structure of the tone? This paper is a unit in a series of experimental studies on the acoustic characteristics of the violin. Tones were recorded from good violins, played mechanically in a dead room and submitted to harmonic analysis. The effect of shape, weight, material and seating of the mute was studied on each of the four open strings. It was found that the chief variable in a mute is its weight. The effect of size, material and seating were relatively insignificant; although different for the different strings. The mute tends to reduce the total intensity of the tone, not in the fundamental but in the other partials at various levels. The change of harmonic structure varies with the string, the pitch level, the character of the violin, the character of the mute and other factors. Results are shown in graphs.

History in the archives of the Royal Society: SIR WILLIAM BRAGG. The large store of papers in the possession of the Royal Society provides material for history from many different points of view. In particular, it shows how the simple experimental science of its founders, with their common interest in all that came under their notice, has gradually become the highly developed science of to-day, each section of which is intelligible only to its specialist. At the same time, the study of natural knowledge has become of great importance in all branches of human activity. The effects of these changes upon the relations between science and the human society are obvious and very important. They are in consequence receiving serious consideration. For this purpose it is of interest to compare the position of experimental science at different times since the Royal Society was founded: and the society's archives furnish convenient illustrations.

Higher element transformations: EDWARD KASNER. The concept of differential element is important in differential equations and physics. The simplest type in the plane is a point with a direction represented by (x, y, y'). The next type, here studied, is curvature element (x, y, y', y''). A set of ∞^1 elements is called a *series,* ∞^2 elements a *field,* ∞^3 elements an *opulence,* and the totality of ∞^4 elements a *plenum.* The transformation problem of unions is known, the new problem relates to integrable fields (see *Proceedings* of the National Academy, February, 1939). The corresponding problem of surface elements in space (x, y, z, p, q) relates to integrable fields and is more difficult (see *Duke Journal,* March, 1939). A new problem in space relates to sets of ∞^1 surface elements. When will surface strips go into strips? Finally, we study lineal elements in space (x, y, z, y', z'). If we consider merely ∞^1 elements, we obtain the classic theorem of Lie. However, when ∞^2 elements are considered, a new theory is obtained.

(To be concluded)

OBITUARY

HERBERT HENRY WOOLLARD

THE sudden death, on January 18, of Herbert Henry Woollard, professor of anatomy in University College, University of London, is a great blow to British anatomy and to his many friends throughout the world.

Woollard was born in Australia on August 4, 1889. He attended the University of Melbourne, graduating in medicine in 1910. With the coming of the Great War he joined the Australian Army Medical Corps, serving in both Gallipoli and Flanders and attaining the rank of lieutenant-colonel, with three decorations for gallantry. Following the war, he went to University College, London, to work for the fellowship of the Royal College of Surgeons. Here, largely through his contact with Professor Grafton Elliot Smith, Woollard's interests soon shifted to the field of anatomy and he became a member of the anatomy staff of University College, serving as assistant professor from 1923 to 1927. During this period he spent a year in the United States as a Rockefeller fellow, an experience that exerted a profound influence upon his later work. The friendships formed in America forged a strong link between British and American anatomy. In 1927, he was appointed to the chair of anatomy and histology at the University of Adelaide, returning to London in 1929 as professor of anatomy at St. Bartholomew's Hospital Medical School. Finally, in 1936, he succeeded Sir Grafton Elliot Smith in the chair of anatomy at University College, a post of utmost distinction. He was elected fellow of the Royal Society in 1938.

Woollard's interests covered an extremely broad scope. In his earlier years he chiefly devoted his attention to morphological problems, publishing, for example, a monograph on *Tarsius*—an outstanding contribution to primate anatomy—and a number of papers dealing with the visual pathways of primates. Much of his later work was of an experimental nature. It produced among others a series of publications on the innervation of the heart, blood-vessels and skin, which constitute his major contributions to anatomical science. At the time of his death he was concerned with other problems of cutaneous innervation and with the nervous system of coelenterates.

He was a man capable of inspiring deep devotion. Those who were privileged to work with him are particularly able to appreciate his sterling character—his uncompromising and outspoken honesty; his willingness to give unstintingly without thought of return, especially to younger workers; and his intense loyalty and devotion to his friends.

The death of Woollard at the early age of 49 years is an inestimable blow to British anatomy, for he was equally at home in microscopic and gross anatomy and, what is less common among morphologists, he knew how to utilize experimental methods for determining

the functional significance of the structures with which he was dealing. The success with which he already had applied these methods to some of the most important of anatomical problems gave much promise for the years ahead. His death therefore is all the greater loss.

