lated or cowled in a very peculiar manner. The centre of the flower is yellowish and maculate; the laminæ of the petals blue.

NEMOSTYLES GEMMIFLORA, *Nuttall*, in Trans. Philad. Phil. Soc.

Flowers a beautiful blue an inch or more in diameter. Found by myself in the vicinity of Fort Towson, western Louisiana, eastern Texas, and the prairies of Alabama near Demopolis, as long since as the year 1821. Both species are beautiful plants, belonging to the natural order Iridæ.

You will perceive my object in the details of this communication. It is—

1st. The description of new and unknown plants.

2d. Additional memoranda relating to those that are rare and little known.

3d. To enlarge the knowledge of the range of certain plants.

Waterbury, Ct., May 5, 1845.

ART. XIV.—*New Electro-Magnetic Engine;* by CHAS. G. PAGE, M. D., Professor of Chemistry and Pharmacy, Columbian College, Washington, D. C.

THIS new species of electromotion, which by way of distinction I denominate the axial reciprocating engine, was unsuccessfully attempted in the year 1838, and notice made of it in this Journal, Vol. xxxv, for 1839, pp. 261 and 262, together with some other experiments upon the interior of helices. My failure at that time was owing to a want of suitable batteries, but being furnished in the winter of 1843–4, with some of the excellent batteries of Prof. Grove, I recommenced the experiment, and exhibited one of these interesting engines to the members of the Geological Association held in this place in May, 1844. To sustain a small needle within the helix is a trite experiment, but by the arrangements I have adopted, a bar of soft iron or of steel (which becomes instantly and powerfully magnetized) is sustained entirely free from any visible support, and this too by the action of only six small Grove's batteries. This is almost a realization of the fable of Mahomet's coffin, or the statue of Theamides. When the helix is connected with six pairs Grove's, in good action, it will draw up within its centre a bar of iron or steel weighing two or three pounds, and sustain it with its upper

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end projecting above the helix. When the bar is very light, for instance a tube of sheet iron, and somewhat longer than the helix, its upper end will project nearly as much above, as its lower end is below the helix. A variety of very pleasing experiments may be made with things thus arranged. If the battery circuit be broken rapidly, the bar will not drop, but exhibit a rapid vibratory or dancing movement. If the battery current be slightly diminished without actual interruption, and there are various well known ways of doing this, the bar will sink, and rise again on restoring the full power of the circuit. The sensation is novel and peculiar when the bar is pulled down slowly through the helix, owing to the great space—at least three inches—through which the action is sensibly maintained. If a string be attached to the bar and the circuit broken by drawing the wire across a rasp or file, to a person holding the string, the sensation is precisely that felt by the angler when the fish has seized his hook. As pleasing modifications of this experiment, I have contrived several instruments, one of which is called the *watchman in his tower*.* The helix is mounted upon a stand, and the connexions with its extremities so arranged, that when the connecting wires with the battery are made to touch the legs of the stand, the armature or bar which is concealed within the helix, instantly starts up and exhibits the figure of a man upon its upper end, which falls back upon breaking the circuit.

Another curious instrument is the galvanic or magnetic gun. Four or more helices arranged successively, constitute the barrel of the gun, which is mounted with a stock and breech. The bar slides freely through the helices, and by means of a wire attached to the end towards the breech of the gun, it makes and breaks the connexion with the several helices in succession, and acquires such velocity from the action of the four helices, as to be projected to the distance of forty or fifty feet. Among the useful results of this principle of action, are a galvanometer of great value to the experimenter, and the electro-magnetic engine. The galvanometer gives an actual measurement by weight of any combination of pairs, up to that number which is beyond the saturating power of the bar or magnet within the helix, that is to say, for an instrument with a given sized

* This instrument and the magnetic gun will be particularly described in the next number.

