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STATE ICHTHYOLOGY OF MASSACHUSETTS.

I.

THE history of the ichthyology of Massachusetts has never been written and a sketch of such appeared to me to be the best and most seasonable response I could make to the invitation to address the investigators and students assembled at the headquarters in Massachusetts of the United States Fish Commission. The history is an interesting and a rather remarkable one. Of course, in the time allotted for an address, only the salient features of a long history can be given and many minor communications and even popular works relating to the ichthyology of the region in question must remain unnoticed. The room is requisite for a neglected subject. We are often curious to know something about the personality of the men whose work we consider and such information is generally difficult for the scientific student to obtain. Of several of the old and departed writers on the fishes of Massachusetts notices will be now given, and when reference is next made to their writings, perhaps it may be done with a new interest and better means of judging their work.

The history of Massachusetts ichthyology begins early in the history of the United States—earlier even than any set-

* An address delivered at Woods Hole, before the Marine Biological Laboratory, on the evening of August 3, 1904.

The early history may be found given at greater length in the new edition of Goode's 'American Fishes,' edited by Gill and published by Dana Estes & Co., of Boston (1903).

tlement by English in the state. Captain John Smith, who acquired celebrity in connection with a more southern province, having induced certain London merchants to furnish him with two vessels for exploration of the New England coast, in the spring of 1614, visited and made a sketch map of part of the coast of territory granted to the Plymouth Company. In 'A Description of New England,' published in 1616, he enumerated the fishes. Excluding the 'whales, grampus, porkpisces' or porpoises, and the shell-fish, the names of sixteen were mentioned—'turbut, sturgion, cod, hake, haddock, cole, cusk, or small ling, shark, mackerrell, herring, mullet, base, pinacks, cunners, perch, eels.' In another paragraph, we are told, 'much salmon some haue found vp the Riuers, as they haue passed.' Smith claims for the cod that 'each hundred is as good as two or three hundred in the *New-found Land.* So halfe the labor in hooking, splitting, and turning, is saued.' He in short takes a very practical view of the subject, and has quaintly expressed it. "And is it not pretty sport," says he, "to pvll vp two pence, six pence, and twelue pence, as fast as you can hale & veare a line? He is a very bad fisher, cannot kill in one day with his hooke & line, one, two, or three hundred cods: which dressed & dryed, if they be sould there for ten shillings the hundred, though in England they will giue more than twentie; may not both the seruant, the master, & marchant, be well content with this gaine?"

Doubtless such a report had some influence in determining the trend of immigration into Massachusetts, and one of the newcomers, 'a reverend Divine' (Francis Higginson), was ready to confirm Smith's praise, and wrote, in 1630, 'The abound-ance of Sea-Fish are [*Sic*] almost beyond beleeuing, & sure I should scarce haue beleeued it except I had seene it with mine owne Eyes.'

Numerous other chroniclers testified to the richness of the New England seas and gave lists of the fishes. The most lengthy of the lists is that in 'An Account of two voyages to New England' by 'John Josselyn Gent.,' published in 1675; this includes sixty-five names, of which forty-six are those of what we would now call fishes. This list, which is simply a nominal one, supplements slight descriptive notices of eight others which precede it.

It would scarcely repay us, on the present occasion at least, to give further attention to such lists, but the common names introduced by the early settlers furnish an interesting theme for consideration.

The known fishes of England are few in number, and the emigrants knew few of them even, and knew those few very imperfectly. When the earliest of those emigrants lived, naturalists even had no idea of the diversity of animal life or the facts of geographical distribution. For instance, John Ray, the best naturalist of his age, who flourished in the last quarter of the same century, thought that there were only 'near 500' fishes in the whole world! Naturally, the common people were unprepared to appreciate the diversity of the new life which they were to see.

The immigrants were astonished at the abundance of the fishes about their new home. To these numerous fishes they transferred names of English species with which they were more or less familiar. On account of the greater number of species, or at least of genera, common to the two countries, the emigrants from Old England to New England were not very far astray in naming many of the fishes of their new home; but as they, or their successors, wandered farther and farther from their old home, they made many mistakes. A

few examples of the very many will illustrate.

Among the most common of the English fishes are the cod, perch, bass and trout. The immigrants into Massachusetts applied these names to fishes of the same genera as the originals, or to very closely related genera, but mostly of different species. As population extended into remoter regions and stranger faunas, the meager supply of names had to be doled out to forms quite unlike those to which they had been originally applied.

Cod was used in a few cases for the only fresh-water species of the same family—*Lota maculosa*, otherwise called burbot; but when the Americans reached the Pacific coast, not finding the true cod, they misapplied its name to fishes of very different families, although generally with qualifying prefixes. Thus, the young of the boccaccio (a scorpænoid fish, *Sebastodes paucispinis*), which were caught at the wharves of San Francisco, were dubbed tom-cods; a hexagrammoid fish (*Hexagrammus decagrammus*), also inaptly named spotted rock trout, was by others called rock cod; another species (*Ophiodon elongatus*) was designated as the cod or 'codfish where the true cod is unknown,' and, where it is known, the cultus cod.

Perch was subject to much greater misuse. In England the name is specifically applied to a well-known fresh-water fish (*Perca fluviatilis*). The immigrants into New England found a fish almost undistinguishable from it, and properly gave it the same name. Others gave it to fishes having no real resemblance; such is the one called also white perch along the Atlantic coast, which is a bass (*Morone americana*); others are sciænids, as the silver perch (*Bairdiella chrysura*), the gray perch (*Pogonias chromis*) and the white perch of the Ohio River (*Aplodinotus grunniens*); another, the red perch (*Sebastes marinus*), is a scorpænid; and still another, the blue perch (*Tautogolabrus burgall*), a wrasse or labrid. The name is also given in some places to various species of a family peculiar to America, the centrarchids, and among them to the black basses and the sunfishes. Along the Pacific coast it is given to viviparous fishes or embiotocids, especially, in California, to the alfione (*Rhachochilus toxotes*), and in Oregon and Washington to another, likewise miscalled porgee (*Damalichthys argyrosomus*). The Sacramento River embiotocid (*Hysterocarpus traskii*) is called river perch or simply perch.

Bass is applied to so many different species—a score and more—that we can not spare the room to enumerate them. In England it is the proper name of a marine fish common only along the southern coast, formerly called *Labrax lupus*, but now named *Dicentrarchus labrax*. A related species, though of a different genus, was found by the new settlers of Massachusetts and New York, and quite properly called bass or striped bass; it is the *Roccus lineatus* of modern ichthyologists. There are several other species, including the white perch, also entitled to the name. All others are quite remote from the true bass—even the black basses. These last, however, must retain the name, and it might be better to always use the hyphenated form, *i. e.*, black-bass.

