wheel, U, and ending at a stationary engine placed at one end of the field. The starting or stopping is effected through a lever, P, placed within reach of the hand of the two operators. In measure as the machine moves forward, the operator at the lower part puts pipes into the curved cylinder which extends to the bottom of the machine, and the pipes are thus laid upon the ground, one after the other. The earth, on reaching the upper extremity of the screw, is emptied upon an endless cloth in the box, G, whence it falls into the passage, H, which may be inclined to the right or left, so that the earth may be made to drop upon the pipes, or be deposited to the right or left of the trench.

In order to prevent the earth from entering the joints of the pipes, the joints are covered with a band of paper led to them by a guide seen at the back of the machine.

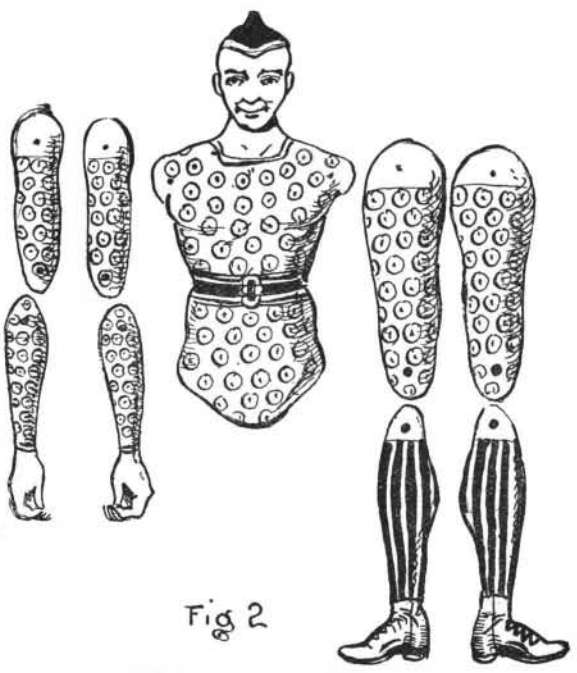
It may happen that the screw, in its operation, may meet with excavations deeper than the trench that it is desired to form, and that consequently the pipes may be insufficiently supported at such points. In order to remedy such a difficulty, there is arranged immediately behind the screw a drum, S, which bears constantly upon the ground, and against which abuts the extremity of the rod of a valve closing a box of sand. When the drum enters an excavation, the valve rod, actuated by a spring, lowers, and the valve leaves its seat and allows of the passage of a certain quantity of sand, which falls into a vertical chute situated behind the drum and fills the excavation. A second roller, *t*, equalizes this layer of sand, and the bottom of the trench is thus made perfectly level.—*Les Inventions Nouvelles.*

HOMOGENETIC ENUMERATION.

It has generally been supposed there are but two systems of numeration, the Arabic and the Roman. Here, however, is a third, which, for want of a better name, we will have to call homogenetic enumeration. In this system the limbs of the human body may be made to represent all numbers and their relations that can be expressed in the ordinary manner, and more concisely, for the use of ciphers is dispensed with.

The series consists of nine puppets that represent the nine digits by extending the left arm in different positions; first at a right angle to the body, then at an acute, and then at an obtuse angle. The elbow bent while the left arm extends at a right angle to the body gives a succession of the same angles, and at an acute angle another succession, making nine in all. The right arm extended in the same manner as the left gives a second period, that of tens. The left leg reversing the angles of the left arm represents hundreds, and the right leg reversing those of the right arm, thousands.

