numerous other tracks of birds and animals, including the mammoth, deer, wolves, and possibly a horse.

The first series of sandal tracks seems to have been made in a layer of mud perhaps two inches deep. It consists of twelve tracks, to which four were subsequently added by tunneling into the rock, about fifteen feet of rock overlying the continuation of this ancient trail. In his report to the academy Dr. Harkness says:

"In each instance the mud had been raised by the pressure of the foot into a ridge which entirely surrounded it. This mud is only partially solidified, and is still flaky and easily broken on exposure. Each of the imprints furnishes us with evidence, as we believe, that the feet of the one making the tracks were protected by sandals. In no single impression, perhaps, do we find conclusive evidence of this fact, but when we study them as a whole we find that that which is wanting in one is furnished by others which follow. In nearly all the toe portion of the sandal is well shown, it being as smooth as the work of a mason for the distance of two or three inches. Backward from the toe we generally find the impression of the outer portion of the sandal. When studied as a whole we can determine with a good deal of exactness the actual length and breadth of the sandal, which we find to be nineteen inches in length, eight inches at the ball of the foot, while the heel is six inches in breadth. In its outline the impression follows clearly the shape of the human foot. From the great toe outward there is a really graceful curve, which draws in toward the heel; while from the great toe inward the line is drawn toward the instep and thence in an outward curve to the heel. In one series this curve is deeper, showing a slightly different form of sandal. The average length of the stride is two feet three inches. The distance between the feet or the straddle is eighteen inches. In all these tracks the toes are turned well outward."

Near the series of tracks described are eight other tracks which are attributed to the mammoth. The foot is twenty-one inches in diameter, only the general outline being preserved; also many tracks of wading birds, not differing materially from those of modern herons and the like.

Several quite distinct tracks of deer are also to be seen. Others, again, were found which in size and length of stride much resembled those of a wolf. At one point these tracks may be traced for a distance of twenty feet, where they also are lost in the ledge. There are also a few poorly defined imprints of what Dr. Harkness believes to be a horse. Near the western limit were clear indications of animals having wallowed and lain in the soft mud.

Touching the great size of the tracks attributed to man, Dr. Harkness supposes that the feet were protected by sandals of wood. It may be that foot-gear of exceptional size was used in hunting on soft and muddy grounds. The stride is that of a man of average height, and the straddling gait a natural one in walking over soft and slippery places.

It is proper to add that Professor Le Conte, of the California University, is not entirely satisfied that the supposed sandal tracks are human footprints. Their great size staggers him, though the peculiar outline of the human foot is distinct. Since Dr. Harkness and Professor Le Conte were at the prison, Warden Garrard has developed three more series of footprints apparently made by men.

One series of more than a dozen prints was uncovered by means of a stream of water turned on the floor of the quarry next to the ledge where the rocks are about thirty feet high. These tracks lead into the cliff, and appear to have been made by a man who was dragging a heavy load after him through the mud. The tracks are all turned sidewise, as they would be under such conditions.

THE BRITISH ASSOCIATION.

The fifty-second meeting of the British Association for the Advancement of Science began at Southampton, August 23. After mentioning the losses which the association had sustained in the death of its distinguished member, Charles Darwin, and that of its Secretary, Professor F. M. Balfour, whose promising career was recently cut short by accident in the Alps, the President of the Association, Dr. C. W. Siemens, proceeded to give the usual review of recent scientific progress and its conditions, dwelling, at first, especially upon the interdependence of theoretical and practical science.

Speaking of the facilities which the railway systems afford for the holding of scientific meetings among men, and of the extraordinary development of scientific journalism, he remarked that however much the means of acquiring scientific information have increased, the necessities for scientific inquiry have increased in a greater ratio. The time was when science was cultivated only by the few, who looked upon its application to the arts and manufactures as almost beneath their notice. That was left to others, who cared little for the pursuit of science for its own sake, but merely sought to turn scientific discoveries to practical account.

