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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 401,

For the Week ending September 8, 1883.

Price 10 cents. For sale by all newsdealers.

BORING DEEP WELLS BY WATER PRESSURE.

A new and great advance has been made in sinking deep well pipes, say from 100 to 300 feet or more in depth, in soil that will resist the sinking of the driven well pipe.

The hydraulic pressure system has been successfully applied at Adams, Mass., where six artesian wells are now flowing; one of 187 feet in depth, which was sunk in two hours; five wells of from 100 to 150 feet in depth, one of which has a 10 inch pipe, from which flows 400 gallons per minute under a head of 13 feet above the surface of the ground.

The method of sinking these wells is by the boring power of water under pressure—the pressure being obtained by a steam pump, or in places where a steam pump is not available a hand force pump answers the purpose. A peculiar feature was developed in the experiments made in perfecting this system, and the stern fact brought to light that a stream of water forced into the top of the pipe would keep an opening around the outside of the pipe for a depth of 40 or 50 feet, and would reopen the passage after stopping to put on an additional length of pipe; but after getting down to greater depths the stopping of the flow would allow the sand, gravel, and stones to settle down and wedge the pipe so tight that no available pressure could start it again. In the avoiding of this difficulty consists the novelty of this system. The placing in the line of pipe at every two or three lengths of a three-way cock with the use of two lines of hose gives a perfect control and steadiness of the flow down the pipe during the whole operation.

The hose being attached to the side outlet of the three-way cock, with the plug across the upper outlet until the section of pipe is sunk until the attached hose reaches the ground, when another section is added and another hose is attached to the next three-way cock as before, and the pressure of water put on, when the lower cock is turned so as to shut off the lower hose and continue the stream from the upper hose. In this way a depth of 200 or 300 feet may be attained without difficulty, possibly a much greater depth. A curious property of the power of water in keeping an open passage in an ascending current has been observed in these experiments. A plumb bob upon a line was dropped to a depth of 50 feet upon the outside of one of these pipes while in the process of sinking, and again hauled to the surface, showing that the current maintains a clear space around the outside of the pipe, probably for its whole depth—for in addition to this, the pipe is so loose in the hole that it can be turned around by the hand, and feeds itself down.

The author of this system is Jarvis B. Edson, of North Adams, Mass.

THE POTATO ROT.

At the time of writing, August 23, the daily papers contain telegraphic accounts of the great destruction of the potato crop in various sections of the country. The disease, judging from the descriptions, is doubtless the one known as the "potato rot." This is not a new trouble, and most of the older inhabitants can remember the ravages of this pest in 1842 and again in 1845, when it spread over Great Britain, Ireland, and the United States, causing much distress to those who make the potato the leading article of food.

The rotting of the potatoes is caused by a microscopic fungus, *Peronospora infestans*, which infests the potato plant. By fungus is understood a plant of a very low order, the more familiar members of which are the toadstools, mushrooms, mildews, and moulds. Some of the fungi live only on decaying organic matter, and are comparatively harmless; in fact, are often helpful in hastening decay and preparing substances for future usefulness. Other species of fungi are parasitic, growing upon living things. The bread mould is a familiar illustration of a small fungus which feeds upon dead matter, while the potato rot fungus is an equally striking example of one thriving upon a living plant. The mildew of the grape, which has caused great damage in many vineyards, is a close relative of the potato rot. They both belong to the same genus (*Peronospora*), a genus which contains a large number of species, and all are destructive to the host plants.

The potato rot fungus consists of long filaments or threads, which grow through the substance of the potato plant, and rob it of juices and induce a rapid decay. The fungus usually makes its first appearance upon the under side of the leaves as frost-like patches, soon causing the foliage to curl and turn brown. This frost-like appearance is due to a multitude of spores which have formed upon the ends of fungus threads protruding from the breathing pores of the leaf. There are many thousand stomata or breathing pores to the square inch, and a dozen or more threads may come out at each opening. Each of these threads forms branches, and each branch bears a spore. This helps to give an idea of the vast number of spores formed upon a single affected leaf. These spores germinate quickly and in a peculiar manner—each spore giving rise to several smaller spores provided with hair-like appendages (*cilia*) by means of which they move quickly around. This is a most admirable provision for the rapid and perfect spreading of the disease when it has once "struck" a potato field.