Trout is another of the English names variously misapplied. In the old country it is given to a single species generally distributed through the island in clear cold streams. The Pilgrims found in similar streams in Massachusetts a fish somewhat like it, and called it by the same name, although if good Isaak Walton or some other angler had been among them, he might have told them it was not a trout, but a char. Others found in Maine landlocked salmon and in various large lakes

another good-sized salmonid (*Cristivomer namaycush*), and applied to them also the name of trout, but often with a qualifying prefix, as schoodic, or sebago trout, and lake trout. The old specific name was thus applied to representatives of three distinct genera; but the offense was venial, as the genera are closely related and belong to the same family. But this was not the case with others. Settlers in troutless southern states, bound to give the name to some fish, gave it to the centrarchoid fishes generally known as black-basses. This perversion even found its way into scientific literature, for 'Citizen Bosc,' French consul at Charleston a century ago, sent specimens to Paris, with the information that it was called trout, and 'Citizen Lacépède' gave it the specific name *salmoides*. Along the southern coast, too, the name trout or sea trout was given to sciænoid fishes of the genus *Cynoscion*. When the Americans reached the Californian coast they found certain fishes of a peculiar family (hexagrammids), not at all like trout in shape or fins, but spotted, and these also they called trout. Still another fish, found in the Gila River, a slender large-mouthed cyprinid, *Gila gracilis*, was called by early explorers trout, and still bears the name.

But this is not all, or the worst! These old names are not only widely scattered; they may be more or less concentrated on one fish. We need only take those already considered as instances.

Cod and trout are given to the same hexagrammids along the Pacific coast. The *Hexagrammus decagrammus*, for instance, is called rock cod about Puget Sound, and rock trout and sea trout at San Francisco. Bass may also be given in some places, as a somewhat related fish, less like a bass (*Sebastodes melanops*), is called black-bass.

Trout, bass and perch are also given to the black-basses, as already indicated, in various places in the southern states.

Our forefathers likewise brought with them fish-names which have become almost obsolete in England, but which have entered on a new life in the new land. One such is alewife (*Pomolobus pseudoharengus*), so familiar in connection with the enormous schools of the clupeid, so called, which enter the rivers of New England. So entirely has the name been submerged in England, so prominent has it become in the United States, that it has been supposed by some lexicographers to be of American origin. For example, in that monument of industry and erudition, 'A New Dictionary on Historical Principles [etc.], edited by James A. H. Murray [LL.D., etc.], with the assistance of many scholars and men of science,' the etymology of alewife is given in the following terms: "Corrupted from 17th c. *aloofe*, taken by some to be an American-Indian name; according to others a literal error for French *alose*, a shad. Further investigation is required." (It is defined 'An American fish [*Clupea serrata*] closely allied to the herring.') Further investigation has demonstrated that the supposed etymology is based on errors of several kinds. Too much space would be required to give the details, and those especially interested may find the record (by the present writer) in that receptacle of notes curious and philological entitled, 'Notes and Queries' (9th s., VIII., 451–452). In brief, the status is this:

First, alewife is not only an old English name, but still survives in southwestern England, as attest the works of Couch and Day on English fishes. *Second, alose*, as such or with literal modifications, has existed as an English word, in certain localities, for centuries, although it was doubtless derived from the French through the Normans. In the same year, 1620, that the 'Pilgrim Fathers' left Old England and reached New England, one Venner published the statement that 'The *allowes*

is taken in the same places that sammon is.' *Third, aloofe* is simply the result of a printer's mistaking an old-fashioned median *s* for an *f*. The second John Winthrop sent to the Royal Society an article on 'maiz' which was published in 1679 in the *Philosophical Transactions* (XII., p. 1066). In that article he noted the coincidence of the planting of corn by the Indians and the 'coming up of a fish, called *aloofe,* into the rivers.' Of course that fish could only have been the one called by his contemporaries, Morton, Wood and Josselyn, *allize* and *alewife*. *Fourth, alewife* is doubtless a mere variant—an accommodative form, perhaps—of the word variously spelled in olden days *alose, aloose* (the *oo* has the value of a prolonged *o* sound), *allowes, allow, alice, olafle* and *oldwife*. *Fifth,* the Narragansett Indian name of the alewife was (in the plural) *aumsuog,* according to Roger Williams, or *umpsauges,* according to Stiles. *Sixth,* the current English name of one of the shads is *allice* or *allis* shad.

Let it not be inferred from this that disrespect is held towards the great New English dictionary. Even the very best are liable to err, and the dictionary is not exempt from the liability, although it does rank among the 'very best' and most useful of works; it may be added, too, that an American book to be noticed later on—Smith's 'Natural History of the Fishes of Massachusetts'—had some share in misleading the learned Englishmen. Smith says (p. 164): 'It has been suggested that alewife is derived from the Indian word *aloof*—signifying a bony fish.'

Naturally, the Indians had names for all fishes of economical value, and even for others. A few only, however, were adopted by the new colonists, and those only in forms considerably different from the originals. Such are, besides menhaden, scup, chogset, tautog and squeteague, still more or less used along the Atlantic coast, namaycush, masamacush, winninish (ouananiche), togue, siscowet and cisco in the interior, and stit-tse, nissnee, quinnat, kisutch and eulachon or oolachan along the Pacific coast.

II.

The first special memoir of a really scientific nature on the fishes of our region was communicated in 1794 by William Dandridge Peck, but not published till 1804 in the *Memoirs of the American Academy of Arts and Sciences.* Peck was then resident at Kittery, N. H., and his memoir was entitled 'Description of Four Remarkable Fishes, taken near the Piscataqua in New Hampshire.' He aptly prefaces his article with the remark that 'that part of the Atlantic which washes the extensive sea coast of Massachusetts, affords a considerable number of fishes, many of which are but little known' and, after some further remarks, proceeds to describe the species.

William Dandridge Peck was born in Boston, Mass., May 8, 1763, graduated at Harvard in 1782, and subsequently served for some years 'in a counting house in Boston.' "He was an ingenious mechanic, and made a microscope and many other delicate instruments." At the same time he was a devoted student of natural history and especially of ichthyology. His studies were crowned in 1805 by the reward of a professorship of natural history in Harvard College and this was held till his death. He died October 3, 1822.

Let us now return to his memoir. As already noted, the species were four. The first was identified by him with the *Ophidium imberbe* of Linnæus; the second received a new name, *Stromateus triacanthus;* the third also has a new name, *Blennius anguillaris,* and the fourth was considered to be specifically identical with the *Cyprinus catostomus* of Forster. Peck's descriptions were very good—for the time at

least—and by them his species can readily be recognized.

