

especially unusual knowledge and patience. In this volume, and the one to come, every original description and figure has been reproduced; and the tangles, into which the various species were tied by fragmentary

material and inadequate comparison, have been straightened out. This will be the starting point for all future students of the elephant family.

F. B. LOOMIS

ACADEMIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE 1936 fall meeting of the Tennessee Academy of Science was held at Vanderbilt University on November 27 and 28. Dr. C. R. Fountain, president, presided at the general session in Furman Hall; L. R. Hesler, chairman, at the botanical session in Buttrick Hall on Friday afternoon.

Schools represented on the program were: University of Tennessee, King College, Carson-Newman College, Teachers College, in East Tennessee; Vanderbilt University, University of the South, Teachers College, George Peabody College, in Middle Tennessee; the Southwestern, Teachers College, Freed-Hardeman, in West Tennessee. Botany and biology claimed more than half of the subjects, but physics, mathematics, archeology, geography, bacteriology, engineering, were also included.

Three members of the academy, in turn, discussed the rainbow trout, the wild trilliums of the Great Smoky National Park and the availability of the park as a field for biological research.

Dr. Clinton L. Baker made a report of investigations at the Reelfoot Lake Biological Station last summer by eleven selected workers under his direction as associate director and resident biologist for the Tennessee Academy of Science. The researches are soon to be published by the academy.

The procedure and results of a research of considerable importance made by E. W. Goodpasture and Katherine Anderson were given by Dr. E. W. Goodpasture, professor of pathology in the Vanderbilt Medical School, in a paper with illustrations entitled "The Problem of Infection as Presented by Bacterial Invasion of the Chorio-allantoic Membrane of Chick Embryos."

The American Association for the Advancement of Science research scholarship for 1936 was awarded by the executive committee to Dr. Horace B. Huddle, professor of chemistry in the State Teachers College, Johnson City, Tenn.

On Friday evening there was a dinner at the Andrew Jackson Hotel, which was followed by an address, "Radio Gives the Doctor a New Weapon—ultrasonic Waves," by Dr. C. R. Fountain, president of the academy and professor of physics at George Peabody College for Teachers.

Officers were elected for the ensuing year as follows:

President, Louis J. Bircher, Nashville.

Vice-President, Peyton N. Rhodes, Memphis.

Editor, Jesse M. Shaver, Nashville.

Secretary-Treasurer, John T. McGill, Nashville.

Director of Reelfoot Lake Biological Station, Clinton L. Baker, Memphis.

Librarian, Eleanor Eggleston, Nashville.

JOHN T. MCGILL,

Secretary

THE TEXAS ACADEMY OF SCIENCE

THE annual meeting of the Texas Academy was held in the Plaza Hotel, San Antonio, Texas, on November 12, 13 and 14. The annual dinner of officers and committees was held on Thursday night, during which time an informal discussion of the business of the academy was held. This was followed by the standing committee meetings.

The general program was divided into four sections, meeting in the various assembly rooms within the hotel. The Biology Section, with E. J. Lund as chairman, listened to a number of papers ranging in subject from the experimental work done with cotton to a synopsis of the monumental paper, "The Amphibia of Texas," by A. H. and A. M. Wright, Cornell University, N. Y.

The Geology Section had a full program, with subjects ranging from the "Pleistocene Man in Texas," by M. L. Crimmins, to the first of the papers on the geomorphology of the Rio Grande Delta, by W. Armstrong Price, A. E. Anderson and John Doering.

During the noon hour the sections held independent luncheons. Outstanding among these was the geology luncheon upon the invitation of the Petroleum Club, followed by a paper on "Heaving Shales and Evidences for Their Associations with High Rock Pressures in Oil Fields," by Paul Weaver.

In the afternoon the Chemistry, Mathematics, and Physics Section had a full program with two papers on mathematics and two on physics.

The Biology Section had a program that crowded the time. The outstanding papers were those by E. P. Cheatam, Southern Methodist University, relative to his studies on mollusca; the distribution of Texas Acridians, by E. B. Isely, Trinity University; and notes concerning the vegetation of the Woodbine Sands, Denton County, Texas, by H. L. Graham, Gainesville Junior College.

