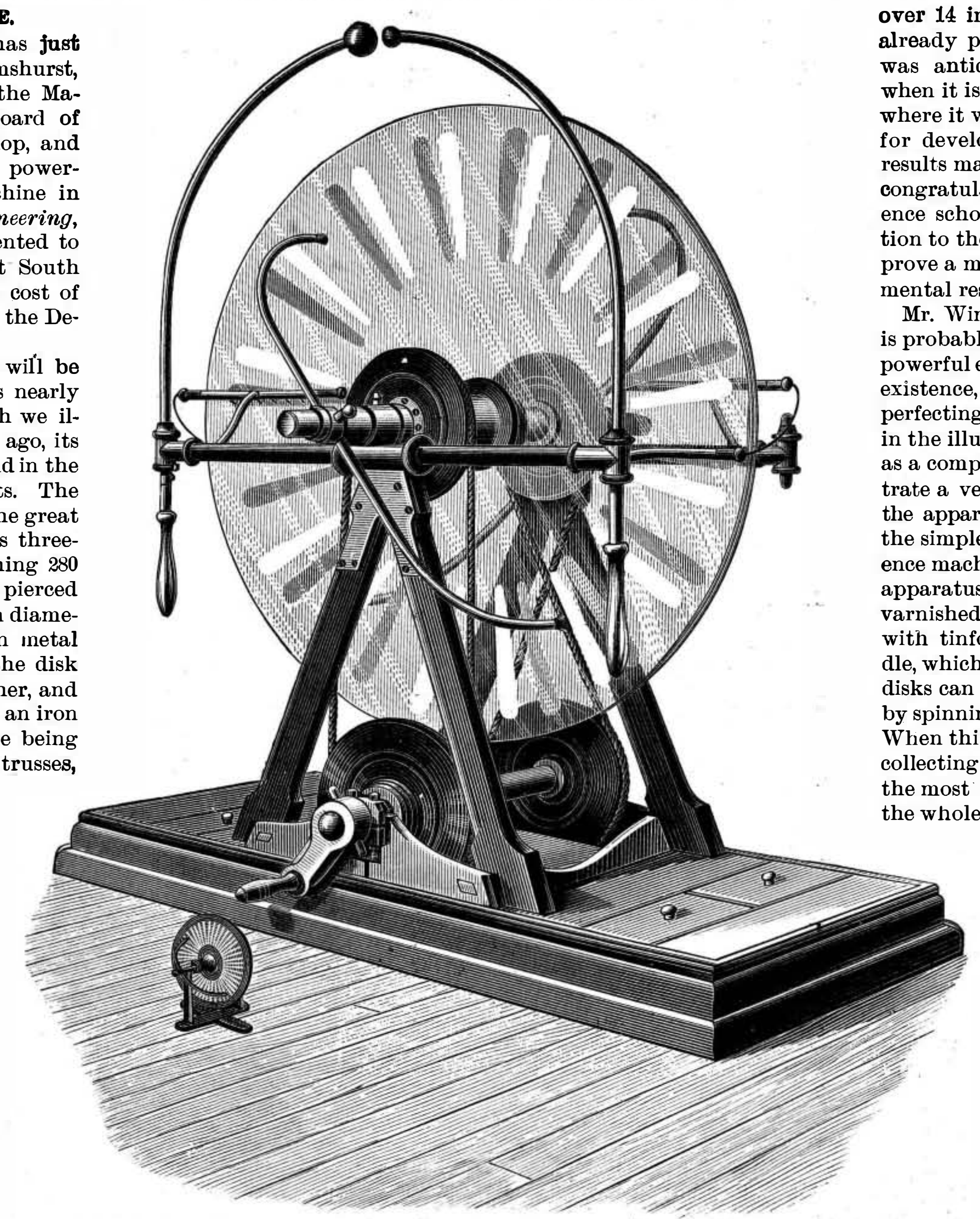
A GREAT ELECTRIC MACHINE.

