cine. And it has exerted an enormous influence, not only on the increase of knowledge concerning disease but on the practice of medicine and on practitioners as well. Let students obtain a real interest in physiology and, if they have intelligence, the bearing of physiological facts will be obvious to them when they study about disease.

That medical students at present acquire an enormous fund of information is certain. In interviewing students fresh from the schools I frequently stand amazed by the fluency and skill with which they discuss the most complicated subjects of physiology and pathology and the very latest discoveries in medicine and related sciences, at times even before the ink is dry on the reports. One sometimes wonders, however, if range of information is necessarily identical with depth of knowledge, or whether the facts have been digested and transmuted into wisdom. That medical students possess so much information is not surprising. For four years each of the various professors, and there are very many of them, have attempted to compel the students to learn everything that is known about his particular subject up to the moment of going to press. It is not necessary to recapitulate the large number of special divisions into which medicine has been divided; the students are expected to take at least a few meals in each one of them. There is so much hospitality that the meals all turn out to be banquets. Is it any wonder that most of the students have indigestion, mental as well as gastric? In recent years many attempts have been made to correct this situation, and they are undoubtedly in part successful, but I am sure many deans still have very bad hours worrying for fear their students will not have mastered every subject in the field of medicine. So far as I can see there is only one remedy. Let it be required that every professor, every teacher, each year pass an examination not only in his own subject but one in every other subject in the curriculum. Let the professor of biological chemistry keep familiar with the latest methods in obstetrics, the professor of ophthalmology be informed of progress in physical chemistry and endocrinology, the professor of bacteriology keep abreast of improvements in x-ray therapy. It is frequently held that at least once in their lives all medical students should have heard about all that is known in the whole field. A doctor should never be ignorant of any fact relating to medicine! But is this necessarily education on the university plan? Is this cramming with facts scientific education or does it produce scientists?

Over thirty-five years ago, long before the first university department of medicine was established, the following words were uttered by a man who was primarily a practitioner and clinical teacher: "All that the college can do is to teach the student principles, based on facts in science, and give him good methods of work. These simply start him in the right direction, they do not make him a good practitioner—that is his own affair. To master the art requires sustained effort, like the bird's flight, which depends on the incessant action of the wings, but this sustained effort is so hard that many give up the struggle in despair. And yet it is only by persistent intelligent study of disease upon a methodical plan of examination that a man gradually learns to correlate his daily lessons with the facts of his previous experience and with that of his fellows and so acquires clinical wisdom."

Let the university heed that it turns out men who have the scientific habit of thought, not merely men who are stuffed with facts. Let us, however, not ask too much of the university. If the prevailing standards of practice do not fulfil our expectations, let us not blame this all on the university, but let us keep in mind the parts which the hospital, the visiting physicians and even the interns and practitioners themselves should play in the training of good physicians.

If to-day I have attempted a "counsel of perfection" it has not been uttered in any spirit of arrogance or criticism. We are still far from the perfect state. The future rests with you who are beginning your careers. You are fortunate in the choice of your time. May you continue to be scientifically and critically minded. May you continue to be students as long as you live.

OBITUARY

ERNEST WILLIAM BROWN

IN any account of Brown's life his work on the problem of the motion of the moon must necessarily occupy the central place. At any time during a period of fifty years he was working on some phase of this subject. His lunar theory has justly been called definitive. The creation of this theory and the construction of his "Tables of the Motion of the Moon" are among the greatest accomplishments in the history of gravitational astronomy.

In the summer of 1888, then a student at Cambridge, England, he began the study of Hill's papers on the lunar theory at George H. Darwin's recommendation. In a series of publications beginning in 1891 he presented theoretical developments inspired by Hill's work, and their numerical application, *i.e.,* the coefficients of certain classes of inequalities in the motion of the moon. For six years he continued his preparatory studies. His mastery of the whole field is apparent in his "An Introductory Treatise on the Lunar

Theory," published in 1896. Intended to be an introductory text-book, it is elementary in many parts, but it also deals with the advanced phases of the subject.

