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Science and People

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Because I feel so deeply and so strongly concerning what I have to say on the subject of science and people, I shall run the risk of being dully pedagogical and state my plan at once. First, I am going to ask what successes man has had in his various endeavors and inquire why science seems to bulk so large among these successes. I am going to recount some foolish ideas concerning science that have arisen partly because of its successes. I am going to contrast these with a series of statements that seem to me more accurately to describe science and its relation to life. The main conclusion will be that science belongs to all the people, and that this fact presents the American Association for the Advancement of Science with a great opportunity and a great duty.

Man's Major Successes

Think of the various major tasks to which men have, over the ages, addressed themselves. They have sought food, warmth, shelter, and other guards against the physical assaults of nature. Each individual or group has also sought protection against attack from the rest of mankind.

Men have tried to understand the physical universe. They have striven to apply this body of understanding to attain control of and to exploit this power over physical nature.

Men have tried to understand organic nature—how it evolved, and how individual organisms reproduce, grow, and function. They have sought health of body. They have tried to understand the nature of mind, of consciousness, of memory, of the learning process. They have endeavored to manage personal relationships within family groups, the village, the tribe, the state, the nation, and the world at large. They have attempted social and eventually political organization at all levels of inclusiveness and complexity, and they have tried to understand human behavior as it affects all these interrelationships.

Men have created methods for ownership of property and have elaborated systems of customs and laws in an attempt to protect individuals and serve society. They have recorded history and have attempted to understand it. They have, at great cost and with high dedication, tried to strike a balance between regulation and liberty.

Men have sought to enrich life through development of the pictorial arts, literature, music, drama, and the dance. They have created systems of logic and metaphysics and have tried to analyze the nature of knowledge and reality. They have formulated codes of esthetics and morals and have contemplated the purpose and meaning of life.

In this vast and interrelated range of concerns and activities, where do the successes lie? What things have men really done well?

Each man is entitled to his own answer, but my own reply would go as follows. Probably the most conspicuous, the most universally recognized, and the most widely applied success lies in the understanding and control of the forces of physical nature. Coupled with this, I would place the progress that has been made—even though it is but a start—in the understanding of organic nature.

But along with these two I would want to bracket, without attempting to suggest an order of importance, two other major successes. The first of this second pair of successes is to be found in the grandeur and practicality of the principles of personal conduct that have been enunciated by the great religious leaders. I would suggest, for example, that the Ten Commandments, the Golden Rule, and the rest of Sermon on the Mount have the generality within their realms that Newton's laws of motion have in theirs, plus the fact that no religious Einstein has found it necessary to insert correction terms of higher order.

The second further success that seems of major proportion is to be found in the degree to which life can be and has been enriched by the arts. Thus it is my own conviction that the poet has done a job that science must thoroughly respect, and perhaps should envy.

In listing only these four major successes, some real unfairness may have been done to our social advances. Granting all the confusions and troubles that greet us with each issue of the newspapers, it remains true that man has made great progress in sorting out his human relationships. The cry "Who goes home?" which still adjourns the House of Commons, reminds us that not too long ago members required armed escort to protect them from the brigands who lurked between Westminster and the City. The constitutional experience of the American republic is impressive evidence that society does not always blunder. His Majesty's loyal opposition—the difference between political opposition and treason—is the basic treaty of political life in widening areas of the world. If science has made great contributions to man's well-being, the institution of contract has, in an unobtrusive way, made it possible. And it is deeply satisfying to recall that the daily lives of most people are saved from Hobbes' jungle by the presumption of good faith that infuses our relationships with one another.

To return to the four major successes, it seems interesting to note certain features that show how disparate they are. The first success—that of the physical sciences—is in a field where logic and quantitative measurement are dominant. The second—the dawning light of understanding of animate nature—is far less advanced, and it involves factors that are certainly nonquantitative and may

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well prove alogical. The third—the perfection of the codes of personal conduct —is curiously and unhappily more a matter of theory than of practice. I believe it was Chesterton who remarked that no one knows whether Christianity will work because no one has ever tried it. As an ex-mathematician, I would point out that one single clear exception proves that a presumptive general rule is incorrect, and I would therefore say that Chesterton's remark is characteristically vivid and interesting, but that it is false. The fourth success—man's enrichment of his life through the arts—presents features that are baffling to a scientist. Indeed, I am not sure that the word *success* really applies here, for success connotes a bad start and good progress. But the arts, as a previous AAAS president has pointed out, seem to constitute an almost completely nonaccumulative part of experience. Rutherford had a great natural advantage over Faraday, and he over Gilbert; with respect to electric phenomena, both theory and the techniques of experimentation kept advancing, and each step was built on top of the preceding one. But Emily Dickinson had no advantage over Sappho. Each simply had words, the challenge of beauty, and the ineffable genius to condense, purify, and universalize experience.