The first species is clearly the one later (1839) named *Cryptacanthodes maculatus* by Storer; Peck's misidentification undoubtedly was very bad, but he manifested a better appreciation of the relationship of the species than did Storer. The *Ophidium imberbe* of Linnæus was primarily based on the common gunnell of Europe, *Pholis gunnellus*. Apt as Peck's description was, however, Storer did not recognize his fish. Dekay later (1842) equally failed to recognize it, but, concluding that it could not be the *Ophidium imberbe* of Linnæus, referred it to the genus *Fierasfer* and called it *'Fierasfer borealis?'* The name was new, and by the interrogation Dekay evidently intended to question whether the species belonged to the genus *Fierasfer* and not whether it belonged to a species already named *Fierasfer borealis*. The correct identification of the species was not published till 1863 (*Proc. Acad. Nat. Sc. Phila.*, p. 332).

Peck's second species is the one now known as *Stromateus triacanthus* or *Poronotus triacanthus;* his third species is *Zoarces anguillaris*, and his *Cyprinus catostomus* is the *Catostomus commersonii*, the common sucker of Massachusetts.

III.

In 1817 the United States was visited by a Frenchman who is well entitled to be considered as the first ichthyological artist of his time—so far superior to all others, indeed, that there was no close second. I mean, of course, Charles Alexandre Lesueur, who was born in Havre on the New Year's day of 1778. He became the companion of François Peron in the notable expedition to southern lands which left Havre in 1800, under the command of Baudin, and was so fruitful of novelties for science. In 1815, he made arrangements with William Maclure by which he was enabled to visit the United States. After a prolonged voyage by way of the West Indies with Maclure, Lesueur arrived, May 10, 1816, at New York and there became acquainted with the statesman-ichthyologist Samuel Latham Mitchill. In the fall of the same year, he visited the coast and especially fishing towns of New England and the fish market at Boston. His collections afforded him a number of new species which he subsequently described in various articles in the *Journal of the Academy of Natural Sciences of Philadelphia.*

In 1817, he settled down in Philadelphia and at once became an intimate associate of the scientific men of that city, and his was the first article contributed to the first volume of the *Journal of the Academy of Natural Sciences*—that journal which has since extended into so many. It is in that series that were published a number of articles, illustrated by his unrivaled pencil. Thirteen specific names were framed for fishes obtained in Massachusetts, but most of them have not stood the test of time and comparison with more material. Lesueur remained at home in Philadelphia, more or less, till 1825. He then accompanied his old patron, Maclure, to New Harmony, Indiana, where they hoped to live an ideal life in a socialistic colony. It is almost needless to say that they were disappointed. While in New Harmony, Lesueur issued a prospectus for a work to be published in parts, by subscription, on the 'Fish of North America with plates drawn and coloured from nature.' The demand for the work was not sufficient to justify its publication and the project fell still-born. After various adventures and much sickness, he left, by way of New Orleans, for France, and after an absence of twenty-two years, was again at Havre in 1837. In Paris and in Havre he passed most of the remainder of his life and for the last two

years was director of the museum of the latter city. He died on the twelfth of December, 1846.

A very interesting biography of Lesueur by Dr. E. T. Hamy, a member of the Institute of France, appeared in 1904, entitled 'Les Voyages du Naturaliste Ch. Alexandre Lesueur dans l'Amerique du Nord (1815–1837).' It was published (1904) in the *Journal de la Société des Americanistes de Paris* (Vol. V.) as a special 'Numéro dédié par la Société a l'occasion de l'Exposition Universelle de Saint Louis.' It is illustrated by many landscape views reproduced from originals of Lesueur.

IV.

Next in order of time comes a work whose like was never seen in any other country and has never been equaled since. An expert in ichthyology, who should see it for the first time, without previous knowledge of it, might suppose that the author was an irresponsible idiot who had not intelligence enough to appreciate elementary facts. An ordinarily bad book might be left unnoticed, but the one in question is so abnormally bad as to be a curiosity of ichthyological literature, and interest and wonder must be excited at the variety of errors an educated man may be subjected to in a field of which he had no knowledge. Now hear who this man was and what positions of honor and profit were conferred on him.

Jerome Van Crowninshield Smith was born in Conway, N. H., July 20 (or 22), 1800, was graduated at the medical department of Brown College in 1818, and again at Berkshire Medical School in 1825 (or 1822). He became the first professor of anatomy and physiology in the latter institution. In 1825, he settled in Boston, was port physician from 1826 to 1849, and meanwhile was editor of several medical or other periodicals, among which were the *Boston Medical Intelligencer* (1823–1826), the *Boston Medical and Surgical Journal* (1834–1856), and the *Medical World* (1857–1859). In 1854, he was elected by the Native American, otherwise called the 'know-nothing' party, mayor of Boston, and served a single term (1854–5). Subsequently, he removed to New York where his son was resident, and was appointed to the professorship of anatomy and physiology in the New York Medical College. During the war of 1861–5, 'he went to New Orleans, where he accepted the position of acting inspector-general, with the rank of colonel, and he was the chairman of a commission appointed by Banks to consider the sanitary condition of the city.' He died at Richmond, Mass., in the residence of his sister-in-law, August 21, 1879.

His obituarist, in his old periodical, the *Boston Medical and Surgical Journal,* records that, 'although a man of no great ability, he could turn his hand to almost anything. For instance, it is said of him that, as a college boy, he was the champion drummer of his class. Later in life he was alternately anatomist, historian, naturalist, politician, a writer of books of travel, sculptor, editor and orator. He kept a whole set of the 'Encyclopædia Britannica,' on his office table and nearly every page was said to have a book-mark in it. He was a successful modeler in clay. Although a busy and active man, his practise was never a large one, but he nevertheless acquired considerable property'—testifying to another important talent!

Smith was a voluminous author and, besides numerous contributions to the periodicals he edited, published nearly a dozen independent volumes on various subjects. The only one of interest in the present connection is his 'Natural History of the Fishes of Massachusetts,' issued first in 1833, and again, as a 'second edition,' in

1843.* The second edition is a mere reissue, apparently, of the unsold remainder of the original, with a new title page and publisher's name. Even the original list of 'errata' is retained without any additions.

Now let us examine the work and we will find out what a strange production it was.

Smith's chief fountain of information was Mitchill's monograph, 'The Fishes of New York described and arranged,' published in 1815 in the *Transactions of the Literary and Philosophical Society of New York.*

He evidently had, as a standby, John Starks's 'Elements of Natural History,' published at Edinburgh in 1828, in which the classification proposed by Cuvier in the first edition of the 'Règne Animal' (1817), was followed. This served Smith as a guide for the arrangement of his material. Although the second edition of the 'Règne Animal' (1829) had been translated and published in New York a couple of years before (1831), it was unknown to Smith.

Another work he referred to as 'the Conversations Lexicon'; it was the 'Encyclopædia americana' of those days, which had then been very recently published.

For the illustrations, he had a work long ago forgotten, but which had a considerable circulation in its day; it was Strack's 'Naturgeschichte in Bildern mit erläuterndem

* Smith (Jerome Van Crowningshield). 'Natural History of the Fishes of Massachusetts, embracing a practical essay on angling.' By Jerome V. C. Smith, M.D. [Fig. of Falls.] Boston: Allen and Ticknor. 1833. [12mo, vii, 399 (+ 1). pp.]