After the foliage has become affected the disease passes into the stems and down to the tubers, when the most destructive work is done. The farmer should be on the watch for this fatal pest of his potato field. Like most fungi this Peronospora thrives best in warm, rainy, or "muggy" weather. In one of the recent press reports it was stated that the decay was caused by the wet weather which has prevailed in many parts of the country. The weather was only a favoring condition for the growth of the rot plant, as much so as the rains are aids to the profitable development of the various field crops. Weeks ago we predicted, and with a great degree of certainty, that the potatoes would rot in many sections. This came from a knowledge of the nature of the rot and the conditions which favor its development.

It has been shown that the disease is first seen upon the leaves. When the foliage begins to curl and turn brown, the potatoes should be dug at once, and in this prevent the fungus from reaching the tubers. The potatoes should then be placed in a cool and dry place—the conditions least favorable for the further growth of the fungus should it be present. All affected tubers should be thrown out and gathered with the vines and burned. This destroys multitudes of spores which might otherwise live through the winter and be ready to propagate the rot the following season.

There has been a great deal said about "rot proof" varieties of potatoes, but they probably do not exist. Some sorts are more susceptible than others, probably from constitutional weakness. Many prizes have been offered in England for the finding of the best sorts to withstand the attacks of the rot fungus, but without any satisfactory results. Knowing that the disease is caused by a parasitic fungus, the rapid development of which is favored by moist, warm weather, there is little hope of finding a variety of potatoes so abnormal as to be "rot proof."

CHEMISTRY FOR DIGESTION.

In all lands, and in all ages, the instinctive cravings of the human system have demanded and have eventually succeeded in obtaining as an article of food something which should give such a combination of nitrogen, carbon, and hydrogen with oxygen as is not readily accessible in any form of food of natural production. The savage, in temperate or cold climates, may subsist almost exclusively on flesh or fish, and in the tropical regions on vegetables and fruits, as they grow. But it is only the savage who does this. The first elevation from the savage state lifts him above such things and such simplicity of diet. He makes a combination, though without knowing the chemical reasons for it. The combination takes various forms and names, but it serves the same purpose, or aims to do so.

For us the name is *bread*, and no nations can be reckoned who have not been so dependent on that which has been to them what bread is to us, as that it should merit the name we so often give it, "The Staff of Life." And the more advanced the nation has become, the more has their type of bread grown into importance, and the more complete its preparation. The title of "bread winner" given to the supporter of the family but serves to show how absolutely the article is understood to satisfy the wants of the system.

We will not discuss the types as they exist in the present age, here and there throughout the world. Our purpose is a more practical one. It may do us no harm to just give a thought or two to *our* bread; to see what it is that we eat, and how near it comes to being the article which we fondly hope it is, and at any rate to consider what it ought to be, only supposing that human nature was honest.

We are very gravely told that our children should have bread and milk, or its equivalent, as the main article of their diet for the first four to six years after weaning, to the exclusion of almost everything else. Like a great many other of the sagacious plans for bringing up all children on one system by one rule, this may theoretically have some basis in truth. But alas! we are often disappointed. "Things are not what they seem," and while we flatter ourselves that the child is building up its strength and vigor, it is on the contrary only laying the foundation for a lifetime of weakness and suffering because of the very bread on which our hopes were placed. It is an actual fact, as all physicians of skill and experience now recognize, that in most of our families at the present time the *bread* is about the first article which needs watching in cases where weakness of digestion requires the observance of strict regimen in diet.

And it is also true that a very large part of the horrors of dyspepsia, of which we hear so much and from which a fearful proportion of the community are constantly suffering, are due in a great degree to *bread*, that is, to the various forms in which it comes to us, either under its own name or in the guise of its various substitutes—griddle cakes (*ad infinitum*, from buckwheat down—or up), hot biscuit, hot rolls, muffins, waffles, etc., etc. The evils which this array of breakfast diet especially have produced are already telling fearfully on the nation. To find a stomach thoroughly vigorous and perfect in its functions is in most classes and most communities an exception, and the bread supply has really been, and is, responsible for a large part of the evil.

In great measure this sad state of things has sprung from our rapid growth as a nation springing up in the wilderness. This has not only caused the national habit of eating rapidly, but has associated with it the equally widespread habit of preparing the bread food as rapidly, that is, extemporaneously, and consuming it on the instant. We have been taught to consider it scarcely hospitable to set before a guest at the breakfast table *cold* bread. If we cannot give him something *hot* with which to poison himself we apologize, and if the guest is an American he accepts the apology and is sorry for us—and for himself.