Progress could not be rapid under this condition of things, because the man of pure science rarely pursued his inquiry beyond the mere enunciation of a physical or chemical principle, while the simple practitioner was at a loss how to harmonize the new knowledge with the stock of information which formed his mental capital in trade. Under the new order of scientific and practical development the purely scientific man has become more inclined to consider the utility of his discoveries, while the practical man has become scientific, often taking the lead in scientific discovery. The application of chemistry to dyeing amply illustrates this change. So too does telegraphy and the new arts of applying electricity to lighting, to the transmission of power, and to metallurgical operations, in which the practical man is beset at every turn with problems requiring for their solution not only an intimate acquaintance with, but often a positive advance upon, electrical science as established by purely theoretical research in the laboratory. Equally is this interdependence of theoretical and practical science the rule in the advancement of constructive engineering.

"It is to the man of science, who also gives attention to practical questions, and to the practitioner who devotes part of his time to the prosecution of strictly scientific investigations, that we owe the rapid progress of the present day, both merging more and more into one class, that of pioneers in the domain of nature. It is such men that Archimedes must have desired when he refused to teach his disciples the art of constructing his powerful ballistic engines, exhorting them to give their attention to the principles involved in their construction; and that Telford, the founder of the Institution of Civil Engineers, must have had in his mind's eye, when he defined civil engineering as 'the art of directing the great sources of power in nature.'"

The principal subjects discussed at the meetings of the Association are becoming more and more general in their scope, and many of them of international character; such as the systematic collection of magnetic, astronomical, meteorological, and geodetic observations; the formation of a universal code for signaling at sea, and for distinguishing lighthouses, and especially the settlement of scientific nomenclature and units of measurement, regarding all of which an international accord is a matter of the utmost practical importance.

The subjects which Dr. Siemens discussed at greatest length were those of which he has done so much to further the development—both practically and scientifically—namely, electrical measures and measurements, the transmission of energy, the application of electricity to horticulture, electric railways, electric lighting, and so on.

A full report of this instructive and suggestive address will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

A Massive Safe Deposit Vault.

The safe deposit vault for the Nassau Bank, corner of Beekman and Nassau streets, is said to be the largest steel vault ever constructed. It is made of welded chrome steel, iron, and Franklinite, and is, to all appearances, thoroughly fire and burglar proof. Entrance to the vault is effected through the bank proper. A staircase of marble and iron leads down into a well lighted and ventilated basement, about 12 feet high. The floor is paved with tile mosaics and marble. The vault, which is 35 feet long, 22 feet wide, and 9 feet high, is built clear of the walls of the building, and rests upon a thick foundation of concrete and granite. The sides, bottom, and top of the structure are very thick, and comprise inner and outer walls of welded iron, chrome steel, and Franklinite, between which is a solid layer of fireproof cement, 9 inches thick. There are two massive iron doors at each end of the vault, and the outer ones are the largest single doors ever made for this purpose. The doors are built of the same material used in the construction of the vault. The inner doors are about 6 inches thick and the outer are of the same thickness, but larger and hung on central hinges. Their locks are double dial time locks of the very best make. It will require two persons to get into the vault, for one will have the combination of the inner doors and the other the combination of the outer doors. Outside of the heavy steel doors are electric burglar alarm doors, which cannot be tampered with without sounding a loud alarm. There are now nearly 1,400 safes in the vault, but that number is to be increased to 4,000. These safes are 24 inches deep, of various sizes, and are made of half-inch chrome steel. The door of each is provided with a double key lock, and some of them have combination locks. No customer can unlock his own without the help of the attendant, who has a key with which he sets each lock. Neither the customer nor the attendant can get in singly. The vault is lighted by the electric light.

The Fur Seal at Sea.

On the voyage to Sydney two fur seals were seen about the ship. They were of a smaller species than that occurring at Kerguelen's Land. They swam alongside with remarkable ease and rapidity, having in the water just the appearance of porpoises.

The hind limbs were stretched out straight behind as the animals swam, and the motion mostly maintained by rapid strokes of the fore limbs. The tail, however, *i. e.*, the fin-like expanse formed by the closely applied and outstretched flat hind flippers, was used with an undulating movement, just as is the tail fin in porpoises.

