and has applied it to the question of the thermodynamic relations exhibited by the universes contemplated in relativistic cosmology. He has, for example, thus sought to establish the possibility of a universe in which radiation is in equilibrium with matter and which, although expanding or contracting at a finite rate, does not suffer the ultimate "heat death" which an observer viewing it through the eyes of classical thermodynamics would predict.

Finally, I must call your attention to a doubt which the results outlined above have raised. The time scale which the observed red shift in light from the distant nebulae leads to if interpreted as due to velocity is rather meager. What are we to think of a universe whose radius is at present expanding at such a rate as to double itself every 1,400 million years which contains stars whose age is estimated at millions of millions of years?[3] Perhaps we may be able to conclude that the processes which lead us to these tremendous ages were proceeding at a much greater rate when the world was young, or it may be that the astronomers have been over-zealous in demanding millions of millions of years when but a fraction of that would have sufficed. Einstein and de Sitter appear to have been moved by the rather short time scale to favor a periodic universe in which we are now enjoying the expansion phase, but which may conceivably reverse this tendency before the sun becomes too cold to support life. In addition to those who believe that the at first sight paradoxical time scale is nevertheless reconcilable with the observed facts there exists a group which would attribute the observed red shift, which we have throughout interpreted as a velocity, to a property of light which has traveled the tremendous inter-nebular distances. Zwicky suggested a few years ago that there may exist a mechanism by which the light-corpuscles surrender a minute fraction of their energy to nebulae and other matter which they pass on their journey to us; this loss of energy would be proportional to the distance through which they travel and would, in accordance with our present theory of light, give rise to a red shift in the observed spectrum. In this case our interpretation would be quite false—the observed red shift would be due to the properties of "tired" light rather than to the nebulae themselves. But I do not believe that even if room could be found in our theories for such a modification it would alter essentially the general outlook with which we have been concerned this evening, for so long as we have sufficient evidence in other fields to hold to the general theory of relativity and so long as the homogeneity assumptions with which we started are not at variance with the observations we may consider relativistic cosmology as a simple corollary of the relativity theory. Robbed of all contact with the empirical we would of course be unable to decide which of the alternatives was best suited for a description of the actual universe—perhaps we should fall back on the Einstein universe which was originally offered to us as escape from the paradoxes of an infinite world filled uniformly with matter. But in the lack of further facts I should prefer to wield Occam's razor on all *ad hoc* explanations of the red shift and accept that one which follows so naturally from our present views of the nature of the physical world, the bold outlines of which I have had the pleasure of sketching before you this evening.

[3] I here refer to the attitude which has been expressed by de Sitter (Bull. Astron. Inst. Netherlands 5 No. 193, p. 212, 1930) and which has been adopted by others. I do not consider the objection to be as serious, but do hold it to be a valid argument for a universe of the type $\lambda = \lambda_E$ resulting from a perturbation of the unstable Einstein world.

OBITUARY

CHARLES WILLISON JOHNSON

IT has been said of many great men that kindliness of manner and disinterested helpfulness were among their outstanding traits. Joseph Leidy is remembered by those he taught almost as much for these qualities as for the greatness of his intellect or his innumerable and far-reaching discoveries. Into the early lives of many of us standing awestruck at the threshold of the world of nature, which we wished so much to know better, a hand was stretched out, and a kindly teacher—or better, friend—led our faltering steps through the portal and fixed our life's greatest interest. This brief tribute is to one whose guiding hand placed me on the happy road which teaches boys to see, to understand and to appreciate the world about them.

Charles Willison Johnson was born at Morris Plains, Morris County, New Jersey, on October 26, 1863. Educated in public and private schools at Morristown, New Jersey, he early showed a deep interest in natural history. In 1881, his family removed to St. Augustine, Florida, and there during the succeeding seven years he continued his studies and made extensive collections, chiefly of insects, mollusks and fossils.

