

THE PSYCHOLOGICAL REVIEW

JAMES McKEEN CATTELL

1860-1944

In the history of American psychology very few figures are so outstanding as that of James McKeen Cattell whose long and active life has just come to a close. He did not, indeed, belong to the first generation of American scientific psychologists—consisting mainly of William James, G. Stanley Hall and George Trumbull Ladd—but he was probably the most influential of the second generation which included Titchener, Müns- terberg, James Mark Baldwin, Jastrow, Sanford, and Scripture, with others coming along just a little later. Though Cattell was not a systematist and did not found a school in that sense, he was the leader in what became a widespread and distinctive movement in American psychology. His interest from the very outset of his career was in introducing quantitative methods into psychology and especially in using such methods for the measurement of individual differences.

Cattell graduated in 1880 from Lafayette College, of which his father was the president. His undergraduate interests had centered largely on literature. His first step toward a professional career, however, was to go to Europe for the study of philosophy. He heard Wundt lecture at Leipzig and Lotze at Göttingen and was much impressed by

James McKeen Cattell was the joint founder with James Mark Baldwin of THE PSYCHOLOGICAL REVIEW in 1894. He was co-editor of the *Review* with Baldwin until 1904, each editing it on alternate years. THE EDITOR.

both of these men. A paper on Lotze won for Cattell a fellowship in philosophy at Johns Hopkins, where he spent the year of 1882-83, with John Dewey and Joseph Jastrow as fellow students. It was during this year that Stanley Hall set up his psychological laboratory at Johns Hopkins, with some assistance from this group of students, and it was there, apparently, that Cattell began his "psychometric investigations," concerned with the timing of various mental processes. He took his data and his designs for improved apparatus back to Germany the following year and remained in Wundt's laboratory for the three years, 1883-1886, being for part of this time Wundt's first laboratory assistant.

From the outset Cattell seems to have been impressed with the variability of human performance and the consequent need for long series of observations in order to reach reliable results. He set up his apparatus in his own rooms at Leipzig so that he could work longer hours than Wundt permitted in the laboratory, and carried out an extraordinarily thorough and extensive study of reaction times, ranging all the way from the simple reaction through the reactions with discrimination and choice up to free and controlled association. Reaction time was of course no novelty in the Leipzig laboratory, being in fact a line of experiment on which Wundt was pinning great hopes. Cattell's conception of reaction time studies, however,

differed radically from that of Wundt. Wundt hoped by variation of the experiment, with certain introspective controls, to tease out the time constants for elementary mental processes such as perception, choice and association. Cattell found that he could not himself carry out the required introspections and subjective controls, and he came to doubt the ability of others to do so. It seemed to him that the simple reaction became with practice a "prepared reflex" and that in the more complex reactions the constituent processes overlapped in time and so could not be measured. Yet the reaction time experiment, he still held, was of great value as a tool for determining the speed and difficulty of many everyday mental processes. He could show, for example, that the time required to read a short familiar word was no greater than that required to read a single letter, so that the practice then coming into vogue of teaching the child to read whole words before the single letters had a scientific basis. Without pretending to analyze the complex processes into their elements, Cattell used the total reaction time obtained under various conditions for studying attention, fatigue and practice, for comparing the legibility of the different letters of the alphabet and for many other practical and scientific purposes.

Cattell's Leipzig studies were all concerned with time, but they were not limited to reaction time (3). He used his 'fall tachistoscope' also for determining the exposure time necessary for perceiving colors, pictures, letters and words (2). He also made an interesting use of a serial exposure apparatus (1)—a type of experiment which has not been followed up as much as it deserves.

Cattell continued to use the reaction time method in important later studies (7) and directed quite a number of his Columbia students in similar work.

