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ARRESTED DEVELOPMENT.

The interest excited by Von Chauvin's recent observations upon the axolotl seems to be somewhat in excess of the actual novelty or importance of their results. The axolotl is not the only creature whose development has been rapidly carried forward from a stage, permanently low in the natural state, to another and higher one, in consequence of human interference. Nor, as we noticed the other day, were that lady's specimens of the axolotl the first to undergo, under observation, the, to them, abnormal transformation into fully developed *amblystoma*. Besides, we are strongly inclined to suspect that, so far from determining or compelling the evolution of the two which survived her treatment, the German lady's attention to her pets was the reverse of helpful. Had they been let alone, it is quite possible that the fatalities would have been fewer and the progressive development of the survivors not less remarkable.

For the benefit of those unfamiliar with the creatures in question, we will note here that the transformation alluded to corresponds to that of the water-breathing tadpole into the land inhabiting and air-breathing frog. Seventy years ago Cuvier suggested that all siredons (like the axolotl) might in reality be larval salamanders, that is, the tadpole stage of higher batrachians. The observations of Dumèril upon numerous specimens of axolotl, bred in the Natural Historical Museum at Paris, proved the old suspicion to be substantially true, at least in one instance. In its natural habitat—the Lake of Mexico, and neighboring mountain lakes—the axolotl is, so far as known, always an inhabitant of the water. The specimens transported to Paris remained unchanged; but some of their offspring passed on to a higher stage of development, developing lungs in place of branchia, and becoming perfect *amblystoma*, hitherto regarded as belonging to a distinct family. Why all did not complete the same course of development was a mystery to Dumèril (whose observations were published in *Comptes Rendus*, 1865 and 1867); but a possible explanation was suggested by observations made soon after by Professor Marsh and other American students, upon several allied species of siredons from the elevated lakes of the Far West. Professor Marsh's observations were published in the *American Journal of Science* for November, 1868.

That distinguished observer had seen Professor Dumèril's account of the remarkable metamorphosis of the second generation of the axolotl (*siredon Mexicanus*) in Paris; and, during his next summer's excursion to the Rocky Mountains, took pains to secure a number of specimens of *siredon lichenoides*, Baird, from Lake Como, Wyoming Territory. At the same time a number were secured by Professor Eustis, of Harvard. The two lots were brought to New York together and here divided, part going to New Haven with Professor Marsh, the rest to Cambridge, to be observed by Professors Wyman and Eustis. Professor Marsh's specimens made the passage to New Haven without apparent inconvenience, either from the long journey or their transference to fresh water, the water of Lake Como being brackish. They fed readily upon worms and insects, and occasionally came to the surface and inhaled air. More rarely an exhalation occurred, usually under water. On being removed from their native element they showed the same distress as fishes under similar circumstances, although in a much less degree.

The first indications of any change were observed in one of the smaller specimens; and the metamorphosis apparently began during the journey, which lasted about a week. The animal first became spotted and of a darker hue. Then the broad thin membrane along the back, and above and below the tail, was gradually absorbed; the external branchia followed more slowly; the dark spots increased in number; and the animal came more frequently to the surface for air. By the time the swimming and water-breathing appendages were absorbed, and the openings on the neck closed up, the head had undergone marked changes in shape; the eyes had become more convex and prominent; the body had largely decreased in bulk; the thin external skin was shed, and the secretion of mucus from the surface sensibly diminished. At the same time the animal showed an increasing desire to leave the water, often remaining for some time with its nostrils above the surface, and occasionally made violent struggles to escape. Aided by a heavy rain at night it at last succeeded, and thus put an end to further observation, just at a time when it had lost the generic characters of siredon and become a true *amblystoma*.

A few days later, several other specimens of various sizes began to show signs of transformation. Two were placed in a glass jar, and left in a strong light, and five others were left in a cooler place in the shade. At the end of three weeks the first two had completed the metamorphosis. The others changed less rapidly, or not at all, three completing the metamorphosis in about six weeks, while two showed little or no change, remaining typical siredons. In those that were transformed, a succession of warm days hastened the process remarkably, while it was all but arrested by a series of cooler days. Of the specific changes which the specimens underwent in structure, dentition, habits, etc., in passing from the siredon to the amblystoma state, full information may be found in Professor Marsh's paper.

At the time his specimens were under observation, the specimens taken to Cambridge were being studied by Professors Wyman and Eustis. Only one of the latter was transformed, and change occurred much less speedily than those in New Haven. Two, kept by Professor Eustis, escaped during a rain storm, and six days after one was found still alive, though shrivelled up and the branchia partially gone. On being placed in water, it refused food and died. The lateness of the season probably prevented the transformation of the others.