Success of Physical Science

Of these four major successes, I believe it is rather clear that the most tangible and obvious is the success of physical science. And this is an instance in which success and danger are close companions, as they often are. I do not refer here to the danger—ominous as it is—that science has unleashed forces that can physically destroy us. I refer to the more subtle danger that this success may mislead us concerning the real nature of science and its relationship to the rest of life and thus destroy something that is in the long run more important than a factory or a city, namely, our sense of value.

What made possible the great success that the physical sciences have experienced, particularly during the last century and a half? The explanation appears actually to be rather simple. *Physical* nature, first of all, seems to be on the whole very *loosely coupled.* That is to say, excellently workable approximations result from studying physical nature bit by bit, two or three variables at a time, and treating these bits as isolated. Furthermore, a large number of the broadly applicable laws are, to useful approximation, *linear,* if not directly in the relevant variables, then in nothing worse than their second time derivatives. And finally, a large fraction of physical phenomena (meteorology is sometimes an important exception) exhibit *stability*: perturbations tend to fade out, and great consequences do not result from very small causes.

These three extremely convenient characteristics of physical nature bring it about that vast ranges of phenomena can be satisfactorily handled by linear algebraic or differential equations, often involving only one or two dependent variables; they also make the handling *safe* in the sense that small errors are unlikely to propagate, go wild, and prove disastrous. Animate nature, on the other hand, presents highly complex and highly coupled systems—these are, in fact, dominant characteristics of what we call organisms. It takes a lot of variables to describe a man, or for that matter a virus; and you cannot often usefully study these variables two at a time. Animate nature also exhibits very confusing instabilities, as students of history, the stock market, or genetics are well aware.

If the successes of physical theory had remained limited to those highly useful but none the less essentially simple situations covered by two variable equations such as Ohm's law in electricity, or Hook's law for elastic deformation, or Boyle's law for volume and pressure of gases, or even to the vastly greater range of dynamic phenomena that are so superbly summarized in Newton's second law of motion, then it seems likely that mankind would have preserved a reasonable, take-it-or-leave-it attitude toward science. But two further things occurred.

Physical science pushed on to much more subtle and more complicated realms of phenomena, particularly in astrophysics and in atomic and then nuclear physics. And it kept on having successes. Second, physical science (and remember that nowadays it is not really useful to discriminate between physics and chemistry) began to be applied more and more to certain limited sorts of problems of animate nature. Biochemistry, to take a very conspicuous example, began to deal successfully with phase after phase of the happenings within the individual cells of living creatures.

At the same time, of course, scientific theories kept getting more and more complicated and technical. Not only were they generally formidable to the public at large—scientific experts themselves had increasing difficulty in understanding anything outside their own specialties.

Superstitions

All this has tended to create a set of superstitions about science. These seem to be rather widely adopted by the public, and some of them even have adherents among scientists! These superstitions go something like this:

Science is all-powerful. It can just do anything. If you doubt this, just look around and see what it has done. A procedure known as "the scientific method" would in fact, if we only used it, solve all the problems of economics, sociology, political science, esthetics, philosophy, and religion. And the reason why science has been so successful, and the basis of confidence that it can go on to do anything whatsoever, is that science has somehow got the real low-down on nature and life. It has found out how to capture absolute truth, exact fact, incontrovertible evidence. Its statements are just "mathematically true," and in the face of that, you had better be confident and respectful, even if you are confused.

But science (to continue the superstitions) cannot be understood by ordinary folk. It is too technical, too abstruse, too special, and too different from ordinary thinking and ordinary experience. There is a special small priesthood of scientific practitioners; they know the secrets and they hold the power.

The scientific priests themselves are wonderful but strange creatures. They admittedly possess mysterious mental abilities; they are motivated by a strange and powerful code known as "the spirit of science," one feature of which seems to be that scientists consider that they deserve very special treatment by society.