WILLIAM L. STRAUS, JR.
THE JOHNS HOPKINS MEDICAL SCHOOL

RECENT DEATHS

DR. EDWARD ANGUS BURT, formerly mycologist of the Missouri Botanical Garden, who has been living in retirement at his early home near Middle Grove, N. Y., since impairment of his eyesight, died on April 26 at the age of eighty years.

DR. ARTHUR P. JACOT, associate conservationist at the Northeastern Forest Experiment Station, U. S. Forest Service, New Haven, Conn., an authority on the fauna of forest soils, died on March 24 at the age of forty-nine years.

DOUGLAS D. H. MARCH, curator of the Old Panama Zoological Garden, died of a snake bite on April 3 at the age of fifty-two years.

IVAN GUBKIN, explorer and vice-president of the Russian Academy of Sciences, died on April 21 at the age of sixty-eight years.

DR. PAUL EUGENE LINEBACK, professor of microanatomy at Emory University, died on February 8 at the age of fifty-eight years.

PROFESSOR JAMES WILLIAM EDINGTON, professor of bacteriology and director of the Public Health Bacteriological Laboratory of the University of Sheffield, England, died on April 8 from injuries received in an automobile accident. He was fifty-four years of age.

DR. ERNEST H. HANKIN, bacteriologist, retired, of the Indian Service of the British Government, died at the age of seventy-four years on March 29.

SCIENTIFIC EVENTS

GRANTS FOR RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

UPON recommendation of the Committee on Grants, consisting of Drs. J. G. Lipman (Agriculture), *chairman,* McKeen Cattell (Medical Sciences), Moses Gomberg (Chemistry), G. H. Parker (Zoology), F. K. Richtmyer (Physics), Joel Stebbins (Astronomy), Sam F. Trelease (Botany), and A. T. Poffenberger (Psychology), the council of the association has awarded grants in aid of research from the $2,000 fund appropriated for the year 1939 as follows:

Harold C. Bold, Vanderbilt University, for studies of the algal flora of the Highlands of North Carolina and in other portions of the southern Appalachian Mountains, $150.

Kendall B. Corbin, University of Tennessee Medical College, for investigation of the source and nature of the proprioceptive components of the cranial nerves, $200.

Frank H. J. Figge, University of Maryland, for continuation of investigations on the intra-cellular factors controlling enzymatic pigment formation, $250.

Arthur H. Graves, Brooklyn Botanic Garden, for attempts to develop, by breeding, a blight-resistant chestnut tree of a type suitable for timber to replace the now practically extinct American chestnut—*Castania dentata,* $200.

F. R. Hunter, Rhode Island State College, to study the relationship between the respiratory activity of the cell and its selectively permeable properties, $65.

Daniel Linehan, Weston College, to make a seismological study of the earthquake near Lowell, Massachusetts, of June 23, 1938, $80.

Isabelle W. Pfeiffer, Yale University, to aid in a histological study of the corpora allata of the grasshopper, *Melanoplus differentialis,* in correlation with various physiological conditions, particularly those relating to moulting and reproduction, $75.

Christianna Smith, Mount Holyoke College, for the study of the rat embryonic liver in its hematopoietic stage by the tissue culture method to elucidate the origin and differentiation of red blood corpuscles, $100.

M. L. Pool, Ohio State University, to construct a beta-ray spectrograph suitable for measuring the beta-ray spectra of artificial radioactive nuclei; the gamma-ray spectra to be measured by Compton recoil electrons, $300.

H. S. Reed, University of California, Berkeley, to provide help for clerical and bibliographical assistance, for photostats, and possible short trips to other libraries, in connection with preparation of a book on the history of the plant sciences, $150.

Elizabeth S. Russell, Jackson Laboratory, to continue a study of the genetics, histology and physiology of the various benign and malignant tumors in the fruit-fly, *Drosophila melanogaster,* $230.

Sherwin F. Wood, Los Angeles City College, to determine insect reservoirs for *Trypanosoma cruzi* Chagas in the state of Texas and the virulence of these insect infections for white-footed mice, $200.

SUMMER BOTANICAL MEETINGS IN VIRGINIA, WISCONSIN AND CALIFORNIA

DR. GEORGE S. AVERY, JR., secretary of the Botanical Society of America, writes that there will be three regional meetings of the society during June, the first at the Mountain Lake Biological Station, Mountain Lake, Virginia, on June 15, 16 and 17; the second at the University of Wisconsin on June 21, 22 and 23, and the third at Stanford University from June 26 to July 1.