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1871—1942

A Biographical Memoir by

WALTER R. MILES

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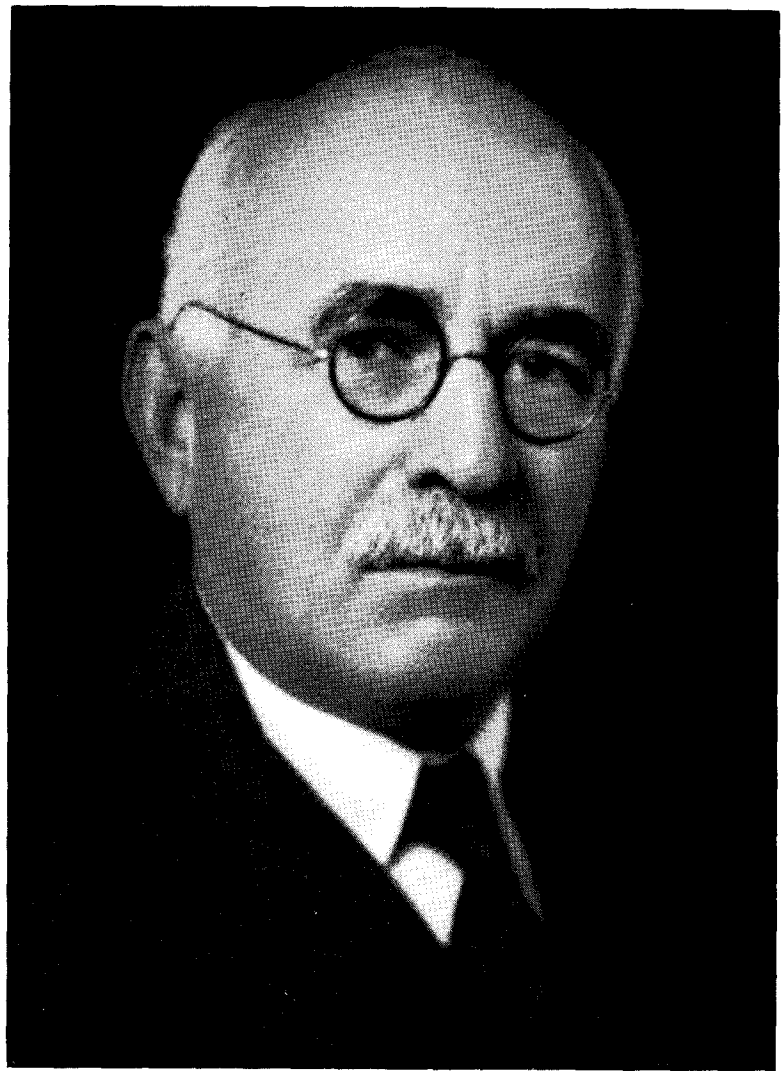

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IN HIS FRESHMAN YEAR at Williams College, Raymond Dodge kept a diary. Its early entries reflect a sensitive, meditative boy, rather lonesome and homesick, finding his chief solace in thinking about the sermon which President Carter had preached the first Sunday of the school year. But he showed himself capable of "adaptive adjustment," to use a phrase of his mature years, and at the end of a month was able to say, "Everything is fine." His mother had visited him, his first examination in Greek had not turned out as badly as feared, and he had decided to stay at the college and work in the library during the Thanksgiving vacation. Of this vacation period he recorded, "I stayed here all the time, wrote my editorial for the Weekly, worked up my debate, and read 'Wallace on Darwinism' and 'A naturalist's voyage around the world' by Darwin. I wanted to get a deeper insight into Darwin's theories and didn't know when I could do it if not during this vacation." Turning this diary over and beginning at the back, one finds the note which he wrote after reading Darwin's "Voyage." It gives the Williams College Library accession number, title, author, and then "p. 61, ⅔ down The most remarkable circumstance is the number [of bores made by lightning in the sand] in a limited space. In the case which I have observed more than four existed within the space of sixty by twenty yards." This is the only thing he seems to have noted, in writing, from his reading of Darwin's account. Whether it was the oddity of forked lightning or

some sensed application to his rapidly developing interest in education is not clear. However, educational lightning was striking around him, he was mentally alert, and enjoying the process. On December 14 he writes, "Only three days more and I shall be at home once more. Yet this is a happy existence, the happiest I shall ever know, I am told. So I wonder what makes it happy. It is this, man enjoys use of his faculties. Now I have wondered what it is a man enjoys through his intellect and I have come to this conclusion: his happiest moment is just as a new thought, a brilliant idea, bursts upon his imagination. I am not especially [happy] because I can say 'amo-amas-amat'; to learn that was drudgery, but I was happy when I discovered that the pass [*sic*] imperative was = to the infinitive present. But that does not please me much now. Thus we see why games and jokes are for a time pleasing or funny because for an instant or longer the mind is delighted by discovering something or some new and brilliant idea is grasped and there is pleasure in the grasping. An old joke told and told again becomes a positive painful thing, just as what was fun for once in a game of leaping becomes work when the leaping is without variation, when from being alert for special contingencies it comes to be simply a monotonous motion." This passage from the freshman's diary has its parallel years later in the scientific writings of the mature scholar Raymond Dodge on the consequences of the refractory phase on nervous activity and of mental fatigue on the mind.

Raymond Dodge was born in Woburn, Massachusetts, on February 20, 1871. He was the second of two sons born to George S. and Anna Pickering Dodge. His brother Ernest, about ten years older, became a painter and etcher, whose subjects were chiefly interiors and landscapes. He married a German girl, lived in Europe, and died a victim of pneumonia at 38, survived by his wife and a son Ernest. At the time of Raymond's birth his father was an apothecary and their dwelling house was attached to the drugstore. In his autobiography Dodge recounts with enthusiasm his early childhood memories associated with the drugstore and the beginning of his services and re-

sponsibilities there.[1] In addition to the store, as such, there were two other special foci having to do with home that offered attractive scope and opportunity to the type of boy which Raymond proved to be. These two spots were his father's shop, which seems to have been unusually well supplied with tools and facilities for construction in wood and metal, and his father's library, where there were numerous books on plants and drugs, medicines, physiology, anatomy, and also on philosophy and religion. The latter subject was a dominating interest in the home, which fact is clearly reflected in the freshman diary, where several entries indicate the tacit assumption that Raymond was to become a minister.

Raymond's parents were able individuals. The mother had artistic interests and abilities, the father was scientific and philosophical. It is of note that while he made his living practicing pharmacy he studied medicine and in middle life was granted the degree of Doctor of Medicine by Harvard University. Home was a happy, exciting place, where interesting things and possibilities were abundantly at hand. The father chose to make his younger son his comrade and pupil in the store, in the shop, in the library, and on long walks for nature study. "Maternal influence appears to have been lessened by his mother's invalidism after Raymond's birth, by disparity of tastes and interests, and by the natural preference of the boys—the elder for his mother, and the younger for his father. Raymond is said to have resembled his mother physically, his father in temperament and intellect."[2] Memories of walks and talks with his father remained with Dodge throughout his life. "I still vividly remember," he writes in 1930, "my first intimation of the difficulties of the concept of space, when we argued together on Powder House Hill as to what might be beyond the blue sky."

With this paternal guidance and stimulation it is no great sur-

[1] Raymond Dodge, *History of Psychology in Autobiography,* ed. C. Murchison, Worcester, Mass.: Clark University Press, 1930, I, 99-121 (see p. 100).

[2] R. M. Yerkes, Raymond Dodge, 1871-1942, Am. J. Psych., 55 (1942): 584-600 (see p. 584); R. S. Woodworth, Raymond Dodge, Psychol. Rev., 49 (1942): 396-402; C. E. Seashore, Raymond Dodge, Science, 95 (1942): 472-473.

prise that at college Raymond, as a freshman, found interest in philosophical problems. On his own initiative he secured and read John Fiske's *Essays,* and *Cosmic Philosophy,* and also found Herbert Spencer interesting. Thus he got the idea of specializing in philosophy as far as the course of study at Williams permitted. His decision to cultivate philosophy was augmented through the personal interest taken in him as a student by Professor John E. Russell and President Franklin Carter of Williams.

Suddenly the question of continuing his college course became a major problem. Dr. George Dodge, due to failing health, had to give up his store and medical practice just when his son became a sophomore. From then on Raymond had to shoulder the burden of earning his way through college.[3] This circumstance of having very restricted economic resources, while undoubtedly limiting him with respect to many social and extracurricular activities, did, however, intensify his studious interests. It happened that he found part-time employment during the school year as a college library assistant. The job required intimate daily contact with books on all sorts of subjects; this he viewed as a privilege rather than as drudgery, and counted it of more value than the financial return for the time expended. At all events he was not slowed up in his progress through college and in 1893 graduated with his class with the degree of Bachelor of Arts. No yearbook for Williams College of 1893 is at hand to look up what the class prophet said about Raymond Dodge, as one of the graduating seniors. However, one of his classmates has written as follows: "In our junior year . . . when we were introduced to subjects fitted to the mentality of an upperclassman, such as logic and psychology, and more particularly in

[3] There is a bright side that should be noted. When Dr. and Mrs. George Dodge sold their Woburn property they moved to West Acton, Mass., and purchased a residence. Raymond on his first trip to his parents' new home met Miss Henrietta Cutler of West Acton. They were introduced at the railroad station while waiting for a train and talked for about ten minutes. But that did it, starting seven years of correspondence (three years without seeing each other) before they were married.

the senior year, when we were subjected to philosophy, we began to realize that Dodge had one of the best minds in the class. His questions and his answers often amazed us. . . . I think that all of us felt, when we graduated, that Dodge was likely to outstrip any of us in the field which particularly attracted him, because of his philosophical bent. His career since graduation has justified that opinion."[4]

When Dodge was about to begin his sophomore year, dependent upon his own resources, on taking leave from home, his father said, "Wherever you work and at whatever you work, endeavor to make yourself indispensable." Dodge seems to have followed this advice, for after graduation he was continued in the library under appointment as assistant librarian. During this year, 1893-1894, he studied part time as a graduate student in philosophy and, aside from current expenses, was able to save $500, which he decided was enough to enable him to start work for the doctorate and which sum, according to his later statement, did actually finance him through two years of study in Germany. It was not his plan originally to go to Germany for graduate work in philosophy, his ambition was Harvard or Columbia. Whether or not he had engaged in any preliminary correspondence with students or faculty members at either of these two institutions is not now clear, but it seems probable that he kept his plans to himself, in line with his tendency to shyness and reticence about putting himself forward. As part of his graduate work at Williams he prepared a thesis entitled, "Certain Differences between Psychological and Philosophical Conceptions of Space." He presented this thesis in support of his application for a scholarship and admission as a graduate student at both Harvard and Columbia, and neither institution offered to accept him.

In place of enrolling in some other American institution as a graduate student of philosophy in the fall of 1894, Dodge crossed the Atlantic that summer and entered the University of Halle. Later he claimed that his enrollment at Halle was determined by "a mis-

[4] Note 2, Am. J. Psych., 55 (1942): 585.

fortune, a conviction, and an accident." The misfortune was that he was not admitted to Harvard or Columbia; the conviction was his idea that if he was going to be a philosopher he would need to achieve a good command of the German language, and this would best be accomplished by a period of study in Germany. And as for the accident, it happened that the copy of Kant's *Kritik des reinen Vernunfts,* which Professor Russell at Williams had given him, was edited by Professor Benno Erdmann. The choice of Erdmann as the professor of philosophy under whom to study for his doctorate proved more fortunate than might have been predicted. It is hard to believe that Dodge had no other information about Erdmann than the fact that he had edited Kant's *Kritik*. Perhaps Professor Russell was behind this choice in other ways.

