at the end of the eighteenth century. Germany rises rapidly from the second half of the seventeenth century, and the American curve then begins with much promise for the future.

An analysis of the kind of performance shows that France has excelled in war, science and scholarship, England in politics, poetry and philosophy, Italy in art. Of the eighteen great musicians, Germany has produced ten, Italy six. Of the fourteen great explorers, England has produced five, Spain four. Though text-books and treatises on history, at least until the most recent period, are mainly concerned with wars and politics, there have been fewer eminent sovereigns, soldiers and statesmen than scientific men, philosophers, poets, artists and the like. The rising curves for science, the falling curves for philosophy and the church are significant. Soldiers have been surpassed in numbers by men of science and the curves predict a gradual cessation of war and the predominance of science. Similar curves have been made for the percentage of the total population of different countries engaged in war through the centuries and, though the data were inadequate, they also point to the gradual elimination of war. But of course the projection of curves is a scientific method that must be used with the utmost caution. By similar methods a list of 1,000 American scientific men who died prior to 1900 has been compiled and the changing interests can be shown by curves. A quantitative study of history is a possibility of the future.

Data have been collected concerning some of the 1,000 eminent men of history and a supplementary list of 10,000 has been used, with a view to placing information in regard to them on a statistical and quantitative basis, determining how they differ among themselves and from others, and the conditions favorable to performance. Our present information is from anecdotes and examples from which almost anything can be deduced. We do not even know whether history depends on its great men or whether these are by-products of economic and other forces. We do not know the extent to which their performance depends on heredity and on opportunity.

The distinctions hold not only for men of eminence, but extend to differences adapting ordinary individuals to the work that they can do best. Thus three types of people, intergrading but often well defined, are those most satisfied and competent when dealing, respectively, with personal and emotional relations, whether the poet or the salesman; with material objects and definite situations, whether the military leader or the mechanic; and with abstractions, whether with the Deity or the atom or simply with words and figures. In the transportation services most of the employees have functions separated on the lines of these three types. The clerks, bookkeepers and stenographers are concerned with words and figures; the conductors and pursers must remember faces, be obliging, ready to answer questions, interested in the affairs of the passengers; these traits are disqualifications for motormen and engineers, who should be concerned about objects and machines. By a rough natural selection those tend to become clerks, conductors or engineers who are best suited for the work, but probably over ten per cent. of the employees could be transferred with an average increase of more than ten per cent. in their efficiency; new employees could from the start be assigned to work for which they are best fit. By the use of the psychological tests that we now have and by research to perfect these tests, the corporations concerned with transportation could effect a direct saving measured by tens of millions of dollars a year, indirectly of a comparable sum through the greater welfare and contentment of their employees.

In addition to the groups already noted a study has been made of American men of science, selected by the order of merit method. The sciences were divided into twelve groups and the number in each was taken approximately proportional to the total number of scientific workers, ranging from 175 chemists to 20 anthropologists. In each science the men were arranged in the order of the value of their work by ten leaders. The average positions and probable errors were then calculated, giving the order in each science. These were interpolated to give a list of about 2,000 names, but in the main only the first thousand have been considered. The list was obtained in 1903 and again in 1910. In 1920 it was compiled for the third time, but by a different method, used partly for its scientific interest, partly in order to avoid too great demands on the time of a few leading scientific men and to prevent any inbreeding from a limited number of judges.

The names and addresses of the scientific men included in each science in the two previous selections were sent to those on the list and they were asked to increase it by about 20 per cent. All those who received more than one vote were then asked to make nominations and those who received the most votes were added to the list up to a number of names twice as large as was to be selected. The names were then sent in alphabetical order to each of those included and he was asked to check about half the names to indicate those whose work he regarded as of most merit, with a double check for about one in twenty whose work he considered the most important. Some 2,000 scientific men were asked to take part in the selection and about 1,000 complied. The probable error of the position of the individuals was nearly the same as before. The measurement of the validity of a vote has application from the decision of a committee to a national election.

The scientific men are thus arranged in the order of the value of their work with a probable error which shows the correctness of the position assigned to each and also measures the differences between them. It consequently becomes possible to measure the scientific productivity of a region of the country or of an institution and its contemporary strength, with the changes that occur at different periods. The single figure giving the gain or loss in position of a scientific man in the course of ten years condenses a great deal of information and is dramatic in its implications. When we put knowledge concerning men of science on a statistical and quantitative basis, we may hope ultimately to determine the hereditary and environmental conditions favorable to the production and to the productivity of workers in science.