Now these are dangerous misconceptions about science. If they were wholly untrue, if they were total and complete nonsense, then one could confidently await the general recognition of their fraudulent nature. But there is just enough apparent and illusive evidence in favor of these statements to give them an unfortunate vitality.

Alternative Statements

Let me list as briefly as I can a set of alternative statements which I believe to be more reasonable and accurate.

1) Science has impressively proved itself to be a powerful way of dealing with certain aspects of our experience. These are, in general, the logical and quantitative aspects, and the method works superbly for linear and stable physical problems in two or three variables. The physical universe seems to be put together in such a way that this scientific approach is exceedingly successful in producing a good, workable, initial description. And with that kind of solid start, physical science can then safely proceed to elaborate more sophisticated theories.

2) We simply do not yet know how far these methods, which have worked so well with physical nature, will be suc-

cessful in the world of living things. The successes to date are very impressive. One feature after another that previously seemed to fall in a special "vital" category has usefully yielded to biochemical or biophysical attack. But it is also the case that we have as yet made only a beginning. How far the logical-quantitative method will succeed here, one would be rash to forecast, although the prospects do indeed seem extremely promising.

3) We have made small beginnings at extending the scientific method into the social sciences. Insofar as these fields can be dealt with in terms of measurable quantities, they seem to present closely intercoupled situations that can very seldom usefully be handled with two or three variables and that often require a whole hatful—for example, W. Leontief's input-output analysis of the U.S. economy deals with some 50 variables and regrets that it does not handle more. Science has, as yet, no really good way of coping with these multivariable but nonstatistical problems, although it is possible that ultrahigh-speed computers will inspire new sorts of mathematical procedures that will be successful in cases where the effects are too numerous to handle easily but not numerous enough or of suitable character to permit statistical treatment. If we try to avoid the many-variable aspect of the social sciences by using highly simplified models of few variables, then these models are often too artificial and oversimplified to be useful. The statistical approach, on the other hand, has recently exhibited—for example, in the stochastic models for learning—new potentialities in the field of human behavior.

4) It is, incidentally, not at all necessary that the particular analytic techniques of the physical sciences be forced upon biological or social problems with the arrogant assumption that they can and should make unnecessary other types of insight and experience. During the recent war, an extremely useful collaboration was developed, known often as operations analysis, in which reasoning of a mathematical type was applied to certain aspects of very complicated situations, but with no expectation that judgment, experience, intuition, or a vague sort of general wisdom would be displaced or superseded—rather only that these would be aided by whatever partial light could be furnished by quantitative analysis.

5) An important characteristic of science, which we must note in passing, is its incapacity to be impractical. The most far-reaching discoveries and the most widespread useful applications flow regularly out of ideas that initially seem abstract and even esoteric. These ideas arise out of the unguided and free activity of men who are motivated by curiosity or who, even more generally, are thinking about scientific problems simply because they like to. The way in which apparently aimless curiosity stubbornly refuses to be foolish and leads to important goals doubtless seems strange or even incredible to some persons. The eventual usefulness of the initially impractical is widely held to be a very special feature of science, but I am not so sure of this. I think that apparent impracticality is more generally important than we are inclined to suppose.

6) Science presents the kind of challenge that attracts to it young men and women who tend to have a rather high degree of a certain kind of intelligence. Since this particular kind of intelligence is relatively easy to recognize and measure, and since many other types are subtle and illusive, even though perhaps more important, we tend to adopt this one type as the norm. In addition, this particular type of intelligence leads rather promptly to tangible results. These circumstances lead to the conclusion, which is then something of a tautology, that scientists are more intelligent than other people. This may or may not be true; more important, however, it may be neither true nor untrue in the sense that the attempted comparison is meaningless.

7) However, despite their appearing to be so bright, scientists are not special creatures: they are people. Like lots of other people, they are good at their own tasks. Off their jobs they seem, as Shylock remarked in another connection, "to be fed with the same food, hurt with the same weapons, subject to the same diseases, healed by the same means, warmed and cooled by the same winter and summer" as other men are. When you prick them, they do indeed bleed.

A. V. Hill, while he was president of the British Association for the Advancement of Science, stated: "Most scientists are quite ordinary folk, with ordinary human virtues, weaknesses, and emotions. A few of the most eminent ones indeed are people of superlative general ability, who could have done many things well; a few are freaks, with a freakish capacity and intuition in their special fields, but an extreme naiveté in general affairs. . . . The great majority of scientists are between these groups, with much the same distribution of moral and intellectual characteristics as other educated people."