Erdmann proved to be a remarkable guide and friend and apparently did more than most German professors of that period by way of making Dodge's student days pleasant and stimulating. And there were two sides to this relationship. Dodge, by his imagination and ingenuity and his utter devotion to the opportunities offered him, made contributions which served to open new lines of thought and scholarly publication to the professor. Fortunately Erdmann was interested in psychology as well as philosophy and apparently had no prejudice against this young experimental science, which was growing up within the philosophical departments of Germany in that period. Dodge from his studies at Williams was interested in psychology, although less than in philosophy. And right here was where Professor Erdmann found that he had drawn a prize student in the person of Raymond Dodge. The professor in a seminar on the psychology of reading discussed the need for a special piece of apparatus which could serve to exhibit a word or diagram all at once and in clear view for binocular reading or perception. The desirable features of this ideal tachistoscope the professor could enumerate but he could not picture what the apparatus would look like, and he expressed to his seminar the opinion that it would not

be possible to build such a piece of equipment. All unwittingly, by this little addendum to his discussion on the psychology of reading, the professor had started a train of scientific events which was to produce a change on the face of Western elementary education.[5] Dodge took the prescription for the tachistoscope which Professor Erdmann had propounded and made it his own problem and project for scientific meditation and planning, and to the astonishment of the professor came up with the answer. In fact, the professor received a series of pleasant surprises in this connection. The sketch which Dodge prepared and explained pleased him, but he could scarcely give up the idea of the impossibility of such an apparatus. When the drawings were shown to Dr. Dorn, professor of physics, that gentleman, after very careful and critical review of the scheme, expressed his enthusiastic approval of it. The process of building the equipment in the instrument shop went ahead without meeting any insurmountable hurdles. The instrument included a high-speed rotary shutter and Dodge developed a unique form of rigid table as support. Then there was designed a supplementary instrument, a chronograph, with paper ribbon records, made by ink pens for registering the time intervals. It is not surprising, after all, that the professor found time to do quite a little talking outside class hours with his student Raymond Dodge. Actually the creation of

[5] One is reminded in this connection of an event that took place about 384 A.D., when St. Augustine at the age of 30 visited the study of St. Ambrose. Augustine and the other visitors sat silent in the presence of St. Ambrose, who proceeded with his studies. Augustine noted with surprise that the Father read without speaking aloud what he was reading. He says, "When he was reading, his eyes glided over the pages and his heart searched out the sense, but his voice and tongue were at rest." Augustine meditated that probably St. Ambrose had developed this method of reading so that he could pursue his studies in the presence of others without the interruption of being asked for interpretations. When one realizes that such a brilliant and well-educated man as Augustine did not appreciate the value of silent reading or know it was possible, it brings home to us how slowly and as by chance scientific information on our familiar traits and activities is achieved. *The Confessions of St. Augustine,* tr. Edward B. Pusey, Cardinal Edition, Pocket Books, Inc., New York, 1953, Book VI, p. 86.

this apparatus started the professor and the student on a long period of collaborative research that resulted in a large and important publication.[6]

Professor Erdmann seems to have acted with good insight as a counselor. On the one hand he was much impressed with his student's competence in solving problems having to do with instrumentation and apparatus. He and others about him could see clearly that this student might very reasonably and with good prospects of success enter the field of engineering. On the other hand it seems from what Dodge has told us in his autobiography[7] that the professor early came to the conclusion from indications of class discussions that this American would not be likely to reach high distinction as a philosopher. It seems probable that this latter impression might come from Dodge's unfamiliarity with the language, a large handicap in drawing fine distinctions of argument. At any rate, the professor counseled Dodge to go into experimental psychology and future events have vindicated the soundness of this judgment. Dodge appreciated this help in solving his problem and made the transition to psychology as his professional field.

In turning to psychology he did not turn against philosophy. Throughout his life he retained an interest in speculative philosophy and his writings reveal this interest. He chose his problems, explored their orientation, developed his observations and data, analyzed the results, and examined the implications in a philosophical fashion. During quite a portion of his experience as a teacher he taught logic and other aspects of philosophy as well as both physiological and experimental psychology. Apropos his interest in speculative philosophy he said, "I am inclined to believe that the study of the history of philosophy and the logic of science form a valuable

[6]Benno Erdmann und Raymond Dodge, Psychologische Untersuchungen über das Lesen, auf experimenteller Grundlage. Halle: Max Niemeyer, 1898. viii + 360 pp.

[7] Note 1, p. 102.

background for estimating the possibilities and the limitations of experimental evidence."[8]

The graduate student days at Halle seem to have been concentrated to an unusual degree on Professor Erdmann and his interests. Dodge has not told us about courses taken with other professors or of other exciting academic interests outside those then included in philosophy. For an American spending his first year as a graduate student in Germany things had developed unusually. He had to give much attention to the building of the specialized tachistoscope he had devised. It was not ready for use until the beginning of his second year at Halle. He was closely occupied in the study of the German language and during the second year most of the afternoons Erdmann and Dodge worked together at the psychology of reading. Some days the time was spent in conducting experiments and gathering data, other days in working over these data in Professor Erdmann's study. Dodge says, "Those afternoons are delightful memories. During them I learned how a philosophically and logically trained mind formulated experimental hypotheses, built up experimental situations, estimated evidence, and sought just expression of results. The master's mind was always orderly and exact, the pupil's often vagrant and exploratory, impatient of experimental routine, seeking insight and crucial experiments. With growing respect and admiration for the master's intellect there developed also an affection amounting almost to adoration."[9] Later in this sketch we shall see that Professor Dodge, in his own teaching at Wesleyan University, employed with great skill during a period of approximately twenty years this pattern of education through the close and prolonged association of teacher and student as a pair of diligent explorers hunting information and seeking out the meaning and connections of what they found. Not a few of the American students who went to Germany in the 80s and 90s at-

[8] Note 1, pp. 102-103.
[9] Note 1, p. 104.

tended for a semester or so two or more of the famous German universities and listened to the lectures of perhaps a half-dozen or more distinguished men. The stimulating effects of such a diversive program were undoubtedly important and provided the students with a wealth of material to use in their own classes and seminars. By comparison the concentrated stay-in-one-place program which Dodge followed at Halle may seem meager but, at least in his case, it was extremely effective in starting him on the path of a creative and leading scientist.[10]

The doctor's thesis seems to have taken a relatively minor place in R. D.'s scheme of work. One gathers that the thesis problem was not as interest-consuming as the problems in the psychology of reading under joint study with Professor Erdmann. Concerning his thesis and doctor's examination Dodge writes: "It was in 1896 in the midst of our studies on reading that I took my doctor's examination, magna cum laude, thanks doubtless to Erdmann's persuasive ability. My thesis was another outgrowth of the seminar, where it became evident that my verbal imagery was predominantly kinaesthetic or motor. 'Die motorischen Wortvorstellungen' was my first published essay in descriptive psychology. The study of the psychology of language, which its preparation entailed, was probably more important to me than the thesis itself."[11]

Some American students in Germany after completing the work for the doctorate spent a year visiting other universities or institutes or touring the continent before returning to the United States. For Dodge's next year, 1896-1897, there was a job waiting immediately at hand in Halle an der Saale. A stipend had been secured from the Berlin Academy, supplemented by a loan from America, and

[10] The three Christmas vacations Raymond had while in Germany were pleasantly spent with his brother Ernest, who was married and lived in Munich.

[11] Note 1, p. 107. In the Vita at the end of his thesis Dodge mentions his obligations to thirteen teachers at Williams College and six at Halle: "Scholis interfui virorum clarissimorum in Collegio Guilelmui: Bascom, Burr, Carter, Clarke, Dodd, Fernald, Hewitt, Lefavour, Mears, Rice, Russell, Safford, Woodbridge. Halis: Conrad, Diehl, Droysen, Erdmann, Haym, Vaihinger."

he was to spend his first post-doctoral year completing the work-up of the experiments he and Erdmann had performed, and writing the first draft of "Uber das Lesen." This was a third year of very close association with Professor Erdmann. Dodge has characterized the monograph which resulted as "the happiest and most perfect collaboration I have ever known. To me it was a most important lesson in the delicate art of cooperative scientific work."[12]

The trial of three years' separation from his fiancée, Miss Henrietta Cutler, did not break the bond between them and they were married in August, 1897, shortly after Raymond's return home. Before leaving Germany he had been fortunate to receive a teaching appointment as Professor of Philosophy in Ursinus College, Collegeville, Pennsylvania. The newly married couple were able to begin housekeeping joyously in a college community, and Raymond, having financed his own education after his freshman year, thus began his professional life as a teacher at the age of 26.[13] He considered himself fortunate, even though somewhat in debt, and had hopes that the job he was to begin would allow him some time for his own research studies. But there was the irony of too much scope in his title, Professor of Philosophy. He was sadly surprised to learn that his teaching load, although large in hours per week, was also heavy in diversity of subject matter. He was required to teach not only psychology but logic, history of philosophy, ethics, aesthetics, pedagogy, and the history of English literature. It was a terrific load for one who had gained insight into the requirements and ideals of the scholarship expected from the college teacher. Ursinus, among small colleges, was not unique in the demands it made on the members of its faculty. Many before and after Dodge have carried similar teaching burdens with the associated distress and depression of

[12] This remark was written in 1930 when R. D. could look back on about twenty instances of joint authorship.

[13] A fellow American student in Germany, who had majored in history, returned to the United States a year or two before Dodge; he taught at Ursinus and it was through him that Dodge got this appointment.

spirit which a beginning instructor experiences in such a situation. In addition to the subjects enumerated, in Dodge's position he was expected to give some instruction in the Ursinus Academy. Here he was very fortunate in having a wife who was willing and able to relieve him of this obligation. Experimenting and research were, however, naturally at a standstill during this year. Fortunately Dodge was a born teacher and no doubt he carried on quite successfully in terms of the standards of the institution. But after one year at Ursinus he was appointed Instructor in Philosophy at Wesleyan University, where he joined Professor A. C. Armstrong in planning and teaching courses devoted only to philosophy, including psychology.

A file of Wesleyan University catalogues provides some details concerning the development of psychology as an academic subject in that institution and outlines the background of Dodge's new position. Beginning as early as 1890 the Rev. A. C. Armstrong, M. A., offered a course in psychology employing Sully's *Outlines of Psychology* as text, with references to McCosh and Ladd. In 1891 a second or advanced course was offered, which presented the then existing several schools of psychology, including Wundt's school, Ladd's physiological psychology approach, also the writings of Hoffding, Volkmann, and William James. The President that year, reporting about various departments, stated that two psychological investigations were being carried on, an investigation of the mental imagery of college students, following the method of Francis Galton, and an inquiry into "Unconscious mental cerebration." In 1894, William J. Shaw, M. A., was made assistant in philosophy and psychology and a new course in physiological psychology, made up of lectures, demonstrations, and a few experiments, was offered. Charles H. Judd was awarded highest honors in the department of philosophy for his work on "The mental imagery of American students," and two years later, that is 1896, Judd became instructor in philosophy, taking the place of William J. Shaw. Dr. Judd carried out some experiments with the class taking his course in physiological

psychology. The next year, 1897-1898, the experimental psychology laboratory was established at Wesleyan. The President's report enumerates a good many additions in the way of apparatus to the equipment already owned and specified as serving for psychology. The laboratory occupied Room 7 in South Hall. Dr. Judd seems to have pushed things forward quite rapidly in the organization and in building up the laboratory, also in teaching and in publication. He got out five articles, three published in *The Psychological Review* and two in *Science,* and then that fall left Wesleyan and went to New York University as Professor of Experimental Psychology.

