physiology of man and the mammals where they were particularly appropriate, but would, for the most part, be concerned rather with general principles applicable to all forms of life than with the physiology of any single group of organisms. At the other extreme would be a text-book of human physiology of the usual sort. The author has chosen to avoid these two extremes and to follow a middle course by including as much as possible of both sides of the subject. This policy, while it has certain obvious advantages, has necessarily resulted in some loss of detail in the treatment of many individual topics.

Approximately the first third of the book is devoted to such subjects as: the food of plants and animals; proteins, fats and carbohydrates; the behavior of electrolytes; H and OH ions; vitamins; enzymes; and the physico-chemical structure of protoplasm. A considerable degree of condensation has been necessary to keep this part of the book within the limits assigned to it by the author. Thus, colloids are treated more or less incidentally under proteins, surface tension and cell permeability under fats, osmotic pressure under electrolytes, the rate of chemical reactions under H and OH ions, etc.

The remainder of the book gives a sufficiently complete account of human physiology to make it a suitable text for college students whose interests are primarily in this field. The chapter headings of this part of the book are: "Excitation and inhibition," "Physiology of contraction," "The functional units of nervous systems," "Reflexes," "The correlating action of the nervous system," "Receptors," "Digestion," "Chemistry of blood and lymph," "The circulation of the blood," "Respiration," "Physiological oxidations and heat regulation," "Excretion," "Protein metabolism," "Amounts of food required by animals," and "Internal secretions." In the treatment of these subjects, while the general point of view has not been entirely abandoned, the chief emphasis has been placed upon and most of the illustrative material drawn from the field of mammalian physiology.

The book is written in a clear and interesting style, and typographical errors are relatively few. It is perhaps inevitable that a work which covers such a wide field should in its first edition contain a number of statements which are either inaccurate or misleading. As examples, may be mentioned the following: "This coefficient for chemical reactions is always equal to or greater than 2 for an interval of 10°C." (p. 275), "another advantage of subdivision is the increase of surface tension thus obtained," etc. (p. 236); "This is further confirmed by the smallness of the part of the blood $CO_2$ which may be removed by the vacuum pump without adding acid to break down the bicarbonates of the blood" (p. 566). The author has also at times shown a certain carelessness in his use of physical terms, as, for example, on p. 140, where he speaks of a force of 22.4 atmospheres, and on p. 326, where the statement occurs that "this work is sufficient to raise a weight about nine times as great as that of its own body"—the distance through which the weight is lifted being unspecified. However, such defects as these can readily be eliminated, and they doubtless will be in the second edition which the work deserves and is likely to have. On the whole, the author is to be congratulated on having produced a book which will be of much assistance to teachers and students of college physiology as well as to general readers interested in this subject.

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## RECENT CONTRIBUTIONS TO OUR KNOWLEDGE OF THE FOSSIL FISHES OF CALIFORNIA

THE present note is written for the purpose of calling attention to certain recent discoveries, by David Starr Jordan and associates, through which the remarkable fish faunas of the Miocene and other beds of California are being disclosed.

Dr. Jordan's earlier contributions[1] in this field (and also his two latest papers[2]) dealt largely with the teeth of sharks. A number of interesting fishes of other groups were, however, described. Among these may be mentioned a crossopterygian scale and a remarkable jaw-bone named *Xenesthes velox,* in which the outer surface seems to be covered with denticles, both assigned to the Triassic; a new type related to the pholidophorids, namely *Etringus,* and another new genus *Rogenio,* from the Soledad formation (probably pre-Miocene); a fossil *Gasterosteus,* and finally a series of Quaternary remains of a sturgeon, from the deposits of Potter Creek Cave, and of salmons and suckers from Oregon lake beds.

[1] Jordan, David Starr. "The fossil fishes of California with supplementary notes on other species of extinct fishes," Univ. Cal. Publ. Geol., 5, 1907, pp. 95–144, pls. 11, 12. "Note on a fossil stickleback fish from Nevada," Smiths. Misc. Publ., 52, 1908, p. 117. Jordan, David Starr, and Carl Hugh Beal. "Supplementary notes on fossil sharks," Univ. Cal. Publ. Geol., 7, 1913, pp. 243–256.

[2] Jordan, David Starr. "Some sharks' teeth from the California Pliocene," *Am. Jour. Sci.,* 3, 1922, pp. 338–342, figs. 1–3. Jordan, David Starr, and Harold Hannibal. "Fossil sharks and rays of the Pacific slope of North America," Bull. Sou. Cal. Acad. Sci., 22, 1923, pp. 27–68, many figures.

In 1919 the fishes of the supposedly pre-Miocene Soledad deposits were treated at greater length.[3] *Etringus, Rogenio* and allied forms were discussed, along with the new genus of primitive scombroids, *Auxides,* and a little fish called *Bulbiceps.* The last was referred to the liparids (later doubtfully transferred to the gobiesocids), but the distorted imprint shows no decisive character.

