THE GEOLOGICAL HISTORY OF NORTH AMERICA.

BY DR. STEVENS.

Fourth Lecture.

How long the molluscan era of the earth continued, in which the Siberian seas swept around the verdureless islands and boreal continents, now united to form the North American continent, we have no means for measurement; sufficiently long, however, for the broad bosom of the seas to be filled up with immense deposits of limestones, known as the Trenton, magnesian, Galena and blue limestone, in different parts of our country; for equally immense deposits of shales, known as the Hudson river, Utica slates, and black slates of the West, and for the gypsum and salt-bearing rocks of New York.

As the era drew near to its close and a new animal kingdom was about to be introduced, a vast deposit of sand was brought by some unknown causes into the bottom of the seas, the currents bearing it sweeping from the east westward. These sands blotted out the life of the old seas, obliterating the past and preparing for the future. These sands are now known as the Oriskany sandstone in New York, and forming a range of Mountains in Pennsylvania and Virginia. They lie at the base of the new, the fish era, or Devonian age, which is the subject of the lecture this evening.

This map shows you what may have been the shape and dimensions of the Devonian and carboniferous continent of the then western world—at least of such portions of it as have been preserved to us from amid the wreck of continents and the crash of worlds. You perceive that since the primitive or azoic, it has vastly increased, but still preserving its triangular form, growing toward the equator. A remarkable feature of it is the absence of lofty mountain ranges, and consequently of an extended river system, for without mountains to condense the evaporated moisture from the seas, there can be no springs or perennial sources of flowing water. Into the seas that surrounded the dry land were introduced an entirely new population of shellfish with an order of fish, designated by Agassiz as the *Ganoid*, or those fish having thick, bony plates for scales, covering the body from the head to the elongated tail, serving the double purpose of a buckler for defense and covering for the muscular system. No higher order of the animal kingdom was known, and hence the name of the fish era to this age of the earth. Of this great order of fish, once so abundant in the seas, only two species have come down to the present—the gar pike of our western waters, and the other of the Nile in Africa.

We first find their bones, teeth and scaly plates in the limestones at the base of the system, which, in our country, underlie the Cattskill mountains, and are found along the western shores of Lake Erie and again at the Falls of the Ohio. The great receptacle of the remains of the fish, however, is in the old red sandstone system which caps the Cattskill mountains and the lofty hills in north-eastern Pennsylvania. These cemeteries of the dead have been industriously worked by the Scotch geologists, and made classical ground by Miller and Anderson.

The predominance of fish as the highest type of life in the seas, continued through all of the coal era, or carboniferous age. Indeed, as this may be considered as but another chapter of this history, we shall so treat it this evening.

The Devonian continent gradually grew into the carboniferous. Land plants appeared in the former, few in species and sparsely distributed; in the latter, flourishing in the most abundant profusion and luxuriant foliage and verdure. In this cartoon you see a sample of three genera of the three vegetable kingdoms. This one, with jointed column, fluted longitudinally, is called the *calamites*, and was the gigantic representative of the scouring rush of sandy and damp lands. This one, with lofty stem and umbelliferous top, is now known as the lowly fern tree, to be seen only in some collection of exotic plants. The other, with ten or more leaves surrounding the stalk, is also a lofty representative of the fern family.

It is seldom that we find in the rocks well-preserved specimens of entire individual trees. They have come down to us in fragments, and the botany of the continents has to be studied on fragmentary sheets of preserved specimens and not in well-printed and carefully-illustrated editions. Enough, however, is known of the profusion of species at the period we are speaking of to understand that the forests were variegated in appearance, rich in profusion of species, and that lofty trees were loaded with fruit, and rich and costly gums exuded from the broken branches. That the savannas were green with ferns and mosses, that the air was laden with the aroma of flowers, and that the insects came home loaded with pollen and the mellifluous fruits of their aerial journeys.

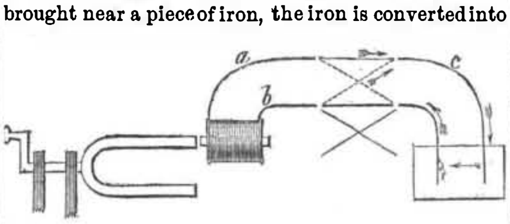
The minerals of this age are galena, copper ores and zinc blende, found in the limestones at the base of the carboniferous, the galena becoming in the West and Southeast a silver-bearing ore. Iron ore, as a carbonate, and known as kidney ore, clay ore and various other synonyms, is diagnostic of this age. Coal in various forms is also diagnostic.

This section will show the order and arrangement of the various minerals of this age better than any extended description.

Pittsburgh series,	Coal, Clay, Shale, Coal, Clay, Shale, Coal, Clay, Limestone.	These are commonly known as the upper coal.
Barren Measures,	Shales and Sandstone.	Several hundred feet of strata which do not contain coal.
Ohio System,	Shale, Blackband Ore, Coal, Clay, Sandstone, Coal, Clay, K. Ore, Coal, Clay, Shale, Oolite Ore, Sandstone, Limestone, Coal, Clay, Shale, Limestone, Cannel Coal, Clay, Sandstone, Shale, Coal, Clay, Conglomerate Rock.	These strata vary in different localities; the shale in one will be loaded with iron, in another having but very little; limestones will run out; sandstones will be thicker, and coal veins will disappear.
Sub-Carboniferous of the West,	Shale, Limestone, Sandstone, Shale, Limestone, Sandstone.	These limestones in Missouri, New Mexico, the Indian country and Mexico, are lead and silver rocks having fish remains.
Devonian,	Sandstone, Shale, Carbonate Iron Ore.	Upper Devonian of Pennsylvania and N. Y., with fish remains.