In 1888, having been appointed curator of the Museum of the Wagner Free Institute of Science in Philadelphia, he brought to this work a broad knowledge of natural history and an intimate acquaintance with the existing and fossil fauna of Florida. At

the Wagner Institute he proceeded to develop in the museum an excellent local natural history collection and also a detailed synoptic collection of the animal world. At the same time he was able to broaden and increase his interest in the Diptera, so that he soon became one of America's authorities on that group of insects. Recent mollusks also occupied his attention, and these with the Diptera remained his major fields of investigation. For a number of years during his Philadelphia residence he was also actively at work on fossil mollusks, and in charge of the Isaac Lea Collection of Eocene Mollusca at the Academy of Natural Sciences of Philadelphia. In the development of this collection he visited the Eocene deposits of the southern United States a number of times. In 1891, accompanied by William J. Fox, of the Academy of Natural Sciences of Philadelphia, Johnson visited Jamaica, and made extensive collections of the insects and mollusks of that island, his important study of the Diptera of the island being based on these investigations.

With Henry A. Pilsbry in 1890, Johnson assumed the management of the *Nautilus,* associate editor and business manager of which he remained until his death. In 1897 he married Miss Carrie W. Ford, a daughter of John Ford, one of Philadelphia's group of conchologists.

The post of curator of the Boston Society of Natural History being vacant, in 1903 he was appointed to that office, and in the conversion of the Boston Society's museum into a strictly New England one, the succeeding years witnessed the application of his unusual ability to adapt, rearrange and develop museum collections under conditions of limited financial support. This is a rarely met capability, little appreciated by those with lavish funds and many assistants. How much personal labor the years in Philadelphia and the early ones in Boston required is known only to those intimately associated. My personal contact with C. W. Johnson was during most of the Philadelphia period, and it was during these busy years, filled for him with duties of many kinds, that his encouragement of boyish enthusiasm, and the tolerance and patience of our revered teacher and guide, laid the foundations for entomological careers in three of his volunteer youngster helpers.

While on a short collecting trip to his favorite locality, Martha's Vineyard, he was seriously stricken, and died in Boston on July 19, 1932. A fellow of the American Association for the Advancement of Science, Johnson was also a fellow of the American Academy of Arts and Sciences and of the Entomological Society of America, to the presidency of which latter he was elected in 1924. In addition to membership in a number of other scientific organizations, he was a member of the Malacological Society of London and of the Conchological Society of Great Britain and Ireland.

Johnson's studies in the Diptera were productive of numerous original contributions, while his generous aid to fellow students placed at their disposal in special studies the collections secured on his innumerable field trips in the Philadelphia district and in New England. The number of beginners who drew their early encouragement from this born naturalist will never be known, but the memories of his personal magnetism, ever-youthful enthusiasm and kindly help will remain cherished possessions of many now seasoned scientists.

JAMES A. G. REHN
THE ACADEMY OF NATURAL SCIENCES
OF PHILADELPHIA

RECENT DEATHS

DR. OLIVER DIMON KELLOGG, professor of mathematics at Harvard University, died suddenly when climbing a mountain near Greenville, Maine, on August 27. Dr. Kellogg was fifty-four years old.

DR. MOSES ALLEN STARR, professor emeritus of neurology at Columbia University, died on September 4. He was seventy-eight years old.

PROFESSOR EDGAR JAMES SWIFT, head of the department of psychology at Washington University, St. Louis, since 1925, died on August 30, at the age of seventy-two years.

JAMES E. DONAHUE, associate professor of mathematics in the University of Vermont, died suddenly on August 13, at the age of fifty-two years.

DR. NATHANIEL ALLISON, formerly professor of surgery in charge of the division of orthopedic surgery at the University of Chicago, died on August 25, at the age of fifty-six years.

THE death is announced of Dr. Adolf Sauer, professor of mineralogy and geology at the University of Stuttgart; of Dr. Otto Mügge, professor of mineralogy at Göttingen, and of Dr. Albert von Ettingshausen, professor of physics at Graz.

SCIENTIFIC EVENTS

BRITISH VITAL STATISTICS FOR 1930

THE Registrar-General's Statistical Review of England and Wales for 1930, the last of the three volumes for that year, is summarized in the *British Medical Journal.* It contains the official commentary on the vital statistics in Part I Medical Tables and