In the next number of the *American Journal of Science*, Professor Silliman contributed a note describing a colony of *amblystoma* in the possession of a person at Cheyenne. The proprietor assured him that when they were received from Lake Como, a few weeks before, they were all in the "fish" state; that they began to change soon after, and in about three weeks were all completely developed into salamanders. That this change ever occurs in Lake Como, there is, so far as we are aware, no evidence. In this connection, Professor Marsh remarks that, in the elevated region where Lake Como is situated (7,000 feet above the sea), although the weather in summer is quite warm, the nights are always cool, and the changes of temperature often sudden and very great; hence the metamorphosis, if it began, would probably proceed slowly and be liable to suspension during its various stages. That the animal breeds in the siredon state, like the axolotl, he is quite ready to believe; and he remarks that it is probable that after reproduction the power of complete development would be lost. Here is, perhaps, the explanation of the persistence in the siredon state of the majority of the specimens of axolotl observed by Dumèril and Von Chauvin.

A legitimate inference from all the facts would seem to be that the siredons of the elevated lakes of Mexico and the United States are *amblystoma*, whose complete development has been arrested by increasing elevation and consequent climatic change, at a period relatively so recent that they have not entirely lost their ancestral capacity for becoming fully developed under favorable conditions. The transference of reproduction to the larval state is not an insuperable objection to this inference, since, as Professor Marsh observes, the near approximation in many batrachians of the periods of reproduction and metamorphosis, and the effects (especially upon the latter) of even slight differences of physical conditions, are known to produce remarkable variations in the same species, as well as other results, until recently quite unexpected.

It is well known, for example, that our common large bullfrog (*rana pipens*) may remain in the larval or tadpole state, in the colder parts of New England, for many times the normal period; and Professor Wyman once kept the transformation of such tadpoles under arrest for a number of years, the experiment being thwarted at last by an accident, which emptied his tank and killed his specimens. This line of investigation is worth the attention of some of our younger naturalists. It is quite possible that, by a skillful use of light and temperature, the tadpole stage in the bullfrog may be continued until after the reproductive faculty has been developed, and the natural history of siredons paralleled by art.

PROFESSOR TYNDALL ON THE PHENOMENA OF HUMAN LIFE.

Professor Tyndall has recently delivered before the Midland Institute at Birmingham, England, one of those characteristic addresses of his which seems to us likely to excite discussion as widespread as that aroused by his famous prayer gauge proposal and the great Belfast speech. The idea that there is no necessity for invoking the supernatural to account for the ordinary phenomena of human life has already been repeatedly foreshadowed in Professor Tyndall's writings. Nor has he been at all alone in that view, as it is virtually the same as is held by the majority of scientific reasoners of the present time. But in this late address, (which, owing to its length, we cannot publish in these columns, and therefore refer the readers to the pages of the SCIENTIFIC AMERICAN SUPPLEMENT, current issue, where it is printed in full) he crystallizes, so to speak, that opinion and the arguments on which it rests into a compact mass of logical reasoning. With all that clearness, precision, and beauty of language which have rendered him almost without a peer as a public lecturer, he places before us a chain of argument, or rather causes his hearers to forge the links themselves, he only acting as guide, and thus enables them to reach for themselves a logical conclusion.

Just as in the opening of a musical work, a suggestion is given of the themes afterwards to be wrought out, so in his introductory sentences, by which the audience is placed in good humor with themselves and the lecturer, Professor Tyndall manages to shadow forth an instance of absence of free will. Half humorously he deplores the hard fate of modern scientific men, who like himself are drawn from their quiet laboratories and forced into publicity which is not conducive to the exercise of their best powers. Unlike Joule and Darwin, who are not dragged from their seclusion and made presidents of associations, he himself is a special sufferer, but social duties are paramount to his will. With this much preamble he launches into a splendid account of that great theory of modern science, the doctrine of the conservation of energy. "There is nothing gratuitous in physical nature," he says, "no expenditure without equivalent gain, no gain without equivalent expenditure. With inexorable constancy the one accompanies the other, leaving no nook or crevice between them for spontaneity to mingle with the pure and necessary play of natural force. Has this uniformity of nature ever been broken? The reply is, 'Not to the knowledge of natural science.'" Then follows a wealth of illustration to show the universal application of the great law, and through this, step by step, the hearer is led to the