to them in the meantime. The fact that many of the known white dwarfs are components of binary systems, whose other members belong to the main sequence, suggests that, after all, they may not be much older than other stars—only more decrepit. If they have passed through such intermediate stages of contraction with very hot centers as have previously been described, it is hard to see how any hydrogen can be left inside them—though their atmospheres might still contain it, as their spectra indicate. But it is well to be cautious.

If annihilation of matter takes place within the stars on a large scale, their lives may be hundreds of times longer, and a star, during its history, may diminish greatly in mass and in luminosity. The possible life-histories may be much more complicated, depending on how much mass is lost by the consumption of various kinds of expendable material in different stages. The early stages of large mass and great luminosity will be relatively short, and the final faint stages of very long duration. Provided that any indestructible atoms remain, the final state is a black dwarf, as before.

The great problem of the longer or shorter time-scale may find its solution in another way. The theory of the expanding universe indicates that at a relatively recent time—something like 10^{10} years ago —the universe was probably either just beginning to expand perceptibly after a previous eternity of sluggishness, or very much smaller than at present, and expanding rapidly. The latter type of theory—adopted in different form by Lemaitre, Tolman and de Sitter—leaves hardly time enough for much change even in a massive star, and certainly none for a star of smaller mass. If such an epoch of intense cosmic activity occurred in the relatively near past, the stars may be indeed all of the same actual age, and may, with few exceptions, still be almost fresh from the mint—" in their first innings" as Eddington puts it. On Tolman's hypothesis, the universe previously to this "age of confusion" was contracting after a long history. It is perhaps permissible, and certainly attractive, to suggest that dense bodies like the white dwarfs may be survivors of this earlier world, which have come unscathed through the cataclysm.

Once again, we lack many data necessary for a definite solution. We do not know whence the stars arose, nor what their histories have been. But so much of the nature of the greatest material objects in nature has already been revealed from the study of the minutest that there is better reason than ever to hope, with Eddington, "that in a not too distant future we shall be competent to understand so simple a thing as a star."

OBITUARY

ELIAKIM HASTINGS MOORE

FOR forty years Moore has been a leading figure in the mathematical world. His fundamental researches have been recognized by many honors bestowed here and abroad. He played a leading rôle in the conversion of a local mathematical society into the present national one and in the initiation of the research journal of the nationalized society. He inspired and started on their research careers many of the younger generation. It is not possible to exaggerate Moore's profound influence on the development of mathematics in America.

He was born in Marietta, Ohio, on January 26, 1862. He graduated at Yale in 1883 and received his Ph.D. there in 1885. At the University of Berlin in 1885–86, he was most influenced by Kronecker, who like Moore had an abstract type of mind.

Young Moore taught at Yale for two years and at Northwestern University for four years. In 1902, President Harper selected Moore to initiate the department of mathematics at Chicago. With the effective support of two colleagues, Bolza and Maschke, who were seasoned research men, Moore began with great enthusiasm to develop a research center.

His plans matured so favorably at Chicago that Moore could extend his influence elsewhere. He took an important part in the conversion of the New York Mathematical Society into the American Mathematical Society and in making the latter truly national. Prior to 1899, the society published a single journal, its *Bulletin*. Moore was the first to foresee the rapid growth of research in mathematics in America and hence the need of an additional journal devoted exclusively to research. His influence was now so great that he was able to overcome the opposition to this expansion. Having been the father of the *Transactions* of the society, it was natural that he should serve as its editor-in-chief for the next eight years. Later he became president of the society. Ten years later (in 1921), he was elected president of the American Association for the Advancement of Science, the subject of his retiring address being "What is a Number System?"

Moore received numerous honorary degrees: Ph.D., Göttingen, 1899; LL.D., University of Wisconsin, 1904; Math.D., Clark University, 1909 (where he lectured on "The Rôle of Postulational Methods in Mathematics"); Sc.D., Yale, 1909; University of Toronto, 1921; Northwestern and Kansas Universities, 1927.

Since 1908, he has been associate editor of *Rendi-*

conti del Circolo Matematico di Palermo. In 1924, both the Mathematical Association of America and the National Academy of Sciences elected Moore a member of the American section of the International Mathematical Union.