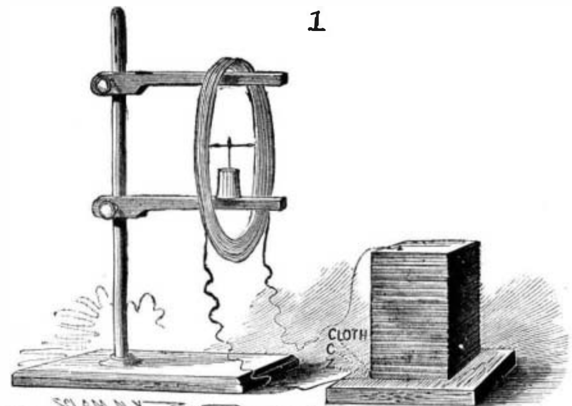
We illustrate a machine which has just been completed by Mr. James Wimshurst, one of the consulting engineers to the Marine Department of the London Board of Trade, in his own private workshop, and which is, undoubtedly, the most powerful and efficient electrostatic machine in existence. This apparatus, says *Engineering*, has been constructed for and presented to the Science and Art Department at South Kensington by Mr. Wimshurst, the cost of the raw material being defrayed by the Department.

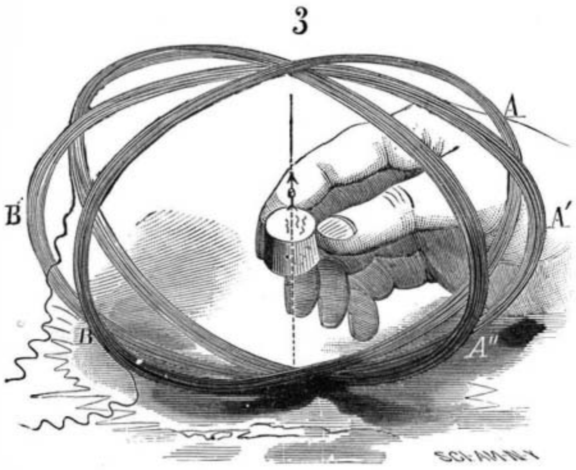
On reference to the illustration, it will be seen that the form of this machine is nearly identical with the smaller type which we illustrated and described two years ago, its points of difference lying in its size and in the construction of the supporting parts. The diameter of the circular plates of the great machine is 84 inches, of plate glass three-eighths inch in thickness, and weighing 280 pounds each. Each of these disks is pierced at its center with a hole, 6½ inches in diameter, and is firmly attached to a gun metal boss, 15 inches in length, carrying the disk at one end and a pulley at the other, and which is bored so as to run freely on an iron tube, 3 inches in diameter, this tube being supported at each end by strong oak trusses, rising from a firm base, also of oak, and which is fitted with lockers at each end, for holding spare parts and accessory apparatus. The heads of the two trusses, or A frames, consist of massive castings of gun metal, which are so shaped as to hold the hollow iron tube and the ebonite rod to which the collecting combs and discharging terminals are attached. The iron tube projects at each end beyond the trusses, and to the projecting ends are attached the brass "neutralizing" rods, which terminate in light wire brushes, shown in the illustration.



THE WIMSHURST SEVEN FOOT DUPLEX ELECTRIC MACHINE.

To the disks, which are well varnished with an alcoholic solution of shellac, are attached, at equal angular distances apart, radial sectors of tinfoil, sixteen on each disk. These sectors are 19 inches long, and have a mean width of 1·65 inches, thus having an area of 31·35 square inches. There is thus on each plate a metallically coated area of 500 square inches, or a thousand square inches on the two disks together.





The apparatus may in principle be regarded as a sort of double-acting "Nicholson's revolving doubler," the sectors on the one disk acting as inductors on the other, and *vice versa*, and that the extraordinarily high efficiency of the machine is probably due to the fact that both plates contribute charges of electricity to the collecting combs, and that the sectors on the one disk act as inductors and as carriers respectively to those on the other when they approach the best positions for those respective actions to take place.

