forests, houses, other property are borne down stream. One gorge alone has been known to sweep away $3,000,000 worth of property, besides making a tremendous destruction of life. A gorge will often require three days to pass a given point.

Another enemy to investigation and to embankments are the snags which infest the river. These, in their worst form, are large trees with roots and limbs. So rapidly are they loosened and borne down that the government is required to keep several snag boats constantly at work. Perhaps the greatest of all enemies to embankments is the period of high water. At this time most of the country adjoining the river, known as the "bottom lands," is flooded to a greater or less depth. This is a most dangerous period, the result of which is awaited with anxiety by land-owners involved. The various floods occurring since 1850, principally in that year, and those of 1864 and 1874, have carried away 200 miles of embankment between New Orleans and Cairo alone, which will cost the government alone $6,000,000 to repair.

There are many schemes offered for the construction of permanent embankments. Some are practicable to an extent, and others are but empty air. It is evident, however, that the government can never secure sufficient funds to inaugurate a system of embankments which shall have a foundation resting on the bed-rock below the river's bottom. Captain Charles M. Scott proposes a method which is, in brief, to weight and sink a reach of trees with their roots in such a manner as shall change or keep the current within bounds. A careful consideration of this method shows that after every high-water season these trees would be "reaching" in all directions along the river. Captain James B. Eads once proposed a system of ditches which shall narrow the river in wide places and compel the current to cut a deeper channel. As I understand this method, it is hardly practicable. There are other methods proposed. That of Captain Cowden is, perhaps, worthy of trial, though I am compelled to believe that it must be accompanied by a permanent system of levees. A very simple method, which has a semblance of practicability, is being experimented on near Omaha and at Nebraska City by Major C. R. Suter. An examination of this exhibits a simplicity which may circumvent the action of the water. No rip-rap is sunk and no piles are driven down. The sloping bank is covered with a mattress of brush. Stones are piled on this to a thickness of seven or eight feet, which holds the bank in its place and retains its sloping form. The water seems to have little inclination to work under this as in the case of a perpendicular embankment. I believe it is the invention, for the most part, of Professor L. E. Cooley, late professor of Engineering in the Northwestern University at Evanston, Ill., and now in charge of the works at Nebraska City, Major Suter also employs a simple and inexpensive method of changing the current of the river where it is wearing away the bank. A line is fastened to a buoy near the centre. Branches of trees are tied along one-half of this, leaving the other half bare. Anchors are attached at both ends of the rope and the half without bushes is run up the river as a guy, while the buoy holds up the centre of the rope at the surface. A line of brush then runs from the surface diagonally to the bottom. A series of these is placed out in the stream near where the damage is being done. The sediment coming down stream catches on the brush, sinks and forms a bar, and either breaks the force of the current or throws it out into the stream away from the endangered bank. This latter method has long been in use by the Corps of Royal Engineers with success.

Hegar's formula for an effective non-poisonous preservative and antiseptic is as follows:

℞	Salicylic acid	20 parts.
	Boracic acid	25 "
	Potassium carbonate	5 "
	Dissolve in hot water	500 "
	Glycerine	200 "
	Then add oil of cinnamon, oil of cloves, each 15 parts, dissolved in alcohol	500 "

It is an exterminator of moths and vermin and has a pleasant odor.

ON THE NUTRITIVE VALUE OF FISH.*

By Prof. W. O. Atwater.

This paper gives the results of an investigation made under the auspices of the Smithsonian Institution and the United States fish commission. They included analyses of a large number of specimens of more common food fishes, whose details, though quite extended, were mainly of theoretical value. Some of the applications, however, were of much practical interest. In 100 pounds of the flesh of fresh cod we have 83 pounds of water and only 17 pounds of solids, while the flesh of the salmon contains only 66½ per cent. of water and 33½ per cent. of solids; that is to say, about one-sixth of the flesh of cod and one-third of that of salmon consists of solid, that is, nutritive substances, the rest being water. Lean beef, free from bone, contains about seventy-five per cent. water and twenty-five per cent. solids. The figures for some of the more common sorts of fish were:

	Solids. per cent.		Solids. per cent.
Flounder	17.2	Halibut, fat	30.7
Cod	16.9	Mackerel	22.2
Striped bass	20.4	Shad	30.7
Bluefish	21.8	Whitefish	30.4
Halibut, lean	20.6	Salmon	33.6