It was indeed an excellent academic opening to which Dodge came in the fall of 1898 as instructor, taking Judd's place. The institution had a fine history and location; it had high academic standards, several distinguished people on its faculty, and was infused with a vital spirit of research. On the other hand, Charles Judd was a particularly difficult man to follow in this specific position at Wesleyan. Judd was a graduate of Wesleyan and had been an outstanding one. He was the protégé of Professor Armstrong, Chairman of the Department of Philosophy. Armstrong had brought him back into the department as soon as Judd had gotten his degree at Leipzig. On his return to Wesleyan, Professor Armstrong did much to clear the path for the rapid development of Judd's scientific interests, which meant the setting up of a laboratory. No doubt the senior professor hoped for many years of pleasant academic association and collaboration. Now that a substitute came, a man well recommended but of quite different personality, Armstrong became more critical of psychology and its needs at Wesleyan, and consequently Dodge was on the spot, being compared with his predecessor and later criticized by him. But Dodge was lucky to be invited to Wesleyan, and Professor Armstrong and Wesleyan University were lucky in getting Dodge. Viewed in retrospect it would seem that the one thing wrong was that Wesleyan University was actually an undergraduate college, whereas Dodge was capable of guiding students in their thesis work for the doctorate. Wesleyan University

did, however, decidedly live up to its name in terms of scholarly leadership and in this area Dodge was to play a leading role.

At this point in the life story of one of America's outstanding psychologists let us glance ahead a few years to see what happened and then come back and note how it happened. In 1906 J. McKeen Cattell published a biographical directory entitled *American Men of Science*. It was compiled in 1904 and 1905, published early in 1906, and contained about 4,000 biographies, including one for Raymond Dodge, whose professional field was given as psychology. We note that Dodge was Instructor at Wesleyan, 1898-1899; Associate Professor, 1899-1902, and Professor of Psychology 1902. He was a member of the American Psychological Association and of the American Philosophical Association. His special scientific interests are listed as follows: The psychology of reading; the function of eye movements in vision; types and velocity of eye movements; the function of eye movements in the visual perception of motion. The shape of the cornea; errors of fixation; theory of visual space. In Dodge's case the word "psychology" was preceded by a star (*Psychology). The meaning of this star was that he was considered one of the 50 leading psychologists of America and one of the 1,000 scientists in the country whose work was supposed to be most important. To have won such distinction within five or six years after coming to Wesleyan is noteworthy and indicates a high level of scientific productivity.[14]

In his beginning year at Wesleyan Dodge offered a laboratory course in psychology which became a regular and important feature of his scientific program. A part of this laboratory course was always devoted to investigating some psychological problem, with the

[14] The ranking of psychologists for assigning stars for the first (1906) edition of *American Men of Science* was done in 1903. See *American Men of Science*, 5th ed., ed. J. McKeen Cattell and Jaques Cattell, New York: The Science Press, 1933, Preface, p. viii, and pp. 1269-1278. In the psychology list Dodge stood 27th in the total group of 50. The psychologists ranking 1-30 included one man who was 68, 4 who were born in the '40s, 7 born in the '50s, 15 born in the '60s, and three bright young fellows born in the '70s, to wit: Edward L. Thorndike, Charles H. Judd, and Raymond Dodge.

members of the class serving as junior colleagues in the investigation. The subject for the first year was "The psychology of language." Succeeding problems covering several years were: quantitative determination of eye movements; the visual perception of motion; modes of eye reactions to eccentric visual stimuli; the psychology of reading; and fatigue.[15]

The work topics were reflected in the titles of Dodge's early publications after going to Wesleyan. In teaching his advanced students through the device of analyzing and working out problems with their active assistance he was following the Socratic method and imitating Erdmann. And he did this with such skill and genuine evidence of comradeship that his students became devoted to him and the reputation of Dodge and of psychology became a Wesleyan tradition. There was another reason why Professor Dodge was popular at Wesleyan, and that reason was Mrs. Dodge, who as wife and companion aided at times in some of the research work. Their gracious home was always open to students. Having no children of their own they seemed to take great delight in sharing their companionship with the Wesleyan boys, by no means limiting their hospitality to their departmental majors and assistants.

Records in the registrar's office at Wesleyan University show that 154 Wesleyan men majored in psychology under Professor Dodge between 1902 and 1924. In 1935 Dean Paul W. Stansbury of the University of Toledo, one of Dodge's group, undertook to correspond with all these majors.[16] He received letters from sixty. Among these there were eight professional psychologists, eight educators engaged in non-college teaching, five college professors in addition to the psychologists, seventeen ministers of the church, five lawyers, and five physicians. The letters from these professional men were elo-

[15] There were years when the class seems to have taken part in developing and trying out some major piece of apparatus, or in moving the psychological laboratory to new quarters, as occurred in 1904.

[16] *Psychological Studies of Human Variability,* ed. by W. R. Miles, Dodge Commemorative Number, Psychol. Monog. 47, 1936, xxxvi + 415 pp.; see pp. xxv-xxvii.

quent about Professor Dodge as teacher and educational guide. One letter says in part, "Professor Dodge made three closely knit contributions to my professional attitude. First, his insistence on experimentally determined facts; second, his intelligent selection of experimental problems, which could be made to yield facts; and third, his enthusiastic persistence in the pursuit of facts." One man writes, "He was so human, so vitally alive, so broad in his interests, so impartial in his judgments, so fair to his students, so enthusiastic about his subjects, and so interested in his work, that he was the man on the faculty I most desired to be like." A third Wesleyan man says of Dodge, "He gave me as a student a feeling of adequacy and an experience of achievement, which was and still is one of the most important contributions to my development." And finally, another graduate remarked, "Curiously enough, whereas Professor Dodge is primarily thought of as an experimentalist, he stimulated more than any teacher before or after him my interest in clinical psychology and the broader aspects of individual conduct and social problems." As a teacher and faculty member concerned with higher education, Dodge consciously or unconsciously carried out his father's advice and made himself "indispensable."

The Wesleyan faculty was a stimulating group, mutually interested in each other's research activities. Professor W. O. Atwater, a chemist, trained at Yale, headed a group that had built the first calorimeter for studying human metabolism. His laboratory was carrying on a vigorous research program supported in part by the Carnegie Institution of Washington and in part by the United States Department of Agriculture. This new work had brought Wesleyan to public attention as a research center and this condition of affairs was stimulating to other members of the faculty engaged in scientific research. Dodge did not have to fumble for a research program. From his work in Germany, which was largely sparked by his own ingenuity, he developed many questions that needed further investigation. His first paper, "The Reaction Time of the Eye," appeared

less than a year after his arrival at Wesleyan.[17] Reaction time had been much studied in psychology but the reaction time of the eye was something new. To make his measurements Dodge had designed a pendulum tachistoscope; he made very clever use of it as a timer and exposure device to let a beam of light fall upon the blind spot of the subject's eye. When the subject shifted the fixation of his eye, the light beam could then be seen. At the moment the light was turned on, the subject got his signal to shift his fixation point. The duration for the light beam on the blind spot up to the instant when the eye turned and could see the light was the time measured. This work was done with the assistance of an honor student, a Mr. Quittmeyer, of the class of 1899. After hundreds of trials made on Dodge and Quittmeyer, alternately serving as subject and experimenter, it turned out that Q. had a mean reaction time of 162 ms. and D. of 170 ms. Dodge was able to make an important recommendation for psychological experimentation from this particular piece of work. The question had often been raised how long an exposure of letters or words could safely be made without giving the eye a chance to change its fixation point within that exposure period. The recommendation was for a duration of 0.1 sec. (100 ms.) if the experimenter wished to be sure that eye movements did not take place during the exposure.

Work on reading which Dodge did in Germany showed that the eyes make very regular series of full stops in reading. In between these stops there are quick movements called saccadic eye movements. It is a commonly experienced visual illusion as one glances over a picture, landscape, or the page of a book, that he sees all of it in clear detail. Actually this impression of sharpness of detail comes from the moments when the eyes are stopped. Dodge's second paper from Wesleyan reports five series of experiments, showing that under usual circumstances of contrast no visual impressions that carry important meanings about words or objects occur during the short

[17] September issue of the *Psychological Review*, 1899.

intervals when the eyes are in quick motion between stops.[18] If the visual field includes a bright light, eye movements across it may give the appearance of faint streaks. It was important to prove the retina sufficiently sensitive to register impressions of fusion while the eye is moved at high velocity. But on the other hand these impressions tend to be neglected and the eye movement interval, rather than constituting a period for stimulating the retinal elements, serves as a rest period and may reduce fatigue in reading.

A book review published in 1901 provides important information concerning Dodge's early scientific work after leaving Germany and throws light on his energetic and determined manner of pursuing scientific problems growing out of his work on the psychology of reading. The conclusions which had been drawn by Erdmann and Dodge were challenged by a new study.[19] Dodge writes, "The distinctive feature of Herr Zeitler's article is the attempt to demonstrate that the apparent simultaneous apprehension of a word as a whole is an illusion of assimilation; that the real apperceptive process consists of a successive apprehension of the word, part by part, by a movement of attention from left to right, in which part of the letters are passed over rapidly while the attention fastens upon the dominating letters and letter complexes." Prior to Zeitler's work Professor W. Wundt had reviewed the monograph by Erdmann and Dodge and, as Dodge says, "in his unfortunate critique of 'Untersuchungen über das Lesen auf experimenteller Grundlage' Professor Wundt asserted that the apprehension of such long words as were read by the authors must be conditioned by a movement of the attention during the long exposure of 0.1 second plus its afterimage." It was clear that Wundt had set Zeitler to work to demonstrate the soundness of these criticisms he had lodged against Erd-

[18] One of the most convincing of these experiments is for a person standing in front of a mirror to look first at the image of his right eye and then the left, and back and forth; he notes that he always seems to see his eyes stationary and cannot see them move from one position to another.

[19] Julius Zeitler, "Tachistoskopische Versuche über das Lesen," *Philos. Studien,* 1900, Bd. 16, Heft 3, 380-463.

mann and Dodge. We have here a scientific controversy in which the importance of winning the decision called for devoted and prolonged efforts on the part of Dodge to build up a body of well-established scientific evidence. It was no small achievement for a young American psychologist to cross swords with Professor Wundt, the chief of the famous Leipzig laboratory, on an important psychological problem, susceptible of experimental proof, and prove that he was wrong. In this review of Zeitler's work Dodge answers the counterclaims by good objective scientific evidence and at the end generously says, "While the author's interpretation of his work in the form of Wundtian concepts is far from satisfactory, the experimentation itself is a valuable piece of work."

