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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

question of the energy of the human machine. Joule's statement is quoted, that unless we abandon the physiological axiom that "the animal body cannot create heat out of nothing, we are driven to the conclusion that it is the total heat within and without that ought to be regarded as the real calorific effect of the oxidation within the body." A man weighing 150 pounds consumes, we are told, in lifting his own body to a height of 8 feet, the heat of a grain of carbon. Jumping from this height, the heat is restored. The muscles of a laborer whose weight is 150 pounds weigh 64 pounds. When dried they are reduced to 15 pounds. Were the oxidation corresponding to a day laborer's ordinary work exerted on the muscles alone, they would be wholly consumed in 80 days. It is but a step further on to ask what enables the production of bodily motions, and to enquire whether it is the action of the will. The answer is that the will is mediate, not direct. The nerves controlled by the brain pull, as it were, the trigger, but the gunpowder which they ignite is stored up in the muscles. "We all know the effect produced on a nervous organization by a slight sound which causes affright. An aerial wave, the energy of which would not reach the minute fraction of that necessary to raise the thousandth of a grain through the thousandth of an inch, can throw the whole human frame into powerful mechanical spasm, followed by violent respiration and palpitation."

Thus far—and we have given but the barest outline of the argument—nothing has been advanced which rises to any other level than that of plain scientific truths which no one can hesitate to accept. But now comes the question: What causes the nerves to act and liberate this gigantic power? Who or what is it that sends and receives massages through the bodily organism? The query is answered thus: "You picture the muscles as hearkening to the commands sent through the motor nerves; you picture the sensor nerves as the vehicles of incoming intelligence; are you not bound to supplement this mechanism by the assumption of an entity which uses it? Are you not forced by your own exposition into the hypothesis of a free human soul?" Henceforward the whole drift of the address changes—persuasion and abstract argument replace scientific deduction; but the speaker has proved us necessitarians by necessity, and then, lest the dilemma afflict us, goes on to show that the belief is by no means such a dreadful one.

Are the brain, and the moral and intellectual processes known to be associated with the brain, subject to the laws we find paramount in physical nature? This is the final problem. Science has led us into the domain of metaphysics, and we have been prepared for the affirmative response. The phenomena of heredity, of how much we owe to the transmitted influences of the past, how closely we are bound up in a chain of events—evolution, whence we cannot escape—all are adduced to prove that we are not masters of the circumstances in which our motives and wishes originate, and "if finally our motives and wishes determine our actions, in what sense can these actions be said to be the result of free will?" "There is," says Professor Tyndall, in his closing sentences, "on all hands a growing repugnance to invoke the supernatural in accounting for the phenomena of human life; and thoughtful minds, finding no trace of evidence in favor of any other origin, are driven to seek in the interaction of social forces the genesis and development of man's moral nature. If they succeed in the search—and I think they are sure to succeed—social duty would be raised to a higher level of significance, and the deepening sense of social duty would, it is to be hoped, lessen, if not obliterate, the strife and heart burnings which now beset and disguise our social life."

THE AMERICAN RAILWAY SYSTEM.—MAINTENANCE OF WAY.

In presenting some facts illustrative of the progress in railway management in this country, we take data from the Pennsylvania Company, that great organization, by virtue not only of the unparalleled extent of its lines, but by the rare administrative ability by which they are controlled, preeminently deserving to take first rank as an example. In no other similar organization are the principles of engineering, construction, maintenance, and management carried to higher standards, and we doubt if any other road can show so thorough a system in all its departments. In each of these, for example, certain standards are decided upon as a result of long experience, and these become the inflexible and governing law, whether it be a mechanical measurement or a matter of policy, and subordinates are rigidly held thereto, no departure being permitted. A somewhat amusing illustration of this occurred recently, when a friend, traveling on their line on a pass issued to him as the company's guest, because of an informality therein, and having insufficient funds to buy a ticket, had presented to him by the conductor the alternative of getting off the train or depositing his watch as security. Being a sensible man he appreciated the situation, surrendered his time-piece, and continued his journey, receiving his property back in due time with a polite explanation from the company's office. The conductor had no discretion in the matter, and courteously maintained the regulation for such case made and provided. This inflexibility might appear to defeat progress in certain departments, but to prevent this tendency, the company maintains a corps for the express purpose of conducting experiment, and any practical improvement reported by it, is put to the working test, and, if demonstrated to have real value, is adopted, but is not, prior to its adoption, allowed to affect any of the railway company's operations in the slightest degree.