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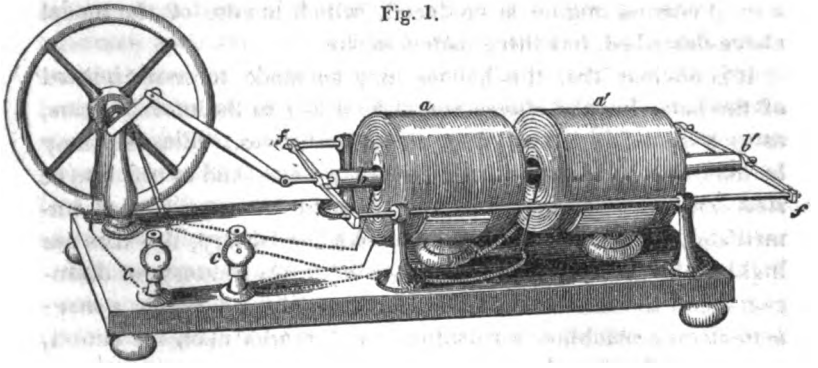
helix; for the size of the helix and bar may be increased so as to measure the power of any number of combinations. The bar in this case has its lower end just within the upper part of the helix, and its upper end attached to the hook of the spring balances commonly used in shops and elsewhere, for weighing light goods, &c. The great power of the helix in this case is due to the proportions of its length and diameter, and the length of the wire to the quantity and intensity of the current. The helix is about four inches long, three inches diameter, central opening three fourths of an inch diameter, and of one continuous copper wire, of size No. 16.

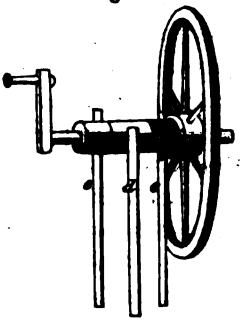
Fig. 1.



AXIAL RECIPROCATING ENGINE.

The construction of the engine will be readily understood from inspection of fig. 1. *a*, *a'* are two helices of the above description, firmly secured to the base board, and set with their axes exactly in a straight line. The two bars, *b*, *b'*, connected together by a stout brass rod, are attached to a sliding frame, *f*, *f*, and made to play with as little friction as possible. The wires from the extremities of the helices pass down through the base board, and the proper connexions are made with the cut-off upon the shaft of the fly-wheel, as shown in the detached figure 2. The dotted lines indicate the course of the wires and their connexions with the cups, *c*, *c*, and the conducting springs, *e*, *e*, fig. 2. The operation of the cut-off or electrotome, will be readily understood by any one familiar with the rotary machines without change of poles, which I published several

Fig. 2.



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years ago in this Journal, where the same device was used for the purpose of intercepting the galvanic current from one helix or magnet, and throwing it upon a second, then a third, and so on in succession. The bar *b*, as represented in the figure, has nearly reached its position of equilibrium with the helix *a*, and by its motion through the helix, has carried the bar *b'*, which is attached to the same frame, into a position to be acted upon by the helix *a'*. When *b* is at its position of equilibrium, the crank of the fly-wheel is at one of its dead points, the cut-off on the shaft intercepts the galvanic current from *a*, and conducts it into *a'*, which then draws in the bar *b'*, and thus a reciprocating engine is produced, which in case of the model above described, has three inches stroke.

It is obvious that the helices may be made to move instead of the bars, but the choice would be given to the movable bars, as they are in this case lighter than the helices. The bars may be hollow or solid—solid bars answering best—and of soft iron or steel, but soft iron is preferred. When the bars are of steel, immediately after using the machine with the battery, the bars are highly charged with magnetism, and if the battery be disengaged and the machine worked mechanically, it becomes a magneto-electric machine, furnishing bright sparks upon the cut-off, and strong shocks. In this experiment the two cups, *c c*, are connected by a short wire. In operating this machine by the battery, it exhibits one of the most beautiful, simple, and at the same time most powerful movements ever produced by electro-magnetism. The peculiar advantages of the arrangement are as follows: *First*, a continuous action may be maintained through a very great distance, as will be by-and-by explained. *Second*, the retardation common to all other forms of electro-magnetic engines, cannot occur here; for as the bars to be magnetized are small, they are very rapidly charged, and whatever magnetism they may retain after the galvanic current is intercepted in the helices, cannot retard their motion, as there can be no attraction between the copper wire of the helices and the inclosed iron bar. Hence with a given quantity of battery surface the maximum of speed and power is obtained. The retardation from the permanent retention of magnetism, the time occupied in charging a magnet to saturation, and the time required to discharge the magnet, are serious obstacles in the way of obtaining any availa-

