

### Johannes Schmidt.

JOHANNES SCHMIDT died in Copenhagen on February 22, 1933, at the all too early age of fifty-six years. He was a sturdy man to all appearance, and young-looking to the last; but heart trouble, which had long threatened him, laid him low. Schmidt was a very great naturalist, in a time when great naturalists have been few. His diligence kept pace all his life long with his opportunities, and both were ample; his learning and his originality were one as conspicuous as the other. He had the good fortune to solve, and to solve completely so far as we can see, a problem as old as Natural History itself, the ancient mystery of the place and manner of reproduction of the eel. This was his chief and crowning triumph, and brought him world-wide fame; but it was far from being the only work he did.

Nothing in biological science came amiss to him, and he was eager to borrow from the other sciences what they could lend to biology. He was botanist, zoologist and physicist by turns; he was one of the first to see that the distribution of a fish in the sea was a problem in oceanography, and called for all one could discover of the varying temperature, salinity and oxygen-content, and the wide-flung currents of the sea. He was no less quick to use statistical methods and the theory of probabilities in apparently simple but actually subtle and recondite questions as to local races or allied species of fish.

Two thousand years ago and more, Aristotle knew a good deal about eels, how to keep and feed them, how, where and when to capture them; but he thought that they proceeded neither from pairing nor from the egg, and was content to suppose that they came forth out of the mud, as worms which the sun had begotten of putrefaction. A great Italian, Redi, had a glimpse of the truth nearly three hundred years ago; he saw, I suppose, the eels going downstream in the dark moonless nights of autumn and the elvers coming up the rivers in spring; and he drew the bold, if simple, inference that they bred somewhere out at sea. The story took a long time to tell. A little thin transparent fish, sent in the eighteenth century from Anglesey to Pennant, was recognised a hundred years later to be the peculiar larva of an eel; and this, the so-called *Leptocephalus*, was presently found in numbers, and of several kinds, in the Mediterranean, especially in the Straits of Messina, where Charybdis

turns the waters upside down and brings strange creatures out of the depths into the light of day. Here, for many years, Grassi had studied the problem of the eel, and had discovered much before, some thirty years ago, Johannes Schmidt's work began. On a fishery-cruise on board the *Thor*, Schmidt happened to find a *Leptocephalus*-larva to the westward of Faeroe; and searching the North Atlantic for two whole summers (1904-5) he found the same larvæ all the way from Spain to Iceland and far to the westward, but never off the Norwegian coast nor in the North Sea. In the spring he found only larvæ, but later on he began to find them metamorphosed into elvers or little eels. It was clear that the eels were breeding far off in the west: it was remarkable that no eels at all were found in the South Atlantic, nor even as far south as the Equator. Two or three years later Schmidt began to explore the Mediterranean, and found that there were no eel-larvæ farther east than the west coast of Italy, or the Straits of Messina; and even there, there were no young larvæ but only large ones, not far off the time of their metamorphosis. In short the Mediterranean, which had seemed in Grassi's time to be a breeding-ground for eels, was found to breed none at all; they all came in from the Atlantic, helped along by the steady current running in through the Straits of Gibraltar. The larvæ take three months or so on their way from Gibraltar to Messina, and there are few eels or none in the Black Sea; they have all turned aside, into one river or another, before they get there.

Johannes Schmidt's voyages of discovery were interrupted by the War, but by 1921 he was out in the Atlantic again; and in this year and the next he tracked down the eel to its actual breeding-place, south-west of Bermuda, in the salt warm waters of the Sargasso Sea. Once in their lives the old eels resort to this far-off breeding-place; they spawn there, but they come back no more. Only the little larvæ, wafted by the currents, come eastward home on a voyage three years long; and turning into elvers as they go, they grope their way at last into this river or that, from Iceland to the Baltic, from the Baltic to the Nile, as chance may lead them. Not the least curious part of the story is that the American eels, differing slightly but unmistakably (so Schmidt declares) from the European stock, breed in the self-same waters or close by; but their progeny are somehow guided, westward instead of eastward, to American rivers instead of ours. In the South Atlantic there seem to be no waters so warm or so salt as those of the Sargasso Sea, nor is there any system of currents setting to the shore; these seem to be the reasons why no larval eels are to be met with there. But in many other parts of the world, in the East Indies, in the archipelagos of the Pacific, and very notably in New Zealand (where eels were very important to the Maori)—in all of these regions

eels are plentiful; and in his later years Schmidt made a round-the-world cruise with the special object of tracking these many eels to their breeding-places in the Southern Oceans.

Johannes Schmidt was a born traveller. After his student days in the University of Copenhagen he went at once to Siam, as botanist to a Danish Expedition; he brought home very large collections, and for many years after, while busily engaged in other work, he continued to edit the *Flora of Koh Chang*, and contributed several sections to that work, on the Mangroves, the Combretaceæ, and other families. He had already written, with a colleague, a useful textbook on the Bacteria, soon translated into German; and an elaborate account of the Danish Cyanophyceæ or Blue-green Algæ.

Johannes Schmidt was a member for many years of the International Council for the Investigation of the Sea. In this capacity he did a deal of work, chiefly in connection with the cod and other Gadoid fishes, whose spawning-grounds, from Iceland to Spain, he traced out as diligently as the eel's. In this investigation he made full use of his knowledge of hydrography; and showed how the distribution and migrations of the cod were simply determined by the physical phenomena of the sea.

As Director of the Carlsberg Laboratory he became interested in hops, and published a series of papers on their growth, breeding, and variation. Lastly, he made a number of laborious and important studies of variation in particular fishes, eels among the rest. He was especially interested in those many cases where two races, varieties or so-called species, were so nearly alike that a single individual of either could not safely be identified; but statistical evidence, the average characters of a large random sample of individuals, gave characters about which there could be no mistake. The European and American races of the common eel are a case in point; both vary in such a way that their characters overlap, and a single specimen cannot be safely referred to either. But a count of the vertebræ in a hundred individuals of each shows an average of nearly ten vertebræ more in the one group than in the other. In a certain inshore fish, common in the Baltic, the viviparous blenny, he found a similar difference between the fish in the fjords and those in the open sea, even between those in one fjord and another; he found that these small differences were in the main hereditary, as he followed them through six generations or more; but yet, after all, he discovered that a change of conditions, or environment, did produce a small but perceptible change of characters. These statistical studies, and the whole concept of racial groups on which they are based, have an importance that as yet we are slow to realise.

Johannes Schmidt was a fortunate man. His marriage was singularly happy, and his wife became a friend of his friends and a worker by his side; it associated him closely with the Carlsberg Brewery, and helped him to a share (without which his work could never have been done) in the munificent trust under which the profits of that great business go to the advancement of knowledge. He was a member of many Academies besides ours, into which he was elected in 1927; he had decorations from ten countries (I believe) besides his own. He was at home in several languages. His life was as simple as it was happy; he was modest as he was learned; he was big-hearted and most generous. I found him a rarely lovable man during a friendship of more than thirty years.

D. W. T.