A recent article furnished some interesting facts relative to the running of their trains under the block system, and it is proposed herein to explain the method by which their magnificent roadway is maintained in such superior condition. To begin with the official organization of the company is such as to secure with a proper distribution of labor and responsibility the greatest possible efficiency.

The entire line is divided into three grand divisions, severally known as the New Jersey, the Pennsylvania, and the Philadelphia and Erie. Over the whole there presides, independent of the Board of Direction, one general manager and two engineers, one of the latter having charge of bridges and buildings, the other of maintenance of way. Each division is under a general superintendent, and being divided into sections of about 100 miles each, called sub-divisions, for each of which there is a division superintendent. These subdivisions are again divided, say into three parts, over each of which is a supervisor. Under him are sub-division foremen, having 2½ miles of track each to work and keep in order. The number of men allowed to these foremen is determined by the peculiarities of the locality, more men being necessary for difficult sections, as in the mountain regions or wherever the trackway is exposed to exceptional danger.

The important relation of the condition of a road way to its carrying capacity, and the economical management of the traffic over it, was so evident that it was determined to develop the highest possible standard of excellence in this department. The various engineers, superintendents supervisors, and other practical men, met in consultation to decide what various items were essential to the production of a perfect road. Suggestions were made and discussed fully, after which short sections were ordered, constructed according to the plans agreed on, and when ready these were inspected and criticised by the same officers, some modifications suggested, and still further improvements developed. This sample track was as nearly ideal in every particular as it could be made, as to solidity, evenness, drainage, joints, ties, etc., while the surface was finished with all the care and accuracy of that of a drive in Central Park.

When completed to the satisfaction of all, the sub-division foremen and others were referred to it as the standard, and notified that it was expected that the entire line would be brought to a like condition. To encourage a healthful emulation among the subordinates, it was suggested (by Mr. Cassatt, Vice-President) that premiums should be offered for excellence of trackway, namely, $100 to the supervisor whose section should rank highest, and $50 to each foreman whose piece should approach most nearly to the standard. The method employed to determine these awards is both thorough and impartial. About the first of November the various engineers, superintendents, and others go over the entire line in a special car from east to west at a speed of forty-five miles an hour, to test severely the riding qualities of the road. Then the party make the return trip at ten miles an hour in a gondola car, as it is called, which is placed in front of the engine and has seats arranged in tiers, so that all have an unobstructed view of the track. Each person is provided with a printed table, the horizontal rulings of which represent the different 2½ mile sections, with the names of their respective foremen at the left side and the perpendicular rulings representing the different items, specified by name, which are to be examined and criticised. Under these latter rulings each inspector enters a number from 1 to 10 to express his estimate of the quality of each part of the work; 10 is the symbol of perfection, and is never employed, on the principle that the ideal is never quite reached; in fact 8 is rarely used.

The total of each foreman's number is extended to the right, and his average obtained by dividing the sum by 11, that being the number of ratings on the table. Each member of the inspecting party makes his own figures independently, and they are subsequently aggregated and a grand average struck to determine which of the men are entitled to the prizes. It should be remarked, however, that as not all the eleven items that go to make up the perfect roadway are of equal importance, discrimination is made in favor of the foreman whose track is in the highest mechanical condition in the essential points, these features very properly outweighing mere superficial appearance.

When the awards are made, printed announcement is given, and the effect has proved most healthful. The prize money is of course in itself very acceptable, but the prestige is still more valued, as the man is put in the line of promotion, and his work attracts much attention from his fellows, who are guided by its excellence in the next competition.

It is by this system that the Pennsylvania Railroad Company, having first constructed its roadway upon the most thorough principles, not only maintains its excellent condition but constantly improves it. No thoughtful traveler in passing over it can fail to be struck with its solidity and fine appearance, it being in fact a great macadamized way. If he is really observant he will see that its condition is an explanation of the safety and comfort of the great travel over it. Those familiar with the freedom from dust, secured by the stone ballasting used on the entire line in Pennsylvania, will be pleased to learn that the road between New York and Philadelphia is to be finished in the same way, the work now being in progress.

NOTES OF PATENT OFFICE DECISIONS.