Not during his years at Leipzig, but

shortly afterward, Cattell carried on extensive work in another of the classical fields of experimental psychology, psychophysics, (5, 6). Here, as well as in reaction time, he broke away from the older view of these experiments as being concerned with the measurement of consciousness and substituted a more objective and operational conception. Experiments using the method of right and wrong cases or of constant stimuli, for example, are not directed operationally toward the measurement of intensity of sensation. They are experiments in observation and judgment and the results come out as measurements of the error of observation. Psychophysics, accordingly, should be conceived as a study of accuracy of observation under different conditions—a study of obvious practical importance. It seemed to Cattell more in accordance with the theory of probability (a theory in which he took much interest) to expect the error of observation to increase as the square root of the observed magnitude, rather than in direct proportion to that magnitude as asserted in Weber's law. As a matter of fact, the data usually come out between these two formulas. That is, the error of observation usually increases less rapidly than Weber's law would predict but more rapidly than predicted by Cattell's square root law.

A little later (12), by combining his interests in psychophysics and reaction time, Cattell invented a new psycho-physical method, the discrimination time method for indicating the difference between magnitudes or qualities—the larger the effective difference, the quicker the discrimination.

Though differing with Wundt on some matters of theory, Cattell always retained a warm personal affection for his master and a high respect for his services as a founder of experimental psychology. After leaving Leipzig Cattell soon came into personal contact with

Francis Galton—"the greatest man whom I have known"—and was confirmed by Galton in his own long-held view that the measurement of individual differences would be one of the most fertile fields for the new psychology. Cattell was perhaps the first (1890) to use the term mental tests, and he thus expressed his high hopes regarding them:

Psychology cannot attain the certainty and exactness of the physical sciences, unless it rests on a foundation of experiment and measurement. A step in this direction could be made by applying a series of mental tests and measurements to a large number of individuals. The results would be of considerable scientific value in discovering the constancy of mental processes, their interdependence, and their variation under different circumstances. Individuals, besides, would find their tests interesting, and, perhaps, useful in regard to training, mode of life or indication of disease (4, p. 373).

At this time he described a series of ten tests which he apparently was using at the University of Pennsylvania. Shortly afterwards, at Columbia, he developed a more extensive list, known for many years as the Freshman Tests, though they had nothing to do with the admission of freshmen to college (10). They were given to 50 or more volunteers from each successive freshman class, in order to obtain data for the study of individual differences and the factors on which the differences depend. When the sample of freshmen had grown to a sufficient size, the Pearson method of studying correlation having meanwhile become available, these data were subjected to correlational analysis. Though the low correlations obtained were surprising and rather disappointing to Cattell—they suffered from attenuation, as Spearman soon pointed out—this study has considerable historical importance in the development

of the correlational method in psychology (28).

Cattell's plan of testing separate functions—the senses, quickness of movement, perception of time, memory, imagery, etc.—was rather left behind with the appearance of Binet's method of testing intelligence, though it is more in line with recent efforts to develop tests for specific mental abilities.

Reaction time, psychophysics, and tests were thus the main lines of Cattell's early researches. A minor extension of his work on errors of observation is of historic interest as being probably the first study of the reliability of testimony. He wrote:

. . . we do not know how likely it is that a piece of testimony is true, or how the degree of probability varies under different conditions. If we could learn this by experiment the result would be a contribution to psychology, and would at the same time have certain important practical applications (8, p. 761).

His experiment consisted in asking college students questions about distances on the campus, the weather a week before, the dates of certain historical events, etc. He found wide individual variation in the students' answers. In some cases the average of the answers was close to the truth while in other cases there was a large constant error.

When students were asked what was said during the first two minutes of the lecture in the same course given one week before, the accounts were such that the lecturer might prefer not to have them recorded. From the testimony of the students it would appear that two minutes sufficed to cover a large range of psychological and other subjects, and to make many statements of an extraordinary character (8, p. 764).

A major contribution, besides those already mentioned, was the invention of the order of merit or ranking method for use both in psychophysics and in