This series may be carried as much further as is desired by very simple devices, such as standing them upon their heads and making this equivalent to adding a requisite 10,000 to their value, adding hats of different patterns, which will give additional values; or by simply placing above or below the figures a horizontal,



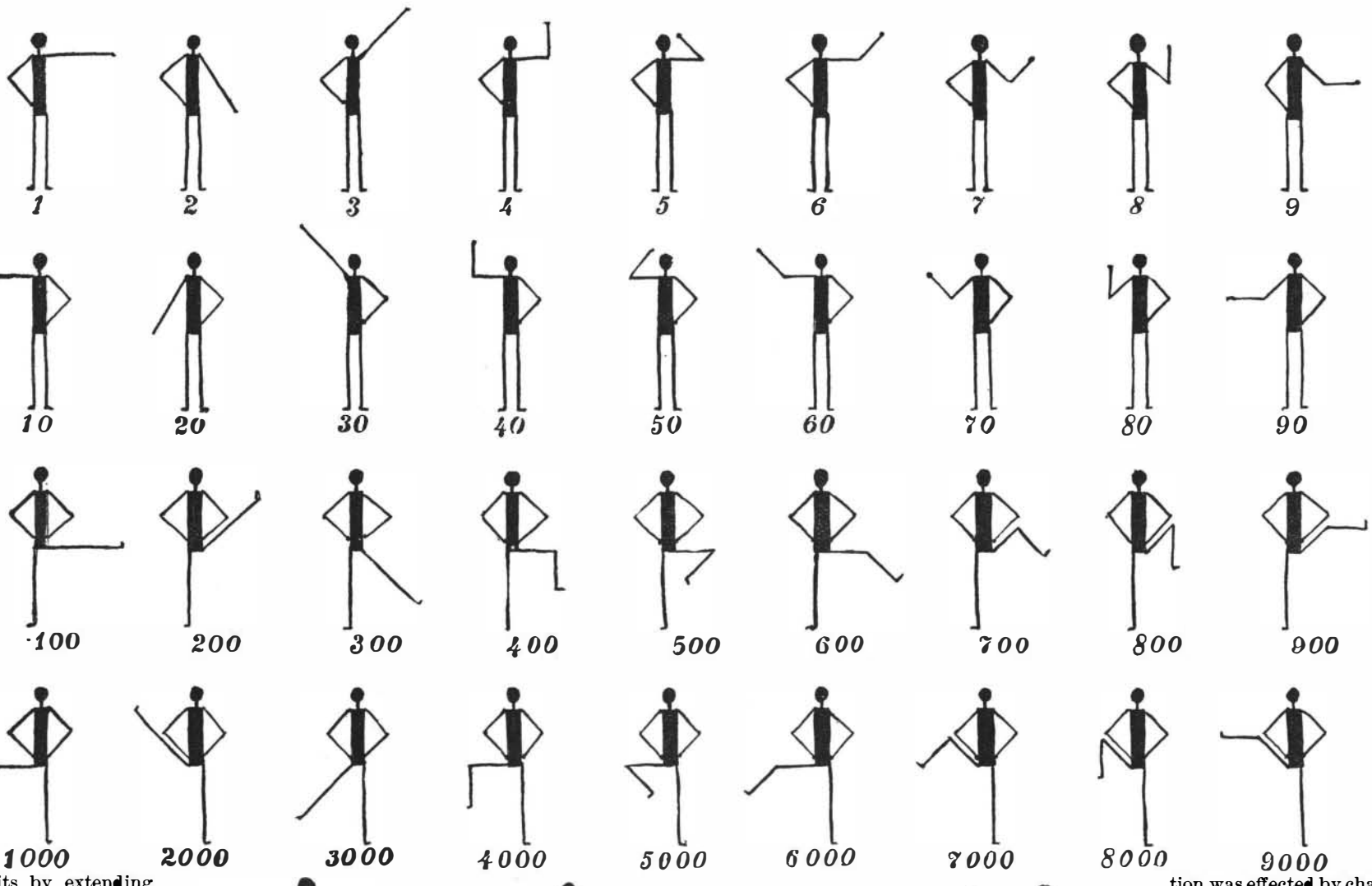
HOMOGENETIC ENUMERATION.

oblique, or vertical stroke; a right, acute, or obtuse angle; or in any way differentiating them from the first series here given. In order to represent any given number by means of these figures, it is first necessary to divide it into units, tens, hundreds, and thousands. Thus 1892 will not be represented as eighteen hundred and ninety-two, but as one thousand, right leg extended at right angles to the body; eight hundred, left leg drawn up to an acute angle with the body and bent to an acute angle at the knee; ninety, right arm from shoulder at an acute angle to the body, right forearm horizontal; and two, left arm at an acute angle to the body. Eleven would be represented by puppet ten, with the left arm extended as at puppet one.