The evil result of this has become as truly national as the habit itself. A few words as to the chemistry which the matter of the hot bread involves may serve to set the evil and the danger in a clearer light. We will assume the bread in all cases to be made from a mixture of flour and water; we will say nothing of the other ingredients, for these two only are to the purpose. Such a mixture taken into the stomach in the state of a raw paste is almost absolutely indigestible. It becomes a solid mass, whose fermentation is full of danger. If on the contrary, it is cooked, say baked, it forms a firm, hard substance, which can be eaten, as we know, for a time, but which few persons choose to eat in continuance.

What we do, therefore, is to puff up the paste of flour and water by means of an elastic gas, and it is largely in the changes connected with this gas and its development that the evil resides. If it is formed properly, and the formation *finished*, wholesome bread is the result. There are, however, two sources of danger here indicated, only one of which we can at this moment consider—that is, that *the process is not completed*. Here is where the whole evil of hot bread in all its evil shapes reaches its culmination. The changes in chemical composition, with the molecular structure necessarily connected with them, which are required to transform paste into dough, do not cease when that dough is baked, and has thus become bread. They continue for quite a time afterward, and until they have entirely ceased the material has not become what it ought to be—bread easy of digestion. It is a burden to any stomach, to a weak one it is simply *poison*.

Here in few words is the source of unbounded difficulty and suffering. Hot bread, in any form whatever, ought never to be eaten. Some forms are very much worse than others, but all are bad, and should in reason be banished from every table. The manner in which the changes are wrought we may consider at another time.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY H. C. HOVEY.

Looking over the register on this, the closing day of the Minneapolis meeting, I find it to contain only 321 arrivals, which is considerably less than the usual attendance. There were 186 new members and 60 fellows elected. The list of scientific papers read includes 166 communications, most of which elicited more or less discussion by the members. It cannot be expected that I should give even the mere titles of so many valuable contributions to science, much less an account of all the papers and all that was said about them. Intensely interesting as the mathematician might find a treatise on conic sections, or on the calculus of direction and position, it may be fairly presumed that the ordinary reader would turn to fields less dry. The same may be said of chemical treatises on gammadichlordibromopropionic acid, or of astronomical observations on the light variations of T Monocerotis. These and similar matters are highly important, but not easily made popular and entertaining.

Some of the sections, like that of statistics and economic science, for instance, actually found it difficult to get a fair hearing; while the sections of geology, biology, and anthropology were uncomfortably crowded. In selecting, therefore, a few papers as specimens of work done by the association the risk is run of choosing what attracted attention rather than what was really of greatest intrinsic excellence.

The most exciting theme in the section devoted to chemistry was, no doubt, that of "American Butters and their Adulteration," on which Prof. H. W. Wiley said that the false butters melt at about the same temperature as the true, hence a better test is by saturation, determining the amount of alcohol necessary to set the various fats free. The point of saturation is much lower for good than for poor butter. There is scarcely any soluble acid in the latter, while in the former it is about 5 per cent. The condition of the cows has also to be considered as to the production of the best butter. Oleomargarine shows a peculiar structure in polarized light. The curious fact was stated that oleomargarine had lately been made from cotton seed oil! The whole matter is receiving very careful attention from the United States Department of Agriculture.

Another paper that attracted attention was concerning the "Composition of American Wheat and Corn," by Prof. C. Richardson, of Washington, D. C. The results were tabulated of more than 200 analyses of wheat and 100 of corn. The wheats of the Atlantic States are poorest in nitrogen and albumen, and smallest in size. Those from New York are larger, but still inferior in nitrogen. Those of Maryland are the best among them. The wheats of the middle West are much larger, yet poor in quality. In Colorado, Minnesota, and Dakota we reach the most desirable wheat. The average amount of albumen in our cereals is: Wheat, 14·8; barley, 14·8; oats, 13·8–9; rye, 13·9–25; corn, 10. Corn is not so exhausting a crop as wheat, and will succeed where wheat fails.

Prof. J. C. Arthur described a poisonous aquatic weed found in the lakes of Minnesota in such quantities as to alarm the inhabitants by the sudden and mysterious mortality among their cattle and hogs. Observations as to the cause led to the discovery of a great number of minute balls, only one millimeter in diameter, with fine filaments, at the base of which the microscope disclosed small knobs containing a green liquid. These were found for a few weeks in May and June, and there was proof that cattle that drank the water in which they abounded died in a space of time varying from 20 minutes to 34 hours. The balls were a species of *Rivularia*.

Among the most interesting short papers was one by Prof. J. M. Coulter on "The Development of a Dandelion Flower," in which he traced the floral organs from the microscopic germ to their maturity, illustrating the subject by crayon sketches.

