accurate, clearly written, with as few technicalities as the subject permits. Moreover, admirably illustrated, and withal well printed. Every phase of reptile life is fully treated from the origin of the class estimated as some ninety million years ago (its forebears, the amphibia, three or four millions of years earlier), to the last note on the song of the tree frog. It concludes with a brief but wise commentary on Darwinism. Barbour remembers, what some evolutionists have forgotten, that the origin of species is an outdoor matter, in which nature takes her own time.

The numbers of kinds of these creatures, the world over, is far beyond the usual conception. Barbour estimates 6,875 living species; 50 of them crocodiles, 225 turtles, 2,300 snakes, 2,500 lizards, 1,500 frogs and toads, and 50 coecilians, blind, worm-like creatures. With the rest, one singular lizard of New Zealand, *Sphenodon,* of ancient type in which the ancestral middle eye (pineal) on top of the head is still extant.

Every phase of reptilian life is well considered. Some of the most interesting chapters relate to the poisonous snakes, the nature of their poison, and the methods of giving immunity through dilution of venom.

BERING'S VOYAGES

Bering's Voyages. An Account of the Efforts of the Russians to Determine the Relations of Asia and America. By FRANK A. GOLDER, in two volumes. Vol. II, Steller's Journal of the Sea Voyage from Kamchatka to America and Return on the Second Expedition, 1741–43.

A REMARKABLY valuable work, from the standpoint of geographical history as well as of natural science, is the record of Bering's voyages by Professor Frank A. Golder, of Stanford University. The first of these two volumes contains an annotated translation of the official reports. The second volume contains the Journal of Georg Wilhelm Steller, the gifted naturalist of the second expedition. This is especially interesting for the spirited narrative itself, and for the first account of "the four great beasts," Sea Lion, Sea Bear (Fur Seal), Sea Otter and Sea Cow, the last named now extinct. This journal is translated and in part annotated by Leonhard Stejneger, of the U. S. National Museum, whose own studies in this region have been of the highest importance.

American Geographical Society, Research Series, No. 2. W. L. G. Joerg, Editor. New York, 1925.

DAVID STARR JORDAN

SHERBORN'S "INDEX ANIMALIUM"

EVERY zoologist regards the accurate naming of animals as a matter of far-reaching importance. Sooner rather than later he must even refer to original papers or to complicated nomenclators, and find out whether his beasties have been described accurately, and whether names given to them have not been earlier used for entirely different creatures. It was the idea of simplifying this universal labor which led the English naturalist, Charles Davies Sherborn, to undertake the Herculean labor of preparing an index which should put an author's finger upon all species and genera hitherto described.

Beginning thirty years ago, Mr. Sherborn has overhauled all zoological literature from Linnaean beginnings to the year 1850, indexing (*mirabile dictu!*) some 27,600 works. His plan was to complete in an encyclopedic way the first century of zoology and to include, naturally, references to animals, recent and fossil, in the writings of all countries.

Thus far ten parts of his work have appeared, in all comprising 2,570 pages. Part I was published in 1902 by the Cambridge University Press: thereafter the work was taken up by the trustees of the British Museum. At the close of the present section (part X) the literature dealing with the genera and species has been accounted for from 1801 to 1850, up to the word *funereus.* The eleventh part, which will complete the letter G, will appear in December. The manuscript cards for the remaining letters are being revised, but from the nature of the task five or six years more will probably be required to complete the publication of an epoch which witnessed the description of the greatest number of animals. When this turning of the road has been reached, Mr. Sherborn plans to cease his labors and let the later literature be worked out by his successor, if such a one may be found. It would not be unfair to Mr. Sherborn to note that this vast work has been carried out largely as a labor of love.

BASHFORD DEAN
THE METROPOLITAN MUSEUM OF ART

SPECIAL ARTICLES

LOSSES IN TROUT FRY AFTER DISTRIBUTION

ON seining a quarter of a mile of Forbes Brook, Prince Edward Island, Canada, there were found, October, 1925, trout, yearlings and older, 319; fundulus, 82; salmon parr, 33; stickleback, 16, 152; a

total of 16,586. At the same time only about 1,066 trout fry were found alive out of 4,020 distributed in this same area in July, 1925.