Twelve would be expressed by puppet ten with the left arm in the position of puppet two; thirteen by puppet ten with left arm as at puppet three; twenty-two is shown by puppet with right arm as at twenty and left arm as at two; one hundred and fifty-two with left leg as at one hundred, right arm as at fifty, and left arm as at two, etc.

A pasteboard puppet, as shown in the accompanying Fig. 2, may be made and jointed with thread. It can be worked to solve arithmetical problems, and according to certain fixed successions of movements or postures of the jointed parts may be made to add, subtract, or divide. In fact it may be taught to dance according to arithmetical measure and made to save a vast amount of ciphering, performing in this respect the use of the abacus.

You may also, if you choose to do so, make your puppet spell words. In order to do this you have only to call 1 = A, 2 = B, 3 = C, etc., until you reach the end of the alphabet, and put your figure successively into the attitudes representing the numbers that stand for the different letters forming the word you wish to spell. This whole scheme, although it has here a comical and amusing development, is a very suggestive one, and opens the question lately started in a popular scientific journal as to whether the Arabic numeration, which has for so many centuries been supposed the perfection of number expression, may not be greatly improved upon.



HOMOGENETIC ENUMERATION.

Alteration of the Great Western Railway.

For several years back the alteration of the gauge of the track of the Great Western Railway, of England, from 7 feet to 4 feet 8½ inches has been contemplated, and in the construction of new rolling stock that end was had in view. The gauges of several of the branch lines have been altered from time to time, until the remaining portion of the system not changed covered only a distance of about 200 miles. On May 19 the final arrangements were made for completing the change. Five thousand men were distributed at different points along the line before midnight, Friday in readiness for work, May 20, the intention being to have the work on the main line completed by the following Sunday at midnight, and in one day longer the branch lines and sidings completed. Throughout nearly the entire length of the line changed the alteration was effected by changing only one of the longitudinal sleepers on which the rails are laid. In some places renewals were made and at these points cross ties were used instead of the longitudinal timbers which existed in the old track. Between some points where mixed gauges existed the track will not at present be interfered with. By the use of branch lines, other roads and steamships, traffic was but slightly interfered with, and at 9 o'clock Sunday night, May 22, it was expected to run the first train over after the alteration of gauge, after which the traffic will be resumed as usual.

The New Metal Vesbium.

With regard to the alleged discovery of a new metal, "vesbium," in the Vesuvian lava, by Prof. Scacchi, Dr. T. L. Phipson writes the following in *Iron:*

"I formerly discovered notable quantities of selenium in the arseniferous sulphur of Puzzuoli, near Naples, in 1862. I have lately examined the lava and yellow crusts of the fumarole from the crater of Vesuvius (specimens taken in 1879), and have found, besides the substances usually met with in volcanic products, considerable quantities of fluorine, which appears to have escaped the notice of Sylvestri, and minute quantities of molybdenum, which has, perhaps, given rise to the belief that a new metal, vesbium, exists in the yellow and green crusts of some ancient lava of Vesuvius, as described by the veteran observer, A. Scacchi.