Prof. W. R. Dudley read an essay on the "Origin of the Flora of the Central New York Lake Region," from the Genesee River to the Oneida Lake. The whole region is a series of old eroded valleys filled with drift deposits and occasional lake basins. A large and varied flora characterized this region, whose natural habitat was variously situated to the southwest, west, and northwest. His conclusion was that the great lakes had formerly flowed through these old valleys and carried with them the several varieties of widely scattered plants that had been localized here. This theory was confirmed by the abrupt eastern limit of the peculiar flora.

Perhaps the most interesting of the many papers read in the Biological section was that by Dr. E. P. Howland, on the application of nitrous oxide and air, or oxygen, under pressure to produce anæsthesia. The application is made in condensed air chambers. The reason why nitrous oxide alone cannot be used in prolonged dental and surgical operations is that the blood does not obtain oxygen from it, hence asphyxia follows. Dr. Howland claimed to have administered this gas to over 30,000 persons, and he found the average time of producing anæsthesia to be about 50 seconds, and the average time till the return of consciousness two minutes. The longest period of unconsciousness was 35 minutes. This was effected by allowing the patient to breathe air and then inhale the nitrous oxide again before returning fully to consciousness, the interval varying from a quarter to half a minute. In experiments on animals it was found that death generally followed from breathing pure nitrous oxide for two and a half minutes. If air or oxygen is mixed with it, under ordinary pressure, it will not produce anæsthesia. But mixed with equal quantities of air and breathed from a gas bag in a condensed air chamber at 15 pounds pressure per square inch, or mixed with oxygen in proportion of 85 parts of nitrous oxide to 15 of oxygen, in a chamber where the pressure is five pounds to the square inch, the mixture can be breathed an indefinite length of time without danger or injury, producing perfect anæsthesia and also complete oxygenation of the blood.

The compression of the gas into smaller space enables the lungs to hold a sufficient quantity of each element to cause the desired effect. It has been found that by this process animals may be kept insensible for an indefinitely long period without disturbing their vital functions. The method has been applied successfully by various surgeons, and it is demonstrated that thus the progress and duration of anæsthesia may be regulated at will and with the utmost safety and precision. Dr. Howland illustrated his remarks by experiments on a living animal. No experiments have yet been made on man; but it would be perfectly safe to do so, and it may be regarded as certain that this method, now described for the first time in the United States, will shortly supersede the use of ether and chloroform.

Several valuable papers were read in the department of Anthropology. Mr. Wm. McAdams, a farmer in southern Illinois, who has for several years been delving amid the mounds, gave an interesting account of "The Great Mound of Cahokia," located between Alton and St. Louis, in the so-called American Bottom, where 200 mounds in all have been found, 72 of which are along the Cahokia Creek. The largest of these is 100 feet high, having two terraces, covering several acres and with a flat area on top of an acre and a half. It is built of black earth, pyramidal in shape, and in good preservation. Flint tools have been found in it, and an ax of white flint, smooth and polished as ivory. Opinions are divided as to the purpose of the mound, whether as the site of a temple or village. Other papers were read on the mounds and mound builders by Profs. West, Peet, Campbell, Mason, and Morse.

The chief interest, however, centered in Prof. Putnam's illustrated lecture on "Altar Mounds and their Contents." He explained the best methods of excavating mounds so as to make sure of getting all their contents, by means of a system of cross trenches. The mounds particularly described were found about five miles from Madisonville, Ohio. The diagrams showed the numerous artistic designs wrought out in constructing the mounds, and also the curious and unique objects found in them. There were perforated pearls, strings of bear's teeth, and ornaments of silver, copper, and iron. There were carved images, some of which resembled the Egyptian style of sculpture. In Prof. Putnam's opinion it is an error to suppose all the mound builders to be of one race, as much so as to say now that all men who build railroads are of one nation. There were many different kinds of Indian mounds, evidently built on different plans and for diverse purposes. The ancient mound builders probably belonged to the short-headed American Mongoloids.

By special request your correspondent repeated his illustrated lecture on "Subterranean Scenery," and he also read a paper on "Oyster Farming." The latter was discussed mainly with regard to what is being accomplished in the Connecticut portion of Long Island Sound, since the State boundary was fixed in 1879. Shell fish commissioners were appointed in 1881, by whom the oyster grounds were surveyed, and designated to applicants at the nominal price of $1.10 per acre. The progress of oyster culture can be realized if we note the fact that whereas, in 1880, the active extent of Connecticut beds, as stated by the census, was but 6,934 acres (aside from natural beds, which cover 5,000 more), there are in 1883 single oyster farms larger than that aggregate; and the State has sold to private growers more than 100,000 acres in all. With modern appliances oysters are actually cultivated at depths varying from 25 to 75 feet, and there is no reason why nearly all the Long Island Sound might not be made productive.

