the ability to meet emergencies are more important requisites for success than deep or accurate scientific knowledge.

The author of the work under review is not only possessed of deep and accurate scientific knowledge, but has had an exceptionally wide and valuable experience as an engineer. The present work is not an ordinary text-book; indeed most of the subjects discussed in ordinary text-books are entirely omitted here. This work begins, broadly speaking, where the usual text-book leaves off, and concerns itself with an exhaustive discussion ranging from large questions down to details of design, and throughout it all the author draws upon his experience, and, in an easy conversational way which makes the book very readable, places here on record his opinions, his deductions, and his experiences regarding most of the important matters involved in the design of bridge structures.

The work is a large one, comprising two bulky volumes, with a total of over two thousand pages. Indeed, if any criticism is to be made of the work, it is that it is too bulky and includes some information which might well have been omitted, such for instance, as a glossary of terms covering 220 pages which might have been relegated to a technical dictionary rather than included in a treatise on bridge engineering. However, the book, as stated, is not a text-book, and will not be carried about by college students in their grips; it is a reference book for the office and for the consulting engineer, and for such it will be found of great value. The bridge engineer who desires to inform himself with reference to any type of structure, or to investigate any particular problem, will be apt to find in this work some clue which will guide him, if indeed he does not find the direct answer to his inquiry.

The book is rather uneven, it is true, in its treatment, devoting for instance, forty-eight pages to the subject of cantilever bridges, thirty pages to arches of all the various kinds, sixteen pages to suspension bridges, and seven pages to wooden bridges and trestles. However, the work does not pretend to be a complete treatise; it is supplementary to the usual text-books and the author has not thought it necessary or desirable, merely for the sake of completeness, to cover ground which is quite adequately treated in other works. This work is supplementary to such treatises and aims to give the profession the results of the experience and study of its author, and the opinions which he has been led to hold on the various matters of bridge design and construction. It will be found a very valuable work for the consulting engineer and the bridge specialist, while the engineering student will find an opportunity therein to pursue lines of inquiry upon which he may be engaged, and to learn the opinions of an eminent bridge engineer.

A characteristic of the work is the inclusion therein of a number of chapters relating to matters not generally touched upon in such works, such, for instance, as "Esthetics in Design," "Office Practise," "Bridge Failures and Their Lessons," "Responsibility of the Bridge Engineer," "Ethics of Bridge Engineering." A very interesting chapter is that on "Expedients in Design and Construction" in which instances are give of the exercise of the important quality of "gumption" which every successful engineer must possess in greater or less degree. The book will be found of value, not only for the technical information which it contains, but because it emphasizes the necessity for qualities, other than mere mathematical ability or an understanding of small technical details, for the successful structural engineer. It is a book which will tend to broaden the view and so increase the usefulness of the young engineer.

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SPECIAL ARTICLES

ON THE ELECTRIC ORGANS OF GYMNOTUS CARAPUS

IT was suggested to the writer by Professor U. Dahlgren, of Princeton University, that *Gymnotus carapus* might furnish material for the study of electric organs. Miss A. Lowrey[1]

[1] *Jour. Morph.*, Vol. 24, p. 693.

in her examination of several Gymnotid fishes was unable to find electric tissues. She found that

> in or between the first and second muscular units of the ventral portion of the great lateral muscles, there was a slight degeneration of parts of the muscles. The larger units had been reduced to two minute oval muscles embedded in either strands of cartilage, or strands of cartilage and fat, and occupied parts of two triangular spaces, one on each side of the median septum just above the (muscle) unit which controls the anal fin. No plates, special nerve fibers, or nerve endings were seen.

In my examination of the specimen which had been collected by Professor Dahlgren some years ago, I noticed that when the fish was scaled a portion of the body appeared almost translucent. The location of this part corresponds exactly to the location described by Miss Lowrey where "slight degeneration of parts of the muscles" had taken place. Sections were made of this portion of the body, and a study of these has shown beyond all doubt that the portion of the body in question is composed of electric tissue. Not only were the characteristic electroplaxes found, but also the special electric nerve fibers and blood-vessels supplying them.

The fish used for this study measured approximately 31 cm. in length. The body is more or less filiform, tapering to an extremely finely pointed tail. The head is flattened dorsally and the upper lip projects slightly over the lower lip. The gill opening is rather small with a dusky spot just above it. The vent opens just behind the throat. The dorsal fin is entirely lacking, while the ventral fin extends from the tip of the finely pointed tail to a position just posterior to the vent opening. The fin is controlled by a muscle unit lying just dorsal to it. The electric organs extend from the tip of the tail forward, following along the entire length of the ventral fin and lying dorsal to the muscle unit controlling the fin. There are two such organs, one on each side of the body, each tapering more or less at the cephalad and caudad ends, thus giving the organs the form of much-elongated spindles. In cross-section these electric areas appear triangular in shape and are separated by the median septum.