The seals swam with ease and rapidity from the stern to the bows of the vessel, though it was going 4½ knots at the time, thus going 9 knots at least. In fact, they swam with all the ease of a porpoise, and as once or twice they threw their heads and backs out of the water in a forward leap I should certainly have mistaken them for these animals had I not seen them almost at rest several times, and with their heads well out of water.

I never before realized the close connection between the seals and whales, and how easily a whale might be developed out of a seal. The fur seal is one which, on land, still bends its hind limbs forward, as do land mammals.

The seals without external ears, like the sea elephants, carry them habitually stretched out behind, as this one does in swimming.

Little modification would be necessary in order to turn the otherwise useless hind limbs of the earless seals into the whale's broad tail fin, which probably represents the remains of the seal's webbed hind flippers.

We afterward, in the Straits of Magellan, became familiar with the motions of fur seals in the water, and frequently saw them there in shoals, progressing through the water by a series of leaps exactly like porpoises or rock-hopper penguins.—*Challenger Notes—Mosely.*

A New View of the Earth's Evolution.

The assumption that the earth was at one time in a fluid condition, as held by Laplace and by many astronomers and geologists, was disputed with a suggestive array of evidence by Dr. Houghton, of Dublin, before the Science Association at Montreal.

Following are some of his reasons for doubting the fluidity of the earth or any other planet at any stage of its evolution:

1. The possibility of the equilibrium of the rings of Saturn, on the supposition that they are either solid or liquid, has been more than doubted, and the most probable hypothesis concerning them is that they consist of swarms of discrete meteoric stones, discrete meaning that they are separate from each other in space.

2. It is difficult to understand the low specific gravity of Jupiter and the other planets on the supposition that they are either solid or liquid, for we know of no substance light enough to form them. If the outer planets consist of discrete meteoric stones moving around a solid or liquid nucleus, the difficulty respecting the specific gravity would disappear.

3. The recent researches connecting the periodic showers of shooting stars with comets tend in the direction of showing that comets in cooling break up into discrete solid particles, and that probably the solar nebula cooled in like manner into separate fiery tears, which soon modified by radiation into the cold of space.

Mr. Huggins's recent comparisons of the spectroscopic appearances of comets and incandescent portions of meteoric stone shows the presence in both of hydrogen and nitrogen compounds, confirming the conclusions drawn from the identity of the path of comets and meteoric shooting stars.

From all these and other considerations it is allowable to suppose that the earth and moon, when they separated from the solar nebula, did so in the form of solid meteoric stones, each of them having the temperature of interstellar space—that is, something not much warmer than 460° Fahrenheit below the freezing point of water.

Enameling Cast Iron Pipes and Castings.

A recently invented process is as follows. There are various receipts for the enamel, depending on the purpose for which it is applied. One for water pipes is as follows: twenty-eight parts by weight of silica, eleven calcined carbonate of soda, and six carbonate of lime. Another is: thirty-four silica, eleven carbonate of soda, twelve chalk, and eleven dried pipe clay, to which boracic acid or lead oxide can be added when a more vitreous enamel is required. The core forming the inner surface of the pipe—and if desirable, the mould too—is coated with blacklead, smoothed, and the enamel as a powder, paste, or pigment, applied to the thickness required. The molten iron causes the enamel to soften and firmly adhere to the iron. If it is not necessary that the enamel should not be smooth, the blacklead is omitted.

The enameled pipes are much appreciated in Bohemia; the Municipal Council of Egar have passed a resolution to use no other kind. The enameled pipes are now being manufactured in several works in Germany and Austria.

Fishing for Rats.

A novel mode of catching rats is thus described in the *American Angler*. The writer says that a person having the patience of most fishermen can have much sport in hooking the vermin.

The warehouse adjoining his place of business is infested by these "file-tails," and our friend may be seen in the early spring, and late fall, on an occasional evening just after dusk, seated at the back window of his counting room (overlooking the yard of the warehouse), with an ordinary rod in hand, strong linen line, and a spring hook, commonly called a "sockdolager," baited with a lump of fresh beef, patiently waiting for a bite. It does not tarry long nor does it consume itself in nibbles, but with a hungry snap the bait is seized and the hooks of the sockdolager impales the rat, when the excitement commences.