—— The same with fifty-four wood engravings. By Jerome V. C. Smith, M.D. [Fig. of Menhaden.] Second Edition. Boston: William D. Ticknor. MDCCCXLIII. [12mo, vii + 399 (+ 1) pp.]

Its character was exposed in "Remarks on the 'Natural History of the Fishes of Massachusetts. * * *' Read before the Boston Society of Natural History, March 20, 1839. By D. Humphreys Storer, M.D. < *American Journal of Science and Arts* (Silliman's), Vol. XXXVI., July, 1839, pp. 337–349." According to Dr. Storer (p. 348), the work of his compatriot contains "notices of 105 species, of which 80 are foreigners, and but 25 are found in the waters of our State. Of these 105 species, 36 are illustrated by figures; of these 36 illustrations, but 9 accompany species which are found on our coast; of these 9 figures, 6 are copied from 'Strack's Plates,' and 3 from Mitchill's 'Fishes of New York'; of the 36 illustrations [small wood-cut figures] contained in this 'History,' not one is drawn from nature."

The other contributions of Smith to the ichthyology of Massachusetts are mere lists of names, viz:

—— 'A Catalogue of the Marine Fishes taken on the Atlantic Coast of Massachusetts. * * *' [Also, 'Fishes found in the Rivers, Mountain-Streams and Ponds of Massachusetts.'] > Report on the geology, mineralogy, botany and zoology of Massachusetts. By Edward Hitchcock. Boston, 1833, pp. 553–554.

A list of 52 nominal species of marine and 17 of fresh-water fishes.

There is discrepancy between the different biographical sketches of Smith as to name (Crowninshield or Crowningshield) and several dates. The article in Appleton's Dictionary of American biography is chiefly followed.

—— ['Revised Catalogue of the Fishes of Massachusetts.'] < *Op. cit.*, 1833, pp. 597–598.

A list of 102 nominal species, 83 of which (including the Bodiani = Morone) are salt- or brackish-water, and 19 fresh-water.

—— 'A Catalogue of the Marine and Fresh-Water Fishes of Massachusetts. < *Op. cit.*, second edition. Boston, 1835, pp. 534–538.

A list of the same character as the preceding, enumerating 106 nominal species (and 2 varieties), of which 89 are salt- or brackish-water, and 17 fresh-water. Reproduced (pp. 15–18) in the 'Catalogues of the Animals and Plants of Massachusetts' (edited by Edward Hitchcock), Amherst, 1835, reprinted (same type) from the second edition of the above-cited work.

The catalogue is a repetition of the names (without description or remarks) of the author's 'Natural History of the Fishes of Massachusetts.'

This compilation was also criticized (by Dr. D. H. Storer) in 1837 in "An Examination of the 'Catalogue of the Marine and Fresh-water Fishes of Massachusetts,' by J. V. C. Smith, M.D.," contained in Professor Hitchcock's 'Report on the Geology, Mineralogy, etc., of Massachusetts, by D. Humphreys Storer, M.D.' < *Boston Journal of Natural History*, Vol. I., pp. 347–365, pl. VIII. (May, 1836).

Text'; of the fish part two editions had been published at Düsseldorf, one in 1819–26 and the other in 1828–34. This work was the source of most of the reduced and very poorly engraved wood-cuts which accompany the text; three were borrowed from Mitchill's 'Fishes of New York.' Such are the facts, but in his preface Smith makes no mention of Strack's work and leads up to the supposition that his cuts were original. His words are, "With respect to the engravings, they are far short, in many instances, of what was anticipated. Some of them are beautifully and accurately executed; but others are miserable caricatures. The artist was young and inexperienced, and when he would have willingly made a second drawing the press could not be kept in waiting."

He has certainly told the truth in the acknowledgment that the engravings were 'miserable caricatures.' They are generally very poor copies of the originals. For example, Strack's figure of the fresh water lamprey represented correctly seven lateral branchial foramina; Smith's copy only five! A few examples may now be examined as samples of the many kinds of errors he committed. To expose all would require a volume as large as the one noticed.

Under the caption 'GEN. SCYLLIAM' three species are claimed for Massachusetts, the 'sea-dog, *Scyllium Canicula*' (p. 80); the '*Scyllium Catulus*' (p. 81); and the 'dog-fish, *Squalus Canis*' (p. 82). Now, no species of the genus *Scyllium* has ever been obtained from the coast-waters of Massachusetts and the only sharks called sea-dog or dog-fish that could have been known to Smith were the picked dog-fish, *Squalus acanthias,* and the smooth hound, *Mustelus canis,* which were not named by him.

Gray mullets or mugilids, as every one here knows, are among the most common of the shore fishes from Woods Hole southward, and, under the name *Mugil albula,* were well described by Mitchill in 1814, in New York, but Smith urges (p. 268), 'Notwithstanding the minute description there given, we think there must be some mistake, and our private opinion is that no other species than the red mullet is a native fish'! Following up this fancy, under the caption 'GEN. SARMULLUS' (a new name!) he specifies (p. 271) the 'red mullet, *Mullus Barbatus,*' and, after a break of many pages, immediately after the mackerel (p. 304), he names 'the surmullet, *Mullus Surmuletus.*' As to the former, he avers (p. 271) that 'red mullet have appeared, within the last few years, in the neighborhood of Boston, but not being at all prized, a few only have been exhibited in the market.' The surmullet was declared (p. 304) to be 'a variety of the mackerel,' and this remark was followed by comments on its place in Roman estimation, on what was evidently the chub mackerel, and on fishing for mackerel!

There is a peculiar genus of gadoidean fishes named *Raniceps,* represented by a single species of northern Europe, and the type of a distinct family, Ranicipitidæ. To this 'GEN. RANICEPS' Smith referred two species; one named (p. 209) 'Blenny, *Blennius Viviparus* [*Raniceps Trifurcatus, Cuv.*],' the other (p. 211) '*Raniceps Blennioides.*' The former was evidently the *Zoarces anguillaris* and consequently belongs to a widely different species from the '*viviparus,*' a different family from *Blennius,* and a different family also from *Raniceps trifurcatus.* The latter name, we learn from Storer, represented a specimen 'purchased of' Smith, by the Boston Society of Natural History, of a *Cryptacanthodes maculatus* 'with *the cuticle* abraded'; consequently the species belongs to a very distinct family from the genus *Raniceps,* as well as from the first species.