At the same time Jordan, in co-authorship with J. Z. Gilbert—who already had described a fossil flounder from the same beds[4]—published a first account of the truly remarkable teleost fauna of the California Miocene.[5] Although a few of the genera represented, as *Ganolytes* and *Rogenio,* were referred to older (Soledad) types, the majority of the remains were found to be related to fishes living in present, usually Californian, seas. An atherinid genus, *Zanteclites,* was regarded as related to the Melanotaeniinae of Australian fresh waters; it was discussed at greater length in a subsequent paper.[6] The fact that a number of the forms have a high number of vertebrae suggested the hypothesis that the seas in which these fishes lived were cool.

The Pliocene fishes were discussed in a separate, briefer report.[7] Two new genera were described from imperfect remains: *Ectasis,* very dubiously a gonorhynchid (perhaps an elopid), and *Arnoldites,* apparently a gadid.

The Miocene fishes of the richest horizon yet uncovered in North America, namely, the diatom beds of Lompoc, were again described by Jordan and Gilbert in 1920.[8] In this paper a number of new generic types were diagnosed, and the large series of scombroids found in these beds reviewed. In a supplementary paper,[9] the remains first regarded as a flounder were shown through more complete examples to represent the remarkable oceanic fish, *Lampris.* This discovery was of particular interest in demonstrating the antiquity of this peculiar type.

A popular account of those Miocene fishes followed.[10] In this, the simultaneous destruction of about twelve hundred million individuals of a herring-like species (*Xyne grex*) was recounted.

Subsequently, the Tertiary fish fauna of California was again revised, the paper being illustrated with numerous restorations.[11] "The purpose of this paper is to make old bones live again." The dermal structures, which of course were largely unpreserved, were drawn from the supposedly nearest living relatives.

In this paper Jordan advanced a series of very interesting and important generalizations regarding the fauna.[12] He concluded that:

> The present fauna of California is derived from that of the Miocene period with a slight admixture from the northward and from Japan. The Tertiary fauna of California is nearly all included in families still extant on the coast. All the species are distinct from their living allies, and most of them must be placed in different genera.
>
> The most striking difference which appears thus far is that we have found no trace among the fossils of the viviparous surf-fish (Embiotocidae) which form so conspicuous a part of the existing fauna.
>
> Among the fossil fishes actually known we have none which suggests any affinity with Asiatic forms. Most of them are distinctly characteristic of California, a few only belonging to types now wanting in that region, but represented in the Gulf of Mexico, and in one or two cases in the Mediterranean. In Miocene times, the present Isthmus of Panama was an open channel.
>
> No species, either distinctly tropical or distinctly subarctic, appear among the Tertiary fishes of southern California. We must, therefore, conclude that the Miocene temperature differed little from that which obtains at present.
>
> It is evident from the absence, partial or complete, of silt or other rain-washed material in the deposits containing the fishes, that the climate was arid.

It is a matter of high regret that many of the fish remains of these diatom shales are so poorly pre-

[3] Jordan, David Starr. "Fossil fishes of southern California. I. Fossil fishes of the Soledad Deposits," Stanford Univ. Publ., Univ. Ser., 1919, pp. 3–12.

[4] Gilbert, James Zaccheus. "Evesthes jordani, a primitive flounder from the Miocene of California," Univ. Cal Publ., Geol., 5, 1910, pp. 405–411, pls. 41–42.

[5] Jordan, David Starr, and James Zaccheus Gilbert, "Fossil fishes of southern California. II. Fossil fishes of the Miocene (Monterey) formations," Stanford Univ. Publ., Univ. Ser., 1919, pp. 13–60.

[6] Jordan, David Starr, and Carl Leavitt Hubbs. "Studies in ichthyology. A monographic review of the family of Atherinidae or Silversides," Stanford Univ. Publ., Univ. Ser., 1919, pp. 1–87, pls. 1–12 (*Zanteclites* described on pp. 10–12, and figures on pl. 11).

[7] Jordan, David Starr, and James Zaccheus Gilbert. "Fossil fishes of southern California. III. Fossil fishes of the Pliocene formations," Stanford Univ. Publ., Univ. Ser., 1919, pp. 61–64.

[8] Jordan, David Starr, and James Zaccheus Gilbert. "Fossil fishes of diatom beds of Lompoc, California," Stanford Univ. Publ., Univ. Ser., 1920, pp. 1–45, pls. 1–29.

[9] Jordan, David Starr. "An ancient moonfish," *The Scientific Monthly,* 2, 1920, pp. 470–473, figs. 1–3.

[10] Jordan, David Starr. "A Miocene catastrophe," *Natural History,* 20, 1920, pp. 18 ff. (reprinted in *The Guide to Nature,* 13, 1921, pp. 132 ff.).