The collecting combs are attached to the discharging terminals, as shown in the engraving, by interchangeable brass rods, some being straight, while others are bent, so that their positions with respect to the horizontal diameters of the disks may be varied within a range of about 16 inches, that is to say, between about 8 inches above and 8 inches below the horizontal diameter. The discharging rods or terminals are constructed of brass tubes, 1¼ inches in diameter, and are fitted with terminal balls of different diameters, which are also interchangeable. The distance of these balls apart—and therefore the striking distance of the spark discharge—can be varied by the glass handles with which the discharging rods are fitted at their lower ends, and as these handles have their attachment in a hinge joint, they can be used as levers wherewith to turn the terminal rods around a vertical axis, and thus to vary the distance between their upper ends.

The two disks are rotated in opposite directions by the lower driving gear, shown in the figure; this consists of a horizontal spindle fitted with a winch handle at each end, and carrying a pair of oak pulleys which are connected respectively to the two pulleys attached to the disks by endless cords, one of which, being crossed, causes one disk to be rotated in the opposite direction to the other; and as the height of the bearings of the lower spindle is adjustable, the driving cords can always be maintained perfectly tight.

The principal characteristics of this form of electrostatic machine, and to which its exceptionally high value as a laboratory instrument is due, are (1) that it is readily self-exciting in almost every condition of the atmosphere; (2) that the polarity of the apparatus never changes, as it is so liable to do in other forms of induction machines; (3) that the charge is very large compared with the area of the glass employed in the disks; and (4) the small cost at which the machine may be constructed.

Although the great machine which we illustrate in this notice was working in a workshop in which there was a steam engine and boiler at work, and consequently with a considerable quantity of water in the atmosphere, and although it was closely surrounded with lathes and shafting and other metallic conducting bodies, not only did it pick up its charge even before a complete revolution was made, but kept up a constant stream of discharge sparks between its terminals of over 14 inches in length. The results have already proved far more satisfactory than was anticipated before it was tried, but when it is set to work at South Kensington, where it will be under far better conditions for developing its full powers, still higher results may be expected. We may, indeed, congratulate Professor Guthrie and the science schools generally on this new acquisition to the physical laboratory, which must prove a most valuable instrument for experimental research.

Mr. Wimshurst has in his laboratory what is probably the largest collection of the most powerful electrostatic induction machines in existence, having worked for several years in perfecting this class of apparatus. We have in the illustration introduced (partly to serve as a comparison of size and partly to illustrate a very interesting and typical form of the apparatus) a sketch of what is perhaps the simplest and the cheapest electric influence machine ever constructed. This little apparatus consists simply of two disks of varnished glass, 12 inches in diameter, fitted with tinfoil sectors, and mounted on a spindle, which can be held in the hands, and the disks can be rotated in opposite directions by spinning them with the finger and thumb. When this is done—although there are no collecting combs or discharge conductors—the most brilliant effects can be produced, the whole apparatus literally bristling with electric discharges immediately the rotation commences, and one of the most remarkable and not the least valuable features of this beautiful little instrument lies in the fact that it can be constructed in a good, salable, and workmanlike manner and sold at a very small charge.

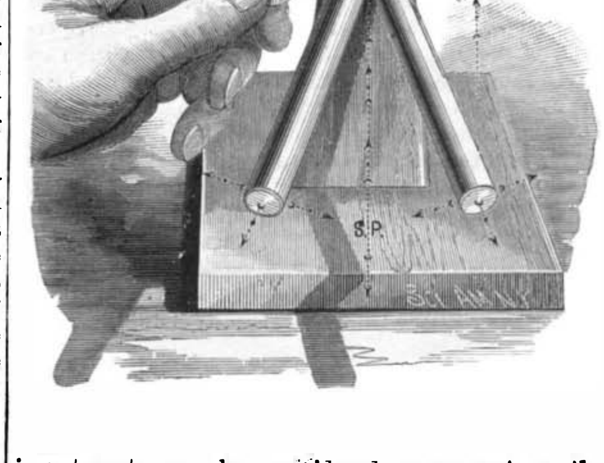
INTERESTING ELECTRICAL EXPERIMENTS.