Another striking manifestation of his

ignorance and rashness is displayed in the treatment of a couple of other species. Under the 'Gen. Cobitis' (p. 183) he notices the 'sucker, *Cyprinus Teres* [*Catastomus*].' In the third paragraph under the specific caption he refers to 'a strange fish' given by the keeper of the Boston Lighthouse, unknown "to any of the fishermen in his service, which has a mouth precisely like the fish above described; but the body, instead of being round, is quite thin [!] and wide, back of the gills. The color is silvery, mottled with dark waving lines. It is in length about ten inches, and appropriately denominated the *sea-sucker.*" What could this 'sea-sucker' have been? One familiar with the fishes of the coast and with Smith's idiosyncrasy might reconcile the notice with the king-fish (*Menticirrus nebulosus*), but the sucker is a malacopterygian and the king-fish an acanthopterygian, and, besides, the latter has a mouth not at all like that of a sucker in reality! All this is quite true, but on an examination of the very specimen mentioned by Smith, it was found by Storer to be a king-fish.

How Smith was led to put the sucker in the genus *Cobitis* and to separate it from its near relation, the chub sucker, *Erimyzon sucetta,* which was placed in the genus *Cyprinus* as the 'chub, *Cyprinus oblongus,*' is not at all comprehensible.

The habit of assuming that the popular names were correctly applied led to other curious results. Some of the most abundant of the fishes of the state are the cyprinodonts known as minnows and the sun-fish, called also bream and roach. The cyprinodonts and sun-fish do not appear at all in their proper persons in the 'Natural History'; the only mention of any minnow is under the head of 'minnow, *Cyprinus atronasus*'; the names of 'bream, *Abramis chrysoptera,*' 'roach, *Leuciscus rutilus,*' and 'dace, or dare, *Leucisus vulgaris,*' are found, but only in connection with the European fishes, which, it scarcely need be added, are not American fishes.

Still another kind of error is found in statements respecting distribution. As we all know, the shad was introduced into the waters of the Pacific slope by the United States Fish Commission because it was supposed none were there. According to Smith, however, 'on the northwest coast of America, they are inconceivably numerous'!

The examples thus given are quite enough to illustrate some of the kinds of errors Smith fell into.

The only item of new or special interest found in the entire volume is not from the pen of Smith, but of a correspondent, Jas. P. Couthuoy, captain of a merchant vessel, who later became known as an able conchologist and accompanied Captain Wilkes in his celebrated voyage around the world. In a postscript to a general letter, published in the article on the mackerel, Couthuoy added, 'though you are already, perhaps, aware of it, * * * the male dolphin may be easily distinguished from the female in the water, by the shape of the head; that of the former being abrupt, and almost perpendicular, * * * while the female's is more rounded.' This statement, written in January, 1832, and published in 1833, anticipated by five years the discovery of M. Dussumier, announced in the 'avertissement' (p. vii) to the twelfth volume of Cuvier and Valenciennes' 'Histoire Naturelle des Poissons' (1837). In view of our knowledge of Smith's character, the suggestion that he was aware of such a fact sounds quite ironical. No ichthyologist has recognized the claim of Couthuoy to the discovery in question.

Smith's wretched book misled many of the anglers of the middle of the past century; frequent evidences are to be found of his influence in the principal works

(Brown's 'American Angler's Guide' and Herbert's 'Frank Forrester's Fish and Fishing of the United States') which served as guides to the fishermen of that time; even so able an ichthyologist as Sir John Richardson quoted it and was evidently much puzzled by it.

V.

The next author whose work demands examination was a man of quite a different character from Smith, and who, for nearly three decades, published the results of studies of the fishes of Massachusetts. His last work is still the most comprehensive illustrated volume descriptive of the fishes of Massachusetts alone.

David Humphreys Storer was born in Portland, Maine, March 26, 1804, attended Bowdoin College and was graduated there in 1822, then studied medicine, and was graduated from the medical department of Harvard College in 1825. Immediately afterwards he established himself in Boston as a general practitioner of medicine. "In 1837 he cooperated in founding the Tremont Street Medical School. He became interested in natural history in 1831 and was one of the founders of the Boston Society of Natural History," and in 1838 was elected curator of the herpetological and ichthyological collections. He was also 'commissioned' in 1837 as one of the commissioners to report on the zoology and botany of Massachusetts under an act of the legislature 'approved 12th April, 1837.'

In 1854 he was called to the professorship of obstetrics and medical jurisprudence in the medical school of Harvard; in 1859 became also the dean, and held both appointments till 1868. Meanwhile, from 1849 till 1858, he was physician to the Massachusetts General Hospital. In 1866 he served as president of the American Medical Association. He was honored by Bowdoin College in 1876 with the degree of LL.D. In 1883 he retired almost entirely from practise and spent the remaining years of his life in the enjoyment of well-merited leisure.

His principal works relative to the region under consideration are 'A Report on the Fishes of Massachusetts,' published in the *Boston Journal of Natural History,* in 1839, and 'A History of the Fishes of Massachusetts,' published in the *Memoirs of the American Academy of Arts and Sciences,* from 1853 to 1867.* These were

* Storer (David Humphreys). 'A Report on the Fishes of Massachusetts.' By D. Humphreys Storer, M.D. < *Boston Journal of Natural History,* Vol. II., 1839, pp. 289–558, pl. VI.–VIII.

Descriptions are given of 107 nominal species, 91 of which are salt- or brackish-water, and 16 fresh-water; in the concluding remarks, 9 additional undeterminate species are indicated as probable inhabitants of the Massachusetts waters.

—— 'Supplement to the Ichthyological Report.' < *Ib.*, Vol. III., 1841, pp. 267–273.

—— 'Additional Descriptions of, and Observations on, the Fishes of Massachusetts.' 1842. < *Ib.*, IV., 1844, pp. 175–190.

A second supplement to the report.

—— 'Reports on the Ichthyology and Herpetology of Massachusetts.' By D. Humphreys Storer, M.D. < Reports on the fishes, reptiles and birds of Massachusetts. Published agreeably to an order of the legislature, by the commissioners on the zoological and botanical survey of the state. Boston: Dutton & Wentworth State Printers, 1839. [8vo, xii [+2 l.], 426 pp., 4 pl.], pp. 1–253, with half-title,—Fishes of Massachusetts,—pp. 1–202, pl. 1–3.

The report on the fishes is the same as that published in the *Boston Journal of Natural History,* but (1) an entirely different introduction is added, (2) the supplementary observations on '*Carcharias obscurus*' (*B. J.*, III., 558) are omitted and (3) supplementary observations are added (pp. 405–409) on several species.

The plates are apparently printed from the same lithographic stones.

—— 'A Synopsis of the Fishes of North America.' < *Memoirs of the American Academy of Arts and Sciences.* New series. Vol. II. (Cambridge, 1846), pp. 253–550.

739 nominal species from all North America (including the West Indies) are described. The

later published as separate works and with independent pagination, and doubtless are in such form constantly referred to at Woods Hole, as they are still the largest complete works that refer avowedly to the region in question.

The report of 1839 was a useful compilation of existing knowledge respecting the subject-matter, and for the first time brought together descriptions which could only have been found previously in scattered publications. The classification of Cuvier, then almost universally accepted, was adopted.