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ble power in ordinary electro-magnetic machines, and occasion that singular anomaly,—that the actual power of such machines diminishes as their rate of revolution increases. Add to these difficulties, the influence of secondary currents, which, as I have shown several years since,* always remagnetizes a bar of iron after the battery current is cut off, and the *third* advantage of the new engine will be appreciated,—for in the first place, the secondary current occurs in all other forms of electro-magnetic machines, when the armatures or magnets are very near the point of greatest action, but in this engine the secondary current occurs at the farthest possible distance from this point; and in the second place, the secondary current has no perceptible influence upon the inclosed bar when it *does* occur. The mechanical power derived from this arrangement, should it ever be found economical, will be increased, by increasing the number of small machines. Any length of stroke may be obtained by arranging the helices in a straight line and causing the bar or bars to pass through the whole length, multiplying the number of helices, in proportion to the length of stroke.

It has long been a mooted question among mechanics, whether a rotary steam engine would have any real advantages over the reciprocating engine, and as no genius has arisen to give us a rotary engine which might claim comparison, it is *still* a question. But in regard to *this kind of electro-magnetic engine*, the rotary form is most desirable, for certain reasons to be hereafter explained. This interesting modification of the experiment, was matured some few days after the reciprocating engine was completed, and will be shortly explained. In addition to the power of the helix in drawing the bar within itself, I have availed myself of an extra source of attraction, viz. the actual power of the magnet, which receives an additional impulse by the attraction between it and an armature or bar of soft iron. This impulse, which is powerful, is received at an unfavorable moment, as it is nearly at the end of the stroke, when the crank is only a short distance from the dead point; but I have made use of it nevertheless to advantage, by an arrangement which I will describe in the next number. In the rotary form there is no mechanical difficulty of this nature to overcome.

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* This Journal, 1838, Vol. xxxiv, p. 372.

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ART. XV.—*Axial Galvanometer, and Double Axial Reciprocating Engine;* by CHARLES G. PAGE, Prof. Chem. and Pharm. Columbian College, Washington, D. C.

The Axial Galvanometer.—As this instrument possesses characteristics distinguishing it from all others, I have selected for it the term *axial*, as appropriate and in some measure descriptive of its character. In all the known forms of galvanometer, the magnetic needle or a bar of magnetized steel is used, to indicate the action of the galvanic current, or else the coil of wire itself is free to move, while the needle or bar is stationary. In all such instruments there is one liability to error from a source not sufficiently regarded, viz. the frequent disturbance of the power of the needle by the magnetizing power of the current in the coil, which, if the needle is in such position as would naturally result from the action of the coil, will slowly increase its magnetic power, and if forced by accident or otherwise into a reverse position, will diminish its power, and ultimately reverse its polarity, provided the current be powerful and the action continued for any length of time. In the new instrument, no permanent magnet is used, the motion necessary for purposes of indication being made by the action of the coils upon a bar of soft iron. Every bar of soft iron retains, after being powerfully magnetized, a certain amount of magnetic power; but this, if the bar is not very large and hard, is very small, and may be considered as nearly a constant quantity. I have sometimes thought that the term absolute galvanometer might well be applied to this instrument, as it immediately indicates by weight the absolute force exerted upon the iron bar. I would not recommend the mounting of the instrument in the style exhibited in the figure, as the sketch is taken from the instrument in its primitive form. Many modifications will suggest themselves of modes of constructing the instrument, as well as the means of indicating the forces.