A lusty rat is no mean antagonist at the end of a pliant pole and ten feet of line, and his plunges, twistings, and straight-away dashes are more perplexing to the angler, than the leaps, surges, and sulkings of the gamy trout or bass. The rat is generally landed, after seasonable sport, and killed by a blow from a bludgeon.

In this connection we may state that thousands of small hooks are bought by sugar refiners for ratting purposes. The hooks are baited with small pieces of beef on each, and then distributed about the building. The rats swallow beef and hook—the first is digested, the latter is not—death of course results. The remedy is said to be infallible.

Fish Curing in New York.

The practice of setting aside the surplus of our city fish markets in seasons of plenty to meet the demand when fish are scarcer or entirely out of season, has led to the establishment of enormous refrigerators, or buildings for "cold storage," in which tons of fresh fish are securely locked up in ice and kept for months. The magnitude of this cold storage business and its relative novelty have attracted to it no little popular attention.

Less generally known, but probably of greater financial and economic importance, is the business that has grown up here in drying, pickling, and smoking fish. For the most part the city cured fish are taken by fishermen under contract, and roughly salted at sea. They are mainly cod, mackerel, and salmon. Other establishments are directly engaged in sea and shore fishing. One firm, which cures from 15,000 to 40,000 pounds of fish a week, make a specialty of smoked shad and sturgeon. The sturgeon are taken in drift nets off the coasts of Florida and Georgia. The nets are 100 fathoms long and 20 fathoms deep, the sturgeon often weighing from 300 to 500 pounds each. Occasionally the capture of a large shark or alligator gives serious and unprofitable diversity to the work of the fishermen. When caught the sturgeon are cleaned, the back bone is cut out, and the sides packed in ice and sent to Savannah. There the fish is packed in fresh ice and shipped by steamer to New York. Here the sides are cut in slices, pickled in brine for four hours, dried, and smoked. The drying takes about six hours and the smoking fourteen hours. The smoke is made from hickory wood and cedar sawdust, and the smoking room is hot enough to thoroughly cook the fish. Other fish are smoked in substantially the same way. The sturgeon roe is immediately treated to successive washings, passing each time through sieves to cleanse them thoroughly, and are then packed in salt. The result is *caviare*. The same parties have sturgeon fisheries in Delaware, and eel fisheries there and in New Jersey. The best and fattest eels are said to come from the mouth of the Shrewsbury River. The eels are thoroughly scrubbed to remove the slime, and either smoked or put up in jelly. Herring are roasted and put up in kits in pickle. Considerable quantities of smelts from the coast of Massachusetts are smoked. Also many lake whitefish, which is accounted particularly fine in flavor. Mackerel smoked round when fresh—Boston smoked—is becoming a popular preparation. All the fish to be smoked are brought to the city fresh, packed in ice, except salmon, which during part of the year is pickled.

The home and foreign demand for fish cured in New York is large and rapidly increasing. The industry promises to become very large.

Experiments with the Heliograph.

A detachment of nineteen men of the Sixth Cavalry and Twelfth Infantry, near Fort Grant, Arizona, under command of First Lieutenant M. P. Mans, First Infantry, has been testing the practicability of heliographic signaling since July 1, and it is pronounced a grand success. Lieutenant Mans has signaled messages from the top of Dos Cabezas Mountain to Fort Grant, a distance of forty miles, which were read at once by his party at Grant. Messages can be sent with the heliograph at the rate of from six to twelve words per minute, according to the ability of the operator, and it is a splendid substitute for the telegraph, should the Indians cut the lines, which they have been doing, and always can do, when on the warpath, while they cannot cut a sun flash. It is understood that heliograph lines are about to be established by Lieutenant Mans, and partly under direction of Colonel Bracket, commanding scouting operations connecting Bowie, Grant, Thomas, Apache, and points along the Gila River, in the vicinity of Solomonville and Clifton, enabling troops in the field to be in constant communication with one another, without waiting for couriers or the proximity of a telegraph office. The signalmen, on account of their elevated positions, are enabled to observe with their glasses the movements of the hostiles, and in a few minutes to communicate it to any command in the field, each of which is always to be accompanied by one or two heliographic signalmen. The great advantages of this system of transmitting messages in a mountainous and hostile country are self-evident.—*Cor. Morning Call.*

Crayons in Vitrifiable Colors.