William Yarrell, the author of 'A History of British Fishes,' not long before published (1836), was an exemplar for the report, and as Storer acknowledges, 'the generic characters are generally given in the language of Yarrell.' The genera not represented in Britain are defined after the same pattern.

'For many years,' according to his obituarian biographer, 'it was the standard work on our fishes and was only supplanted in New England esteem by the revised, extended and fully illustrated work completed in 1867.'

The history is really an amplified edition of the report with some of the species that had been discovered in the meanwhile incorporated and with plates illustrating all the species described in it but one—the so-called *Blennius subbifurcatus,* which is a typical Stichæid.

Storer claims to have 'carefully redescribed all the species' for his history, and it has been declared by an eulogist that 'it would be difficult to point out a work of greater accuracy in detail.' Consequently it has been proclaimed to be 'a classic in North American ichthyology that must serve as a basis for the future histories of the New England fishes.' Naturally such a work calls for examination. If some discrepancy shall be found to exist between the estimate of the eulogist and that now to be presented, it must be remembered that the former was hampered by the demands of a memorial celebration, while, on the present occasion, only the facts need be considered.

In the sixth decade of the past century, the classification proposed for the fishes by Cuvier, in 1829, in the second edition of the 'Régne Animal,' was still regnant. Naturally, then, Storer adopted it for his 'History' as he had previously for his 'Report.' He added diagnoses of the families which were in almost all cases translations of the essential characteristics assigned to them by Cuvier. In the au-

descriptions, however, are mostly inaptly compiled and insufficient.

—— 'A Synopsis of the Fishes of North America.' By David Humphreys Storer, M.D., A.A.S. Cambridge: Metcalf and Company, printers to the university. 1846. [4to, 1 p. l. (=title), 298 pp.]

A reprint, with separate pagination, title-page and index, of the preceding.

—— 'A History of the Fishes of Massachusetts.' By David Humphreys Storer. < *Memoirs of the American Academy of Arts and Sciences* (Boston), new series, viz:

1. V., pp. 49–92, pl. 1–8, 1853.
2. V., pp. 122–168, pl. 9–16, 1853.
3. V., pp. 257–296, pl. 17–23, 1855.
4. VI., pp. 309–372, pl. 24–29, 1858.
5. VIII., pp. 389–434, pl. 30–35, 1863.
6. IX., pp. 217–263, pl. 36–39, 1867.

134 species are described and (except one—the *Pholis subbifurcatus* = *Eumesogrammus subbifurcatus*) *illustrated,* and, in an appendix, a nominal list (by Mr. Frederick Putnam, of Salem) of 21 additional species is published. Of the 134 species, 116 are salt- or brackish-water, and 18 fresh-water.

—— A History of the Fishes of Massachusetts. By David Humphreys Storer, M.D., A.A.S. * * * (Reprinted from the Memoirs of the American Academy of Arts and Sciences.)—Cambridge and Boston: Welch & Bigelow and Dakin & Metcalf. 1867.

As indicated on the title-page, a reprint of the preceding, or rather a collection of extras of the several parts separately and consecutively paged, and with an independent title-page and index.

thor's nomenclature, he was "guided as far as possible by the principle which would give the credit of a species to the author who first placed it under its appropriate genus. This plan," he truly added, he "was led to understand is being adopted by our most eminent naturalists." For a time such was the case.

The work was and is of such importance that some analysis may be welcome.

As long as the writer had a guide to follow, his faults of taxonomy were mainly those of his guides, but he had the fortune, good or bad, to obtain specimens of types unknown to the authors whose views he followed, and then he had to determine their affinities as best he might. The result by no means did credit to his perspicacity. Among these types were the genera *Boleosoma* and *Cryptacanthodes*.

Boleosoma had been quite correctly referred by Dekay to the family of Percidæ, and is in fact a perch in miniature. Yet Storer referred it to the 'Triglidæ,' between *Acanthocottus* and *Aspidophoroides*, in spite of the fact that he declared (after Cuvier) that 'their general character consists in having the suborbital bone more or less extended over the cheek and articulated behind with the preoperculum.' Why he should have referred to such a family a genus with the suborbitals reduced to such an extent that they had been said to be absent is a mystery which he made no attempt to explain.

Cryptacanthodes was first named by Storer in 1839. It is an elongated naked fish without any enlarged suborbital bones and entirely unlike any recognized triglid. On the other hand, it has many characters in common with genera of the family of 'Gobidæ' (as he called it), and in accordance with his own definition he should have referred it to that family. In fact, the genus is the type of a peculiar family nearly related to that of the gunnells.

The same ineptitude for the appreciation of characters or form is manifest in the treatment of species which he actually referred to the family 'Gobidæ.' To the genus *Blennius* was relegated a species named *Blennius serpentinus*, and to the very closely related genus *Pholis* was assigned another species named *Pholis subbifurcatus*. Now, the true species of *Blennius* and *Pholis* have a very characteristic physiognomy, and only differ from each other in the fact that the former has skinny tufts over the eyes which are wanting in the latter. Yet the *Blennius serpentinus* has a very elongated form and no superciliary tufts and the *Pholis subbifurcatus* has also an elongated form and, therefore, no resemblance to a true *Pholis*. In fact, the two species belong to a different family from *Blennius* and *Pholis* and are related to each other. They are the stichæids now named *Leptoblennius serpentinus* and *Eumesogrammus subbifurcatus*.

The want of appreciation of the value of words as well as of natural relations was also manifested in the treatment of the flat-fishes. Cuvier had divided the typical pleuronectids into three genera or, as he called them, subgenera: *Platessa*, distinguished by a row of obtuse trenchant teeth on the jaws; *Hippoglossus*, having strong pointed teeth, and *Rhombus*, including the turbots. While professedly adopting these genera, he referred to *Platessa* several species (*dentata, oblonga, quadrocellata*) which are really more nearly allied to the halibut and European species associated with that fish. Cuvier had not referred to the American species and Storer had consequently to do for himself.

The last genus that requires attention is *Carcharias*. The part of the 'History' referring to it was published in 1867. As early as 1841 Müller and Henle had published their great work on plagiostomes and the sharks of the American coasts had

long been referred to their proper genera. But all the labor was lost, so far as Storer was concerned. Four species were referred by him to the genus. Only one (*obscurus*) has the characters assigned in the diagnosis. One (*griseus*) is an *Odontaspis*, another (*vulpes*) an *Alopias*, and the fourth (*atwoodi*) is the great white shark (*Carcharodon carcharias*). It will be thus seen that his four species of *Carcharias* belong to four families of Müller and Henle and most modern systematists.

