Longwood estate of Mr. Pierre S. duPont and a display of the electric fountain, which is said to be the most beautiful illuminated water display in the world.

THE second meeting of the International Society for the Investigation of Sex will be held in the House of the British Medical Association, Tavistock Square, London, from August 3 to 9, 1930. It may be assumed that, as was the case in Berlin, the papers presented for discussion will fall into the following groups: biology; physiology, pathology and therapeutics; psychology, pedagogy, ethics, esthetics, religion; demography, statistics, social and racial hygiene; sociology, ethnology and folk-lore. All the arrangements are in the hands of Professor F. A. E. Crew, The University, West Mains Road, Edinburgh, to whom all those who are interested are requested to write.

THE ninth summer session of the American School of Prehistoric Research will open in London on July 1, under the direction of Dr. George Grant MacCurdy, of Yale University. The greater part of the summer will be spent on the continent, especially in France, where excavation will be carried on. Professor and Mrs. MacCurdy will sail from New York on June 15.

THE centenary celebration meeting of the Zoological Society of London was held on April 9 in University College, and was attended by representatives of scientific bodies from Great Britain, America and Europe. According to the London *Times* the Duke of Bedford, the president, gave an outline of the history of the society since it came into existence in 1826, three years before it received its charter. The first piece of ground rented was about five acres in extent, where the clock tower now stands. That had now grown to 35 acres and the society had acquired an estate of 500 acres in Bedfordshire, where a larger and freer zoological park could be developed. In 1831 King William IV, having given the society all the animals in the menagerie at Windsor, became patron of the society. In the first year after the war the number of visitors to the zoo was a million and a half; last year the number was nearly two and a quarter millions, and the society had over 8,000 fellows. Dr. Chalmers Mitchell, the secretary, pointed out that the society was a scientific body founded by scientific men for defined scientific objects, and said the centenary congratulations received from learned bodies all over the world would not have come to them if they were merely exhibitors of living animals, however attractive and educational their exhibition might be.

THE Pacific Division of the American Association for the Advancement of Science, which is to hold its thirteenth annual meeting at the University of California in Berkeley, June 19 to 22, will offer a prize of $100 for the most important scientific contribution reported by a resident of the Pacific Division territory at that time. The committee on award which will judge the contributions reported has been appointed. The members are: Dr. Robert Aitken, associate director of Lick Observatory, for mathematics and astronomy; Dr. I. S. Bowen, of the California Institute of Technology, for physics; Dr. Joel H. Hildebrand, of the University of California, for chemistry; Dr. Herman A. Spoehr, of Carnegie Institution, for botany, and Dr. Charles A. Kofoid, of the University of California, for zoology. The reports submitted need not be the work of members of the Association for the Advancement of Science. They should represent noteworthy contributions to science, founded upon work already accomplished. They may be in part summaries of investigations, the results of which have been recently published.

UNIVERSITY AND EDUCATIONAL NOTES

THE new laboratory of chemistry at Colgate University, which will be built at a cost of $400,000 with funds provided by the will of the late Mary Evelyn Colgate will be named for Dr. Joseph F. McGregory, who was for forty-four years head of the department.

BY the will of the late Emily C. Butler, of Scarsdale, N. Y., New York University and Union Theological Seminary share the residuary estate, each receiving $233,109. In addition, the university receives legacies amounting to $500,000, and the seminary a $150,000 legacy.

PROFESSOR PARKER HAYWARD DAGGETT, head of the department of electrical engineering at the University of North Carolina, has been appointed dean of the engineering school of Rutgers University. Professor Daggett will succeed Professor Edward H. Rockwell, resigned.

PROFESSOR RICHARD G. DUKES, head of the department of applied mechanics, has been appointed dean of the newly established graduate school of Purdue University.

AT a recent meeting of the board of regents of the University of Nebraska action was taken establishing a department of geography as a coordinate unit in the college of arts and sciences, and Dr. Nels A. Bengtson was made chairman of the newly created department. The department also gives courses which are included in the college of business administration, teachers college and the agricultural college.