The electric spindles are divided into five longitudinal tiers by horizontal sheets of connective tissue running the entire length of the organ. In these tiers the electroplaxes are arranged perpendicular to the septa in compartments bounded by the electrolemma and embedded in the "electric jelly." These compartments, with the electroplaxes lying in about the middle, are relatively large, with the result that the electroplaxes are rather widely separated. Since the strength of the electric current produced is proportional to the number of electroplaxes, it is safe to assume that the electric current produced by *G. carapus* must be extremely weak, if it is at all perceptible.

The electroplaxes are plainly seen in any section taken through the electric organ. They are more or less square or oblong in shape, with irregular projections (papillæ) on the cephalad and caudad sides. These papillæ are usually longer on the caudad sides. Numerous oval nuclei are arranged peripherally and no cell walls are present. The core of the electroplax is homogeneous in appearance. The nerves and blood-vessels always approach the caudad side of the plates, a condition which is similar to that found in the electric eel and other Gymnotids.

It is thus evident that the tissue which Miss Lowrey has described as degenerated muscle units is really an electric organ. Her mention of "strands of cartilage" being intermingled with the degenerated muscle leads me to believe that she has seen the electroplaxes and interpreted them as being cartilage. They are usually of a homogeneous, hyaline appearance and with their numerous nuclei might present a cartilaginous appearance. Yet their form is that so characteristic of electric plates that one can not overlook them.

Another of the Gymnotids which Miss Lowrey has examined and reported to possess no electric organs is *Eigenmannia virescens*. In the posthumous work of Sachs (1881) on *Gymnotus electricus*, some of his field notes are published which describe and figure por-

tions of the body which he considered to be the electric organs of *Eigenmannia* (*Sternopygus*). It is interesting to note that his description of the macroscopic appearance of the electric organs exactly fits that of *Gymnotus carapus* presented here.

From an evolutionary standpoint, the weak or pseudo-electric fishes form a subject of interesting speculation. The Gymnotids (except *Electrophorus electricus,* the electric eel) and certain of the Raiidæ possess these weak electric organs. Darwin, in his "Origin of Species"[2] has admitted that the electric organs of fishes present difficulties to his theory of natural selection. Are the weak electric organs rudimentary, or are they new organs in the process of progressive development? If they are rudimentary why have they been discarded; if they are new organs just beginning to appear, of what selection value can they be if they produce no perceptible electric current? Only a study of the development of these organs can throw light on these questions. In certain of the Raiidæ which have been investigated it seems quite evident that the electric organs have been recently acquired and are not, therefore, the rudiments of previously existing well-developed ones.

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PRINCETON UNIVERSITY,
December 14, 1916

THE AMERICAN SOCIETY FOR PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS

THE eighth annual session of the Pharmacological Society took place on December 28, 29 and 30, 1916, at Cornell Medical School, New York City. The other members of the Federation of American Societies for Experimental Biology met at the same time and place.

The sessions were opened and concluded by a joint meeting of all four societies. The papers read at these meetings will be found in the report of the General Secretary of the Federation. In addition to these joint meetings, the Pharmacological and Physiological Societies held a joint session devoted entirely to demonstrations on Friday afternoon, December 29.

[2] P. 167, sixth edition.

Officers for 1917.—The following officers were elected for the present year:

President: Reid Hunt.

Secretary: L. G. Rowntree.

Treasurer: Wm. deB. MacNider.

Additional Members of the Council: John Auer, Carl Voegtlin.

Membership Committee: Torald Sollmann (term expires 1919).

New Members: The following candidates were elected to membership upon recommendation by the membership committee and the council: Franklin C. McLean, Union Medical College, Peking, China; Harold B. Meyers, University of Oregon; Maurice I. Smith, University of Michigan; Julius M. Rogoff, Western Reserve University; James A. Waddell, University of Virginia.

Membership in the A. A. A. S.—The attention of new members is called to the following resolution of the council of the American Association for the Advancement of Science:

Resolved, that the entrance fee to this association shall be remitted for members of regularly affiliated societies who are elected to the A. A. A. S. within one year of their election to membership in the affiliated society.

The extension of this privilege (it was formerly limited to the year 1916 only) to all new members of affiliated societies *for the year in which they join the affiliated society,* is greatly to be welcomed, and all new members of the Pharmacological Society should avail themselves of this opportunity.

Amendment of the Constitution.—The mandatory provision of Article V., Section 1, that the annual meeting of the society be held between December 25 and January 1 at a place determined by the council was altered to read: "The annual meeting of the society shall be held at a time and place determined by the council in consultation with the executive committee of the Federation of American Societies for Experimental Biology." The federal executive committee, it may be added, is formed by the presidents and secretaries of the constituent societies of the federation.

The object of this amendment was to permit a tentative change of the meeting time, if a majority of the federated societies should deem this advisable. There are a number of reasons why the scientific sessions should be held at some other time of the year than Christmas week: the season is usually inclement and imposes hardships and dangers on all members, especially the elderly, who are compelled to travel considerable distances in order to attend; the time available for the preparation of papers from the beginning of the