Pioneers typically devote themselves to seeing and surveying "new country." Dodge was a pioneer who devoted himself to surveying the psychological country of seeing. The importance of vision in the life of man had been recognized for ages, but the way the eye performed its seeing activity in ministering to man's needs was very little understood. It was assumed that the eye in surveying objects and space did its work in a fashion similar to that of the human hand in touching and sensing objects. The eye worked much faster and was not limited to a near distance. Then Dodge, and quite independently the famous French ophthalmologist Dr. Emil Javal, discovered that the eye for seeing made rhythmic pauses interspersed with quick movements. The hand did not have to stop to do its sensing; in fact, in moving the fingers over a surface or around an object the hand performed its best exploratory work.[20] The observation that the eye executed a series of short stops in its exploration of objects and patterns was thus a really challenging discovery and a big surprise, since this basic eye behavior anyone might have seen in face-to-face meetings since Adam looked into the eyes of Eve. Up to 1900 much of the study of eye movements in reading was by direct observation. This gave good results so far as number of fixations was concerned. The method was poorly suited to provide quan-

[20] The blind in reading Braille keep their fingers in motion most of the time.

titative information on distance between fixations and the duration of fixations. Some progress had been made by using after-images and thus examining how many fixations occurred in a given time and their relative positions, e.g., in looking at the setting sun for a few seconds and then glancing away at the sky. Useful as this method was, it lacked scope and objectivity for anyone except the subject-observer. Huey of Clark University succeeded in making a plaster cup attachment to the front of the eyeball and adjusting a tiny light-weight lever system so as to record from one eye the conjugate movements made during reading with the other eye.[21] Adjusting the eye cup to the cornea was a delicate and uncomfortable procedure and subjects required quite a bit of adaptation to the apparatus before their reading records could be considered fairly typical. The weight and friction of the registering levers necessarily interfered to some extent with the normal performance of the eye muscles. However, recording from mechanical levers attached to the human eye was so novel as to claim quite wide and general interest both for the method and the results. This then being the status of eye movement examination technique, it was no small event in science when an article describing an innocuous photographic method, with special new apparatus and presenting data on the angle velocity of eye movements appeared in March, 1901.[22] Dodge's collaborator was one of his students, Mr. T. S. Cline. The apparatus was the result of much thinking and preliminary experimenting. The photographic records were clear for anyone to see and measure; they were continuous photographs taken on a slowly falling photographic plate of high sensitivity. The eye was well illuminated and was pictured by a photographic lens of large aperture. As the eye moved, the border between the sclerotic coat and the iris changed its position back and forth, marking a curve on the negative the features of which corresponded in amplitude and form with the extent and velocity of the eye movements. For some subjects, and Mrs. Dodge

[21] E. B. Huey, *Am. J. Psychol.*, 9 (1898): 575.

[22] "The Angle Velocity of Eye Movement," *Psychol. Rev.*, 8 (1901): 145-157.

was one of the best, the sharp contrast between the sclerotic and the iris gave clear and easily measurable photographs. In other subjects the contrast was poor and the records were hard to read. To meet this latter difficulty and to broaden the usefulness of the method Dodge adopted a lower level of illumination of the eye and recorded only the bright spot reflected from the cornea. Photographing only the corneal reflex, as Dodge reports, "limits the scope of the method somewhat in that the arc of eye movement can no longer be determined with accuracy from the record." The arc of movement is about half that of the actual displacement of a point on the cornea. But in practice the movements required usually are of predetermined total extent and the important operational feature is to register clearly the succession and position of the full stops of the eye, and the tracings of the movements between the stops. The realization and perfection of this photographic method of eye movement recording is one of the achievements for which Professor Dodge is famous. The method has not been superseded for the general purpose it serves; it continues to be useful because of its adaptability to children and adults, its accuracy, and the wealth of scientific detail thus made measurable.

Dodge and Cline were able to give the first dependable quantitative values for the speed of saccadic eye movements of different amplitudes. Analyzing the form of the eye movements they found that all amplitudes studied showed three phases: (1) a positive acceleration to maximum velocity; (2) the maximum velocity which was maintained for most of the arc of movement until it changed to (3) the final phase of negative acceleration. The velocity of these movements was found not subject to voluntary control. Individual differences were present. The movements were interpreted as interruptions of active vision, not unlike the blinking of the eyelids, and incidentally of about the same duration. Their function could now be assumed as solely that of changing the eye's point of seeing. The movements and stops were conjugate, that is, each eye showed them even when one eye was closed.

Science advances by asking questions of nature. The rate of advance can be speeded up if nature is provided with a proper pencil to write out the answers. Motion photography is such a pencil and Dodge had provided a well-sharpened one. Within two years after the appearance of the Dodge-Cline paper he had a sheaf of new answers about types, characteristics, and functions of eye movements to communicate to the scientific public.[23] This paper on five types of eye movement is probably Dodge's most frequently cited contribution. It remains a useful analysis for current scientific thinking, and it is fair to say that most improvements which could be worked into a revised edition of the paper would be those Dodge himself had developed in his experiments of later years.

At Wesleyan University the time of a skilled mechanic, Mr. F. S. J. Newton, was shared between psychology and physics, and to a lesser degree with other departments. As mentioned earlier, Dodge had outstanding ability for inventing and designing apparatus and could envisage its process of construction. With Mr. Newton's experienced assistance excellent results were obtained and several pieces of their equipment were duplicated for other psychologists and psychological laboratories. One piece which was particularly popular for duplication in the early days at Wesleyan was Dodge's falling plate camera. The preliminary form was built around a bicycle pump fitted in a frame with guides provided for the plate carrier. The second model substituted a carefully made brass tube to accommodate the plunger with a water-type valve at the bottom and a by-pass so oil could flow from the bottom around and up into the top as the plunger went down. The third model was still more elaborate and could serve as a kymograph and timing apparatus. About twelve years after Dodge had devised his first falling plate camera Spindler and Hoyer of Göttingen, Germany, sought the privilege of making this apparatus. Their "Prospekt XXX" pictures the Dodge

[23] "Five Types of Eye Movement in the Horizontal Meridian Plane of the Field of Regard," *Am. J. Physiol.*, 8 (1903): 307-329. Grateful acknowledgment is made to a former pupil, Mr. J. J. Cogan.

camera and describes it fully in German, French, and English.[24]

The Dodge falling plate camera was not patented; he invented it several years before there was any need for such an apparatus in connection with medical electrocardiography. It could have been used, however, in recording deflections of light-reflecting galvanometers and could have been adapted for use with the capillary electrometer. He patented only one of his devices; this one he probably thought might have fairly wide usefulness. The application was filed January 9, 1907, the patent granted May 5, 1908, as Number 886,772, entitled "Apparatus for Testing Eyes." Dodge's apparatus used transmitted light and seems to have been an excellent arrangement to detect and measure astigmatism and also visual acuity. This apparatus made for easier and more definite judgments by the subjects than other testing methods commonly in use, and provided the examiner with more specific quantitative information than he usually got from other tests. Other than the text of the patent Dodge published no article describing his test, but he made a certain amount of practical use of this unit. In addition he had an excellent set of trial lenses with the most modern trial frames and other accessories obtainable at the time. He refracted the eyes of various of his assistants, friends, and colleagues, and without charge wrote the prescriptions for their spectacles.[25] This little scientific hobby he used as an avenue for acts of kindness. Dodge made a public demonstration of his apparatus for testing eyes at an evening lecture on May 14, 1907, before the Middletown Scientific Association. The announcement states that the 336th regular meeting of the Association would be held in the Scott Laboratory of Physics, Wesleyan University, and that Pro-

[24] More recently there have been various designs of such cameras brought out both in America and abroad, especially in connection with electrocardiography. The Dodge camera could be loaded and unloaded in daylight like a photographic camera. The image to be recorded was focused on a ground glass plate, visible until the moment when the record began; commercial plates 13 x 18 cm. were used in ordinary metal type commercial plate holders.

[25] Prescription books containing carbon copies, found among Professor Dodge's papers, account for 185 numbered prescriptions in the period from 1906 to 1922.

fessor Raymond Dodge would give an illustrated lecture on "Visual Astigmatism and Its Correction." The announcement issued by the Secretary, T. M. Carpenter, who was a member of Dr. Atwater's staff, began with words of alarm: "There has never been a time when greater demands were made on human eyes than at present. The multiplication of work requiring close attention to fine detail, the spread of education and the consequent increase of reading, all combine to make defective eyesight a conspicuous misfortune."

Returning now to the trail of Dr. Dodge's major scientific discoveries we find that in the years 1904-1906 steady progress was made. There were two research papers, each containing an admirable amount of critique, three reviews, and in addition he edited one number of the Psychological Bulletin, devoted especially to reviews of experimental studies. The two research papers concerned the visual perception of movement. The first one was read before the New York branch of the American Psychological Association, which met in session with the Philosophical Club of Yale University. Dodge explored his topic historically and analyzed it in terms of new data he had procured. He demonstrated the logic of his scientific analysis and concluded, "Not only is there no independent consciousness of the eye movements, adequate to the refinement of the visual perception of motion, but the character of the eye movements, which occur when we view a moving object, furnishes evidence that, if our consciousness of them were complete and exact, it would be either useless or misleading as a datum in the visual perception of motion."[26]

The other paper, "The Illusion of Clear Vision during Eye Movement," was read at a meeting of the New York Academy of Sciences in New Haven, March 27, 1905. In taking up this problem again Dodge was examining it in reference to the hypothesis of E. B. Holt that during eye movement there was a state of anaesthesia of the retina. Dodge presented a considerable body of evidence indi-

[26] "The Participation of the Eye Movements in the Visual Perception of Motion," *Psychol. Rev.*, 11 (1904): 1-14; see p. 3.

cating that Holt's hypothesis was not tenable. He expressed the hope that he should not appear ungrateful for the services which Holt had rendered the problem through his experimentation at Harvard.

The editor of the *Psychological Bulletin,* as he had done with the article by Zeitler, assigned other foreign articles on visual perception and reading to Dodge for review. A study by Messmer thus came to Dodge's notice.[27] It was another tachistoscopic study exploiting the influence of individual variation on four adults and six children, used as subjects. Messmer attempted to distinguish two types of readers, the objective and the subjective. Dodge found Messmer's discussion of word forms in reference to reading to be dogmatic, careless in its generalizations, and indifferent to the experimental data already at hand. Dodge expressed doubt that the results of minimal exposure and threshold discrimination by tachistoscopic methods may be transferred bodily to the processes of normal reading without doing violence to the facts. He did find that Messmer had made a valuable collection of misreadings, which had been grouped according to their kind and frequency of occurrence with children and adults.

Simon's study to determine the portion of the retina used for fixating faint stimuli in the dark Dodge characterized as "a decidedly suggestive contribution." Even though the generalizations were derived from experiments on one subject the data were thought to be the best at hand.[28]

Two quite important contributions to visual perception, both of monographic length, were given Dodge to review late in 1905 or early in 1906. One was a series of eye movement studies done at Yale by C. H. Judd and his associates, and the other was a study of the psychology of reading by W. F. Dearborn, a former student of Dodge's but the work was done at Columbia University. Dodge's review of these two extensive studies was published as the leading

[27] Zur Psychologie des Lesens bei Kindern und Erwachsenen," *Archiv. f. d. Ges. Psychol.,* 2 (1903): 190-298.