"After carefully reading the paper of Professor Scacchi I am almost convinced that he was dealing with molybdenum and copper (and probably minute quantities of other substances) in the green and yellow crusts which he examined on the ancient Vesuvian lava. Nevertheless, further research is requisite. The manner in which I detected molybdenum in the yellow crusts from the fumarole found in the crater of Vesuvius in the spring of 1879 is as follows: The finely pulverized lava and its incrustation is treated with hot aqua regia; the solution, slightly evaporated and without filtering, is neutralized by ammonia in slight excess; yellow sulphide of ammonium is added, and the mixture allowed to remain for some hours in a closed vessel. It is then rapidly filtered, and the filtrate neutralized with hydrochloric acid in slight excess. The flask is closed immediately with a cork, and allowed to remain thus for two days. At the end of that time the brown sulphide of molybdenum will be found upon the precipitated sulphur. (The sulphide of molybdenum requires a long time to precipitate in an acid liquid, and more so when its quantity is small.) The precipitate is collected on a platinum dish and roasted, to drive off the sulphur and convert the sulphide into molybdic acid. Copper and lead are invariably present in small quantities in the incrustated cellular lava. The yellow crust also yields ammonia, and there are indications of many other substances to which I may refer later. I find that the lava, after being treated with a boiling solution of caustic soda, gelatinizes with hydrochloric acid, and this character may, perhaps, enable us to distinguish between the lava of modern and of ancient volcanoes."

New Method of Plating with Iron and Nickel.

Dr. Ludwig Monde recently lectured at the Royal Institution on "Metallic Carbonyls," in the course of which he dealt with the discovery made by himself and Drs. Langer and Quincke, that carbonic oxide gas will take up metallic nickel at a comparatively low temperature, and deposit it upon any surface heated to 180° C., and he exhibited tubes, globes, and other articles of bright, coherent metallic nickel, which had thus been deposited by gas. Works are in course of erection at Birmingham to carry out this curious process on a manufacturing scale.

They also discovered that at a moderate temperature carbonic oxide would take up metallic iron, and deposit it upon any surface suitably heated. Ferro-carbonyl is, however, exceedingly difficult to make. Dr. Monde exhibited some of it in a small hermetically sealed glass tube.

Ferro-carbonyl is, in a high degree, pyrophoric. It forms an amber-colored liquid, solidifies below 21° C., and distills completely at 102° C.; its specific gravity is about 1,466 at 18° C. On heating its vapor to 18° C., bright iron is deposited as a mirror. It remains perfectly unchanged in the dark, but when exposed to sunlight it is transformed into a solid body, of remarkably fine appearance, of gold color and luster.

Soon after Drs. Monde, Langer and Quincke made known the existence of this body, Sir Henry Roscoe found it in carbonic oxide gas which had stood compressed in a cylinder for a considerable time, and expressed the opinion that the red deposit which sometimes forms in ordinary steatite gas burners is due to the presence of this substance in ordinary illuminating gas. Its presence in the compressed gas used for lime lights has been noticed by Dr. Thorne, whose attention was called to the fact that this gas sometimes will not give a proper light because the incandescent lime becomes covered with oxide of iron.

A CORRESPONDENT of *Nature* gives the following interesting facts relating to the strength possessed by certain animals. The shell-less limpet pulls 1,984 times its own weight when in the air, and about double when immersed in water. Fasting fleas on an average pull 1,493 times their own dead weight, while the Mediterranean cockle *Venus verrucosa* can exert a pulling power equal to 2,071 times the weight of its own body.

So great is the power possessed by the oyster that to open it a force equal to 1319·5 times the weight of its shell-less body is required.

Electric Power now Used on World's Fair Buildings.

The engineers of the Construction Department of the World's Fair use electricity to run the machinery used in the work of construction, and have installed in the Fair grounds a perfect electrical power transmission plant—one in which the conditions are of a peculiar nature, on account of the long distances separating the apparatus and the fact that this machinery is being constantly shifted from place to place as it is required. The lines had, therefore, to be erected to satisfy any call for power from any particular spot in the grounds. The buildings of the Fair are of wood, covered with stuff which will give to them the appearance of imposing marble edifices, and the framework of the buildings is of iron. The major part of the machinery, therefore, consists of saw mills to cut the lumber, and hoists for raising into their lofty positions the immense girders, trusses and ponderous beams. In addition, there are moulding machines, planing machines, and pulverizers for the clay. The presence of the electric motors for operating the saw mills insures the absence of fire, from the danger of which the employment of steam engines is no guarantee.

