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<i>Science and the Scientific Attitude</i> : PROFESSOR ROBERT S. MULLIKEN	65	FEFFOR C. N. H. LONG. <i>The Protective Action of Certain Purines against Liver Necrosis Produced by Carbon Tetrachloride and Chloroform</i> : DR. R. C. NEALE. <i>Cortico-adrenal and Neural Effects on Gonadotropic Activity of the Pituitary</i> : DR. HARRY B. FRIEDGOOD	82
<i>Technological Trends and National Policy</i>	69		
<i>Obituary</i> :			
Herbert Ellsworth Slaughter: PROFESSOR L. E. DICKSON and PROFESSOR G. A. BLISS. <i>Recent Deaths</i>	72	<i>Scientific Apparatus and Laboratory Methods</i> :	
<i>Scientific Events</i> :		Glycylglycine as a Sea Water Buffer: DR. ALBERT TYLER and NORMAN H. HOROWITZ. <i>Universal Joints for Skeletons</i> : JUSTIN V. SCHWIND	85
The British Trust for Ornithology; The Atomic-physics Observatory of the Carnegie Institution of Washington; The Scientific Exhibit of the American Medical Association; The National Conference on Weights and Measures; Woods Hole Conference on the Problem of Aging	73	<i>Science News</i>	6
<i>Scientific Notes and News</i>	77		
<i>Discussion</i> :			
An Old Answer to a Present-day Problem: W. D. LAMBERT. <i>The Antiscorbutic Properties of a Salt of Iron and Ascorbic Acid</i> : M. PIJOAN. <i>The Maynard Plum—A Carrier of the Peach Mosaic Virus</i> : E. W. BODINE and PROFESSOR L. W. DURRELL. <i>A Companion Word for Plankton</i> : DR. ROBERT T. MORRIS	79		
<i>Special Articles</i> :			
A Crystalline Protein with High Lactogenic Activity: DRS. A. WHITE, H. R. CATCHPOLE and PRO-			

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SCIENCE AND THE SCIENTIFIC ATTITUDE¹

By Professor ROBERT S. MULLIKEN

UNIVERSITY OF CHICAGO

IN my old home town on the coast of Massachusetts there lived some hundred or hundred and fifty years ago a gentleman who styled himself Lord Timothy Dexter. This self-dubbed nobleman was noted for several exploits, of which I will mention three. Lord Timothy once shipped a cargo of warming pans to the West Indies. This seemed rather a joke to his fellow-townsmen, but, as it happened, the warming pans turned out to be ideal for boiling down sugarcane juice, and Lord Timothy made his fortune there and then. On a later occasion, this gentleman, fearing that his wife did not love him, pretended to be dead. When she failed to weep at his funeral, he jumped out of the coffin and beat her soundly. Finally, Lord Timothy once wrote a small treatise, entitled "A Pickle for the Knowing Ones." He could spell after a

fashion, but he could not punctuate. So, in his text, he put one word right after another, but at the end he included a page of periods, commas and semicolons, with the invitation to his readers to "peper and solt it as they ples." In similar fashion, I come to you now with a discourse that is unseasoned by humor; but I beg you to pepper and salt it to suit your own respective tastes.

Although Lord Timothy was not, strictly speaking, a scientist, he had something of the scientist's experimental and obstinately non-conforming spirit. I think, therefore, that he would not object that I am using him to introduce a speech on science and the scientific attitude. I shall begin with a definition.

The word "science" is derived from the Latin "scientia," which can be translated, roughly, as "knowledge." Present-day science may be defined briefly as *organized knowledge*. More fully, it may

¹ Speech "for the faculty" at trustees' dinner to faculty, University of Chicago, on April 9, 1937.

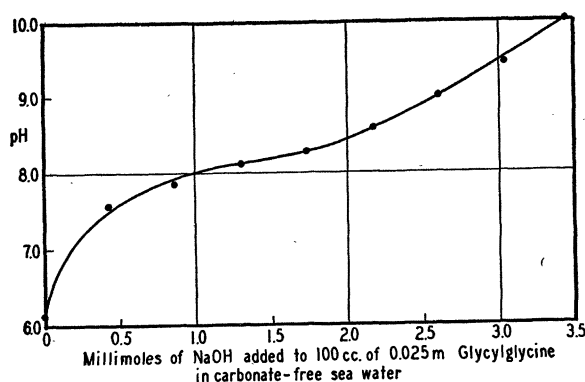


FIG. 1

and were made isosmotic with sea water. Even in the highest concentrations that we employed, namely, 0.25 molar glycylglycine at pH 8.2, cleavage was 100 per cent. Later development is, however, distinctly abnormal in the solutions stronger than 0.10 molar. Between 0.05 and 0.10 molar there is an apparent effect of the glycylglycine in producing thick-walled blastulae and gastrulae. Below 0.05 molar, there is no evidence of any particular effect. For most purposes (*e.g.*, respiration experiments) a 0.005 to 0.02 molar solution provides sufficient buffer action. Veronal⁹ which was tried, since it has also a pH of 8.0, causes abnormal development in a concentration of 0.002 molar; although cleavage may proceed in a 0.01 molar solution.

ALBERT TYLER
NORMAN H. HOROWITZ

UNIVERSAL JOINTS FOR SKELETONS

SEVERAL attempts have been made to produce a mechanical joint for mounted skeletons that would permit motion in all three planes. A joint mechanism was sought that would give movements similar to those observed in a living body, yet without being so large as to be cumbersome nor so flimsy as to be unable to withstand the rigorous handling of freshman medical students.