If we take into account not the flesh only but the whole fish as sold in the market, including bones, skin and other waste, the actual percentages of nutritive material, is, of course, smaller. Thus the following percentages of edible solids were found in samples analyzed:

Flounders	7.1	Shad	14.8
Cod	10.5	Shad	18.7
Mackerel	11.4	Lake trout	13.6
Halibut, lean	15.6	Salmon	25.6
Halibut, fatter	27.2		

The subject has of late attracted unusual attention. The chemico-physiological investigation of the past two decades has brought us where we can judge with a considerable degree of accuracy from the chemical composition of a food-material what is its value for nourishment as compared with other foods. The bulk of the best late investigation of this subject has been made in Germany where a large number of chemists and physiologists are busying themselves in the experimental study of the laws of animal nutrition. They have already got so far as to feel themselves warranted in computing the relative values of our common foods, and arrange them in tables, which are coming into popular use. The valuations are based upon the amounts of albuminoids, carbo-hydrates and fats, each being rated at a certain standard, just as a grocer makes out his bill for a lot of sugar, tea and coffee, by rating each at a certain price per pound, and adding the sums thus competed to make the whole bill. A table was given showing the composition of a list of animal foods. Thus it appeared that, while medium beef has about three-fourths water and one-fourth solids, milk is seven-eighths water and one-eighth solids. Assuming a pint of milk to weigh a pound, and speaking roughly, a quart of milk and a pound of beefsteak would both contain the same amount—about four ounces—of solids. But the quart of milk would not be worth as much for food as the pound of steak. The reason is that the nutrients of the steak are almost entirely albuminoid, while the milk contains a good deal of carbo-hydrates and fats, which have a lower nutritive value. According to the valuations given, taking medium beef at 100, we should have for like weights of flesh free from bone:

Medium beef	100.0	Bluefish	85.0
Fresh milk	23.8	Mackerel	86.0
Skimmed milk	18.5	Halibut	88.c
Butter	124.0	Lake trout	94.0
Cheese	155.0	Eels	95.0
Hens' eggs	72.0	Shad	99.0
Cod (fresh fish)	68.0	Whitefish	103.0
Flounders	65.0	Salmon	104.0
Halibut	88.0	Salt mackerel	111.0
Striped bass	79.0	Dried codfish	346.0

These figures differ widely from the market values. But we pay for our food according, not to their value for nourishing our bodies, but to their agreeableness. Taking the samples of fish at their retail prices in the Middletown, Conn., markets, the total edible solids in striped bass came to about $2.30 a pound, while the Connecticut river shad's

* Read before the A. A. A. S. Boston, 1880.

nutritive material was bought at 44 cents per pound. The cost of the nutritive material in one sample of halibut was 57 cents, and in the other $1.45 per pound, though both were purchased in the same place at the same price—15 cents per pound, gross weight. In closing, Professor Atwater referred to the widespread but unfounded notion that fish is particularly valuable for brain food on account of its large content of phosphorus. Suffice it to say that there is no evidence as yet to prove that the flesh of fish is specially richer in phosphorus than other meats are, and that, even if it were so, there is no proof that it would be on that account more valuable for brain food. The question of the nourishment of the brain and the sources of intellectual energy are too abstruse for speedy solution in the present condition of our knowledge.

ANATOMY OF THE TONGUE IN SNAKES AND OTHER REPTILES, AND IN BIRDS.*

By Dr. C. S. Minot.

The tongue arises as a protuberance on the floor of the mouth, which in the course of development acquires a muscular system ; the latter appears first in the reptiles. The principal muscles are the longitudinal arising from the hyoid bones, morphologically a part of the branchial muscles. In the crocodiles these are the only muscles found. In the snakes, however, proper lingual muscles play an important part, there being a distinct vertical muscle between the *Ceratoglossi*, three distinct transverse muscles, one superior and two inferior, and finally a longitudinal muscle immediately under the upper surface of the free portion of the tongue. Each muscle is distinct and separate throughout its whole course; they can all be traced with facility. The disposition of the nerves and other parts of the tongue was also described. The examination of the tongue of an *Ameiva*, the common long-tail lizard, revealed a structure in all its features identical with that of the snake's tongue. This offers a confirmation of the view that lizards and snakes are closely related, for in no other class of reptiles has a snake-like tongue been observed. On the other hand, the tongue of the Chamæleon is peculiar. It has been previously studied by several authors, all of whom have committed important errors. The whole tongue is exceedingly complicated and difficult to understand. The arrangement of the muscles is the most remarkable yet observed among animals, and they cannot be homologized with the muscles of the tongue of any other animal, until our knowledge of the subject shall be greatly enlarged. Dr. Minot stated, while he had made new observations on the tongue of the chamæleon, that he had been led to recognize more clearly, than previous writers, the difficulty of explaining the mechanism of the organ. The tongue of birds presents a uniform type, distinct from that of any reptile. The tongue has its simplest and lowest form in the crocodiles, is much advanced in the snake and fissilingual lizards, remarkably transformed in the chamæleon, and presents a special type in birds. These points are brought out by numerous microscopical observations on the nerves, blood vessels and other parts.