To the Editor of the Sci. Am.:

Judging from the interest exhibited by the young people in our public library, on the arrival of the SCIENTIFIC AMERICAN, that readers of that class might find the details of some simple experiments acceptable, I send a description of two such, which can be made without much outlay, with simple, easily attainable materials, and which may even possess some interest for older persons.

FIRST EXPERIMENT.

At any tin shop or coppersmith's can be procured, for a trifle, scraps of sheet copper, zinc, and iron, and at any tailor's a few remnants of cloth or flannel. The other materials needed are about twenty-five cents' worth of No. 22 insulated copper wire and a small magnetic needle, costing perhaps 50 cents; both of which investments may be considered permanent, as the needle and wire can be used for many other interesting experiments. The only additional requirements are a handful of common salt, or, if preferred, one or two cents' worth of commercial sulphuric acid, which, to prevent accident, may at once be mixed slowly with ten times as much water.



The young experimenter may now cut the zinc and

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copper and cloth into pieces of about two inches square, dipping each piece of cloth into a saucer containing the dilute sulphuric acid. He is now ready to commence piling, on a small block of wood, a square of zinc, then of copper, then of the moistened cloth, until he has from five to ten pairs or more as he may desire, finishing with a square of copper. Instead of the dilute acid, common salt may be sprinkled on both sides of the cloth after moistening with rain water, and the pile then constructed as before. Also, instead of zinc, strips of sheet iron may be used, although the resultant voltaic pile will not be so strong, in other words, have as much electromotive force.

On a wooden stand, similar to a filter stand with two arms, let the coil of wire hang from the upper arm, and the magnetic needle rest in the middle of the coil on the lower arm. To make the movements of the needle more apparent, remove it from its box, and let it oscillate on a stout sewing needle thrust through a cork and placed, as stated, in the center of the coil.

If now the ends of the coil of wire are so placed that one is under the lowest zinc of the pile, in full contact, while the other end of the coiled wire is pressed flat on the upper or last copper square, the needle in the coil will tend to set itself at right angles to the plane of the coil. By reversing the wires, and placing the end which rested on the copper, now in contact with the lower zinc, etc., then the needle will be reversed also, although still coming to rest at right angles to the plane of the coil of wire, or so-called current of electricity.

One source of interest, connected with this experiment, is the fact that it may aid us in understanding the declination of the needle, which varies as the plane of the electrical current varies. It may also aid in our understanding certain dynamical phenomena, by suggesting that the salt water from the ocean (rendered strong brine by evaporation on reaching heated portions of the earth's crust) may occasionally penetrate deep fissures, and there encounter metals such as native gold, copper, magnetite, etc., besides other more readily oxidizable metals, or those prompt to unite with the chlorine of the salt; thus giving rise to electro-chemical action, and furnishing electromotive force for some seismic phenomena.

Diagram No. 1 is subjoined, to make the above experiment more intelligible.

SECOND EXPERIMENT.

Two bar magnets (costing perhaps 50 cents, and useful for many other interesting experiments) are placed across each other, on a block of wood, as in diagram No. 2, with the S. or unmarked ends of each diverging some 23° respectively to the east and west of the geographical north.

Presenting the small magnetic needle, mentioned in experiment No. 1, while held in the hand successively to the north and south ends of the bar magnets, also to points midway between the two influences, it will be found that, besides the four areas of greatest intensity, near the ends of the magnets, there are curved lines, resembling the agonic, or lines of no variation on our globe, anywhere along which the needle will point to the true north, as indicated in diagram 2. There will also be found a point (resembling the magnetic north pole in Boothia Felix) north of which the magnetic needle will turn its marked end to point due south, while south of that point it will turn its marked end due north. An examination of the phenomena exhibited in this experiment may enable the student to understand the general principles of the declination or variation of the magnetic needle (at many places on our globe) from the geographical north and south; especially when he considers that the same effect may be produced by currents of electricity, if, as in diagram 3, the plane of the main so-called current be successively in A B (solstitial), then in A′ B′ (equatorial), and finally in A″ B″.