[28] "Uber Fixation in Dämmerungssehen," *Zeits. f. Psychol. u. Physiol. d. Sinnesorgane,* 36 (1904): 186-193.

article in the *Psychological Bulletin* for March 15, 1906. The preparation of this review by Dodge was a task interesting enough in itself, but to some extent charged with emotional elements. Dearborn was Dodge's student and was submitting the first study of doctoral dimension made independently by the use of Dodge's apparatus, which had been duplicated and sent to Columbia. On the other hand, Judd was Dodge's predecessor at Wesleyan and for various reasons his critic. Pointing out shortcomings of Dodge's method he had devised one of his own. Judd's method was to attach a flake of white paint to the cornea of the eye, then to photograph this eye with a high-speed motion-picture camera. The subject also wore a spectacle frame with bright dots on it to give a headline from which to compute amplitudes of eye movements. Judd and his associates studied eye movements during visual perception of several well-known geometrical illusions. By measuring these motion-picture films frame by frame, plottings could be worked out for eye movements in different axes. In his review Dodge answered some of Judd's criticisms of the method of photographing corneal reflections and showed that both his and Judd's methods suffered certain defects in common, due to the fact that the eyeball is essentially spherical. Although Dodge's method had not yet been used in recording vertical eye movements it could be adapted to do so. As to the relative comfort of the subject who was examined, the corneal reflection method was certainly to be preferred. Dodge was critical of plotted calculations. "They relied on noting changes in the mutual relation of points on the base line attached to and moving with the head. But since these will change only as the sines of the angle of head movement, their increment may be considerably within the limits of measurement for angles of head movement which occasion entirely measurable compensatory eye movement." There were other criticisms which Dodge made but in general he seems to have been quite generous in his comments.[29] Dearborn's study confirmed the general

[29] R. Dodge, "Recent Studies in the Correlation of Eye Movement and Visual Perception," *Psychol. Bull.*, 3 (1906): 85-92.

facts of the physiology and psychology of reading discovered by Erdmann and Dodge and independently by Huey.[80] Also he had turned up many new features, such as short-lived motor habits due to the particular text; familiarity with the text was found to reduce the number of fixations; false fixation movements occurred in association with printed lines of unequal length, and so on. Dearborn's study had not given support to the theory of Wundt and Zeitler, in fact, their theory was contradicted by the evidence at hand.

In 1906 Professor and Mrs. Dodge went to California, where he taught psychology in the summer session of the University at Berkeley. He was 10 years away from his doctorate, 35 years old, a starred man in *American Men of Science,* and for the next 30 years would have an outstanding reputation—and would deserve it. No teaching leave was required from Wesleyan since its faculty was regularly free from summer duties. The summer in California was pleasant. William James had been visiting professor in philosophy that spring across the bay at Stanford University. In certain other ways it was an exciting time to be there since the earthquake and fire at San Francisco had occurred the previous April and the ruined areas in San Francisco and at Stanford were being cleared and reconstruction at Stanford had begun. Dodge also taught in summer sessions at Columbia in 1909 and again in 1911, but as a rule he chose to use his summers for recreation and meditation. He and Mrs. Dodge vacationed on Heron Island, Christmas Cove, Maine, and had a delightful summer home there, not far from the homes of several friends who were members of the faculty at Wesleyan.

It would be interesting to read Professor Dodge's introduction to his monograph published in November, 1907, entitled "An Experi-

[80] W. F. Dearborn, *The Psychology of Reading.* Columbia Contrib. Phil., etc., 1906, Vol. 14, No. 1, 134 pp. There is a sequel to the controversy about eye-movement recording technique which may be noted. Dr. Judd, who happened to have the same birthday as Dodge (February 20) but was two years younger, left Yale in the fall of 1909 and went to Chicago University as Director of the School of Education. He promptly launched a large research project on the psychology of reading and found Dodge's methods of recording eye movement more feasible than his own.

mental Study of Visual Fixation." This was published in the Psychological Review series, and also bore the title "Studies from the Psychological Laboratory of Wesleyan University, Vol. 1, No. 1." But Dodge did not write an introduction to this monograph of 95 pages, nor did he write a summary for it. Dr. Judd, still at Yale University, was editor of the Monograph Series but he wrote no introductory note for this monograph.

Not long before the preparation of this monograph Dodge had devised an improved exposure apparatus, which bears the name "the transparent mirror tachistoscope." This permitted the maintenance of accurate fixation for a given distance while the material exposed changed, under control, from a mere fixation dot to a word or words without notable change in brightness. This apparatus was compact and cleverly designed. It has been widely used in psychological research in the years that have passed since Dodge described it. The new tachistoscope was used in a good many experiments reported in the monograph on visual fixation. This publication was a major contribution to the analysis of the physical origin of fixation movements, the visual motives for fixation, the nature of the clearing-up process after the eyes change from one field to another, the influence of pre- and post-exposure fields, the normal succession of fixations and factors that interfere, the determination of new points of regard, the function of extra-foveal vision in space perception, the organization of the retinal elements into perceptual constructs, and the bonds connecting visual and tactual organization. Dodge has given us a brilliant analysis of psychological events that are among the most significant for the individual's visual behavior and adaptation to his environment. In an appendix to this monograph he gave a detailed presentation of the technique of recording the eye movements, together with pictures of the apparatus. This publication is one of the most frequently cited references to Dodge's scientific work. Profes-

sor Erdmann made arrangements to have it translated into German and it was published in Germany in 1909.[81]

In the fall of 1908 Dodge had been at Wesleyan a decade, and we note the beginning of a new trend in his scientific life. While continuing the interest in fundamental research he begins development of a parallel interest in the application of his methods and of psychological laboratory techniques to the examination of other problems. This interest in applied psychology, or psychological engineering, to solve or help solve human problems, we find running along parallel to Dodge's other scientific interests during the remainder of his professional life. He started giving a new course at Wesleyan in 1908, called educational psychology, and in his research program that year joined forces with Dr. Allan R. Diefendorf, lecturer in psychiatry at Yale and assistant physician and pathologist, Connecticut Insane Hospital, Middletown. Dodge installed his eye movement camera at the hospital on the other side of the Connecticut River. The subjects examined included a group of 9 normals, composed of female and male nurses, 2 doctors, and others, 21 manic-depressives, in both the manic and depressive phases, 4 cases of dementia praecox of the hebephrenic type, 4 epileptics, 6 paretics, and 1 imbecile. A battery of three eye movement tests was used (velocity of eye movement, eye reaction time, and ocular pursuit reactions); all the measurements were photographic records taken with the eye movement camera. The authors were able to make important theoretical analyses and to draw interesting new conclusions, for example, that "the ocular-motor systematization is not seriously disordered in acute mania. Whereas, in dementia paralytica the entire nervous system is involved in this disorganization, as is shown by the marked retardation and the inefficiency of the simplest as well as of the higher re-

[81] The Dodges were in Europe in the summer of 1901 and Professor Erdmann visited them at Wesleyan both before and after attending the St. Louis Exposition in 1904.

flexes." Brief case histories of the patients studied were included.[32]

Another research paper by Dodge and Diefendorf appeared in 1909 and concerned itself with the analysis of the photographed eye movements of a case of congenital nystagmus. This was a significant "first" in a field that has interested many students of vision in the intervening years. Dodge's photographic records revealed a discovery. Direct inspection of the patient's eyes gave the impression that they were almost in constant motion. The photographs showed that the sweep movements occupied only about one-third of the time. For two-thirds of the time the eyes moved so slowly, or were stopped, when reversing the motion, that the subject could see detail quite distinctly and experienced no dizziness or illusions of motion. These two excursions into the psycho-medical field were quite profitable to Dodge in adding to his rich experience with normal phenomena of visual perception. Also these studies with Diefendorf opened up possibilities that probably should have been further developed. But Dodge's position as a professor of psychology in an institution that did not offer graduate training for the doctorate was in this instance a handicap. If this beginning made by Dodge and Diefendorf could have been turned over to an imaginative and capable graduate student, competent to use the apparatus, both psychology and psychiatry might have benefited.

Wesleyan University gave Dodge sabbatical leave for the academic year of 1909-1910, and with Mrs. Dodge he went abroad. Four months were spent in Paris working at the Marey Institute nearby in association with Dr. Lucien Bull, a physicist-engineer of great capability. Dr. Bull had designed and built his own model of string-galvanometer (the general type that Einthoven had invented in 1906.) Later Bull developed the electromagnetic and optical recording sound-ranging system used in the First World War.[33] The Marey

[32] This paper features an early photograph of Dodge's eye movement camera with him sitting in position at the headrest as subject.

[33] The hot-wire microphone used in this elaborate apparatus was developed by Sir Lawrence Bragg.

Institute performed the services of a standardizing laboratory for France and there were many projects and problems going on. Dodge with his mechanical and inventive ability found this Institute and Dr. Bull's work most fascinating. They had a great time together. Bull introduced Dodge to the technique and use of the string-galvanometer; they made electrograms of frog and human reflexes and Dodge developed a sensitive tambour-type of instrument which he called the microscopic recorder. The moving element in this recorder was illuminated, and projected through a microscope. It was therefore highly sensitive.[34]

It seems that for the second half of his sabbatical year Dodge had envisaged two possibilities; one was to work with C. S. Sherrington, who had given the Silliman Memorial Lectures at Yale in 1904, on "Integrative Action of the Nervous System," the other to work with Max Verworn of Göttingen, who later gave a course of Silliman Lectures on nervous irritability. Back in Germany after a lapse of thirteen years Dodge naturally saw Erdmann, and it was Erdmann's outspoken admiration for Verworn that determined Dodge to spend the latter half of the year at Göttingen. In Verworn's friendly and stimulating institute of physiology Dodge continued his work on the exploration of the knee jerk, applying his techniques that he had polished up at the Marey Institute, but primarily he worked on mental fatigue. It was not a new subject for him but for the results from the study of fatigue at Göttingen we must wait a few years. The knee-jerk study, however, came out with a bounce. Evidently Professor Verworn was well impressed with Dodge's techniques of recording

[34] Dodge published an all too brief description of this microscope recorder in a note entitled "Two New Sphygmographic Instruments," *Psychol. Bull.*, 9 (1912): 72-73. The complete description given is as follows "The first is a pneumatic photographic recorder of extremely low latency and high sensitivity. Used in connection with any good microscope, it records vibrations of over 1,000 per second, shows overtones of vowels and heart tones, and gives pulse waves of any desired amplitude without changing its latency or other constants. Suitable for class lantern-demonstrations of pulse and plethysmographic changes, it is durable and practically fool proof, at least for anyone who can use a microscope."

and examining the patella reflex and also with the manuscript which resulted from his study. It was accepted for publication in English in the *Zeitschrift für allgemeine Physiologie* and to Dodge's surprise he received an honorarium. The paper of 58 pages of printed text with numerous illustrations and small tables and three large folding plates appeared almost before the Dodges had returned to Middletown after their very rewarding sabbatical year.