SOME FACTS AND THEORIES BEARING A RELATION TO THE DISTRIBUTION OF ORGANIC FORMS ON THE GLOBE.†

By W. H. Davis.

The author commenced by pointing out the fact that the inorganic conditions which surround us are in a state of change, ceaseless, and ever varying ; and illustrated this portion of the subject by references to denudation and redeposition of existing land surfaces. It was then shown that these inorganic changes could not take place without at the same time producing an effect on the organic world commensurate in some degree with the intensity of the inorganic change ; this led up to the question of the same area of the earth's surface at successive periods possessing a varying fauna and flora, and the light thrown by palæontological investigation upon the changes of land surface that had taken place, and this knowledge of past conditions in its turn throwing an instructive light upon the former range of the various orders and genera of organic beings. Thus it was, that as there was a perpetual ebb and flow and ceaseless interchange of inorganic structure, so the forms and types of life affected by these influences are also in a continual and corresponding state of unrest, from the necessity of the two conditions being in harmony with each other, the organic and the inorganic.

The first problem, therefore, was, seeing that a change of the organism was necessitated by a variation in the conditions of existence, whether these changed conditions as they arise were of themselves capable of inducing structural differences in organized forms subjected to their influences. Starting with the negative view, it was pointed out that there were but two courses open to the organism affected—migration or extinction ; but the former cause of itself involved a minor change of conditions, and as in the life history of the earth, a second, third, or greater number of migrations were necessitated, at last the probabilities were of the environment of the organism being so varied from its primary condition that extinction in this case must also ensue. Thus a form persisting through several or many periods of geological time would be impossible ; but as this was contrary to many observed facts, the converse view was discussed, and actual structural modifications due to changed conditions referred to, as in the case of animals and plants introduced into West Africa, South America, and other regions. Mimicry was also instanced as evidence of the influence of inorganic form on living organisms. In man the Europeo-American nation of the United States was quoted as an instance of a race being formed under our very eyes.

It may, of course, be urged that the differences here pointed out are only of a character such as might be anticipated to have arisen, and that, pendulum-like, they vibrate through a very small arc, and in no way give rise to fresh species, still less to fresh genera. The next point, therefore, that comes in for consideration is whether these structural differences are ever commutative. We have seen that the change which can be produced in a single species is not an alteration in respect of one character only, but an alteration of many characters affecting different parts and portions of the same organism. Now these modifications, small as they are (in comparison with the question of a complete change of species), certainly did not leap into being in an instant, but have exhibited themselves gradually. Here, then, is a starting-point for the cumulative evidence. The changes themselves, even so far as they have gone at present, are but expressed cumulative results, and having become once established, it is only in accordance with what we have already seen to be the case, that with a further change of surroundings, a corresponding modification must ensue, or extinction alone must follow. But in this argument we are not altogether left to the evidence as visible to the eyes of mankind during the historic period, but a mass of the facts of palæontological history, some embryological investigations, and many zoological observations are absolutely inexplicable save on these grounds. If we trace the connections of the reptilian and avian forms, the progressive stages in time of the Equidæ, or the changes in structure of the more lowly Ammonitidæ, the same answers must be given, that the extremes observed in the respective groups have been the result of a cumulative modification due to the types of life being in a condition of instability, and ever seeking to bring themselves into harmony with their inorganic surroundings.

In further illustration of this portion of the subject, sympathetic modification or correlative adaptation may be noted, as when the change of one structure in an animal induces changes in other structures remote and apparently unconnected with it, as in the pigeon, the beak and toe lengthening and shortening in unison.

Degeneration was strongly insisted upon as a factor in producing fresh types, equally with progressive modification.

Passing, then, to the various views entertained as to the causes of the present geographical distribution of life, the doctrine of specific centres was explained, the author maintaining that this idea was, in effect, but the old teleological argument that every organism was created for a definite

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