aesthetics and other judgments of value. Cattell first employed it in a psycho-physical problem. Having prepared a series of over 200 shades of gray ranging by imperceptible steps from black to white, he asked his subjects to arrange them as well as possible in order of brightness. The observer's errors could be determined by reference to the objective scale of brightness (12). He soon extended the use of the method to the broad field of value judgments. The first value considered was the scientific standing of American men of science, that is, the relative standing of the men in any given branch of science. In the case of psychology, for example (14), he first prepared a list of all who could be regarded as scientific psychologists, and then induced ten leading psychologists to serve as judges and rank the listed individuals in order of scientific merit. The ten judges worked independently and Cattell combined their rankings and computed the average position assigned to each individual, with the variation from judge to judge. The average ranks were not published till thirty years later (16, 5th edition, 1933, pp. 1269 ff.; 24, p. 11). Meanwhile, however, accepting the average ranks as furnishing an approximation to a true order of merit, he was able to use the results in two ways. By comparing each judge's arrangement with the average of all, he had an estimate of the accuracy of each judge. From the average ranks combined with other data he was able to make what might be called an ecological study of *Homo scientificus Americanus* with respect to parentage, place of birth and of education, and present geographical distribution (17); and by repeating this study at about seven-year intervals he brought to light changes and trends of considerable interest (18). The ranking method was quickly applied by his students and colleagues to a great variety of value judgments related

to literature, education and business. Cattell himself made some progress in the difficult task of working out the relations between rank order and quantitative measurement.

As was said before, Cattell did not found a school of psychological theory. He was open-minded towards all kinds of psychological research and application, provided they were serious and scientific, and was willing to have many sorts of experiment going on in his laboratory. His own preference was definitely for the objective type of experiment. He no doubt prepared the way for behaviorism and felt considerable respect for it when it emerged but he was not willing to rule out of the science those who preferred the introspective method. There was a great difference between the types of work done in his laboratory and in Titchener's, yet he had a high respect for Titchener as a scientist. Certain statements in Cattell's address at the St. Louis World's Fair in 1904 have often been quoted and deserve to be quoted again:

Sciences are not immutable species, but developing organisms. Their fundamental conceptions and methods at any period can only be approached by a research into work actually accomplished. . . . The task has been assigned to me of considering the scope, conceptions and methods of psychology, and it is my business to define the field of psychology or to acknowledge my inability to do so. I must choose the latter alternative. I can only say that psychology is what the psychologist is interested in *qua* psychologist. . . . I am not convinced that psychology should be limited to the study of consciousness as such. . . . I admire . . . the ever-increasing acuteness of introspective analysis . . . but the positive scientific results are small in quantity when compared with the objective experimental work accomplished in the past fifty years. There is no conflict between introspective analysis and objective experiment —on the contrary, they should and do con-

tinually coöperate. . . . Let us take a broad outlook and be liberal in our appreciation. . . . As I claim for psychology the freedom of the universe in its subject-matter, so I believe that every method of science can be used by the psychologist. The two great achievements of science have been the elaboration of the quantitative method on the one hand and of the genetic method on the other. . . . It would be an irreparable limitation if either of these methods did not apply in psychology. . . . I see no reason why the application of systematized knowledge to the control of human nature may not in the course of the present century accomplish results commensurate with the nineteenth century applications of physical science to the material world. . . . In the end there will be not only a science but also a profession of psychology (15, pp. 176, 179, 180, 182, 186).

If we try to bring before us the young Cattell who emerged from Leipzig in 1886 with the degree of Doctor of Philosophy, the picture is one of a man of great initiative and energy, eager for large enterprises, and filled with missionary zeal for the advancement of a psychology which should be experimental, quantitative and practical, with great emphasis on the study of individual differences. For two years this young man divided his efforts between England and America, working in Galton's Anthropometric Laboratory in London, lecturing in Cambridge University and making a start toward a laboratory there, and lecturing also at Bryn Mawr College and the University of Pennsylvania. In 1888 he became a professor at the latter institution, and he was always proud of the fact that he was Professor of Psychology and that this was the first professorship of psychology as distinguished from philosophy that was ever established anywhere (23). Cattell was never hostile in the least to philosophy or philosophers; he was especially appreciative of John Dewey; but he be-

lieved that psychology should align itself with the sciences. His laboratory at Pennsylvania was the first one to provide not only for research but also for the initiation of the college student into the methods of experimental psychology. After a few years at Pennsylvania he accepted a call from Columbia University where he started the laboratory in 1891. Here his influence was felt by many students, including over fifty who took their doctor's degree with him up to 1917 when his connection with the university ceased. The majority of these graduates became active psychologists in various parts of the country, and they look back to Cattell with loyalty and with gratitude for his helpful stimulation and guidance.

