100 YEARS AGO

It is stated in the *Times* that the committee, presided over by Mr. Haldane, M.P., appointed to consider the allocation of the increased grant-in-aid of education of a university standard in arts and science has now finished its inquiry… the committee proposes that the sum of 45,000*l.* be allotted as follows: — Manchester, 6000*l.*; University College, London, 5000*l.*; Liverpool, 5000*l.*; Birmingham, 4500*l.*; Leeds, 4000*l.*; King's College, London, 3900*l.*; Newcastle-on-Tyne, 3000*l.*; Nottingham, 2900*l.*; Sheffield, 2300*l.*; Bedford College, London, 2000*l.* … The committee expresses the view that the time has come for making a new departure in the principle on which State assistance is to be given to the highest education. It is recommended that a moderate sum should be set aside for distribution by way of payment to post-graduate students from the university colleges who devote themselves for one, two, or three years to special problems; and that to ensure the money being applied most efficiently to the stimulation of individual study, … the distribution should assume the form of a grant made directly to the student on the advice of some impartial authority.

From *Nature* 16 March 1905.

50 YEARS AGO

Medical findings during the inquiry into the recent *Comet* disasters have suggested that the possibility of lung damage by impact with a water surface at the terminal velocity of fall (about 160 ft./sec.) should be investigated… Penney and Bickley suggested that the lungs of any man or any animal would be severely injured by transmission of the shock wave set up if the chest wall were flung inwards with a velocity of 20 m./sec. (66 ft./sec.) acquired in 0.5 m.sec. or less… the critical velocity of impact is 99 ft./sec. for a guinea pig, 118 ft./sec for a mouse and 94 ft./sec. for a man… Some animal experiments were devised for testing the validity of these deductions. A vertical catapult was specially constructed for projecting guinea pigs, belly first, into a large tank of water… Grave injury to the lungs, and other viscera, was found in animals projected into water at velocities greater than 104 ft./sec., both anæsthetized and dead specimens giving the same result. … The closeness of the agreement must be regarded as largely fortuitous in view of the approximate nature of the calculations.

From *Nature* 19 March 1955.

Holland *et al.*[2] (page 374 of this issue), who report the collection of the first good-quality specimen of a 'lophenteropneust' — the supposed 'missing link' between the two groups.

The story starts with photographs of the sea bed taken by US oceanographers in the 1960s using a camera dangled from a ship into an abyss in the southwestern Pacific[3]. These dramatically showed large spiral coils on the ocean bottom, and one photograph was thought to have actually caught an animal in the act of creating one of the enigmatic patterns (Fig. 1). The creature was tentatively identified as an enteropneust worm about a metre in length, with a transparent, gelatinous body 5 centimetres thick and a laterally swollen head end. It was a giant in comparison with shallow-water acorn worms and, rather than burrowing in the sea-bed ooze as the shallow-water worms do, it appeared on the surface of the mud. The characteristic spiral or sometimes looping faecal trail was proposed to be made as the worm moved forward, swallowing sediment and defecating. The evenly separated spiral or looping pattern reflects the side-to-side movement of the head as it forages for particles at the surface of the sludge. These animals turned out to be quite common and widespread denizens of the deep, as shown by photographs of spiral and looping traces at other locations on the abyssal sea floor, particularly in the Southern Hemisphere[4] (see Fig. 3 on page 375 for more examples).

A few years later, Danish deep-sea biologists led by Henning Lemche studied these and other photographs archived at the Scripps Institution of Oceanography in San Diego, California. They came to the startling conclusion that the broadly expanded collar region at the worm's head end bore tentacles resembling the 'lophophore' used for feeding by other pre-chordate groups such as the pterobranchs[5]. The Danish researchers proposed that the worm had a pterobranch-like head end on an enteropneust body. On this basis, they tentatively designated these deep-sea worms as a new group of hemichordates that they termed the 'Lophenteropneusta', or lophophore-bearing enteropneusts. There was a degree of tacit acceptance of this intermediary body form[1], from which some people inferred that the ancestral hemichordates were worm-like. But what was needed to determine whether this worm was indeed a living link between enteropneusts and pterobranchs was the recovery of a good specimen of one of these fragile worms for detailed examination.

Holland *et al.*[2] filmed a lophenteropneust gliding over the northeastern Pacific sea bed at a depth of 1,901 m before collecting it using a remotely operated vehicle. These pictures and the authors' careful anatomical study reveal no evidence for any tentacle-like structure on the broad collar on the worm, which is from a new family, genus and species. Holland *et al.* also review a large number of deep-sea photographs showing broad-collared enteropneusts (including those examined by Lemche *et al.*), and conclude that none of the creatures has tentacles. The previous misinterpretation from low-quality photographs highlights the risks of trying to construe more than is perhaps wise from sparse and imperfect data.

Other questions, such as how these spiral traces seem to appear in isolation on the muddy ooze, are becoming clear from recent work. Time-lapse photography at 4,100 m depth off California[6] suggests that the worms swim or drift to new feeding stations, rather than burrowing to them. The photographs show an enteropneust sweeping up detrital food using its collar, and forming a spiral faecal trace, over a period of 39 hours. The worm then completely emptied its gut and floated off the sea floor. Why don't these abyssal enteropneusts burrow? Perhaps it is because detrital food is limited in amount and quality at these depths, and swimming to a new location rather than burrowing would allow a much wider foraging range.

Other enteropneust species, however, might burrow. Another acorn worm was fortuitously recovered at 2,100 m in the deep northeastern Atlantic using a box corer (specially designed equipment for taking undisturbed samples from the top of the sea floor). The worm was found beneath a mound structure surrounded by burrow openings[7]. Moreover, numbers of yet another, unidentified, enteropneust species were found living on the surface of a soft, sandy contourite sediment at 850–1,000 m on the eastern flank of the Faroe–Shetland Channel off Scotland[8], and multi-opening burrows were found deeper in the channel. But it is unclear whether the worms are responsible for the burrows.

It seems, then, that tentacle-bearing 'lophenteropneusts' can be relegated to the realm of fantasy, and enteropneusts and pterobranchs are not as closely related as some people had supposed. Whether or not the ancestral deuterostome body plan resembled today's worm-like enteropneusts is still unclear; what is more certain is that their body form and way of life reflect their modern-day habitats. ■

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