If we examine his descriptions we too often find that while they fill every requisite as to length, there is too much perfunctory verbiage and too little precision. For example, the 'form' of the striped bass as well as of the common mackerel is said to be 'cylindrical,' while the Spanish mackerel (*Scomber dekayi* or *colias*) is claimed to have the 'body elongated.' Now, there is really no difference in form between the two mackerels and that form is as nearly fusiform as any fish can have. Any one who knows what a cylinder is would be so misled by the use of the word that he would be precluded from identifying the striped bass from the description, if he relied on it. The mackerels are certainly elongated, but so is an eel and so also is a hairtail; it is evident, therefore, that the unqualified adjective is altogether too vague and meaningless. These examples of the want of precision and misuse of terms must suffice.

Another feature which may excite the surprise of the new student is the meagreness of the information respecting habits of species. There are some statistical data concerning the mackerel, herring and cod, some observations on the habits of the sunfish, toad-fish and trout and briefer references to others, but the parental care exercised by the sticklebacks and catfishes and the peculiarities of others, are not even alluded to. Comparatvely little was known in those days of such matters, it is true, but information about the characteristics in question was already existent in the literature.

The best part of the work is the collection of plates. These are really for the most part excellent and among the best that have ever been published. Most of them were prepared by A. Sonrel, who had been trained for such work by Agassiz. But the want of supervision was occasionally evident even here. For example, adopting the fashion then prevalent, scales from the back and lateral line were illustrated for almost every scaly fish. Now, the most characteristic feature of the scales of the sparoid fishes is the divergence of the striæ across the field above and below and their intersection of the margins. Sonrel had represented the fine concentric striæ of the scales of the early families correctly, but, in place of well-marked striæ for the sparids, he gave meaningless dots (pl. 10, f. 2, 3, 5, 6); apparently he had perceived something anomalous to him in the sparoid scales, but was afraid to represent what he saw and adopted the device of obscurity and ambiguity expressed in punctulation.

Another case of bad iconography was exhibited in the figure of the so-called *Blennius serpentinus* (pl. 17, f. 1.) Storer conceived for this fish a very deeply divided dorsal whose parts were 'connected by a membrane' (p. 91). Probably the fin had been injured; in a perfect specimen the fin is uninterrupted. The artist may have been influenced by the ichthyologist; possibly the ichthyologist may have been misled by the artist; anyway, the representation of the fin accords with the description and not with nature.

It will be evident that all the criticisms that have been passed on the 'History' are those that might have been made at the time the parts were published. In the allocation of some of the genera and species

he sinned against his own definitions. His nomenclature has not been considered as such and need not be. Respecting that, hear what his obituary biographer had to say.

In the words of that eulogist, "in the time that has passed since its publication we have changed our ideals of names, and discoveries of new genera or species, or in the anatomy, have compelled changes in our system. The nomenclature of the book has become somewhat antiquated, and the systematic arrangement is not entirely suited to the present time."

His eulogist has further truly remarked that Dr. Storer 'used little of his energy in searching for generalizations.' In fact, the only evidences he has left of any attempts at generalization were a simple table of the geographical distribution of genera of North American fishes and the isolation of the genus *Amblyopsis* in a family he called 'Hypsæidæ.'* We may pass them without comment save that they were laudable attempts at least.

I have alluded to these defects of Storer's work because for a long time they influenced our conceptions respecting the fishes of the coast and were generally adopted. The errors were repeated by Dekay in 1842 and (pardon the expression of personal experience) the discrepancy between the facts and the print sadly perplexed my boyish studies and for a time made me fear that failure to understand was the fault of my stupidity rather than Storer's and Dekay's fault. In fact, they remained uncorrected till I had to demonstrate that the statements were inconsistent with the facts and formulated the views now prevalent.

VI.

In 1872 was published an article which would not call for notice, since it is devoted to a limited locality and covers a very short period, were it not that the locality is very near Woods Hole and that it emanated from such distinguished ichthyologists as Dr. Franz Steindachner and Professor Agassiz, under the editorship of Col. Theodore Lyman. The article is a catalogue of the 'Fishes taken in the Waquoit weir, April 18 to June 18, 1871,' and was published in the 'Sixth Annual Report of the Commissioners of Inland Fisheries' (pp. 41–58, pl. 1–2). We are told that 'most of the nomenclature is by Dr. Franz Steindachner; and some notes by Professor Agassiz are added marked A.' Only forty-four species were obtained. The nomenclature for the most part is that prevalent during the previous half century and not that which had been in general use for the preceding decade and is prevalent now. Some interesting statistical and biological data are given. No species previously unknown to the state or region in question were added.

This was the last authoritative faunal contribution of Massachusetts naturalists. The labors of the excellent ichthyologists of the state, chief of whom, for many years, has been S. E. Garman, have been with excellent judgment devoted to the elucidation of questions of morphology and taxonomy. The greater facilities enjoyed by the United States Fish Commission have been recognized and the task of formal registration has been left to those directly or indirectly connected with that organization.

VII.

Before Storer's 'History,' was completed and before the Waquoit weir was examined, Professor Spencer F. Baird visited Woods Hole and spent part of several summers there with his family. His first visit was made in 1863; he then found forty-seven species and among them, for the first time, the very young of *Trachynotus carolinus* and *T. ovatus*

* Syn. Fishes N. A., pp. 4–8; 183, 184, 1846.

(*falcatus*). These as well as *Cyprinodon variegatus* were recorded by Gill in the *Proceedings of the Academy of Natural Sciences* for 1863 (p. 322) and later, with other material, served as the basis for the reduction of three genera of earlier American ichthyologists to one species and of the generalization respecting the mode of development and growth of the carangids and scombroideans generally.

The United States Fish Commission was established in 1871 and the village that the commissioner had proved as a private was selected by the officer as a station of the new commission. With government means for exploration, many species previously unknown to the coast were added, and up to 1873 not less than twenty-three species new to the region were found, exclusive of those already referred to. These were enumerated in a 'List of the Fishes collected at Wood's Hole, by S. F. Baird,' published in the 'Report of the United States Commission of Fish and Fisheries' for 1871–2 (pp. 823–827). The list was one of names (scientific and popular) only, arranged in accordance with Gill's 'Catalogue of the Fishes of the eastern coast of North America' printed just in advance of it.

Conspicuous publishers of an enumeration of Massachusetts fishes were G. Brown Goode and Tarleton H. Bean, connected with the United States Fish Commission. Under the form of 'A Catalogue of the Fishes of Essex County, Massachusetts, including the Fauna of Massachusetts Bay and the Contiguous Waters,' they gave the names of all the species known from the state; 'it is believed to be complete to the date of publication.' The catalogue was published in 1879 in the *Bulletin of the Essex Institute* (XI., pp. 1–38). The sum total listed amounted to '183 species, of which 163 inhabit salt or brackish water, 20 fresh water.' The 'number of marine species from within the limits of Massachusetts Bay * * * is 133; while 29 are from the deeper off-shore waters in the vicinity of Georges, Le Have, Browns and Sable Island Banks.'

Only twenty of the species have exactly the same names as were adopted by Storer.