8) One rather accidental fact has led many to think that scientists are strange and special, and this is the fact that scientists often use a strange and special language. Science does find it desirable to use very many technical words, and it has indeed developed, as a matter of saving time, a sort of language of its own. This gives to science an external appearance of incomprehensibility that is very unfortunate. The public need not think itself stupid for failing intuitively to grasp all this technicality. Indeed, what has developed is not so much a language as a series of very specialized dialects, each really understood only by its inventors. "On faithful rings" is not a sociological discussion of marriage but an article in modern algebra. The "Two-body problem for triton" is not mythology but physics: a "folded tree" is not a botanical accident but a term in telephone switching theory.

9) If scientists are human, so also is science itself. For example, science does not deserve the reputation it has so widely gained of being based on absolute fact (whatever that is supposed to mean), of being wholly objective, of being infinitely precise, of being unchangeably permanent, of being philosophically inescapable and unchallengeable. There seem still to be persons who think that science deals with certainty, whereas it is the case, of course, that it deals with probabilities. There seem still to be persons who think that science is the one activity that deals with truth, whereas it is the case, of course, that—to take a very simple example—"the true length of a rod" is so clearly not obtainable by any scientific procedure that, insofar as science is concerned, this "true length" remains a pleasant fiction.

I could document this particular point at length, but will restrict myself to three quotations from the relatively mature fields of physics, astronomy, and mathematics.

Edmund Whittaker said of theoretical physics: ". . . it is built around conceptions; and the progress of the subject consists very largely in replacing these conceptions by other conceptions, which transcend or even contradict them."

Herbert Dingle, in his retiring address as president of the Royal Astronomical Society, said: "The universe . . . is a hypothetical entity of which what we observe is an almost negligible part. . . . In cosmology we are again, like the philosophers of the Middle Ages, facing a world almost entirely unknown."

Alfred North Whitehead has stated: "While mathematics is a convenience in relating certain types of order to our comprehension, it does not . . . give us any account of their activity. . . . When I was a young man, . . . I was taught science and mathematics by brilliant men; . . . since the turn of the century I have lived to see every one of the basic assumptions of both set aside."

10) These quotations indicate that the ablest scientists themselves realize the postulational and provisional character of science. Perhaps not so widely recognized or accepted is the extent to which the

development of Western science, rather than constituting a uniquely inevitable pattern, has been influenced by the general nature of Greco-Judaic culture, including especially the standards, arising within that tradition, of what is interesting and important.

Confronted by the totality of experience, men select the features that seem interesting and important—and the criteria for interest and importance arise not just or even primarily within scientific thought, but rather within the entire cultural complex. One then seeks to find a way of ordering this selected experience so that the end result is acclaimed as satisfying and useful—again as judged within the total culture. This process has different possible beginnings and different possible procedures; so, of course, it has different possible end results. Clyde Kluckhohn has remarked, "What people perceive, and how they conceptualize their perceptions is overwhelmingly influenced by culture." H. M. Tomlinson said, "We see things not as they are, but as we are."

If, for example, a culture almost wholly disregards physical suffering, considers the present life an unimportant episode, and places a very high premium on prolonged mystic contemplation, then this viewpoint regarding values does more than, for example, underemphasize modern scientific medicine (using all these words in the Western sense). It produces something that is different *in kind*; I know of no criteria that justify calling one kind good and intelligent, and the other poor and ignorant.

Chang Tung-San, a Chinese philosopher, has said: "Take Aristotelian logic, for example, which is evidently based on Greek grammar. The differences between Latin, French, English, and German grammatical form do not result in any difference between Aristotelian logic and their respective rules of reasoning, because they belong to the same Indo-European linguistic family. Should this logic be applied to Chinese thought, however, it will prove inappropriate. This fact shows that Aristotelian logic is based on the Western system of language. Therefore we should not follow Western logicians in taking for granted that their logic is the universal rule of human reasoning."

If this general line of thought seems to you either interesting or improbable, I urge you to read some of the fascinating papers of Benjamin Lee Whorf and of Dorothy D. Lee on the value systems and the conceptual implications of the languages of various American Indian tribes. Whorf, for example, points out that the Hopi Indian language "is seen to contain no words, grammatical forms, constructions or expressions that refer directly to what we call *time,* or to past, present, or future, or to enduring or lasting, or to motion as kinematic rather than dynamic. . . . At the same time the Hopi language is capable of accounting for and describing correctly, in a pragmatic or operational sense, all observable phenomena of the universe."