Passing by numerous minor topics, the chief questions of the Association were undoubtedly two, viz., concerning the theory of evolution, and as to glacial action. President Dawson initiated the discussion in his retiring address. His utterances were judicious and respectful in their tone, but so decidedly in opposition to the extreme evolutionists, as to kindle excitement and provoke replies. Besides papers in the Biological Section hearing on the subject, by several members, it was made the burden of a lengthy address by Prof. E. D. Cope in general session, and likewise of a public address by the same champion of the theory in one of the city churches. He holds that the doctrine of direct descent of organic species from pre-existent species, throughout the geologic record, is proved and certain. The process is from simple to complex forms of life. We are approaching a complete genealogy of all existing animals, including man. Facts confirm our belief that however constant species may appear to us now, they have been at some time variable.

Even the structural characters of genera, families, and orders are variable in parts of the system. The speaker passed from a consideration of extinct mammalia to that of man himself, whom he regarded as developed from a simian ancestry, although there were gaps yet to be filled. Evolution has proceeded along the line of profitable variation, and the extinction of so many species is due to the fact that they ceased to be beneficial.

We do not pause at the "survival of the fittest," but seek the origin of the fittest, and for this there is only one explanation, namely, the action of *mind*. If its movements have produced the structures under the influence of impacts, strains, etc., the relation of mind to the development of types becomes clear. It should be added, however, that some pronounced evolutionists do not regard mind as an attribute of matter (the position taken by Cope), but as distinct from and superior to it, and obeying laws of its own, leading to the conclusion that as design proves a designer, and creation a creator, so evolution proves an evolver. At all events, it must be conceded that, in one form or another, most members of the Association appear to hold to evolution, though not always attaching the same meaning to the term While some do not hesitate to speak of it as certainly demonstrated, others declare that it rests on no satisfactory evidence, and can, in the nature of things, never be proved; and probably the majority regard it merely as "a good working hypothesis."

On the grand question of glacial action, numerous papers were read, accompanied by discussion, in which the leading geologists of the country took part. The titles of some of these papers were as follows: "Glacial Canons;" "The Minnesota Valley in the Ice Ages;" "The Glacial Boundary between New Jersey and Illinois;" "The Terminal Moraine west of Ohio;" "The Glacial Dam at Cincinnati;" "The Kame Rivers of Maine;" "Evidences from New England against the Iceberg Theory of the Drift;" "The Eroding Power of Ice." And when I say that these were discussed by such men as Professors J. S. Newberry, J. D. Dana, Richard Owen, T. Sterry Hunt, J. P. Lesley, James Hall, E. T. Cox, Major Powell, T. C. Chamberlin, G. F. Wright, and N. H. Winchell it is evident that the interest created must have been very great. Dr. Dawson took ground against the origin of the drift in a great continental glacier, claiming that there was instead a wide glacial sea with Arctic currents and icebergs, with here and there local glaciers. The gantlet thus thrown down was lifted by those adhering to the notion of a continental glacier. The geological room became too crowded for comfort, and the closing discussions were held in the large Chapel of the University. Amid such opposing theories and conflicting facts, it was not easy for ordinary minds to find a satisfactory resting place; and the outcome of it all was probably but an accumulation of valuable material as to glacial action, to be made better use of hereafter in subsequent researches.

Concerning the general influence of the great scientific gathering amid the commercial scenes of the Northwest, there can be no doubt that good was done by bringing men of science face to face with men of secular enterprise, and the result was new enthusiasm for both.

The hospitality of Minneapolis was abundant, and was supplemented by the courteous attentions of its sister city, St. Paul. The graver duties of the Association were varied by excursions to Lake Minnetonka, the Falls of Minnehaha, the Dalles of St. Croix, and other points of local interest. Special visits were paid to the immense flour mills of Minneapolis. After the adjournment there were limited excursions to Manitoba and the Yellowstone Park. The next meeting will be held in Philadelphia, in the first week of September, 1884, and it is anticipated that the British Association will be present by a large delegation of its members. Prof. J. P. Lesley was chosen president for the ensuing year.

Minneapolis, August 24, 1883.

AN effort was made in the French Chamber to force the railroad companies to adopt a new pattern of cars, with alleyways through them, as in America, but this was defeated.