As just indicated, a number of the species enumerated by Goode and Bean have never been found except in deep off-shore waters, and consequently not within the limits of the state, or even very near it. There are twenty-four such and they should be excluded from the fauna of the state. The ejected species are deep-sea or pelagic forms which are more foreign to the real fauna of Massachusetts than are the fishes of Florida or of Britain.

The catalogue of Goode and Bean, on the whole, is a well-considered and valuable memoir, brought up to the date of its publication.

VIII.

The last census of the fishes of Massachusetts relates to a part of the coast, but that the most important from an ichthyological point of view at least; it is a catalogue of 'The Fishes Found in the Vicinity of Woods Hole by Dr. Hugh M. Smith, Chief of the Division of Scientific Inquiry, U. S. Fish Commission,' now deputy commissioner. It was published in advance and appears in the 'Bulletin of the United States Fish Commission' for 1897 (XVII., pp. 85–111, with folded map); it was supplemented in two later volumes (XIX., 309–310; XXI., 32). These give a most useful summary of the fishes of the region indicated, enriched with notes respecting occurrence, comparative rarity or abundance, and time of appearance. The species are arranged in the sequence adopted by Jordan and Evermann, and their nomenclature is also accepted. The number of species recorded in the main list was 209; in 1899, 16; and in 1900, 4. The present

number of fishes recorded up to date is 229 marine species, and if to these we add 11 fresh-water ones occurring in the vicinity, we have no less than 240. It is remarkable that at so late a day so many species previously unknown to the coast should have been found. Dr. Smith, in his main article, enumerated 23 such species; in 1899, added 16, and in 1900, 4 more. No additional ones have been discovered since—a fact by no means surprising. The additional species, with one exception, were known estrays from tropical waters; the exception was supposed to have been previously unknown and was described as *Chætodon bricei.*

If we now first subtract from Goode and Bean's 'Catalogue of the Fishes of Essex County' 24 species which are deep-sea forms not yet found in Massachusetts Bay, we shall have left 36 species which have not been found about Woods Hole. These, added to the 240 actually found there, and 5 more from fresh water will give us a total of 281, the number of species now known to have been found some time or other along the coast of Massachusetts or in her interior waters.

IX.

A specially notable feature in the late enumerations and additions to the fauna of southern Massachusetts is the great number of young tropical fishes and the comparative or total absence of adults. Sixteen species were added in 1899 to the piscine visitors to Woods Hole and four in 1900, and of these no less than eighteen were the young of typical tropical forms. In round numbers, about three dozen species of tropical fishes have been found along the coast, represented only or almost only by the young—often the very young. In olden times, when persons believed, or thought they believed, that all fishes laid eggs at the bottom, it would naturally have been inferred that such young must have been hatched close by, and that the parent fishes had spawned in the northern seas. Such an inference, with our present knowledge, is quite unjustifiable. We now know that a very large proportion of fishes develop pelagic or floating eggs and not demersal ones. If such fishes, then, would discharge their ripened ovarian burdens near the surface of the open sea where currents would carry them northward, many of the young in time would be drifted into high latitudes. Not a few of these involuntary travelers, by fall time, might reach the latitude of Woods Hole or near it, and winds blowing shoreward might account for their presence along the coast. We know that the parent fishes live close to the gulf stream in southern Florida and you know that masses of gulf weed are frequently drifted on the nearby coast and that such was especially the case in the year when the young tropical fishes were found in such numbers along the coast. It would be interesting to follow the long voyages of such travelers.

Here, then, is a field which the fish commission and the laboratories at the Tortugas and Beaufort might investigate. The towing-net is as necessary a tool for the biologist as the dredge, and surface-collecting, though it may not yield as many new species, will add more to our knowledge of the life-histories of many common animals than dredging. While grateful for all these agencies, and especially the United States Fish Commission, for what has been done, let the past be the presage of a still more active and fruitful future. May American enterprise rival the patriotic efforts of Danish sailing-masters and gather materials which shall compare with those which Christian Lütken used so well, long ago, in the elucidation of pelagic fishes. As to the special Piscifauna of Massachusetts, a future task will be to subtract rather

than to add. A problem to determine must be what shall be considered as fishes really belonging to the fauna. Certainly inhabitants of the deep seas, which never approach the territorial limits of a state, can not properly be considered as members of the fauna. Such types as the chimærids, simenchelyids, nemichthyids, saccopharyngids, alepocephalids and macruids are characteristic constituents of the deep-sea or bassalian realm. The involuntary estrays from tropical seas, whose lives are terminated with the increasing cold of the fall and winter months, also cannot claim to be reckoned as constituents of the fauna. They are representative of a very distinct realm—the Tropicalian. They do, however, furnish very useful hints for the determination of zoogeographical problems. We have the evidence that in times past a few estrays from tropical families have established homes far from those of their kindred. All such problems and considerations, however, must now be left for the future and for other hands.

Theo. Gill.

Smithsonian Institution.

THE COLD-CURRENT SYSTEM OF THE PACIFIC, AND SOURCE OF THE PACIFIC COAST CURRENT.

I propose to offer reasons for believing that an immense system of currents of ice-cold water occupies a large part of the Pacific Ocean, corresponding in magnitude to the vast warm-current system of the equatorial Pacific, which culminates in the great Gulf Stream of Japan, or the Kuro Siwo.

But preliminary to this I would note some points relative to that remarkable stream of cold water, which flows in a vast volume southerly, skirting southeast Alaska, Vancouver's Island, the Pacific states of Washington, Oregon and California, and finally passes out westward to Hawaii, beyond which group it becomes merged into the great equatorial current running westward.

This stream is of very low temperature, of immense volume and of great velocity. It is unique in its powerful effects upon the climates of the coasts along which it flows. To the states of Washington and Oregon throughout the summer it imparts a constantly cool and moist climate extending over one hundred miles into the interior. It also greatly mitigates the cold of winter. Both these conditions are in strong contrast to the arid summer and biting winter climates which prevail in the interior of those states east of the Cascade Range.

To the entire coast of California from Klamath to Los Angeles this current lends chill fogs throughout the summer afternoons, whose moisture clothes with verdure the coast hills for many miles in breadth, while the interior of the state is dry and parched. It makes warm clothing needful in San Francisco every day in the year. It also mitigates the scorching heats of the interior valleys of California, giving cool nights to render them habitable.

Finally turning westward like the trade winds under the impulse of the globe's rotation, this mighty current broadens out into the open ocean, gradually gaining warmth. After traversing 2,200 miles it reaches the Hawaiian Islands, still at the low temperature of 70° in late summer, and of below 60° in late winter. This imparts to that favored group a uniformly subtropical climate such as is unknown to any other land in the same latitude. Borne on this powerful current there may often be seen passing the islands or landing on their shores, immense trees as well as saw-logs which have been swept to sea by freshets in the Columbia River.

What is the source of this mighty current? This is a problem not hitherto solved. It has been the custom to call it a