There are large variations in the origin and in the present residence of scientific men throughout the United States. Their birth rate per million population was 109 in Massachusetts and decreased from that center to 47 in New York, 23 in Pennsylvania, 9 in Virginia, less than 2 in the Gulf states. Their present residence tends to correspond with their place of birth, but some cities and states obtain more scientific men than they produce and conversely. Scientific activity is moving westward. Of younger men added to the list the birth rate fell in Massachusetts from 109 to 85, in New York from 47 to 36, whereas it increased in Michigan from 36 to 74, in Minnesota from 23 to 59.

In academic production and possession of scientific men Harvard leads by a wide margin, though the Johns Hopkins has given nearly twice as many doctorates to those who have attained scientific standing. In 1920 there were at Harvard 73 of our thousand leading scientific men. The numbers in other large institutions were—Columbia, 42; Chicago, 39; Yale, 35; Johns Hopkins, 35; Cornell, 33; California, 31. From 1905 to 1920 the net gain was at Yale, 9; at Harvard, 7; at the Johns Hopkins, 5; at California, 4. Chicago and Cornell were stationary; the net loss at Columbia was 18. The men can be weighted, in which case the relative strength of Harvard becomes greater. The ten strongest departments in each of the twelve sciences have been determined, Harvard among universities standing first in mathematics, physics, chemistry, botany, zoology, pathology and anthropology; second in geology and physiology. The Johns Hopkins had one of our leading thousand scientific men for 37 students. At Harvard the ratio was 1:75, at Yale, 1:105; at Columbia, 1:202. In the fifteen-year period the Department of Agriculture had a net loss of 9, the Geological Survey of 6; the Smithsonian Institution of 5; the Bureau of Standards a gain of 11. The Carnegie Institution and the Rockefeller Institute had large gains as had also the industrial laboratories. The movement of scientific men to the research foundations and laboratories is one of the notable changes of the past twenty-five years.

The list of a thousand scientific men permits not only the measurement of scientific merit and a study of the origin and distribution of scientific workers, but offers opportunity for obtaining vital and other statistics. Thus, to take an example, the average size of the completed family of the scientific men is 2.2. Voluntary control increased from 48 per cent. of marriages prior to 1880 to 70 per cent. of those contracted in the nineties. Childlessness was involuntary in two thirds of the cases; the standardized two-child family was desired in six cases out of seven. Or again, the brother of a scientific man is two hundred times as likely as another to be himself a scientific man.

We need scientific knowledge concerning scientific men and the conditions favorable to scientific work and to the scientific career. In the course of the week during which these remarks are being written, Secretary Hoover in an address to the Society of Mechanical Engineers has stated that the United States is behind most European nations in scientific research, and President Butler in his annual report has stated that Columbia University can not replace "older scholars of distinction and large achievements," because "a choice must be made from a larger or smaller group of mediocrities." It may be that we are inferior to other nations and that we now produce fewer scientific men of distinction than formerly, but both statements are open to question. The circumstance that they are made by men of wide information and can be neither proved nor disproved shows the urgent need of correct information.

It is the business of psychology to secure such knowledge, to determine how those fit for scientific research can be selected, what training should be given to them, what positions, opportunities and rewards are most effective. Scientific men should apply scientific methods to their own work and to securing the widest cooperation. Books and journals, including technical publications for scientific men, others that will interest the "average man" in science and in the wider application of the scientific method, are leading agencies. Science Service, for which this association shares the responsibility, should be made a large factor in the dissemination of science. But of all agencies for the promotion and diffusion of science, scientific societies are the most important—the national societies in each science, the state and local academies, most of all the association in which these are united and which at its annual meetings and at all times advances the interests of science and of scientific men and impresses on the widest public the weight and magnitude of modern science. We owe homage and service to the American Association for the Advancement of Science.

The experiments used in this address as illustrations of work in psychology may seem like an autobiographical obituary notice. It might have been better to have taken as a subject the contributions of our great leader, William James, or those of his contemporary, Stanley Hall, whom we have more recently lost. There are now five or six hundred active psychologists in the United States; their work is bewildering in extent, offering innumerable subjects for discussion. It is, however, easier and more human to play the part of little Jack Horner, and it is perhaps more in accord with the method of science to bear witness to direct experience. The Spanish dramatist pessimistically claims that man's greatest crime is having been born. For an optimist the greatest misfortune is to have been born a long time ago. But in the case of a psychologist there is compensation in the circumstance that he has thus been able to witness and to share the history of his science from the beginning.

