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SCIENCE AND THE SCIENTIFIC ATTITUDE[1]

By Professor ROBERT S. MULLIKEN

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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 sugar-cane 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 plese." 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.

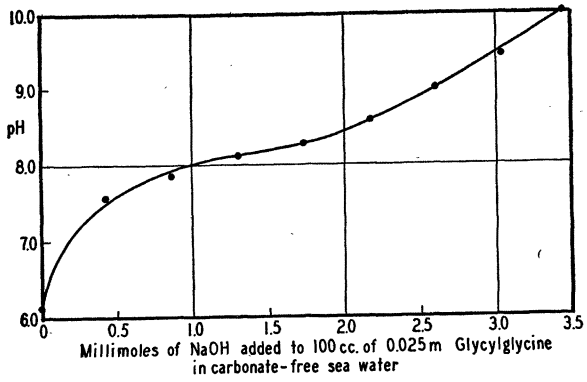

FIG. 1

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. Veronal[9] 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 dissembled in Fig. 2. The part A has two rivets which fit into slots in the part B and

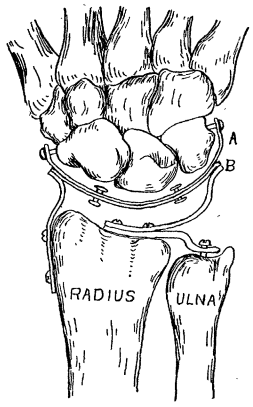

FIG. 1

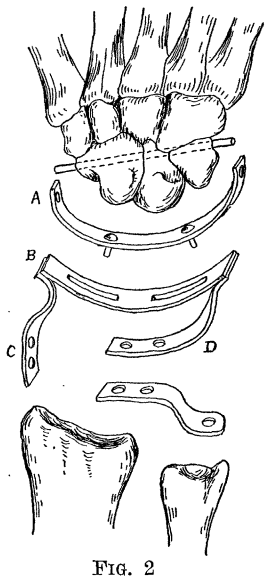

FIG. 2

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. Lippincott. $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.