The systematic development of the theory began in 1894, and in 1908 the fifth and last part of the theory appeared. In an address in 1914 he said: "My own theory, which was completed a few years ago, is rather a fulfillment to the utmost of the ideas of others than a new mode of finding the moon's motion. Its object was severely practical—to find in the most accurate way and by the shortest path the complete effect of the law of gravitation applied to the moon. It is a development of Hill's classic memoir of 1877."

This statement is typical of the modesty which he always showed in referring to his own contributions. It does not emphasize his own resourcefulness in finding that "shortest path." His development of the theory was by no means a slavish following of a standard pattern. He did not hesitate to change from one form of the equations to another if he saw a good reason for doing so, and he introduced minor and major changes of procedure whenever this would shorten the work. This freedom in handling problems in dynamics was a characteristic feature of his work throughout his life. He had no patience with theorists who apply "hit-or-miss methods," as he used to say.

The most original part of the lunar theory is the last part, in which the effects upon the moon's motion due to the attractions of the planets and the deviation from sphericity of the earth and the moon were obtained. There is perhaps no other field in celestial mechanics where a more careful treatment is necessary in order to avoid pitfalls. Probably no mathematical astronomer has ever shown greater ability than Brown in dealing with such a problem.

The accuracy of the solution of the "main problem" is of a totally different order than that of solutions that preceded it. In Hansen's theory some coefficients are in error by some tenths of a second of arc. Delaunay's theory is seriously hampered by slow convergence, some of the more difficult terms being in error by a whole second of arc. Brown's solution gave the coefficients to one one-thousandth of a second of arc, and very few coefficients greater than that value were not obtained. That this accuracy was actually reached was confirmed by the preliminary results obtained in a numerical verification of this part of the lunar theory. This work was carried out by his pupil, Dr. W. J. Eckert, in close cooperation with Brown during the past few years.

Immediately after the theory had been completed he began preparations for the construction of the tables. His approach to this work is again an example of thoroughness. Hansen was a past master in the art of tabulation, but Brown found it possible to introduce a number of important improvements. The most ingenious original feature is the arrangement of the single-entry tables, in which form the largest terms in the moon's motion are tabulated. The perfection of the tables was to a large extent due to the efficient assistance by Dr. H. B. Hedrick, who was employed as chief computer during nine years. In later years he spoke frequently with admiration of Hedrick's work.

While the construction of the tables was in progress a comparison with observations was made in order to ensure that the best possible constants were used in the final tabulations. A proof of the accuracy of this discussion, and of the lunar theory, was obtained some years ago when Spencer Jones completed a revision of Newcomb's occultation work. From totally different material he derived results that were in excellent agreement with those obtained by Brown.

After the tables were completed his most notable contribution connected with the motion of the moon was the well-known publication in 1926: "The Evidence for Changes in the Rate of Rotation of the Earth. . . ." A comparison of the differences between observation and theory in the longitudes of the moon and the sun was used to advance the explanation that both are due to changes in the rate of rotation of the earth.

The progress toward the present status of our knowledge about the earth's rate of rotation was not made in one step by a single investigator. It is generally agreed, however, that Brown's contributions were the most important and the most consequential ones. His definitive evaluation of the planetary perturbations marked the end of a long period of doubt whether the observed motion of the moon could be accounted for by gravitational theory alone. His contribution of 1926 marked the beginning of an era in which the rotation of the earth is definitely known to be affected by irregular variations. This problem had his most vivid interest ever after. His occultation campaign and his discussions of lunar observations during the last twelve years of his life were part of his study of the rate of rotation of the earth.

Until 1910, when the lunar theory was finished and the work on the tables was well in hand, Brown devoted but a small portion of his energy to original studies of subjects not intimately related with the lunar problem. From then on his activity covered a wider field. With the exception of occasional studies on a variety of topics his central subject was the study of gravitational problems presented by the solar system by quantitative methods. In appraising the value of these investigations it should be kept in mind that he was seeking new methods and that he was always attracted by the most difficult problems. His first theoretical papers on the Trojan Group were later followed by a general theory, applicable to all planets of this group, and especially to the more difficult ones having a large amplitude of libration. The study of the motion of the eighth satellite of Jupiter is an example of his preference for difficult problems.