11) The ten preceding numbered comments concerning certain general characteristics of science all contribute, I believe, to a major conclusion—that science is a very human enterprise, colored by our general ideas, changeable as any human activity must be, various in its possible forms, and a common part of the lives of all men.

Indeed, even the impressive methods that science has developed—methods which sometimes seem so formidable—are in no sense superhuman. They involve only improvement—great, to be sure—of procedures of observation and analysis that the human race has always used. In the appeal to evidence, science has taught us a great deal about objectivity and relevance, but, again, this is refinement of procedure, not invention of wholly new procedure.

In short, every man is to some degree a scientist. It is misleading that a tiny fraction of the population is composed of individuals who possess a high degree of scientific skill, while most of the rest are indifferent or poor scientists. This creates the false impression that there is a difference in kind, when it is actually only one of degree.

If, when a window sticks, you pound it unreasonably, or jerk so hard that you hurt your back, or just give up in ignorant disgust, then you are being a poor scientist. If you look the situation over carefully to see what is really the matter—paint on the outside that needs cutting through, or a crooked position in the frame—then you are being a good scientist.

Even primitive men were scientists, and in certain aspects of accurate and subtle observation and deduction it would probably be hard to beat the ancient skilled hunter.

Indeed, one important contrast between the savage and the professor is simply that modern scientific methods make it possible to crystallize our experience rapidly and reliably, whereas primitive science does this clumsily, slowly, and with much attendant error. But it is, after all, well to remember that ephedrine is the active principle in an herb, Ma Huang, that has been empirically employed by native Chinese physicians for some 5000 years. Certain African savages when they moved their villages did take with them to the new location some dirt from the floor of the old hut. Moreover, it is true that they said that they did this to avoid the anger of their gods who might not wish them to move, fooling them by continuing to live on some of the same ground. But the fact remains that by this process they brought to the new location the soil microorganisms that continued to give some degree of protection from certain ailments. We quite properly honor Fleming and Florey, but Johannes de Sancto Paulo, a medical writer of the 12th century, did prescribe moldy bread for an inflamed abscess. "We are all scientists," Thomas Huxley said, because "the method of scientific investigation is nothing but the expression of the necessary mode of working of the human mind."

Science as a Human Activity

Let us now back away from the trees and look at the forest. Where have we arrived in this discussion?

I have just listed 11 points that, in my judgment at least, fairly characterize science as a universal human activity. These comments do not support the concept of science as some sort of super creed, magical and mysterious as it is all-powerful, arrogant from its successes, and avid to invade and conquer, one after another, all the fields of human activity and thought. This viewpoint does not justify the notion that science is so special as to be unique, as well as so curious as to be incomprehensible. This does not depict scientists as strange creatures who are in one sense so objective, judicial, and precise as to be incredible, and in another sense so apart from life as to be selfish and sinister. This does not set up quantitative analytic Western science as the only valid way in which man may approach and interpret experience.

On the contrary, these descriptive comments picture science as the servant of man, not his master; and as a friendly companion of art and of moral philosophy. This is a science that is the way it is because man wants it to be that way. It is a natural expression of both his curiosity and his faith.

If the public could be brought to understand and appreciate this position concerning science and scientists, I do not think that so many persons would harm this great enterprise of ours with a combination of mistrust, fear, and overestimation. I do not think that so many would treat scientists one-third of the time as amusing but beneficial eccentrics, one-third of the time as sorcerers, and one-third of the time as irresponsible rascals. I do not think that so many would view scientists as careless dabblers with danger, or as a selfish minority that, to quote a nationally syndicated columnist, "hold they are an extra special group not tied down by the obligations and rules under which the rest of us work. Hundreds of them are now bellyaching about the Oppenheimer verdict and saying it ruins their morale and makes them hard to get. What goes with those birds?" Or consider another newspaper writer who opened one of his columns with the sentence, "We Americans have been confronted with an arrogant proposition that persons presuming to call themselves intellectuals, and particularly those who claim the title of scientist, are a superior cult entitled to deference or even homage from the common man." One of our greatest universities takes a sound and courageous stand, and a newspaper writer complains, "Harvard has a peculiar fondness nowadays for putting security and the safety of the nation second to their fancy ideas of importance." If some speak out against the climate of fear resulting from the stupidities and iniquities of what is misnamed as the security system—doubly misnamed since it is not a system and does not achieve security—then their protest is labeled, as it was by Eugene Lyons in the *Saturday Evening Post,* as "the mock-heroic posture of this close-knit band of Cassandras"; he insultingly adds that these protesters do not themselves seem to have suffered, for "not one of them has as yet been muzzled, lynched, or denied his due royalties."