The U form bar 2, 2, Fig. 1, is of soft iron carefully annealed, well polished, and graduated to spaces of one sixth of an inch upon one of its legs; the diameter of the iron is about one eighth of an inch less than the opening in the centre of the helix, to allow free play as the helices are raised and lowered, or the magnets drawn down within them. The bar is suspended by a

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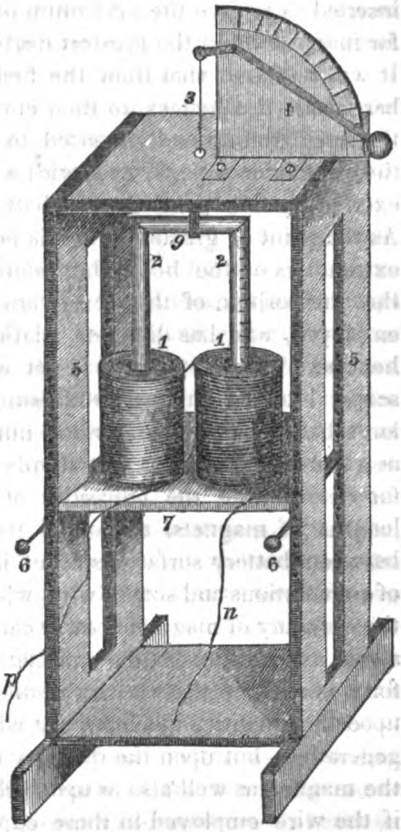
small brass wire 3, passing through the top board of the frame-work, and attached to the short arm of a bent lever balance, 4. The helices are supported upon the shelf 7, which is raised and lowered, and sustained by means of the pins 6, 6 passing through holes in the frame and under a projection from the shelf, which slides freely in the slot 5, 5. The wires from the helices *p*, *n*, are to be connected in any suitable manner with the poles of a battery. Guide-rods or pins may be inserted in the poles of the magnet, which pins or rods may pass through holes in the centre of a plate of metal let into the lower board of the stand, or one a little more raised, so as to allow for the motion of the entire length of the bar; but this last device is hardly necessary, for if the bar should incur friction by touching the helices, it is easily freed from it by slightly shaking the apparatus. I have sometimes used the spring balance instead of the bent lever, and although the former is not so sensitive as the latter, yet it possesses some advantages. In the bent lever balance, the point of suspension of the wire 3 must describe an arc of a circle, while in the spring balance the point of suspension moves in a straight line, making less liability to friction.

Fig. 1.



Operation.—When an intensity battery, say two or any number of Grove's battery, is connected with the helices by means of the extremities *p*, *n*, the bar 2, 2 is drawn down with a degree of force which will be indicated by the scale of the balance. The

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force indicated will vary with the degree of insertion of the bar. When its legs are just within the helices, the action is slight; as they descend further, the action increases, until they reach a point about two thirds the way down the helices, when the action is at its maximum. By raising and lowering the shelf 7, the action may be varied accordingly, and when the bar is so far inserted as to give the maximum of effect, it should be left thus far inserted when the greatest degree of sensitiveness is required. It will be found that from the first insertion of the legs of the bar within the helices, to their entire insertion up to the bend 9, the force is continually exerted to draw down the bar; and in the experiments performed with a bar 10 inches long, the force exerted by five pairs Grove's battery was equal to two pounds. As the point of greatest action is neither in the centre, nor at the extremities of the helix, but somewhere between them, I find that the position of this point varies with the length of the bars employed, and has different relations in differently proportioned helices. This instrument is not offered as a sensitive galvanoscope, but is calculated to measure the force of currents when large batteries are used, or any number of small batteries joined as a compound battery. It affords at once a valuable instrument for determining the properties of helices of various sizes and lengths, of magnets, and of all those relations and proportions between battery surface, size of iron for magnets, and number of convolutions and size of wire, which must be determined before the economy of magnetic power can be settled. It would require a vast expenditure of time and material to settle the above points, for it is obvious that the magnetism of the bar does not depend upon the quantity of electricity which the battery is capable of generating, but upon the quantity circulating in the wire around the magnet, as well also as upon other conditions. For instance, if the wire employed in these experiments be wound after the method of Prof. Henry in separate strands, the five pairs Grove's will manifest but very little action upon the magnet or inclosed bar. And if the same wire is one continuous piece, as it is actually used, and the same surface exposed in the five pairs be converted into one pair, the action will then also be very slight.* This is one of the most important principles to be regarded in all