Gradually Brown became actively interested in the more general problems present in the development of theories of planetary motion. His contributions to the theory of resonance were part of these investigations. He also laid the foundation for the construction of the "Tables for the Development of the Disturbing Function" (1933). Most of his contributions in this field were collected in a coherent presentation in the treatise "Planetary Theory" (1933), written in collaboration with Professor C. A. Shook.

During the last three years of his life the "main problem" of the lunar theory had his attention again. This led to several separate investigations of considerable importance. The most noteworthy of these is the treatment of the stellar problem of three bodies. His analysis of this problem showed again his ability to adapt available methods to the treatment of the special problem before him.

At the very early age of thirty-one he was elected fellow of the Royal Society of England. This was the beginning of a long sequence of honors that continued throughout his life.

In 1891 Brown came to the United States to become instructor of mathematics in Haverford College. Two years later he was promoted to the rank of professor. He remained at Haverford until 1907, when he became professor of mathematics in Yale University. He served Yale until his retirement in 1932. The appointment at Yale came when the lunar theory was nearly completed, and the construction of the tables loomed as the next phase of the work. Arrangements were then made by which Yale University undertook the cost of their calculation, printing and publication.

In earlier years Brown taught various subjects in pure and applied mathematics; in later years his only courses were elementary and advanced dynamics and celestial mechanics. Many of his students kept in touch with him in later years, and some became lifelong friends.

His relations with Yale Observatory, which were entirely unofficial with the exception of a period during which he was acting director, were mutually beneficial.

He was an active member of the American Mathematical Society, was editor of the *Transactions* and of the *Bulletin* for a number of years and president for two years, 1914–16. Of the American Astronomical Society he was president for three years, 1928–31. Since 1911 he was associate editor of the *Astronomical Journal.*

He was born in Hull, England, on November 29, 1866, and died in New Haven, Connecticut, on July 22, 1938. He was unmarried.

DIRK BROUWER
YALE UNIVERSITY OBSERVATORY

WILLIS RAY GREGG

DR. WILLIS RAY GREGG, late chief of the U. S. Weather Bureau, died in the Blackstone Hotel, Chicago, on Wednesday evening, September 14, 1938, where he had been attending an aviation conference between the Civil Aeronautics Authority and the Air Transport Association of America and where he was stricken with coronary thrombosis on the afternoon of Wednesday, September 7. Dr. Gregg, a descendant of James Gregg, who went from Ayrshire, Scotland, to Ireland in 1690, and thence to America in 1718, was born on January 4, 1880, at Phoenix, N. Y., where he grew up on a farm.

His formal education, attested by a B.A. degree in 1903, was obtained at Cornell University. An honorary Sc.D. was awarded to him in 1937 by Norwich University. On March 1, 1904, he entered the Weather Bureau as an assistant observer at Grand Rapids, Michigan. After a service of nearly three years, first at this station and later at Cheyenne, Wyoming, he was transferred to the Bureau's research observatory at Mount Weather, Va., on the crest of the Blue Ridge, 45 miles from Washington. Here for seven years he made important studies of the upper air—a line of investigation with kites and balloons that then was rapidly developing in many countries owing largely to the aid the knowledge thus obtained of winds and weather was to the whole art and practice of aviation. In November, 1914, he was called to Washington as assistant chief of the section of aerology, a section that soon became a division. In 1917 he was made chief of this important division, in which capacity his counsel and active aid frequently were requested by other agencies of the government and by civilian organizations, and always freely given whatever the sacrifice of time and effort on his part.

This wide experience, together with his profound sense of justice, untiring industry, even temper and cheerful optimism, well fitted him for the important position of chief of the Weather Bureau, to which he was appointed on January 31, 1934. This was a high honor, richly deserved, but it carried with it responsibilities, burdens and worries—worries about meeting rapidly increasing demands with a nearly stationary personnel.

Owing to his pleasing personality, ability and willingness Dr. Gregg's services were sought for in many