Anti-intellectual views such as these are widely expressed in those newspapers that combine a wide circulation with a narrow intellectual viewpoint, in some very popular national magazines, and even, one reports with shame, by highly placed persons in Washington.

It is hardly necessary to argue, these days, that science is essential to the public. It is becoming equally true, as the support of science moves more and more to state and national sources, that the public is essential to science. The lack of general comprehension of science is thus dangerous both to science and to the public, these being interlocked aspects of the common danger that scientists will not be given the freedom, the understanding, and the support that are necessary for vigorous and imaginative development. It is, moreover, of equally grave importance that science understand itself.

There are persons who are pessimistic concerning the prospects of materially improving the public understanding of science, and even the understanding that one branch of science has of the other branches. If one subscribes to the falsities and exaggerations that I stated in the first part of this article, then he could properly be pessimistic. If, on the other hand, he accepts the broader, more liberal, more human and humane view that I have advanced here, then—or at least so it seems to me—he can be very optimistic.

When David Brewster, a century and a quarter ago, was one of the prime movers in founding the British Association for the Advancement of Science, he said, "The principal objects of the Society would be to make the cultivators of science acquainted with each other, to stimulate one another to new exertions—to bring the objects of science more before the public eye and to take measures for advancing its interests and accelerating its progress."

This is a challenge which our own Association has always sought to meet. It is a challenge which, at this moment in history, requires renewed zeal and ever-renewed patience. Speaking of the present-day scientist, J. Bronowski has said, "Outside his laboratory, his task is to educate us in what goes on inside it, and to give it a meaning for us. In a world in which statesmen as much as voters are ignorant of the simplest implications in science, this is a formidable responsibility . . . [the scientist] has no other choice today but patiently to become a teacher, in a world in which distrust and prejudice are free. . . . There is no alternative to an informed public opinion: and that can exist only where scientists speak to voters and voters accept their responsibility, which is to listen, to weigh, and then to make their own choice."

If, as I believe, the sciences and the arts are lively and noncompetitive partners in the business of life, it is appropriate that we close, not with a scientist, but with a great artist. "Our privacy," Faulkner says, "has been slowly and steadily and increasingly invaded until now our very dream of civilization is in danger. Who will save us but the scientist and the humanitarian. Yes, the humanitarian in science, and the scientist in the humanity of man."

L. L. Thurstone and the Science of Human Behavior

Louis Leon Thurstone was born in Chicago, Illinois, on 29 May 1887. He received his M.E. degree from Cornell University in 1912 and his Ph.D. from the University of Chicago in 1917. In 1912 he served as assistant to Thomas Edison. From 1912 to 1914 he was instructor in engineering at the University of Minnesota. From 1915 to 1920 he rose from assistant to professor and department head at Carnegie Institute of Technology. He remained as department head until 1923, when he accepted a position as psychologist with the Institute of Government Research in Washington, D.C. In 1924 he was appointed associate professor of psychology at the University of Chicago and in 1928 he was promoted to professor of psychology, a position that he held until his retirement in 1952. In 1938 he was awarded the Charles F. Grey distinguished service professorship at the University of Chicago. During this year he also founded the Psychometric Laboratory. He served as its director until his retirement. He has held visiting professorships in several European universities. After his retirement from the University of Chicago, he moved his Psychometric Laboratory to the University of North Carolina, where he continued his research and publication.

Thurstone was the leading figure in the organization of the Psychometric Society in 1935 and the establishment of *Psychometrika,* which was first published in 1936. He was a member of numerous scientific societies and held high offices in many of them, including the presidency of the American Psychological Association in 1933. His contributions to science are recorded in numerous published articles and in many monographs and books.

It is said that a scientist may count his life a success if he advances but a little the frontiers of knowledge in his own discipline. Louis Leon Thurstone did much more. He explored, charted, and cultivated vast new domains. Early in his career he recognized that there can be no true science without measurement. Beginning with the classical psychophysical methods, he developed psychological scaling techniques and applied them to