The entire plant consists of the generators, the line and the motors, together with the various accessory appliances needed for the successful and economical operation of the electrical apparatus. The current of 500 volts is generated from two 100 K. W. compound-wound Edison generators, of the Edison street railway type, belted direct to two high-speed engines. The duplication of the generating apparatus was decided upon in order that the machines should be continually supplied with power, and the chances of a total breakdown obviated, one generator being capable of supplying the entire demand for a short time in case the other should be disabled. The "temporary" station in which the dynamos and engines are located is so substantially constructed that the term is almost a misnomer. The same may be said of the pole line carrying the wires and making a complete circuit of that portion of the grounds in which the motors are located. It is of first-class construction and of the best material. The high standard of insulation of the wires is always maintained, each circuit being subjected to rigid daily inspection and tests.

In the manufactures and liberal arts building—the largest structure in the Exposition, which covers an area of thirty acres—one of the saw mill plants is erected. This consists of a saw sharpener, band and cut-off saws, a rip saw and a boring machine. This compact outfit is run by a 12 K. W. Edison shunt-wound machine, belted to a line shaft. In the United States government building is another saw mill plant, run by a 15 kilowatt Edison motor. There is still another in the mines and mining building, and one in the horticultural building. In this last-named building is an electric hoist operated by a 20 K. W. Edison motor, fastened to the same frame as the base of the hoist. The hoist is of the double-drum form, with two winch heads, and can be used to raise two separate weights at once, while at the same time the winch heads can be used to drag material into position. It is now used to raise the immense trusses and purlins of the dome of this building, and has proved eminently satisfactory. In the transportation building a huge derrick has been erected for raising the trusses into position. It can be rolled to any requisite point, and has a 20 kilowatt Edison motor erected in its base frame. In this building, as well as in the agricultural building, are other electrically-operated saw mill plants.

The Exposition building, facing toward the lagoon, and ornamented on the exterior with Corinthian pilasters 42 feet high, has another saw mill plant. This building has been especially arranged with a view to electrical illumination at night, which in effect will be unequaled.

Here, too, is the large clay pulverizer, belted to a 12 K. W. Edison motor, which drives it at a speed of 1,200 revolutions a minute. In the machinery hall, the Illinois State building, the fisheries building and woman's building, are other mills and planers.

Each motor is operated by means of an ordinary starting switch and rheostat and main line switches in series with each motor. Protection is afforded by suitable fusible cutouts, and the motors are also sheltered from dust, dirt, rain and accident as far as possible. These machines are let to the contractors by the Exposition managers, the charge for their use being based upon the average daily maximum load, gauged by suitable measuring instruments. As promised by the engineers, the result of the adoption of electricity has proved entirely satisfactory, and the advocates of the portable steam engine and boiler have been compelled to acknowledge defeat. The motors have responded to every call made upon them, even to the extent of sustaining a heavy overload for a short time. The entire plant is leased from the Edison Company, and is to be returned in the same good condition as received. This transmission plant is a most important one, although only temporary, on account of its magnitude, the long distances separating the various plants, and the fact that the line is easy of access from any point within the grounds. The motors are scattered over an area a mile north and south by half a mile wide. The absolute freedom from accident or failure of any kind which the plant has enjoyed proves that this means of power transmission is as reliable as, if not more so than, any known method.

A Great Frozen Lake.