M. Lacroix, a Parisian chemist, has introduced crayons similar to the ordinary lead pencils, the lead being replaced by vitrifiable colors. The colored designs which are executed with these crayons, on slightly roughened glass, bear the heat of a muffle and are fixed like a painting upon glass; the grays especially give excellent results. A similar process which was tried upon porcelain some years ago was unsuccessful, probably because enameled surfaces were used. On biscuit it is likely that good results might have been obtained.—*Chron. Industr.*

IMPROVED WASHING MACHINE.

The engraving shows an improved washing machine recently patented by Mr. Thomas J. Meroney, of Salisbury, N. C. In this machine the clothes, while under the pressure of a corrugated roller, are subjected to the action of steam, so that while the clothes are being agitated or rubbed they are subjected to the action of steam.

This machine has a plain wooden tank lined with copper or galvanized iron, with perforated pipes in the bottom for the admission of steam, with corrugated copper or galvanized iron roller of sufficient weight. This roller gathers the air while passing back and forth over the clothes, and forces air and water through the fabric. At same time the steam is thrown up through the perforated pipes at the bottom of the tank. There are wooden strips between the pipes

MERONEY'S WASHING MACHINE.

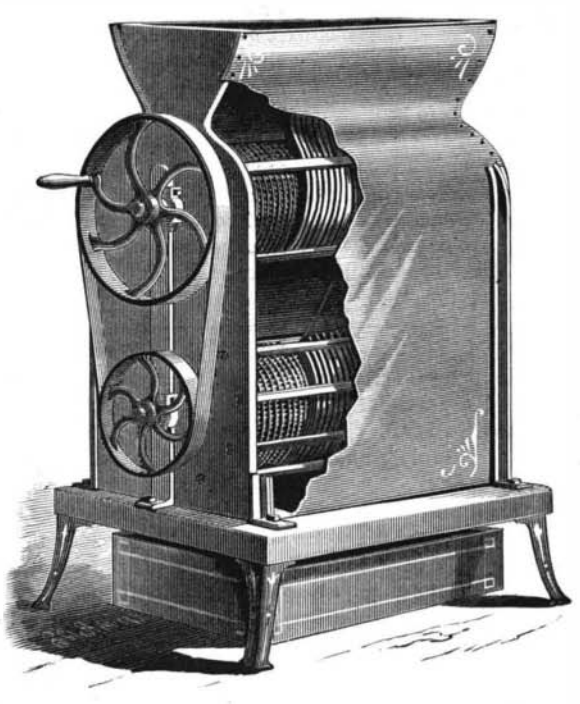
to protect them and make the bottom of the tank smooth. This machine is very simple both in construction and operation. It can be operated with very little exertion, and does its work quickly and thoroughly. It will wash the thickest fabric as well as the thinnest muslin or lace. In addition to its use as a clothes washer it may be used for washing wool, and the boiler answers a good purpose for steaming and boiling grain and vegetables for stock.

This machine differs from other washing machines in using steam as the principal agent for agitating the clothes and removing the dirt. Of course the steam always keeps the water at the boiling point, which is very desirable for rapid work.

Further information may be obtained by addressing the inventor as above.

IMPROVED CORN CRUSHER.

An improved corn crusher invented by Mr. George C. Mueller, of Red Bluff, Cal., is shown in the engraving. It is designed for crushing ears of corn to reduce them to the proper state for fodder. The machine consists of two parallel cylinders journaled in a frame, and inclosed by a suitable



MUELLER'S CORN CRUSHER.

casing surmounted by a hopper, into which the ears of corn are fed. The upper cylinder carries a number of saws arranged a small distance apart, and revolves near a concave also made of saws, which are curved to form a tapering cavity in which the ears of corn are received. The saws of the concave enter the spaces between the saws of the cylinder, so as to insure a more thorough breaking up of the ears.