* The calculations made, and advanced by several European philosophers, upon the amount of zinc consumed, cannot in view of the above, be regarded as affording a test of the inapplicability of electro-magnetism as a mechanical agent.

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of the applications of galvanism for the development of magnetism. The proportions of battery, and length and size of wire, and relations of length to diameter of the helices used in the instrument just described seem to be very near correct, and I am indebted for them to Mr. Vail, Prof. Morse's assistant. I had never seen so great a weight sustained within the helix as in one of about the size used above, and first kindly shown and loaned to me by Mr. Vail. The bar he sustained within a single helix by means of 10 pairs Grove's battery, weighed over half a pound. By modifying the proportions, I have succeeded in sustaining over three pounds, and believe that even ten times that amount may be sustained free of visible support, by proper attention to the several ratios required.

Double Axial Reciprocating Engine.

Before entering upon the description of this improvement, I may be allowed a few remarks as to the nature and design of these publications. Conceiving that this, and the first machine described, and also the several instruments which I have designed upon the same principle of action, form an entirely new era in the science of electromotion, (if we except the delicate experiment of De la Rive's ring, and others of the class of electrodynamics,) I have thought that the invention would ultimately, and perchance very soon, become one of practical value, and am therefore desirous of securing by patent the right to the following modifications, viz. the single axial engine, the double axial engine, and the rotary form of engine, dependent upon the same species of action; which last will be hereafter described. The galvanometer, being an instrument calculated to be productive of great good to science, without any further modification, the galvanic or magnetic gun, the watchman in his tower, and some other interesting contributions to the *physique amusante* hereafter to be mentioned, I give to the public as instruments of philosophical research and amusement. Situated as I am, being one of the examiners in the Patent Office, it becomes necessary for me to take an unusual step, to secure my title to this novel invention. By the statute law, no officer in the Patent Office can take out a patent for any invention, nor acquire any interest in a patent after his appointment to office. Consequently, if one so situated should make an important invention, he can have no security as long as his invention is known to any second person. As publicity with-

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out abandonment is the strongest possible testimony in favor of an inventor, I have resorted, with your indulgence, to the pages of this Journal, to establish the date and nature of my invention, and to give due caution to all as to its use in any way to engender liability. Although I cannot, without resigning my office, enjoy the usual rights of inventors, yet I have every reason to believe that Congress will, by special act, authorize me to receive and hold a patent for this and some other kindred inventions.

The use and action of the galvanometer will readily explain the basis of the double engine. The power of the helices is much better displayed when the U form bar is used instead of a straight bar of iron, as in the first engine. As the straight bar reaches its equilibrium with the helix, when its projecting portions are of equal length, or rather when the centre of the helix exactly coincides with the centre of the bar, it was plainly inferrible, that the U form bar would be drawn through the helices until they were both intercepted by the bend of the bar. This was fully verified by experiment, as follows. A bar of iron of this form, having its legs ten inches in length, was mounted upon a sliding frame—part of its weight counterpoised, and its legs inserted into two helices of three inches length; the helices were then connected with the battery, and the bar was drawn through the helices until they rested upon its bend. Thus with a single pair of helices and a single bar of iron, a continuous impulse was given through the space of ten inches, affording at once the elements for the most simple and efficient exhibition of magnetic power as a propelling agent. The power, as measured by the axial galvanometer, averaged in this experiment $1\frac{3}{4}$ pounds through the ten inches; in the last half inch, or that near the bend, the power was two ounces, and at the point of greatest action it was $3\frac{1}{2}$ pounds. I find, moreover, that the helices, if properly suspended, will pass over the entire length of two feet; though, from the difficulty of magnetic induction through such long bars, the power is feeble through a considerable portion of the space. The machine represented by fig. 2, has six inches stroke, and although its mechanical power has not been absolutely tested, yet, for the elements employed, it is by far the most powerful engine of the kind I have seen; and its operation is so encouraging that I am preparing for another engine, of one foot stroke. Upon inspecting the figure, the whole arrangement, which is very simple, will be understood at a glance. The U