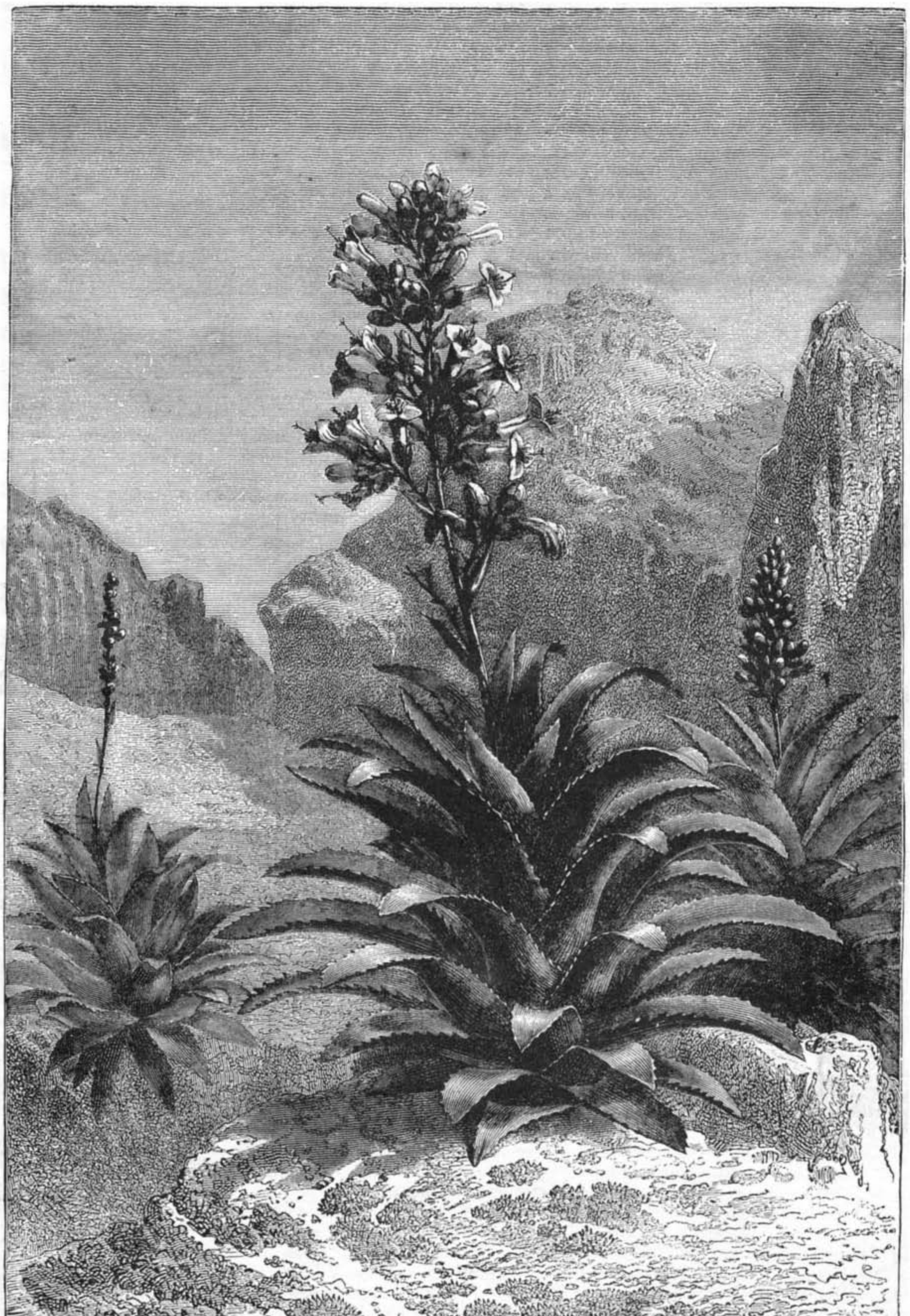
The current A B would necessarily, if strong enough, according to Oersted's discovery, and as shown in experiment 1, produce the same effect, on a small needle, which would be effected by the bar magnet that points in the diagram 2 to the west of the geographical north. The current A′ B′ would produce an effect equivalent to bringing the two bar magnets together; and the current A′ B′ would, in the same manner as if the two bars were made again to diverge, restore the attractive influence (exerted on a small needle) to the region occupied, in diagram 2, by the magnet which points east of north.