MAGNETIC ELECTRICITY.

The fundamental facts of magnetic electricity are few and simple. If a permanent steel magnet is brought near a piece of iron, the iron is converted into



a magnet, and on the withdrawal of the steel magnet the iron loses its magnetism. If the iron is wound spirally with a piece of insulated wire, as the magnet is brought near the iron of the spiral or helix, a wave of electricity goes through the helical wire. This wave is momentary, the current instantly ceasing, and no further manifestation of electricity is made as long as the iron core remains magnetic. But on the withdrawal of the permanent magnet, and the consequent destruction of magnetism in the iron core, another wave of electricity passes through the helical wire in the opposite direction to the first. When the north pole of the magnet is brought near the iron core of the helix, the current is in one direction; and when the south pole is approached, the current is in the opposite direction. Thus the current induced by the approach of the south pole is in the same direction as that caused by the withdrawal of the north pole.

Magneto-electric machines are made with a magnet to revolve as close as possible to the end of an iron core of a helix, and each revolution produces four waves of electricity through the helical wire, two on the approach and withdrawal of each pole.

One half of the time the electricity is going out of the end, *a*, of the helical wire, and the other half out of the end, *b*.

In electro-plating, the metal is deposited upon the plate through which the current leaves the bath. Hence, in electro-plating with a magneto-electric machine one half of the current would be lost unless its direction could be changed at each passage of the magnet past the end of the core of the helix. This is easily done by bringing the wire, *c*, alternately in contact with the wires, *a* and *b*, the contact being made with each wire at the time the current is passing out through it. Many mechanical devices have been employed for changing the direction of the current, and they have received the technical name of pole changers. One of the simplest is represented in the cut. It consists of one pair of parallel wires to be introduced to complete the circuit while the current is passing out through *a*, and a pair of cross wires to be introduced to complete the circuit while the current is passing out through *b*. A glance at the cut will show that this causes the current to pass constantly in the same direction through the bath, though its direction through the wires, *a* and *b*, is frequently being reversed. Any simple mechanism may be employed to introduce alternately the pair of cross wires and the pair of parallel wires.

Electricity, like heat, varies in intensity. A hogshead full of boiling water contains a large quantity of heat, though the heat is not very intense; on the other hand, the jet of a compound blow-pipe is intensely hot though the quantity of heat is small. Electricity varies in the same way in its relative quantity and intensity. In magneto-electrical machines in which a number of helices are employed it is found that the intensity of the electricity is increased by connecting the wire of one halix with that of another in a way to pass the current through several helices in succession, while the quantity is increased by bringing the several wires together in one bundle and uniting thus the currents of all.

These fundamental facts will enable any one who has not made a study of magneto-electricity to understand the beautiful electro-magnetic machine illustrated on another page.

The Armstrong Gun.

The London *Engineer* says:—We shall have greatly mistaken if we are not now near deliverance from the five years' delusion of the so-called "Armstrong gun." In actual range it has been exceeded by Mr. Lynal Thomas's rifled gun; in penetrative power at short range it is notoriously inferior to the ordinary cast-iron service guns, throwing a projectile of even less weight; in cost it is very far more expensive than any other gun, even when made of bronze or of steel, and in the essential qualities of reliability in action it would appear, from all the experiments that have been made, that it is inferior to any and every gun yet produced. As for great range, say beyond three miles, there is no advantage that any one can assign. But even if ten-mile ranges were desirable, it would require only that the gun employed should be able to withstand proportionate charges of powder, exploded behind long projectiles of comparatively small diameter. Given, an unburstable gun and almost any range under twenty or thirty miles would be practicable. Long range, with a given form and weight of projectile, is solely, however, a question of so many pounds of powder and of the strength of the gun. Powder is so cheap that, so far as its cost is alone concerned, it is almost immaterial what quantity be used, and as for the other and far more important condition—strength of gun—it is sufficiently known that the Armstrong gun in no way approaches to the greatest practicable strength. Captain Halsted, in a letter to the *Times*, states that the *Stork* gunboat has had no less than four 100 lb. "Armstrong" guns in succession, the first, second, and third having failed, one after the other.

To Remove Clinkers from Stoves.

Some kinds of coal are liable to form clinkers which adhere to the fire-brick lining of stoves, grates and furnaces, and become a source of great annoyance, as they cannot be removed by usual means without breaking the firebrick. Persons who are thus annoyed will be glad to know that by putting a few oyster shells in the fire close to the clinkers, the latter will become so loose as to be readily removed without breaking the lining. On page 37, Vol. II. (new series) of the Scientific American, we published this receipt, and since that time it has been tried and its utility endorsed by several persons.