In February, 1911, Dodge was just turning 40 when he presented his "Working Hypothesis for Inner Psycho-physics" at a meeting of the New York branch of the American Psychological Association. He challenged his audience to consider what is really meant by psycho-physical parallelism, that is, a thoroughgoing parallelism between the phenomena of introspection and nerve physiology. He maintained that this principle is inhibiting rather than stimulating to a scientific psychology. The correlation of nervous processes and consciousness is a psychological phenomenon that cannot be put aside as meaningless. But Dodge claimed, "It is part of the business of inner psycho-physics to discover the peculiar characteristics of the neural processes which appear to be necessary conditions of that consciousness which we know." He claims that it is the business of psychology as a science to ask "What is the peculiar complication of the physiological manifold whose correlate is actual sensation?" He comes to the position, after examining the concepts of subconscious, of sub-threshold, super-threshold, etc., that as a working hypothesis parallelism for inner psycho-physics leads to absurdity: "We are utterly unable to reason successfully either from known nervous facts to consciousness or from consciousness to its nervous correlates. Phenomenal parallelism as a working hypothesis for inner psycho-physics assumes too much. It is equally embarrassed by the question, where in the scale of organic existence a consciousness comparable to our own begins, as by the question concerning the specific conditions of the only consciousness which we can know directly." As a first step toward developing a working hypothesis Dodge proposed an effort to make some reasonable estimate of the

kind of organic integration that would approximate consciousness as we know it. Starting with apperceptive integration as a general name for a complex reproductive process which occurs in developed consciousness he showed that the nervous excitation present, in so far as it comes to consciousness at all, arouses the traces of earlier similar excitations fusing with them and also arouses the residua of previously associated excitations.

In considerable detail, which cannot be included here, Dodge developed his thesis that consciousness is only known as a kind of organization characterized by systematic groupings of experience into units, tactile and spatial, practical and scientific, logical, ethical, and religious, etc., but he held that consciousness itself is not essentially different from the observable phenomena of consciousness. It is conspicuous that we can never catch consciousness except in organized form. Consciousness never appears as a homogeneous quantum of some specific stuff. It always involves the unification of discreet, more or less highly differentiated factors. Dodge helped to make clear his thesis by applying it to the problems of habit and conduct, which have always been difficult to explain in terms of psychophysical parallelism. With the growth of a coordinated habit, consciousness tends to subside. Dodge would argue that consciousness of a particular kind of organization of organic reactive modifications will lose the particular characteristics of the conscious organization when certain simplifications occur by the development of direct arcs within the cerebrum, or in the lower ganglia. In Section 5 of his paper on inner psycho-physics Dodge addressed himself to the physiological problem and in Section 6 to the stuff of consciousness. He arrived at the conclusion in his final three sentences: "My main contention is that the stuff of consciousness is a logical accident. Whatever it were, the right kind of integration would constitute a kind of consciousness. I can see no reason why any stuff in the universe may not enter into a similar kind of organization if the proper conditions are given."

To the present biographer it has seemed an obligation to use sev-

eral quotations and to devote two long paragraphs to Dodge's paper on inner psycho-physics. In his autobiography he expresses disappointment that this paper was classified in the psychological literature under the subject of Weber's law. Twenty years after it was published he could say, "I have never seen it referred to, though I believe it was a legitimate extension of our experimental knowledge, and that it represents the most important insight I ever had." In the intervening years psychology had turned more and more to the study of personality, but now shows signs of returning to a renewed interest in the conscious and consciousness. Dodge's critique of psycho-physicial parallelism may yet find a place as a classic in the history of psychology.

An oft-repeated line from William James' textbook was that "psychology is the science of consciousness as such," but psychology did not stay that way. Its development in the direction of objective studies of behavior gave minor attention to consciousness and introspection. Dodge did not throw away consciousness as a no-good concept; he labored to refine its meaning and psychological significance. And similarly with introspection as a method of psychological research, he gave it a thorough scholarly examination as to its limitations.[35] Having examined the nature of consciousness in his former paper, he here considers consciousness as a philosophical and scientific tool. This paper is easier reading than the former one. Against a rich historical background it sets forth the theory of introspection in clear fashion and identifies its limitations by pointing out various examples. Dodge asserts that in our scientific effort to apprehend reality all indicators are significant and he takes the stand that introspection is only one of the indicators of mental reality. From his article one would scarcely realize that a non-introspective behaviorism was then making a strong bid for a leading position in psychology. This thoughtful contribution exerted an influence to quicken the advance of objective methodology in psychology.

[35] "The Theory and Limitations of Introspection," *Am. J. Psychol.*, 23 (1912): 214-229.

Dodge's research time in 1912 was not wholly taken up with the examination of introspection. In addition he perfected his experimental technique for the photographic recording of the wink reflex and made a study of this bit of human behavior.[36] When working in Göttingen he had found that Verworn and his pupils had reached the conclusion that the refractory phase of nervous tissue was an elementary phenomenon of fatigue. They had demonstrated that what is commonly known as fatigue caused the refractory phase of reflexes to be prolonged. Dodge had a strong interest in the analysis of mental fatigue. Finding no direct scientific handles to that subject he had now decided to secure the best possible records of the refractory phase of some human reflex. His first attempt was on the patella reflex, but due to technical difficulties concerning stimulation he considered this reflex unsuitable. Several physiologists had done earlier work on the human eye wink, both voluntary and reflex. There was one study, that of Zwaardemaker and Lans, which gave some attention to the refractory phase.[37] Dodge found that the protective eye wink in man (stimulated by a sharp noise) had a very low latency, from 28 to 47 ms., with a mean of 30 ms. His apparatus

[36] The Refractory Phase of the Protective Wink Reflex: the Primary Fatigue of a Human Nervous Arc," *Am. J. Psychol.*, 24 (1913): 1-7. The wink-recording technique made a most attractive demonstration. The reputation of Professor Dodge among experimental psychologists was very high. He was host to the annual Conference of Experimental Psychologists at its tenth meeting, April 10-12, 1913, which took place at Fisk Hall, Wesleyan University (see Notes of Prof. W. V. Bingham, *Psychol. Bull.*, 10 (1913): 211-212). Referring to various of Dodge's methods and apparatus developments Bingham wrote, "The equipment of the small Wesleyan laboratory was a continual source of interest and admiration to the [thirty] visitors. Indeed, several of them expressed the desire that through some means, possibly through the appointment of an American Psychological Association committee on laboratory devices, clear and full published descriptions of such ingenious and valuable inventions as these of Professor Dodge, might be made available in convenient form, for the guidance of all laboratory workers." Dodge was at his best in the annual meetings of the Society of Experimental Psychologists, which he continued to attend until his retirement in 1936.

[37] H. Zwaardemaker und L. G. Lans, "Über ein Stadium relativer Unerregbarkeit als Ursache des intermittierenden Charakters des Lidschlagreflexes," *Centralbl. f. Physiol.*, 13 (1899): 325-329.

with its delicate recording levers did not demonstrate the long refractory periods which Zwaardemaker and Lans had reported. To a second stimulus as strong as the first one all Dodge's subjects gave a second but smaller wink within 0.3 sec. of the initial stimulus. And when the second stimulus came as long as 2.0 sec. after the first stimulus, the second wink was still smaller than the first. The refractory phase of the human wink reflex is thus a fairly long period of response decrement. Dodge now had a new and nicely calibrated neuropsychological measuring stick which he could use on different problems, especially the study of mental fatigue.

The protective wink reflex paper appeared in the *American Journal of Psychology* in January, 1913, and in the same month Dodge also had the leading paper in the *Psychological Review,* where his subject was "Mental Work: A Study in Psychodynamics." In this latter paper Dodge is applying to his own scientific program the implications of his analysis of the limitations of introspection. That analysis forced the conclusion that any complete science of experience and conduct must investigate the dynamic problems of the mental life by some nonintrospective methods and seek to build up scientific constructs of mental reality from data which were beyond reach of introspection. He used the phrase "dynamic psychology" to designate the totality of conditions of mental phenomena. In the present instance he investigated a phase of the energy transformations which were assumed to correlate with mental activity. After his sabbatical year he added an Einthoven string galvanometer to the equipment of the psychological laboratory at Wesleyan. And now in considering how he was to record pulse rate for long periods while his student subjects were writing their term examinations he chose to use the string galvanometer rather than his own pneumatic microscope recorder and he devised a small light-weight skeleton telephone receiver which could be worn on the subject's forehead. A small iron armature carried on a spring, in this receiver, rested against the temporal artery and the movements of the arterial walls caused the string of the galvanometer, placed in an adjoining room,

to beat in synchronism with the wall of the artery. The shadow of the moving string was recorded with Dodge's falling plate camera. Thus the subject was alone and unmolested by any apparatus. Ordinary movements within the radius of the flexible wire connection to the subject's forehead did not interfere with recording. Dodge called this device his "telephone-galvanometer-sphygmograph" and considered it the most satisfactory pulse-recording device yet produced for psychological experiments. The pulse rate could be measured in units of 1 ms., but were ordinarily measured in units of 5 ms. The chief limitation of this type of record was that the height of the pulse curves could not be directly compared.

In planning his study on mental work as correlated with pulse rate during the writing of final examinations by honor students, Dodge had the benefit of the earlier work by Benedict and Carpenter, who had measured the metabolism of students at rest and during the writing of their examinations.[38] These studies had been conducted in the respiration calorimeter at Wesleyan, an unusual environment for examinations. Dodge's subjects were examined individually in a room that was quite familiar to them and the records were made in an adjoining room. A delicate index automatically showed when the subject was doing his writing and when not. By means of a large pneumatic tambour arranged in the back of the subject's chair both slight and gross movements of the body were indicated on the record. Data were secured on three subjects. In the total experiment the median pulse rate of two subjects was about 87 per min. for both the non-writing and the writing periods. The third subject showed a lower median rate and his non-writing median value was lower than that of the writing periods. All three of Dodge's subjects and 16 of the 20 subjects used by Benedict and Carpenter showed a gradual slowing of the pulse rate from the be-

[38] F. G. Benedict and T. M. Carpenter, *The Influence of Muscular and Mental Work on Metabolism and the Efficiency of the Human Body as a Machine,* Bull. 208, Office of Exper. Sta., U. S. Dept. of Agriculture, Washington: Govt. Printing Office, 1909, 100 pp. See section beginning with p. 45.

ginning to the end of the examination period. In the final analysis of the results and their implications in this study of psychodynamics Dodge introduced us to many new problems, which seemed to offer great scope for research and advance in the science of psychology.

Dodge was familiar with the researches on human metabolism which had been carried on by W. O. Atwater, F. G. Benedict, and their associates, and without doubt this had some influence on his thinking. One of the challenging scientific discoveries made at Wesleyan was that ethyl alcohol taken in amounts up to 75 grams per day was completely oxydized in the human body and thus used as a source of energy. This discovery that alcohol was a food made rather startling newspaper headlines, especially so since they were dated at Wesleyan University. The publicity was hard to take by a Methodist board of trustees; however, Wesleyan probably benefited in becoming better known as a center for scientific research. Dr. Atwater died in 1906 and the calorimetric and metabolic work was moved to Boston and housed in a special laboratory near the Harvard Medical School. Dr. Francis G. Benedict was made director of the Carnegie Nutrition Laboratory, which opened in 1907.[39] Benedict had a continuing interest in the physiological and biochemical aspects of the alcohol problem. After conferring with a number of physiologists in the United States and abroad he decided to initiate an investigation on the physiological effects of alcohol on man. He saw the desirability also of a parallel study on the psychological effects of alcohol. In this connection the psychologist he naturally thought of was his friend and Wesleyan colleague Dodge, whose work he admired. It was not difficult to convince Dodge that the psychological side of the alcohol problem was worthwhile as a scientific project. The several developments of technique and apparatus he had brought out during the years at Wesleyan seemed just ripe for use

[39] Nutrition Laboratory of the Carnegie Institution of Washington, Annual Report of the Director, 1908, Reprinted from Year Book No. 7, pp. 158-162; W. O. Atwater and F. G. Benedict, *An Experimental Inquiry Regarding the Nutritive Value of Alcohol,* Washington, Govt. Printing Office, 1902.

in such a study. The opportunity for full-time research on salary and with an ample budget for expenses was attractive and Dodge applied for leave of absence from his Wesleyan duties for the year 1913-1914. Four years earlier he had been off on his sabbatical and Professor Armstrong had looked after the courses in psychology as well as in philosophy. Now he was unwilling to undertake this again. A solution of the difficulty was found when the administration made psychology a separate department.