In Gordon's case, just decided by the Acting Commissioner of Patents, the trade mark sought to be registered was described as a narrow strip of leaf tobacco placed as a wrapper around the mouth piece of a cigarette.

It was held by the Examiner of Trade Marks that the above matter claimed, as a trade mark, was a functional part of the cigarette and was consumed with it; that, in fact, it entered into the mechanical structure of the article itself, and therefore was not an arbitrary symbol or a lawful trade mark.

It will do, however, to carry this doctrine to the extreme of saying that nothing can be regarded as a proper trade mark which is so intimately connected with an article as to be consumed with it; for if that were the rule, a mark upon a cake of soap, a symbol in the sole of a shoe, and many other forms of devices which might be mentioned, and which are undoubtedly excellent trade marks, would lose their character and value as such from the mere fact that the use or consumption of the article would also result in the destruction of the mark.

A distinction must be made in these cases, between the material, which is essential in the structure of the article, and unessential matter placed thereon or incorporated therein, for the mere purpose of distinguishing the origin or ownership of the article.

Thus the box, barrel, or wrapper containing merchandise, whatever its form, cannot, *per se*, be the trade mark; but a name, symbol, figure, letter, form, or device, cut, stamped, cast, impressed, or engraved thereon, or in some other manner attached thereto, or connected with the article itself, may be a proper trade mark. The trade mark need not be inseparably connected with the package, as when blown into glass, but it must have the *independent and sole* quality of distinguishing the goods as being of a particular manufacture, or as belonging to a particular party. There could be, therefore, no legitimate objection to the trade mark sought to be registered by Gordon, on the mere ground that it was connected so intimately with the article to which it was attached as to necessitate its consumption with that of the article itself.

But there was a serious objection to the registration on the ground that it did not perform the *sole* office of a trade mark. No one has a right to appropriate to his own use, as a trade mark, a device which, from the nature of the use to which it is put, others may adopt and employ for the same purpose. Now, in this case, the leaf of tobacco which was wrapped around the mouthpiece or end of the cigarette, answered a practical, and, perhaps, a very useful purpose. Being composed of tobacco, it was an addition to the material of the cigarette, strengthened the wrapper, and was probably more agreeable to the taste than the paper of a cigarette. The useful properties of the article, therefore, seemed to be the predominant ones, while the function the wrapper performed as a trade mark was merely incidental. Perhaps a trade mark would have been granted had Gordon applied merely for a silk band attached to the cigarette, or a colored piece of paper, or similar device connected therewith, since, in such instance, the device would perform no mechanical function, or answer any other purpose than that of a trade mark.

The intent of the trade mark law being to afford protection to symbols, and not to inventions or mechanical devices, the question whether Gordon had introduced an improvement in the manufacture of cigarettes was immaterial. If he had introduced an improvement, and was entitled to protection thereon, it could be by a patent only. In the absence of any patent, other manufacturers of cigarettes could not be prevented from using the like useful device.

The Acting Commissioner of Patents, therefore, while overruling the decision of the Examiner of Trade Marks, that a trade mark, which is so intimately connected with an article as to be consumed with it, cannot be registered, yet affirms the decision of the latter officer, that the strip of tobacco leaf served more a mechanical than a distinctive purpose. He therefore denies it registration as a trade mark.

THE WOODEN PAVEMENTS OF CHICAGO.

The *Engineering News* severely criticises the present wooden pavements of Chicago, and declares they are a standing disgrace to everybody concerned in them. That the foundation of the paved streets is not only filled with earth hauled from adjacent excavations, but with all the rubbish, bricks, stones, manure, and kitchen slops that can be obtained in the neighborhood. Nothing is excluded from the fillings. The material is carelessly dumped, and there is no sufficient puddling, ramming or rolling. The solidification of the accumulated mass is anything but uniform. Upon this foundation, so unfavorable to permanence, the pavement is laid. As a consequence it soon shows settlement in places, and solidity is the general exception. There are some hundreds of miles of wood pavement in Chicago, but the *News* declares that there is scarcely a dozen miles fit to travel on, and this pavement has been laid only from three to five years. A Committee of the City Council have the subject in hand, and are earnestly seeking to improve the condition of things and determine what kind of pavement can be best adopted to replace these defective paved streets.

THE publication of the illustrated article on "Graphic Phonetics," to which reference was made last week, has been unavoidably deferred. It will appear at an early day.