[11] Jordan, David Starr. "The fish fauna of the California Tertiary," Stanford Univ. Publ., Biol. Ser., 1, 1921, pp. 233–300, pls. 1–57.

[12] These generalizations were repeated in another paper, "The Miocene shore-fishes of California," *The Scientific Monthly,* Nov., 1921, pp. 459–463, 4 figs.

served. Sometimes little but the imprint of the fossil remains, and even this is usually much distorted, particularly in the head region. This being the case, the identifications must be based on the general proportions and on the relationships of superficial parts to a greater degree than on osteological details. Dr. Jordan's extremely wide knowledge of modern fishes must, therefore, have been almost indispensable in the work he has done. Despite this advantage, however, the relationships of a considerable number of the forms described could not be definitely determined. Occasionally, the estimate of kinship was widely altered in subsequent papers. For example, a fish first regarded as a herring was (from better material) later referred to the Synentognathi, while a supposed labrid was later shown to represent a clupeid. It must be noted, however, that in the later papers a greater attention to the skeletal features which are yet apparent—particularly the interneurals and interhaemals, as related to one another and to the fin rays—has added an increased definiteness to the identification and the determination of relationships.

The reviewer feels constrained to express his opinion that throughout the work (as in so many treatises on fossil fishes) too many imperfect and incomplete impressions were considered. To name and to attempt the classification of fossil remains of clearly indeterminate relationship can hardly serve to advance our knowledge of extinct faunas. In the case under review, a close study of the best preserved remains of these Tertiary fishes (some show exquisite detail) would in his opinion have yielded the same generalizations, and would have added stability to the nomenclature, and prevented the intrusion into the work of certain elements of unnecessary doubt.

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## LABORATORY APPARATUS AND METHODS

### RESPIRATORY EXCHANGE OF THE FROG

THREE years ago the writer began using a very simple class demonstration to show the change in volume imposed upon respired air during the respiratory exchange of the frog in its winter or early spring condition. A short metal tube was soldered over a hole made in the lid of a one-pint Mason fruit jar. A frog was placed in the jar and the jar-lid was screwed down air tight. About three minutes were allowed for the changing volume of air in the jar, occasioned by the slightly warmer body of the frog, to reach equilibrium, and then, by a suitable rubber tube, the metal tube of the jar-lid was connected with a water manometer. The frog was allowed to breathe the air in the jar for one hour to one and one half hours, during which time the water in the manometer arms gradually changed level several centimeters in such direction as to show a decrease in volume of the air in the jar. The frog appeared to experience no special discomfort in breathing the confined air for that length of time.

This year the thought occurred that this experiment might be easily modified and extended so as to afford a very good method (for class use) of determining the respiratory quotient of the frog. The apparatus now used is represented in the accompanying figure. It consists of the following glass parts: a water manometer, *B*; two heavy T-tubes of small bore, *t* and *t′*; a special respiration chamber, *R*, of 250 cc capacity; an elbow-tube through a rubber stopper, *E*; a special Hempel gas absorption pipette, *H*, of 250 cc capacity, and an ordinary aspirating bottle, *A*, of 250 cc capacity having a Mohr burette (25 cc graduated to 1/10 cc) inserted through a rubber stopper in its top in such manner that, as water rises from the aspirating bottle into the burette, air can not be trapped beneath the stopper. These parts are connected by rubber tubing as illustrated. The neck of the respiration chamber at *E* has an opening of 45 mm in diameter and takes a No. 10 rubber stopper. A metal collar around this neck of the chamber bears two hooks over which a pliable wire may be tightly looped to hold the stopper in exact place during the experiment. The chamber may be closed above with a glass stop cock, *b*. At *c*, *d* and *t* are screw pinch cocks, and at *e* is a Mohr's pinch cock. A solution of one part of KOH to two parts of water is used in the Hempel pipette. The aspirating bottle with its burette and its tubing is filled with pure water. It was found that acidulated water (HCl) may not be used. Even when the acid used is weak enough to seem not especially irritating to the skin of the frog, it nevertheless appears to be absorbed by the skin so that $CO_2$ is liberated from the alkaline carbonates of the blood. Thus the volume of the gas in the respiration chamber slowly but constantly increases until the frog dies.

When an experiment is to be started, the apparatus (as described) and the frog to be used are brought into a room where the temperature is comparatively constant and kept until they are as nearly as possible the same temperature as the air of the room. Then cock, *c*, is closed and cocks *b*, *d* and *t* are opened. The frog is introduced into *R* and the stopper *E*, is fastened securely in place with care not to place the hand on *R* so as to change its temperature. Cock, *e*, is opened to pass just enough water into *R* to cover the stopper, *E*, and seal it. Under these conditions, the manometer will read level