Psychology, like the other sciences, may date back to Aristotle and as much further as records go; but the earliest research laboratory of psychology was established by Wilhelm Wundt at Leipzig in 1879. The first laboratory courses for students were conducted by me in 1887 and 1888 at the University of Cambridge, the University of Pennsylvania and Bryn Mawr College. When in 1881 and later I worked with Wundt, who was professor of philosophy and lectured over a wide range of philosophical disciplines, he held that the object of psychological experiment was to improve the conditions of introspection and that only the psychologist could be a subject in the laboratory. Early experiments led me to adopt the points of view that psychology, on the one side, is concerned with conduct as well as with consciousness, behavior being the more open to experimental investigations and their useful applications; on the other side, that individual differences are of primary importance, both for constructive science and in the practical affairs of daily life.

There are able psychologists who like to narrate what they think they think, what they feel they feel, what they imagine they imagine. Those of us who are concerned with quantitative measurements and objective results wish them satisfaction, even though we may think, feel or imagine that such literary diversions contribute about as much to a science of psychology as similar stories about their rheumatism and other bodily ailments would contribute to a science of pathology. Some good souls may derive comfort from arguing that they are or have good souls. With Browning's Cleon each might like to say:

> And I have written three books on the soul,
> Proving absurd all written hitherto,
> And putting us to ignorance again.

Philosophy may offer God, freedom and immortality, and it may make some difference whether it does or does not. But the shades of metaphysics wander about the Elysian fields in those obscure regions beyond the river Styx to which the light of science does not reach. Hamlet said: "There are more things in heaven and earth than are dreamt of in our philosophy." There are certainly more things dreamt of in philosophy and in some kinds of psychology than are in the heavens above, or in the earth beneath, or in the waters under the earth; but they do not give us a science of psychology.

In spite of the limited value for science of direct introspection, our mental life is part of the real world, and is that part which is of the greatest concern to each of us. It may be, as has been suggested, that psychology lost its soul long ago and is now losing its mind; but it can not lose consciousness. Our perceptions, thoughts, intentions and feelings are not only elements in sensori-motor arcs; for us they are the end to which the whole creation moves. As far as production goes, consciousness may be only a spectator; but it is the ultimate consumer. We shall have in due time a scientific psychology of human welfare, of the things that are beautiful, good and true. But it will not come until we get these things instead of talking about them; for science has meaning and value only in its usefulness. Psychology may supply economic values equal to those of the physical and biological sciences, human values of even greater significance.

Scientific research and the applications of science in the course of 150 years have increased fourfold the productivity of labor; they have doubled the length of life. Science has made it possible for each to work at routine tasks half as long as formerly and at the same time to consume twice as much wealth as formerly. Fourteen hours of labor, shared by women and children, once provided hovels, lice and black bread for most people, luxury for a few. Seven hours of labor will now supply comfortable homes, warm clothes and healthful food for all. If the resources provided by science were properly distributed—as they will be when we have an applied science of psychology—there is now sufficient wealth to enable all to share in the desirable luxuries that science has created, and to enjoy in full measure the most nearly ultimate goods of life—home, friends, things to do, freedom, self-respect.

The better lives secured through the increased wealth provided by science, together with the applications of science to hygiene, medicine and surgery, have doubled the length of life. In the nations of the west pestilence and famine have lost most of their terrors; of the three evil fates only war survives from a prescientific and barbarous past. Much is crude and ugly in the modern world; atrophied instincts and aborted impulses must be replaced by the products of a science of psychology before living can become free and fine. But those who call our industrial civilization materialistic and ignoble have narrow thoughts and scant idealism. They fail to imagine what it means in terms of love and suffering that of ten infants born, formerly only two or three survived childhood, while now eight or nine may live to have children of their own.

The applications of science have abolished slavery and serfdom, the need of child labor, the subjection of woman; they have made possible universal education, democracy and equality of opportunity, and have given us so much of these as we have. Science has not only created our civilization; it has given to it the finest art and the truest faith. The advancement of science should be the chief concern of a nation that would conserve and increase the welfare of its people.

J. McKEEN CATTELL