Fig. 1 shows a joint mechanism that has been successful in three years of service in the medical school laboratory. Twelve of these devices are in good working order on the laboratory skeletons. In the sketch in Fig. 1 is seen a wrist joint assembled in such a fashion as to allow flexion and extension of the hand as well as abduction and adduction. Pronation and supination are obtained by a device modeled after one which has been used by others.

Abduction and adduction are obtained by a sliding joint, which is seen disassembled in Fig. 2. The part A has two rivets which fit into slots in the part B and

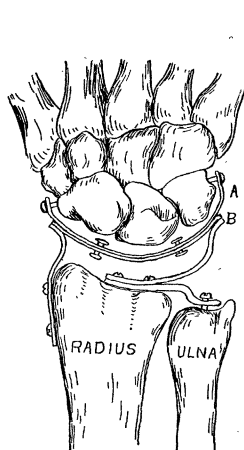


FIG. 1

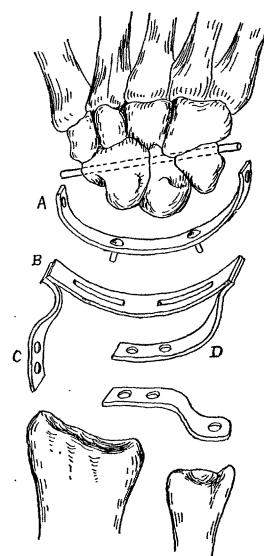


FIG. 2

their ends are headed to hold them in the slots. The length of the two slots can be varied, depending upon the amount of abduction desired. The part B is held stationary to the radius bone by the parts C and D, which are attached to the bone by small brass screws. B is attached to C and D by solder. Such a device allows the part A, which is attached to the hand, to slide back and forth upon the part B and simulate the abduction and adduction of the living hand.

The part A is attached to the carpal bones of the hand by an axle or pin passing through the proximal three carpal bones, as seen by the dotted line in Fig. 2. The ends of the pin are inserted into the holes in the metal piece A, and these ends are flattened to prevent them from pulling out of the holes. A complete flexion or extension of the hand can thus be obtained, as the pin through the carpus acts similarly to an axle.

The same method was utilized in a joint for the shoulder to obtain medial and lateral rotation of the arm as well as flexion and extension, and abduction and adduction.

The parts used in this joint can be made of sheet brass or of any durable iron alloy in bands about one thirty-second of an inch in thickness.

JUSTIN V. SCHWIND

LOYOLA UNIVERSITY, CHICAGO

BOOKS RECEIVED

- Actualités Scientifiques et Industrielles.* Nos. 412, 428, 430, 438, 439, 440, 443, 444. Hermann et Cie, Paris.
GESELL, ARNOLD and FRANCES L. ILG. *Feeding Behavior of Infants.* Pp. ix + 201. 24 figures. 11 plates. Lip-pincott. \$4.50.
MICHELSON, TRUMAN. *Fox Miscellany.* Smithsonian Institution, Bureau of American Ethnology, Bulletin 114. Pp. 124. U. S. Government Printing Office. \$0.25.
MILLER, DAYTON C. *Sound Waves, their Shape and Speed.* Pp. xi + 164. 64 figures. Macmillan. \$2.75.

Amino Acid Manufactures, of the University of California at Los Angeles, was used in these experiments.

⁹ L. Michaelis, *Jour. Biol. Chem.*, 87: 33, 1930.

New McGraw-Hill Books

Senning—Laboratory Studies in Comparative Anatomy

By W. C. SENNING, Cornell University. *McGraw-Hill Publications in the Zoological Sciences.* 195 pages, 6 x 9. \$1.75

This manual comprises a rather extensive set of systematic studies on the shark, Necturus, and the cat, selected and arranged to give a thorough introduction to vertebrate anatomy. Directions are unusually full and complete. Where a thorough knowledge of definite structure is to be gained only through a knowledge of its development, brief developmental accounts have been included.

Outline Drawings for Laboratory Studies in Comparative Anatomy

By W. C. SENNING. 60 plates, 8½ x 11. \$1.50

A distinctive feature of the manual described above is this set of outline drawings. By their use much time ordinarily spent in drawing can be devoted to more complete and careful studies than would otherwise be possible. For many studies mere outline drawings to be completed by the student are provided, so that the desirable training to be gained by the student in making his own drawing is not entirely eliminated.

Trewartha—An Introduction to Weather and Climate

By GLENN T. TREWARTHA, University of Wisconsin. *McGraw-Hill Series in Geography.* 372 pages. \$3.00

The purpose of this book is to meet the need for a brief introductory text covering the field of weather and climate. It is written from a climatic rather than a meteorological point of view and is designed to provide an outline for a general introductory course on the atmosphere. A distinctive feature of the book is the fact that it combines in one volume the physical and regional elements of climate. Another feature is the recognition made of the new methods of weather analysis by air-mass methods. The inclusion of bibliographic outlines at the end of each chapter in Part I is also noteworthy.

Loomis and Shull—Methods in Plant Physiology, A Laboratory Manual and Research Handbook

By WALTER E. LOOMIS, Iowa State College, and CHARLES A. SHULL, University of Chicago. With a chapter on statistical methods by GEORGE W. SNEDECOR, Iowa State College. *McGraw-Hill Publications in the Agricultural and Botanical Sciences.* 472 pages. \$4.50

This book is intended as a reference for teachers of elementary biology and botany, and as a handbook of plant physiology methods for research workers in agronomy, botany, forestry, horticulture and other plant sciences. Thirteen chapters contain laboratory experiments covering the field of plant physiology and ranging in complexity from simple demonstrations to research techniques. There are nine chapters dealing with chemical and physical methods for plant physiology studies.

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