Many of Dodge's weekends during the academic year of 1912-1913 were spent in Boston at the Nutrition Laboratory, building up a small psychology laboratory which included duplicates of his apparatus at Wesleyan and some new contributions.[40] The proposed program for the alcohol study was privately printed and circulated among scientists for suggestions and criticisms. A great deal of checking of apparatus, of reading literature, and of conferring and corresponding was done on those weekends. When the Wesleyan courses were finished and June examinations marked, the Dodges moved to Boston to an apartment on Huntington Avenue near the Harvard Medical School. The new appointee to "fill Dodge's place" [*sic*] for the year was W. R. Miles, who had received his doctor's degree in psychology at Iowa that June. He arrived with his family in mid-August, the Dodges coming to Middletown for that weekend. Dodge gave Miles a brief, intensive course on how to make use of the equipment in the psychological laboratory, and did not appear again at Wesleyan until late the next summer. In the fall of 1913 there was some prospect that Dodge might decide to stay in full time research with the Carnegie and sever his relations with Wesleyan. He was happy and excited at the research prospects. Dr. Benedict also was enthusiastic and tried to provide every facility.

[40] Dr. Benedict in his annual report for 1912 mentions Prof. Dodge's frequent visits and activities, but as explanation says "With a view to broadening the significance of the metabolism measurements made in the experimental work of the Laboratory, preliminary steps have been taken to institute researches on the psychological effect of the ingestion of food and of nutritive processes in general" (p. 217).

But the Dodges were not widely acquainted in the academic community of Boston and Cambridge and they missed their Middletown friends and associations. The experimentation went well but the preparation of the report of the alcohol investigation was tedious and demanding. Dodge was not used to such forthright criticism of his paragraphs as Benedict was in the habit of applying to all manuscripts that came to his desk. Since this was the first major scientific report resulting from the alcohol program and had taken a deal of the Director's time and attention, Benedict felt that his name should appear as one of the authors. Since Dodge had been immersed in this study using his own unique scientific tools in it for almost two years, and had given his full time for one year, he thought of it as his part of the show. But before things came to this stage Dodge had decided to return to Wesleyan the next year. He graciously acquiesced in the joint authorship, pushed the manuscript as far along toward completion as possible by mid-August of 1914, and then spent some weeks on vacation at Herons Island. In returning to his duties at Wesleyan that fall he found one difference: psychology was a separate department and he was chairman of it. He spent considerable time on the report throughout the academic year; it was finally dated May 28, 1915, and was published in 1915.[41] The publication of this monograph was a scientific event of interest to the general public. The author interpreted the results as showing depressive effects from moderate doses of alcohol on the psychomotor and psychological functions studied. The report was widely reviewed in scientific periodicals and in magazines and newspapers. The prestige of Raymond Dodge as a psychologist and

[41] Dr. Benedict had been genuinely disappointed in Dodge's decision to return to Wesleyan. He felt committed to continuing the psychological side of the alcohol program and enlisted Dodge's advice about a successor. After considering various possibilities, W. R. Miles was chosen and joined the Nutrition Laboratory as experimental psychologist in June, 1914, a few weeks before the termination of Dodge's appointment.

as an American scientist was enhanced.[42] At the autumn meeting of the National Academy of Sciences, November 2, 1915, a paper entitled "Neuro-muscular Effects of Moderate Doses of Alcohol" by Raymond Dodge and Francis G. Benedict was presented by Dodge. This occasion was his first appearance before the National Academy. And about two months later, in Chicago, at the Christmas meeting of the American Psychological Association, he was elected its 25th president.

Although Columbia University had not accepted Dodge as a graduate student, twenty years later they appointed him non-resident lecturer in psychology, and in the spring of 1916 he gave at Schermerhorn Hall a distinguished series of eight lectures on the problems and methods in dynamic psychology. The last two lectures of the series were devoted to his alcohol studies. This series of lectures at Columbia might have been put in order for publication but for the pressure of later events. Dodge had to prepare his presidential address, which took much time and thought. He had at last come to the decision to say something on the subject of fatigue, a topic he had investigated by means of various experimental approaches. As a title for his address he chose, "The Laws of Relative Fatigue." He announced two laws of fatigue, both of which emphasize its relativity and its positive rather than negative aspects. In summary he said, "Relative fatigue, then, is not a mere limitation of human efficiency. It is not exhaustion, but prevents it. It is a conservator of organic equilibrium as well as a condition of its development." American psychologists listening to this presidential address felt that it represented a piece of solid foundation work for their science.

And then came World War I, when scientists more than ever before became concerned with military problems. Dodge and Benedict and others of us at the Carnegie Nutrition Laboratory at lunch

[42] In April, 1916, Dr. Benedict gave an address before the New York Academy of Medicine on the alcohol research and Dodge received full credit and praise for his work. See *Science*, 43 (1916) 907-917.

hours in early August of 1914 discussed chiefly the war. But we were not in it then, strange as that seems now, and sympathies were mixed. Dodge had obtained his degree at Halle, Benedict at Heidelberg; both had strong bonds with Germany. But the picture and the sentiment changed. "On April 6, 1917, a group of experimental psychologists, then in session at Cambridge, Massachusetts, appointed a committee to consider the relation of psychology to military affairs and to further its application to practical problems. This was the beginning of concerted action. From that day the psychologists of the country acted unitedly as well as disinterestedly and whole-heartedly."[43] Robert M. Yerkes had presided at this meeting and he was also now president of the American Psychological Association succeeding Dodge. Under Yerkes' leadership of the A.P.A. and at the request of Dr. George E. Hale, chairman of the National Research Council, a Psychology Committee was organized to deal with military problems which the Council might refer to it or which the Committee might formulate for preservation through the Council.[44] There were several sub-committees, some chairmanned by members of the general committee and some by other well-qualified psychologists. Dodge was chairman of two subcommittees: 1, Problems of vision of military significance; and 2, Adaptation of psychological instruction to military educational needs. Also he served with distinction with the Chemical Warfare Service on psychological problems of the gas mask. His work as a military psychologist was singularly effective.

One of the first visual problems referred to Dodge through the Council requested the recommendation of tests to select gun-pointers for merchant ships. There were no such tests available but Dodge

[43] R. M. Yerkes, *The Role of Psychology in the War,* New World of Science, New York: Century Company, 1920, pp. 351-389.

[44] The Psychology Committee after some resignations and additional appointments included the following J. R. Angell*, J. McK. Cattell*, R. Dodge*, S. I. Franz, G. S. Hall, W. D. Scott, C. E. Seashore*, E. L. Thorndike*, J. B. Watson, G. M. Whipple, R. M. Yerkes*, Chairman, and J. W. Baird, Vice-Chairman. Those with stars after their names were or later became members of N.A.S.

proceeded promptly to build one and to try it out on personnel of the U.S.S. Georgia and the U.S.S. Pennsylvania. The test was a simulated gun-aiming and firing apparatus, but with no powder-burning explosions. Among other features it made use of his falling-plate camera mechanism. Qualified gun-pointers made high scores on this test; novices made poorer scores, but those with ability did well and improved rapidly. Although the Office of Gunnery Exercises for some reason did not adopt Dodge's gun-pointing test, it did serve effectively at the Armed Guard Camp of the New York Navy Yard and a number of replicas were built for this camp and other training stations. The success and the military contribution of Professor Dodge through this one development were signalized by a commendatory letter from Rear Admiral L. C. Palmer, Chief of the Bureau of Navigation, Navy Department, dated March 4, 1918. The letter is reprinted in Dodge's condensed report of his military activities.[45] Among other fields of service in the Navy, Dodge was requested to organize a School for Lookouts in connection with the training of officers and men for the Eagle Boats, searchers for enemy submarines. To facilitate the psychological work in his connection with the School he accepted a commission as Lieutenant Commander in the Naval Reserve Force. With the close of the war in November, 1918, Dodge returned to his academic work a fatigued but cheerful man. From 18 months of wide and intensive experience as a consultant on psychological aspects of military problems, as they presented themselves in the Army and the Navy, he had developed convictions about the national importance of technical psychological preparedness. He placed these ideas and a suggested operational program before the American public in the form of two articles. "Mental Engineering during the War," and "Mental Engineering after the War," in two issues of the *American Review of Reviews,* 1919. The following year he published two more articles

[45] See R. M. Yerkes, "Report of the Psychology Committee of the National Research Council," *Psychol. Rev.,* 26 (1919) section entitled "Report of Lieutenant Commander Dodge," 106–124.

resulting from the war work, one on the educational significance of the Army Intelligence Tests, the other an analysis of the psychology of propaganda, pointing out its pitfalls in reference to influencing public opinion.

When academic work was again on an even course after the war Dodge attacked a problem that had long interested him. It concerned the compensatory eye movements which operate free from retinal-visual stimuli and controls. The question was how to record these in the dark or with closed eyelids. He solved the problem by what he called a mirror-recorder. A tiny cube, light in weight and with a bit of mirror attached to one side, was held, pivoted about a vertical axis, on a little lever arm. The side of the block opposite the mirror was placed against the closed eyelid; when the eyeball moved laterally beneath the lid the bulge of the cornea caused the block to turn in the opposite direction to that of the eye. A beam of light reflected from the mirror played upon a camera slit and gave a detailed photographic tracing of the path of movement. This simple and delicate optical lever mounted on a glorified spectacle frame opened up a new field and was the essential means of gathering data presented in a dozen or more papers. These new researches on the reflex movements of the eyes associated with postural changes and rotation of the body were of much interest, not only to psychologists but particularlly to physiologists and neurologists.