The Social Sciences Section consisted of six papers, most of them having to do with the business methods of governments.

The Geology Section listened to numerous papers. Chas. N. Gould, of the National Park Service, spoke on the geology of the national parks. The discussion relative to the geomorphology of the Gulf Coast was completed.

The high point of the meeting was the annual dinner of the academy, with over two hundred and fifty present. After a most enjoyable dinner, a musical program given by the students of the Incarnate Word College, San Antonio, ushered in the regular program of the evening. Secretary Frederick A. Burt gave a review of the year's work of the academy together with the plans for the coming year and the problems that should be brought to the attention of the members. An honorary life membership was conferred upon Clyde T. Reed, the first president of the present academy. The annual address of the president, entitled "Problems of the Texas Pleistocene Ice Age," illustrated by slides, was a scholarly production. An illustrated lecture on "The Next Hundred Years" by Walter P. Taylor, senior biologist of the U. S. Biological Survey, dealt with what has happened in the last hundred years and what might be done to bring back desirable conditions that once existed.

The Saturday program found Sections on Physics,

Chemistry, Mathematics and Biology in session. Chemistry predominated and centered around certain interesting organic compounds rather well known in all sciences. The Biology Section had a very full program, centered around the general topic of a marine biological laboratory to be located on the Gulf Coast. Walter P. Taylor reviewed the Texas Cooperative Wildlife Service, and connected this with what might be accomplished between the Wildlife Service and the marine laboratory. Gordon Hunter, Albert Collier and O. Sanders, all of whom have collected very largely on the Gulf, gave their reactions as to what might be done.

A business session was held during the noon hour. The officers for the following year are: Don O. Baird, Sam Houston State Teachers College, Huntsville, *president*; E. B. Isely, Trinity University, Waco, *executive vice-president*; Frederick A. Burt, Texas A. and M. College, College Station, *secretary*; A. J. Kirn, Somerset, *treasurer*; Mrs. Helen Jeanne Plummer, Austin, *editor*; representative to the American Association for the Advancement of Science, S. W. Bilsing, Texas A. and M. College, College Station. A committee was appointed to select from the numerous offers made a place for the next annual meeting.

H. B. PARKS,
Secretary Emeritus

SAN ANTONIO, TEXAS

SPECIAL ARTICLES

THE SIZE OF THE UNIVERSE AND THE FUNDAMENTAL CONSTANTS OF PHYSICS¹

THE problem of the size of the universe is usually treated in connection with the ideas of a curvature of space and an expansion of the universe. It seems, however, that results concerning the size of the universe may also be gained without any reference to these ideas. If we consider a homogeneous sphere, it follows from the theory of potentials that the amount of the gravitational energy is $3 f M^2 / (5 R)$, where M and R are the total mass and the radius of the sphere and f the gravitational constant. On the other hand, the proper energy of this sphere is $M c^2$, where c denotes the velocity of light.

We may now make the rather obvious assumption that the amount of the gravitational energy of the sphere can not be smaller than its proper energy. This means

$$(1) \quad \frac{3 f M^2}{5 R} \leq M c^2.$$

On the other hand, the mass is equal to the density (ρ) multiplied by the volume of the sphere, or

$$(2) \quad M = \frac{4}{3} \pi R^3 \rho.$$

The combination of the two formulas yields the relation

$$(3) \quad M \leq \frac{5^{3/2} c^3}{6 \sqrt{\pi} f^{3/2}}$$

or, if we insert the well-known values of c and f

$$(4) \quad M \leq \frac{10^{42}}{\sqrt{\rho}}$$

Astronomical research gave for the average mass density in the observable part of the universe the empirical value of 10^{-28} gms per ccm. According to formula (4) we find as an upper limit for the mass of a sphere of this density a value of 10^{56} gms. On the other hand, we find also an upper limit for the density of a sphere of given mass. If, *e.g.*, we assume this mass to be equal only to the sum of the masses of all actually observable astronomical objects, that is, equal

¹ A paper delivered at the Tercentenary Conference of Arts and Sciences at Harvard University, September, 1936.