Besides his research and teaching, Cattell's enterprising activity branched out in several directions. He took quite an interest in designing improved and simplified forms of psychological apparatus and in having it manufactured in the laboratory shop, so making a contribution, as he felt, to the development of experimental psychology in the laboratories that were springing up throughout the country. This was one of his earliest enterprises, continued for a couple of decades at Columbia.

Another early enterprise was the editing and publishing of scientific journals, and this continued as a major activity for the rest of his life. In 1894 he joined forces with James Mark Baldwin, then professor at Princeton, in establishing the *PSYCHOLOGICAL REVIEW* series. In the same year he acquired the weekly journal, *Science*, which had just suspended publication because of financial difficulties. He secured the coöperation of an eminent editorial board while taking on himself the arduous tasks of managing editor and business manager. He set up an editorial and publishing office at his country home on the mountain top in Garrison, N. Y., fifty miles from

the university, and with the able assistance of Josephine Owen Cattell, his wife, produced an extremely well-edited journal which after a few years became a financial success and was accepted as an indispensable service to American science. A few years later he similarly took over the *Popular Science Monthly* and made a success of it, later renaming it the *Scientific Monthly*, and in 1915 he started a comprehensive educational weekly, *School and Society*. All this editorial work took him away from active research, but such services of a psychologist to the causes of science and education redounded greatly to the credit of psychology.

The same was true of his active participation in the general organization of American scientific men. First we should notice that he was one of the small group that started the American Psychological Association in 1892 (21). He was a member of the Council from the beginning, Secretary the third year and President the fourth year (9). Soon after coming to Columbia he became a member of the New York Academy of Sciences and soon induced the Academy to set up a Section of Anthropology and Psychology, so winning recognition for our science from this local scientific body. He was President of the New York Academy in 1902 and set forth in his presidential address his ideas on the appropriate organizational scheme for American science. He said:

The organization of science in America toward which I believe we are moving is this: We shall have a national society for each of the sciences; these societies will be affiliated and will form the American Association for the Advancement of Science. . . . Our national societies will consist of local sections, and these sections will unite to form an academy of sciences. . . . This kind of organization may appear to be almost too logical for a world that is somewhat careless of logic, but it is in part already realized (13, p. 972, 973).

In accordance with this idea of local branches of the national societies, Cattell had already in 1900 secured permission from the American Psychological Association to establish a New York Branch, which maintained a continuous and useful existence till it expanded to become the Eastern Psychological Association of today.

Cattell's interest in the American Association for the Advancement of Science (the A.A.A.S.) evidently began very early, for we find him in 1898 Vice-President of that Association and Chairman of Section H, then the Section of Anthropology but soon to become for many years the Section of Anthropology and Psychology. His vice-presidential address at that time made a definite claim for the recognition of psychology as a science (11). He said:

From our present point of view science in its history appears to have followed a necessary course. The phenomena of the physical world are stable and readily subject to experiment and measurement; their control is essential to material progress. It is therefore no wonder that the physical sciences should have preceded the biological sciences in their development. Far more complex, transient and inaccessible to experiment even than the phenomena of living beings are men, they themselves and their deeds—sciences of these things must come later. . . . Psychology has become an integral part of modern science; it gives and takes with a free hand. A parvenu among the sciences, it is self-conscious and knows its obligations and its limitations; but its position in the body scientific is henceforth secure. . . . When we regard the fifty years of this Association or the century now ending, we cannot fail to see that it has been an era of science. . . . The older sciences have been reformed and new departments have been established. But amid all this scientific progress nothing has been more notable—at least from my own partial point of view—than the development of psychology into a science rivaling in activity and fruitfulness the other great sciences.

From 1900 on Cattell's main interests were probably his journals, especially *Science*, his directory of men of science along with his already mentioned studies of these men, and the A.A.S. In 1900 *Science* became the official medium for the Association, greatly to the advantage of both, and from that time till the end of his life he was a leader in the Association and probably more influential than anyone else in its affairs (26). He was Vice-President again in 1913, this time for the Section of Education (20), and President of the Association in 1924 (22). He was the first psychologist to receive this distinguished honor, as he had also been the first (in 1901) to be admitted to the National Academy of Sciences. As an active member of the National Academy he was influential in building up the representation of psychology in that body. With his extremely wide acquaintance among scientific men and his varied services to American science in general, as well as by his direct efforts in behalf of psychology, he undoubtedly contributed more than any other one man to win recognition for our science among the group of natural sciences.