THE department of physics of the University of California announces the following changes in its staff for the year 1929–30: Dr. Frederick S. Brackett has

resigned as associate professor of physics to accept an appointment at the Smithsonian Institution. Dr. Francis A. Jenkins, of New York University, has accepted a position as assistant professor of physics. As has already been noted here, Dr. Leonard B. Loeb has been promoted from an associate professorship to a professorship of physics.

DR. CLIFF STRUTHERS HAMILTON, associate professor of chemistry at Northwestern University, has been appointed to a professorship in the department of chemistry of the University of Nebraska.

DR. D. G. STEELE, of Yale University, has been appointed assistant professor of genetics in the resident teaching division and assistant geneticist in the experiment station division of the Connecticut Agricultural College.

DR. CLYDE A. MALOTT, of Indiana University, has been appointed professor of geology at Williams College.

DR. JULIA M. SHIPMAN, of the University of Tennessee, and Professor Leland S. Paine, of the Texas Agricultural College, are visiting lecturers who will give courses in geography in the summer session of the University of Nebraska, which opens on June 10 and lasts nine weeks.

DR. JAN SCHILT, research assistant at the Yale Observatory, has been promoted to be an assistant professor.

DISCUSSION

REMARKS ON UNCERTAINTY PRINCIPLES

SINCE the publication of Heisenberg's paper[1] on the "anschaulichen Inhalt" of quantum mechanics, discussions of the fundamental limitations on the accuracy of physical measurements have been much in the foreground. According to Heisenberg, the quantum mechanics implies that it is impossible to measure simultaneous values of a coordinate and its conjugate momentum with unlimited precision. Instead, if Δp be the estimated error or uncertainty in a momentum and Δq that in the associated coordinate one must have the inequality,

$$\Delta p \Delta q > \frac{h}{2\pi} \qquad (1)$$

This inequality has come to be known quite generally as Heisenberg's uncertainty relation.

In discussions on this subject it is essential to distinguish two standpoints. One is the analysis of proposed experiments, whether realizable or ideal, by which it is proposed to make measurements. The other is that of the relation of the uncertainty principles to the laws of quantum mechanics as now formulated. It is only the second standpoint which is considered here.

The origin of the uncertainty relation (1) for p and q lies in the fact that the operators which represent p and q do not commute. Therefore one is tempted to suppose that such an uncertainty relation may be true for any two quantities whose operators do not commute. Such, however, is not the case. These remarks establish by means of specific examples the truth of the following statements:

(*a*) The fact that the operators corresponding to two physical quantities, A and B, do not commute does not imply the existence of an uncertainty relation of the form of (1), namely, that the product of the two uncertainties must be greater than or equal to some lower limit.

(*b*) Even if A and B do not commute, there may be exceptional values of A and B which may be both known simultaneously with no uncertainty.

(*c*) There may exist a limited class of states of the system, with regard to which A and B do commute, but in which nevertheless the two quantities A and B can not be known with unlimited precision.

The relation of the uncertainty principle to the quantum mechanics may be formulated as follows. The configuration of a dynamical system of n degrees of freedom is specified by n spatial coordinates, as in classical mechanics. There may appear new coordinates which do not have classical analogs like the electron spin or the permutation variables but these will be left out of account. The particular state of the dynamical system at any instant is then specified by giving a function $\varphi(x_1 \cdots x_n, t)$ which has the property that $\varphi\bar{\varphi}d\tau$, where $d\tau$ is the volume element of the configuration space, is the probability that the system be found at the instant, t, with its configuration lying in the volume element $d\tau$ of the configuration space which surrounds the point, $x_1 \cdots x_n$.

Corresponding to each physical quantity there is a linear operator, which when applied to φ gives another function of the coordinates, $x_1 \cdots x_n$. Let A be a physical quantity and at the same time A may stand for the operator which represents A. Then

$$\int \bar{\varphi} A \varphi d\tau$$

represents the mean or expected value of A^2 in this state of the system characterized by φ. The integration is over the entire configuration space. Similarly,

$$\int \bar{\varphi} A^2 \varphi d\tau$$

represents the mean or expected value of A^2 in this state of the system.

[1] W. Heisenberg, *Zeits. für Physik*, 43: 172. 1927.