Does not a loss like this (73 per cent.) take place in accordance with the generally accepted biological principle that animals in a state of nature tend to breed up to the limit of subsistence? Even men breed in conformity with this law in thickly populated parts of India and China and in the slum parts of all big cities. Forbes Brook, like most others, produces food enough to feed only a limited number of fish, just as 50 acres of pasture land can feed only a limited number of cattle.

Now a majority of the 319 trout, 82 fundulus, and 16, 152 stickleback during the spring and summer of 1925 bred up to the limit of subsistence, and therefore there would be no extra food for the 4,020 weak and helpless fry which were dumped among the 16,586 enemies and competitors. The result was that some of the 4,020 were devoured by the larger and more active enemies, while others of them, weakened by scarcity of natural food, either died, or, it may possibly be, succumbed to the combined attacks of their numerous competitors, such as the stickleback..

May I suggest, therefore, that we have been trying to build up our fish culture results upon too narrow a foundation, namely, hatchery work alone for over 50 years. We have been limiting our protection of the fry and our feeding of fry to the comparatively short time which they pass in the hatchery. The hatchery, it must be remembered, is only one factor in the artificial production of commercial or game fish. Besides the hatchery there are the streams, ponds, etc., in which the fry are distributed and which must be studied quite as diligently as hatchery operations if fish culture is to be made successful. We must find out (1) the kind and numbers of enemy and competitor fish; (2) the available food supply, and (3) the limiting factors, forces or conditions which nature imposes upon the continuance of life, such as temperature of the water, oxygen supply, carbon dioxide, salinity, hydrogen ion concentration, intensity of light, pressure, desiccation and pollution.

Of the three factors just mentioned—enemies, food supply and physical condition—undoubtedly the most difficult and most important one to determine is the food supply in the streams and lakes in which the fry are distributed.

REMEDIAL MEASURES

1. The ordinary hatchery employee who possesses no scientific knowledge may nevertheless become an expert seiner and procure information as to the different kinds and numbers of enemy and competitor fish. How many of such fish should be removed and destroyed can only be determined by experiment. In order to promote efficiency in seining, surplus cover in the shape of shrubs, large stones, and submerged logs should be removed by the hatchery employees during off time in spring, summer and autumn.

2. Many enemy fish and competitor fish should be seined and destroyed for the same reason that weeds are destroyed in a garden, or wolves on a sheep farm. In this way more food would become available if not immediately for the fry, at least for yearlings or older ones. The food supply and limiting factors on the other hand can be determnied only by well-trained biologists. Until fish culturists extend their knowledge along the following lines so as to form a proper foundation for their science it will be idle to expect the best results.

3. A quantitative estimate to be made of the microscopic and macroscopic animal food upon which both fry and adults live.

4. A quantitative estimate to be made of the plant food upon which the microscopic and smaller macroscopic animals live.

5. An approximate quantitative determination to be made of the substances in solution in the water and which constitute the nutritive material upon which minute aquatic plants grow. These plants in turn form the food of minute aquatic animals.

So then we have this chain of nutritive relations to be studied: adult fish: minnows and fry: minute animals (entomostraca, etc.): minute plants: soluble material or food for the plants.

It may be objected that this broad study of the foundations of the science of fish culture will be an expensive affair. Yes, at first, and until the animals, plants, mineral matter and limiting factors have been determined. But once they are determined we shall have the satisfaction of knowing more or less accurately the approximate numbers of adult fish which we are getting for our legislative appropriations, instead of the guesses which pass current to-day.

A. P. KNIGHT,
Chairman, Biological Board of Canada
KINGSTON, ONTARIO

SEX DIFFERENCES IN MORTALITY AND METABOLIC ACTIVITY IN DAPHNIA MAGNA

FROM studies of the relative mortality of the sexes in *Daphnia magna* throughout their life span a mor-