scribed, since no natural instance of the former kind is known up to the present, and since the latter kind cannot be recognised as compound fluorescence by any optical means.

THE ARTIFICIAL TRANSFORMATION OF THE ALPINE SALAMANDER

THE success of Madame von Chauvin in producing the development of Amblystoma from the Mexican axolotl by gradually accustoming it to live in air, induced her to attempt a very interesting interference with the life-history of the black or Alpine salamander, *Salamandra atra*. This is an ovoviviparous species, and although its young possess large gills while within the body of the mother, they are born to commence a land life immediately; while other species of salamander, especially the spotted one, *S. maculata*, found in adjacent districts to the subject of inquiry, bring forth their young with gills, and they pass a considerable period in water before taking to land. The problem which it was desired to solve was, whether the young of the black salamander, taken from the mother before the normal time of birth, and placed in water under favourable conditions, could become adapted to an aquatic life. It is interesting to note that while only two eggs out of many come to full development in the black salamander, forty or fifty develop in the spotted one; yet individuals of the two species are about equally numerous in their respective localities. This shows the value of the avoidance of life in water with its attendant risks, though probably the diminution of terrestrial enemies in the more elevated localities frequented by the black salamander is a considerable influence in its favour.

Madame von Chauvin's researches are detailed in a recent number (vol. xxix. p. 324) of the *Zeitschrift für wissenschaftliche Zoologie*. They commenced on July 30, 1875, with twenty-three larvæ taken in various stages of development; eight were about 1½ centimetres long, twelve were from 4½ to 5 centimetres, and had almost completed their metamorphosis into land salamanders. One was a little less developed, 4·3 centimetres long, the gills and skin-glands were less perfect, and the skin was very transparent and unwrinkled. This larva, unlike the rest, appeared at ease when placed in water, and made no attempts to get out of it. The next problem was to feed the little creature, and the first attempt was made by supplying a number of various minute water insects; but although it evinced some desire to catch them, the insects were able to escape capture, while the larva seemed to become annoyed by their presence. Later on, a minute earthworm being offered, it was taken and swallowed, and the problem was solved. A daily supply of the same food was thenceforth taken by the young salamander.

The gills which the creature possessed in the oviduct appeared from the first little adapted for life in water; they were of so thin a texture that they could hardly be expected to endure exposure and motion, while their great extent evidently hampered the movement of the animal. Consequently the gills first became pale and bloodless, then shrank, and on the third day were entirely thrown off, down to the very base. But on the same day on the right side, a day later on the left, minute buds appeared, three on each side, which gradually enlarged into ball-like protuberances; from these, after three weeks, gill-fringes were put forth, which finally numbered nine on the first pair of gills. The fringes were mostly arranged along the external border of the gills, and they assumed a brown-spotted character, while the blood-circulation through them became plainly perceptible. They were very much less extensive than the previous set of gills, but appeared to perform the work of respiration perfectly; the creature remained completely beneath the surface of the water, without ever coming up to breathe air. While the new gills were being developed the larva remained at rest as if dead, only eating the earthworms when they were offered.

When the gills had attained a length of 2·2 mm. the larva became lively, and concurrent with this was the completion of another transformation. The delicate and transparent swimming membrane of the tail was lost, and replaced by a less transparent and stouter one, of greater dimensions. The creature now seemed to enjoy life much more than before, exhibiting greater interest in its living food, with which it would play before swallowing it. Finally, after six weeks' residence in the water, a skin-shedding commenced, the skin coming away piecemeal for a fortnight.

The larva continued to grow satisfactorily without undergoing further modification, until it had been fourteen weeks in the water, having attained a length of 6 centimetres. The gills then began to shrink, and the tail to assume a rounder form, and in three days the skin was shed, revealing the normal black and wrinkled skin of the land salamander. In nine days from their first shrinking the gills were nearly absorbed, only little stumps remaining. At last it crawled out of the water, and on the fourteenth day the gills were completely absorbed and the gill clefts closed. The remaining larger larvæ of this experiment lost their primary gills less satisfactorily and in a greater length of time. New gills commenced to bud, but the creatures were gradually destroyed by fungus-growths attacking various parts of their skin. The fact that they were altogether more advanced in their metamorphosis rendered them unable to adapt themselves quickly to their new conditions.

A second series of researches on the Alpine salamander was carried on in the summer of 1876, when a large number of individuals were collected at Thusis, at the confluence of the Rhine and the Nolla. The animals were collected thirteen days earlier than in the previous year, so that the development of the young was not so forward. Thirty-three larvæ were taken from the oviducts, eight of which were from 8 mm. to 10 mm. long, two 12 mm., and twenty-three from 35 mm. to 40 mm. All had their skin still transparent and their gills not yet of full size. After twelve of them had refused insects, minute earthworms were administered to them, but they did not eat them till after some hours. Two larvæ, immediately after being taken out of the mother and placed in the water, fastened respectively on the head and tail of a worm that was wriggling at the bottom of the water. Their difficulty was solved by cutting the worm in two, and each obtained half. This method of immediate feeding was thereafter successfully adopted, and it appeared to develop a good appetite in the larvæ.

One noteworthy circumstance in regard to these creatures was that, at a time when they would normally be still within the body of the parent, they were as active and as eager for food as new-born larvæ of the spotted salamander. They were often so greedy for their prey that they seized hold of the limb of a neighbour of their own kind instead of the desired worm. But nevertheless these creatures did not develop in the desired direction, the gills did not begin to shrink quickly, and when they did they were not got rid of as a whole, but the dead portions, remaining attached to the body, became the seat of fungus growth, which speedily increased and spread so as to kill the animal. Thus none of the subjects of investigation really became adapted to their life in water. In two cases it was attempted to succeed artificially by cutting off the gills nearly at the base; one died soon, owing to fungus growths, the other quickly became a land salamander.

Experiments like the foregoing have the highest interest, for they mark out for us the actual path of adaptation to changed physical conditions. It appears highly probable that the spotted and the Alpine salamanders were at no very distant period of time one species, and that as physical conditions became changed one variety became more and more adapted to more elevated and rocky habitats, where water for the early life of the larvæ was not commonly to be met with. Thus gradually the birth of the young was postponed, and they became non-aquatic; concurrently fewer and fewer of the many eggs were developed. The spotted salamander, meanwhile, became more and more specialised to inhabit the lowland districts. Such cases as Madame von Chauvin's, if they remained single instances, would suffice to establish natural selection as a *vera causa* of the mutation of species.

G. T. BETTANY

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

BRISTOL.—The Council of University College have resolved to found an Engineering School in connection with the scientific and technical courses of instruction already established. It is announced that the scheme will meet with the support of the local engineering firms. In accordance with this scheme the lectureships in Mathematics and Experimental Physics have been elevated into professorships, and the present holders of the lectureships, J. F. Main, M.A., D.Sc., and S. P. Thompson, B.Sc., B.A., have been elected to the new chairs.

It is stated that the new buildings of the College will be commenced at once, an excellent site having been secured several months ago. The number of students attending the present term exhibits a considerable increase upon the corresponding term of the preceding year.