The corn entering the machine is first crushed into small fragments by the saws. It is then delivered by an inclined chute to the cylinder below, which is provided with a series of pins arranged in circumferential rows. This lower cylinder revolves near a concave, also armed with pins, and between these pins the corn is reduced to meal suitable for fodder. The meal is discharged into the box below.

The machine may be driven by hand power, horse power, or by connection with any convenient motor. It is compact, effective, and easily operated.

Further information may be obtained by addressing the inventor as above.

History of Plant Life in America.

An interesting sketch of the history of plant life in America was given by Professor Newberry at the Montreal Science Meeting. In the archæan rocks is graphite, which must have been derived from plant tissues, but all possibly have been obliterated. In the Cambrian only seaweeds have been found. In the Lower Silurian the presence of land-plants had been claimed, but without satisfactory evidence. In the Upper Silurian a few club mosses have been met with in Europe and America. In the Devonian the land was clothed with plants, some 200 species having been described by Dr. Dawson. They were ferns, lycopods, and equiseta. In the Devonian Sea were islands near where Cincinnati stands, and they were covered with tree ferns and giant club mosses.

The carboniferous flora was known the world over. It consisted of ferns, lycopods and equiseta, conifers and cycads. In the time of the Trias, to which the New Jersey brownstone belongs, the vegetation was mainly sago palms and pines, with many ferns peculiar to the age. In the cretaceous age the vegetation of the globe was revolutionized, angiosperms and palms taking the places of the cycads, etc., of the Trias and Jura. In New Jersey and in the far West perhaps 250 species of trees had been found resembling those now living, as they included oaks, birches, and willows, as well as the tulip tree, sweet gum, sassafras, magnolias, etc.

The Tertiary was the age of North America for animals and plants. For them a mild climate prevailed to the Arctic Sea, and the land was covered with splendid forests, of which the great sequoias of California and the finest of our trees are a remnant. Then there was land connection between America and Europe and Asia at high latitude, and the American flora which began here in the cretaceous extended into both continents. When the ice period came on the forests were driven south. In Europe the Mediterranean prevented their escape, and then American plants were destroyed, to be succeeded by an Asiatic vegetation when the climate became milder. The floras of Japan and Eastern America are very like the remains of typical trees of the American flora of this age. Tulip trees, sassafras, and magnolias were found in Europe as far south as Italy. In China and America part of this vegetation survives, and the vegetation of Japan and Eastern China is so very like that all botanists are agreed that they must have had a common origin. Curiously enough some of the plants extinct in America had survived in China, among which are the ginko and glyptostrobus, two beautiful conifers once common on the Upper Missouri, now found only in China.

New Machine for Manufacturing Bone Black and Ammonia.

Messrs. H. Y. Castner & Brother, analytical chemists, of New York, have patented a machine for the manufacture of bone black and ammonia, which, if their claims are to be credited, promises to cause a revolution among manufacturing chemists. The process consists in passing crushed bone continuously through a heated vessel or cylinder, charring the bone thereby; then conducting it without exposure to an air-tight receptacle, where it is cooled, and the gases emitted therefrom are drawn off and subjected to such chemical action as to recover all the ammonia. By this process the bone black and salts of ammonia are produced continuously at a great saving of time, labor, and heat.

The patentees have erected in Jersey City, at considerable cost, an experimental machine, which has been visited by a number of chemical experts, all of whom unite in pronouncing it a great success, not only as a piece of ingenious mechanism, but for the superior quality of its products. With a consuming capacity of one ton of bone per day the patentees claim that they can effect a saving of over twenty-five per cent by this machine; and we understand that a company is being formed with the view of erecting another one capable of burning ten tons a day, in the operation of which, they claim, a still greater percentage of saving will be effected.

FALL OF A METEOR.—During a heavy thunderstorm at Lebanon, Pa., on the 8th of September, a meteor, weighing one pound and eleven ounces, fell in the center of the principal street, appearing like a ball of fire as it struck the ground. It is now in the possession of Dr. Mears.