On the road from Irkutsk to Kiakhta, the frontier town of the Chinese empire, the terrible monotony of Mr. Price's journey was broken, for he had to cross Lake Baikal, the wonderful lake frozen for nine months in the year, which has sixty times the area of the Lake of Geneva, or 12,441 square miles, and has an average depth of no less than 5,404 feet, or more than a mile. Its origin, says Mr. Price, is undoubtedly volcanic. The cold is so terrible that when a hurricane stirs the waters, the waves often freeze as waves, remaining in hummocks above the surface; but when Mr. Price crossed the cold had caught the lake asleep, and the ice was perfectly smooth. He had thirty miles to drive on the solidified water: "For about a mile from the shore the ice had a thin layer of snow over it, but we gradually left this sort of dazzling white carpet, and at length reached the clear ice, when I saw around me the most wonderful and bewitching sight I ever beheld. Owing to the marvelous transparency of the water, the ice presented everywhere the appearance of polished crystal, and although undoubtedly of great thickness, was so colorless that it was like passing over space. It gave me at first quite an uncanny feeling to look over the side of the sledge down into the black abyss beneath; this feeling, however, gradually changed to one of fascination, till at last I found it positively difficult to withdraw my gaze from the awful depths, with nothing but this sheet of crystal between me and eternity. I believe that most travelers, on crossing the lake on the ice for the first time, experience the same weird and fascinating influence. About half way across I stopped to make a sketch and take some photographs. It was no easy matter, as I found on getting out of the sledge, for the ice was so slippery that in spite of my having felt snow boots on I could hardly stand. The death-like silence of the surroundings reminded me not a little of my experiences in the ice of the Kara Sea. This wonderful stillness was occasionally broken, however, by curious sounds, as though big guns were being fired at some little distance. They were caused by the cracking of the ice here and there. I was told that in some parts of the lake were huge fissures, through which the water could be seen. It is for this reason that it is always advisable to do the journey by daylight. We reached Moufshkaya, on the opposite coast, exactly four and a half hours after leaving Liestvenitz, the horses having done the whole distance of over thirty miles with only two stoppages of a few minutes each. It was evidently an easy bit of work for them, as they seemed as fresh when we drew up in the post yard as when they started in the morning."—*J. M. Price*, "*From the Arctic Ocean to the Yellow Sea.*"

A Remarkable Catalogue.

The British Museum authorities have just issued the second volume of a remarkable catalogue, says the London *Standard*. Stored in the drawers and cases of the Museum are some 50,000 inscribed pieces of terra cotta or clay tablets, forming the rescued portions of the great libraries of Assyria and Babylon. The great impetus given to cuneiform studies during the last few years in Germany and America, where they form part of the curriculum for a degree in Semitic languages, has made it necessary that the treasures of the British Museum, the center of Assyrian studies, should be catalogued, and the trustees have now issued these volumes, containing a descriptive catalogue of some 8,000 inscribed tablets. The inscriptions in question come from the Kuyuryik Mound, on the site of ancient Nineveh, which marked the ruins of the great palace and library founded by Assurbanipal, or Sardanapalus, in B. C. 650. The tablets embrace every class of literature, historical documents, hymns, prayers and educational works, such as syllabaries or spelling books and dictionaries. One of the most interesting sections is that of the omen tablets, produced by the court augurs and diviners. They saw omens in all things—the flight of birds, swallows, pigeons, the coiling of snakes, the movements of scorpions, the winds, the clouds, and, above all, the stars. The catalogues have been prepared by Dr. Carl Bezold, are beautifully arranged, and will tend to make the collections more accessible to students, and, in time, better known to the general public, who depend on specialists for the unraveling of the learning and wisdom of Chaldea.

Naval Carrier Pigeons.

The Navy Department is experimenting with homing pigeons as a means of coast communication. Birds have been placed on board the U. S. S. Constellation at Annapolis. They will be taken 100 miles to sea and be liberated at different points off the coast of Maryland and Delaware, bringing messages to the Secretary of the Navy.