Promotion of applied psychology was one of Cattell's ambitions from the very beginning of his career, and one which he emphasized repeatedly in his addresses and writings. He encouraged his students to pioneer in finding applications to education, industry and medicine. Coupled with this desire to make psychology a force for the betterment of mankind was a strong democratic spirit which made him resentful of the necessity of appealing humbly to wealthy donors and foundations, or even to the Government, for the support of scientific research. He pointed to the enormous economic gain resulting from research and urged that a fraction, if only a small fraction, of this gain ought to be turned over to the scientists as a matter of

right and of public policy for the support of further research. It was quite in line with these predilections that he organized the Psychological Corporation in 1921, putting into it funds from his own pocket and securing a liberal charter which permits the Corporation to earn money by applying psychology but provides that a large share of the profits shall be plowed in for further research. In spite of his other responsibilities he helped greatly to direct the policy of the Corporation during its early years of struggling existence, and when it began to have some financial success he turned his own stock into a fund to be used for the support of research in applied psychology.

Even yet we have not mentioned all of Cattell's organizational activities. One of the most important during his last twenty years was an active participation in the development of Science Service. He contributed much to the success of this effort to improve newspaper coverage of scientific events and discoveries, and thus to bring science home to the general public.

He set up the Science Press Printing Company in 1923 for specializing in the printing of scientific journals and books.

His lifelong interest in problems of university organization and management was strongly tinged with the democratic spirit already mentioned (19). His outspoken views on these problems brought on some of the most exciting episodes of his career and led up to his eventual dismissal from Columbia during the excitement of the first World War. His pacifist leanings and his particular antipathy to any form of compulsion even during war did not prevent him from contributing of his best to the war effort of the psychologists in the development of the Army tests.

Unfortunately Cattell could never be persuaded to write even a brief autobiography. His excuse was that an auto-

biography such as he would write would land him in the position of defendant in a number of libel suits. He felt sure he could not bring himself to delete all the pungent comments that would occur to him, and he had found by long experience that such comments were not always accepted in the spirit of raillery that motivated them in his conversation and in his more polemic writings. Autobiographical material bearing mostly on his early career can be found in some of his writings (22, 23, 24), and considerable material on his life is available in other sources (25, 26, 27).

The crowning honor of Cattell's life came when, at the age of nearly seventy, he was chosen by the votes of American psychologists to represent them as President of the Ninth International Congress of Psychology, held at New Haven in 1929. His presidential address on Psychology in America, with the supplementary materials, makes an important historical document (24).

The present attempt to convey to the younger generation some impression of the life and work of one of our leaders in American psychology may be brought to a close by taking note of the hearty appreciation expressed by his numerous friends. His associates on numerous committees and governing boards speak gratefully of Cattell's broad vision and wise foresight, of his initiative and courage, of his keen sense for effective and yet democratic organization, of his sound judgment of men, of his great power of work and his willingness to give unsparsingly of time and thought to the problems confronting an organization, of his ability to integrate the divergent views of a group of men and lead them to a unanimous decision, of his lively wit, and of his warm friendship and personal unselfishness (26).

Visitors to his home, where the latch string seemed to be always out for his colleagues, remember the easy, friendly

atmosphere of that home, with his evident love of children and family life and his delight in the beauty and freedom of the great outdoors.

His old students would certainly be eager to join in a personal tribute to his unfailing interest and generosity. He met the student halfway in the choice of a problem, and while insisting on sincere work by sound methods, he was satisfied with a reasonable achievement. His more promising students were a matter of personal concern to him. He assisted them in many ways, tangible and intangible: guiding them into fellowships and assistantships, supporting their efforts to secure academic positions, and providing employment at scientific work during summer vacations for those who were far from home or in financial need. Of the intangible assistance he gave them, most important was the inspiration that came to the budding young scientists from the kindly interest of one who was clearly a great man and an important figure in the scientific world.

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