The year 1924 brought new honors, responsibilities, and opportunities. Dodge was elected a member of the National Academy of Sciences and was made chairman of the newly created Division of Anthropology and Psychology of the National Research Council. As division chairman, for which he was eminently well fitted, he endeavored to consolidate the scientific gains which psychology had made during the war and its aftermath and to bring these into focus in relation to forward planning for psychology. He organized and carried through conferences and set up committees.[46] On the side,

[46] Accomplishments of the year that should have special mention were (a) The formulation of a new project to investigate the possibilities of tactual

in his spare time, he worked on the experimental results of his research on response variability which he had conducted before the war as Adams Fellow of Psychology, an appointment made by Columbia University. The year in Washington was very satisfying to Dodge. He was naturally a rather shy person but at the same time quite conscious of his abilities. It was not his habit to monopolize a conversation. But his war experiences and associations did change his manner to some extent; he became a bolder and more aggressive man. His chairmanship was thus probably more effective in 1924 than it might have been a few years earlier. In Washington, Dodge was sought out by scientific men in other fields, who wished opportunity to consult with him. His relationship with Dr. R. M. Yerkes, who was Chairman of the Research Information Service of the Council, 1919-1924, was particularly close. Dodge and Yerkes were both imaginative creative planners for the future of psychology and in this they had an able friend and ally in James R. Angell. Angell had been Chairman of the Department of Psychology at Chicago University, he had served as Chairman of the National Research Council in 1919, as President of the Carnegie Corporation of New York in 1920, and in 1921 became President of Yale University. It was no spur-of-the-moment idea that both Dodge and Yerkes were invited to accept professorships at Yale in the Institute of Psychology set up late in 1924 on a five-year grant from Laura Spellman Rockefeller Memorial funds. It was not an easy matter for Dodge to resign from Wesleyan and give up the teaching of undergraduates. However, he had served that institution with distinction for 25 years and had added much to its prestige as an educational and research center. Wesleyan could be proud to contribute such a man to the

interpretation of oral speech by the deaf; (b) Classification scheme for anthropological literature for the use of libraries; (c) The publication of the National Intelligence Tests under arrangements providing that the royalties should be devoted to the work of the Council; and (d) The conduct of a program to stimulate both teaching and research in anthropology in the colleges and universities of the country. The annual meeting of the Division in April, 1924, was made noteworthy by the new feature of a scientific program of 17 papers solicited and arranged by the Chairman.

new venture which Yale under President Angell's capable guidance was initiating in the enlarging field of psychology. When the curtain for 1924 was about to fall Dodge, as Vice-President and Chairman of the Psychology Section of the American Association for the Advancement of Science, gave his address on "Problems of Human Variability" at the Christmas Meeting in Cincinnati.

The Institute of Psychology at Yale was housed in old Kent Hall, at the corner of High Street and Library Walk, the site on which Jonathan Edwards College now stands. Dodge was able to arrange for the transfer of a portion of his research equipment from Fisk Hall at Wesleyan to Kent Hall at Yale. And with funds available to the new Institute he procured further equipment and hired assistant personnel. The advantage of having some apparatus that needed only to be reinstalled was important for making an early start on research work. The Institute was closely associated with the existing Division of Psychology at Yale and Professor Roswell P. Angier was chairman of both. Advance publicity about the establishment of the Institute stimulated enrollment of graduate students, so that from the first there was a goodly group. Dodge already had many things on the fire or essentially ready. He had, as the reader will know, originated numerous techniques and bits of equipment that were capable of being employed or exploited in wider scientific connections. He was fully ready and happy to have capable young colleagues to direct and inspire. A glance at the bibliography at the end of this memoir will give an indication of the acceleration in productivity and publication that took place after the initial year of getting the Institute started. It was indeed a harvest. Those who engaged in collaborative work and publication with Dodge were mostly psychologists and they have continued active in the field. James C. Fox, Jr., M. D., a clinical neurologist who early began such cooperation, continued for many years and was also Dodge's physician.

As a member of the International Committee of Psychology, Dodge was Chairman of the Program Committee that arranged

for the Ninth International Congress of Psychology, that met at Yale University, September 1-7, 1929. There were 424 papers presented before this Congress. "In arranging for so many papers, it was the hope of the Program Committee that the Congress and its Proceedings might come to represent a typical cross-section of psychology as it existed in 1929 and thus an event of some historical significance."[47] Dodge did not himself serve as chairman of any of the many programs and symposia. He had a taxing job already but did take part in the symposium on eye movements. President Angell was Vice-President of the Congress and in his address of welcome called attention to recent developments in psychology at Yale. He said in part, "Here has recently been established the first American university institute of psychology, now to be expanded into an institute for the study of human relations in their widest implications."[48]

Aside from the large amount of research work accomplished and written up for publication in the latter part of 1928 and in 1929 Dodge devoted a major portion of his time to conferences and planning for the Institute of Human Relations. This Institute was to offer a favorable atmosphere and convenient facilities for both individual and collaborative research in psychology and its associated disciplines of psychiatry, neurology, physiology, psychobiology, child development, and so on. Beyond the development of the philosophy of the Institute there were the many details of its architecture, not only the general scheme of its space, but basic, convenient equipment of the rooms. To all these matters Dodge addressed himself with his usual skill and cleverness. He took charge of the organization and direction of an instrument shop for the Institute. He secured the appointment of his long-time associate Mr. F. S. J. Newton as head instrument-maker, and moved him to Yale from Wesleyan. The planning and revision of plans were time-consuming but Dodge

[47] Ninth International Congress of Psychology, *Proceedings and Papers,* Princeton: Psychological Review Co., 1930, xii + 534 pp.; see p. 5.

[48] *Ibid.,* p. 10, n. 47.

was happy in the prospect of having space which approached his ideal of a laboratory for experimental psychology.

In the general scheme of the Institute of Human Relations, psychiatry and psychology were to collaborate, and there was to be a psychiatric laboratory in which psychological tests and experimentation would be appropriately conducted with selected patients under the supervision and direction of Professor Dodge. In preparation for this phase of his work in the Institute, Dodge, accompanied by his wife, went abroad on a scientific mission from April to August, 1930. The general objective was to learn what psychological experimentation and laboratory methodology were currently in psychiatric use in the British Isles and on the Continent, and to learn from leading psychiatrists what, presumptively, were the most profitable lines for future psychological investigation. Dodge returned with a bushel of notes, photographs, and reprints, and some matured ideas of his own. This mission and its associated work in the Institute in a sense had its beginning in his researches with Dr. Diefendorf twenty years earlier at the Middletown State Hospital.

Psychology moved into the new Institute at Davenport and Cedar Streets at the Yale Medical Center during the Christmas holidays of 1930. As an academic subject psychology from its beginnings at Yale had been a part of the Department of Philosophy. This administrative relationship was discontinued and psychology became a separate department with the setting-up of the new Institute in 1929, and occupancy of the fine new building marked this historic change. The new department was augmented by merger with the Institute of Psychology, which had existed for five years, and this total development in psychology became the core of the Institute of Human Relations.

The shake-down cruise of the new Institute during the first year required a great deal of time for conferences, committee meetings, visitors, and other activities, including the building-up of laboratory installations. However, Dodge did start a number of

graduate students on their problems; this required research and thinking on his part that does not show in his bibliography; also he collaborated with Dr. Eugene Kahn, Professor and Chief of the Department of Psychiatry, in writing a small book, *The Craving for Superiority,* the first piece of cooperative work published by the Institute. During 1930-1931 Professor Dodge read the proofs of his book *Conditions and Consequences of Human Variability,* which was published by the Yale University Press in 1931 and became the first volume in the Institute's series of publications. These and others of his activities did much to build a bridge between psychiatry and psychology. He consulted with individual members of the psychiatric staff about research possibilities and problems and regularly attended psychiatric staff meetings, participating in the discussions on patients and topics.

In his earlier research Dodge had given attention to the pulse and circulation and had developed means for their study. Now at Yale in the Institute, which in location and concept was affiliated with the medical center, he took the opportunity to initiate joint work, notably with the heart specialists in the Department of Internal Medicine. He was in fact a member of the Board of Permanent Officers of the School of Medicine and also of the Graduate School. He did not, however, neglect the graduate students and visiting fellows who came to pursue experimental psychology. He participated regularly in the major seminars that were going on under the aegis of the Department of Psychology and in the Ph. D. examinations. It gave him great pleasure to play a leading role in developing well-qualified young doctors in psychology.

At times Professor Dodge at an evening meeting of informal nature would speak to the entire research personnel of the Institute. One short memorandum he prepared for this purpose was entitled, "Two Fundamental Problems in Human Relations." "The first is the problem of determining scientifically the conditions under which social groups are formed; the second is the problem of the

conditions under which they remain permanent or fall apart." [49] Dodge continued, "I believe that group formation and group permanence could be studied profitably within all the sciences which are included in the Institute. . . . The suggested problems and hypotheses are related to the whole question of the survival of cultures. They might be studied comparatively in such phenomena as animal mating, the hunting of the pack, the flight of birds, and the migrations of all migrating creatures. . . . In contemporary society they might be studied in an equally great variety of phenomena. . . . In addition it may be suggested that the hypotheses probably reach well back into biological processes such as the grouping of cells into various organs. . . ." Dr. May, Director of the Institute, said of Dodge, "In 1933 he struck the keynote once more in his paper on 'Mental Nearness.' " Here he developed an analysis showing that the basic biological human urges and cravings underlie many, if not all, human relations problems. Dodge held that "there are three proximate questions at issue in the effort to understand or to facilitate any human relationship. The first one is, 'What is its nature?', the second, 'How may it be measured?', and the third, 'What is its natural history?', or more simply, 'What are its dynamic conditions?' " Professor Dodge's scientific leadership at the Institute functioned at the level of numberless details of technical information on equipment, design, and method, and on, up to the glimpsing of scientific horizons which could be seen by the science philosopher. President Angell once said of Dodge, "Although his own most notable experimental contributions might suggest a highly technical and specialized interest, in point of fact his outlook on psychology and its related disciplines is of the most cosmopolitan character. Few American psychologists have enjoyed his breadth of appreciation for the underlying problems of science and philosophy and few have kept so constantly in mind the far-reaching im-

[49] Mark A. May, "Contributions of Professor Raymond Dodge to the Institute of Human Relations," *Psychological Studies of Human Variability,* ed. W. R. Miles, 1936, pp. xi-xviii.

plications of the most trifling fact." And it should be added, few have offered a richer experience of friendship and joy in living than came through association with this student of man's nature.

Raymond Dodge retired voluntarily from academic work in 1936 and lived his remaining years at his charming estate in Tryon, North Carolina, where he and Mrs. Dodge entertained many friends from the North. He died April 8, 1942. For a number of years before his retirement he had suffered a handicap in his physical activities by reason of paralysis agitans. His father died at the age of 65, his mother lived to be 79. His wife survived him.

KEY TO ABBREVIATIONS

Am. J. Physiol. = American Journal of Physiology
Am. J. Psychol. = American Journal of Psychology
Am. Rev. Rev. = American Review of Reviews
Arch. ges. Psychol. = Archiv für die Gesamte Psychologie
Arch. Neurol. Psychiat. = Archives of Neurology and Psychiatry
Arch. Ophth. = Archives of Ophthalmology
Harper's Mo. Mag. = Harper's Monthly Magazine
J. Abnorm. Soc. Psychol. = Journal of Abnormal and Social Psychology
J. Comp. Psychol. = Journal of Comparative Psychology
J. Exper. Psychol. = Journal of Experimental Psychology
J. Gen. Psychol. = Journal of Genetic Psychology
Proc. Nat. Acad. Sci. = Proceedings of the National Academy of Sciences
Proc. Papers Ninth Int. Cong. Psychol. = Proceedings and Papers of the Ninth International Congress of Psychology
Psychol. Bull. = Psychological Bulletin
Psychol. Monog. = Psychological Monographs
Psychol. Rev. = Psychological Review
Rel. Educ. = Religious Education
Sci. Mo. = Scientific Monthly
Yale J. Biol. Med. = Yale Journal of Biology and Medicine
Zeits. allg. Physiol. = Zeitschrift für allgemeine Physiologie
Zeits. Psychol. = Zeitschrift für Psychologie

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