Accounts of Moore's remarkable papers will appear in mathematical journals and in the "Biographical Memoirs of the National Academy of Sciences." The following classification of his papers shows that Moore devoted his first seven years of research largely to geometry, the next ten years to group theory and related topics, then six years to classical analysis, and his final twenty years to general analysis.

I. *Geometry.* Moore's first four papers (1885–88) were mainly on n-dimensional geometry. In 1900–04 and 1913 he wrote three more papers on geometry. More typical are his two papers (1902) on axioms of projective geometry.

II. *Groups.* When Moore came to Chicago in 1892, group theory was the fashion in the mathematical world. His twelve papers on groups (1893–1905) made fundamental advances. Moore's gift for abstract reasoning was especially effective in group theory. On the closely related topic of triple systems, he wrote four papers (1893–98). Also two papers on Kronecker modular systems (1897, 1907).

III. *Classical Analysis.* Although he was especially interested in improperly definite integrals, Moore published (in 1901) only two papers on them. His eight papers on real variables appeared in 1890, 1895–96, 1900, 1907.

IV. *General Analysis.* This subject is entirely Moore's own invention, and for the past twenty years he devoted his attention entirely to its development. In its final form, it is in MS. But with the aid of the Moore Fund (contributed by his many admirers), it is hoped that this MS. will soon be published in book form.

The oldest version appeared in 1909 in Vol. 2 of the Proceedings of the Mathematical Congress at Rome. Next came his New Haven Mathematical Colloquium in 1910. In all he published thirteen papers on general analysis (1909–22) and three closely related papers on linear integral equations (1912–13). To attempt to explain the nature of general analysis in a few words would be as futile as to do the same for Einstein. The inquisitive reader may well consult Bolza's introduction to Moore's general analysis in *Jahresbericht der Deutschen Mathematiker-Vereinigung,* 23 (248–303), 1914.

Moore's work easily places him among the world's great mathematicians. In America, his various accomplishments made him the leader. But he was a leader who was universally loved, and this was because he was at the same time a prince of a man.

L. E. DICKSON

HARLAN WILBUR FISK

PROFESSOR HARLAN WILBUR FISK, of Kensington, Maryland, magnetician and chief of the section of land magnetic survey, Department of Terrestrial Magnetism, Carnegie Institution of Washington, died at the Washington Sanitarium, Takoma Park, Maryland, on December 26, 1932, after a brief illness. Professor Fisk was born at Geneva, Kansas, on September 25, 1869, and received his early scientific training at Carleton College, Northfield, Minnesota, where he came under the inspiring influence of Professor W. W. Payne. During the period 1899–1906 he held the professorship of mathematics at Fargo College (North Dakota) and was dean of the faculty during 1904–1906. He spent the summers of these three last years at Fargo as magnetic observer in the employ of the U. S. Coast and Geodetic Survey and in October, 1906, he joined the staff of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington in the same capacity. He was successively advanced to the positions of magnetician and chief of the section of land magnetic survey. His field work, however, did not cease with his entrance into the department, for he carried out two detailed magnetic surveys of the Bermuda Islands in 1907 and 1922, respectively, and led a magnetic-survey expedition to British, Dutch and French Guiana in 1908. He also took part in various expeditions sent out by the department to investigate possible effects on the earth's magnetism due to solar eclipses, the most recent of these being on the occasion of the total solar eclipse of last August, when he was in charge of the three parties sent to New England by the department for this purpose. During the last few years he has been engaged in important researches of the secular variation of the earth's magnetism based largely on data obtained under his supervision by observers of the Department of Terrestrial Magnetism. These studies led him to suspect that secular changes in the earth's magnetism as observed on its surface might be the reflection of changes in the earth's interior. His work along these lines was internationally recognized.

Professor Fisk was a member of a number of scientific bodies, including the American Association for the Advancement of Science, Washington Academy of Sciences and the Philosophical Society of Washington. He was also an active member of the American Geophysical Union, being secretary of its section of terrestrial magnetism and electricity during the period 1929–1932. He is survived by his widow, Louie B. Hubbell Fisk, and four children, Clarence Wilbur, Marion Sarah, Willis Hubbell and Ernest Harlan.

Professor Fisk was a man of broad interests who took a leading part in the civic and religious activities