RICHARD OWEN.

New Harmony, Ind., December 31, 1884.

A Chance for American Bridge Builders.

It will be seen from an advertisement in another column that the Colonial Government of New South Wales, Australia, is about to build a new and splendid steel railway bridge, for which proposals are now invited. The bridge structure will be 2,900 feet long; the foundations are to be sunk 120 feet below the bed of the river, in water 50 feet deep.



ÆCHMEAS AT HOME.

ÆCHMEAS.

Everywhere there are evidences that a growing interest is being taken in bromeliaceous plants—an interest that should be encouraged, leading, as it inevitably must, to the introduction into English gardens of a large number of beautiful and eminently useful plants of easy cultivation. England alone among European countries where horticulture prevails has hitherto been practically without Bromeliads as ornamental indoor plants.

Next to Billbergias, the Æchmeas are the most useful among genera comprised in the Bromeliad order, although there are several species of Tillandsia and of Vriesia which are of exceptional beauty. Of the genus Æchmea nearly sixty species are described by Mr. Baker in his recent monograph of the genus, of which about a dozen are known in gardens, both in England and in Continental countries. For the following descriptions of these cultivated species I am largely indebted to Mr. Baker's monograph, prepared from living specimens in the Kew collection, and, therefore, more easily understood by horticulturists than any account could be when based on only herbarium specimens. The habit of Æchmeas is generally vasiform (*i. e.*, the leaves clasp tightly by their bases, so as to form a deep cup or vase) with long, leathery, green, spine margined leaves and central flower scapes. In most of the species the flower scape is clothed with large, bright colored bract-leaves, which are often much more ornamental than the flowers themselves. These latter are much smaller than those of Billbergia, and are red-purple, blue, yellow, or nearly white.

Like all the Bromeliads, Æchmeas are natives of distinctly tropical countries, where, either clothing tree trunks in exposed sunny places, or growing upon the ground, they are often met with in abundance.

In the accompanying illustration a rare and interesting species, viz., Æ. paniculata, is shown growing on the ground in a rocky, moist situation. This species is not known to be in cultivation, nor has it been seen wild for many years. It is one of the handsomest of the genus, and should it be again found in the Peruvian Andes, where it was first discovered by Pavon in 1794, its introduction into English gardens would be most desirable.

Æ. BRACTEATA.—A common plant in the West Indies, growing upon trees in sunny positions. Leaves spiny, with broad, sheathing bases, lorate. Height of plant, 2 feet. Flower scape, 1½ feet long, three parts of which are clothed with bright-red sheathing bracts, 3 inches to 4 inches long, the fourth and upper part bearing a branching panicle of numerous small yellow flowers. A large boat-shaped bract subtends and half envelops the lowermost flower branches. A gorgeously colored plant, owing its attractions chiefly to the brilliant red of the large bracts and the contrast between them and the green foliage and the bright yellow flowers. (Syn., Billbergia exudans.)—*Loddiges' Cabinet*, t. 801.

Æ. DISTICHANTHA.—A Brazilian species, with long ensiform foliage, the base of which is broad and sheathing, margins spiny, back of leaves striped with gray. Height of plant, 2½ feet. Flowers in branching panicles about 3 feet long, much crowded, and subtended by bracts; the latter and pea-like flower-buds bright crimson; flowers when open purplish, almost clear blue on first opening. The flowers are succeeded by berries

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