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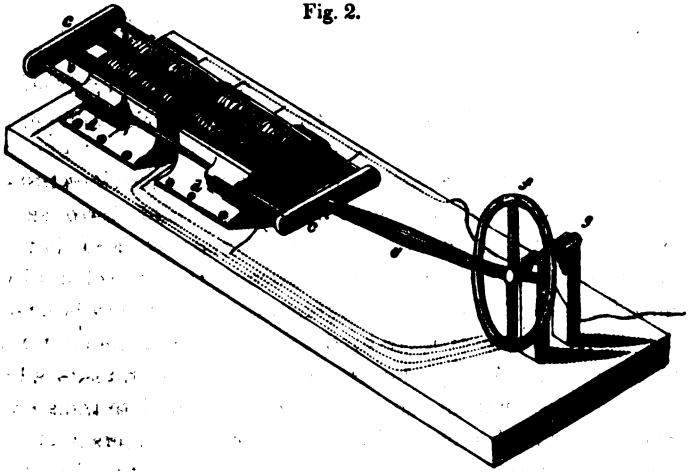
form bar, *b b*, is joined to one of a similar size and shape, placed at the other end of the sliding frame, *c c*. They are joined by means of brass rods about six inches in length, and of the same thickness as the bars of iron, and both are firmly secured by the cross heads and sliding rods of the frame, *c c*. The helices, *a a*, are firmly cemented in a stout casting, *d d*, which also contains

Fig. 2.



the bearings of the sliding rods. The frame is attached to the fly wheel *f*, by the connecting rod *e*, and crank shaft *g*, after the usual manner. The dotted lines represent the course of the wires from the helices underneath the base board, which again pass up through it, near the crank shaft, to be connected with an electrotome or cut off. This part of the engine will be understood without further explanation by all familiar with the subject. It will be noticed, however, that instead of using a single pair of helices upon the U form bar, there are two pairs. This arrangement makes a great gain of power, for the action upon the bars is made consecutively by the helices while the bars are passing the strongest points of each. In the machine of one foot stroke, there will be four pairs upon each bar, operating consecutively. It is obvious that they may be increased in number as the length of stroke increases, even up to two feet. I have also availed myself of a mode of applying the direct power of the magnet upon a bar of soft iron, in conjunction with the continuous action of the helices; which adds about ten per cent. to the actual power of the

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machine. The nature of this last improvement will be hereafter explained. The gun, the rotary engine, and some other modifications, will be hereafter described. The above modifications of the engine, the rotary form and the other instruments, were all invented in less than a month's time after the single axial engine, and communicated in confidence to a few friends.

Washington, D. C., June 10, 1845.

ART. XVI.—*Report of Observations on the Transit of Mercury, May 8th, 1845*; by Professor OLMSTED, of Yale College.

BY recurring to the records of observations on previous transits of Mercury, as given in the Philosophical and Astronomical Transactions, and in various scientific journals, we find that the circumstances under which they have occurred, have seldom been entirely favorable. Either the ingress or the egress has happened in the night; or one or more of the contacts, and frequently all, have been concealed by clouds. Of the several transits which have taken place within the present century, the late transit was the only one which presented itself to our astronomers under circumstances favorable to observation. Fortunately, this transit afforded to a number of accurate observers an unobstructed view of the entire phenomenon, and to others, the opportunity for accurate observations on at least one set of contacts, either those of the beginning or those of the end. Presenting itself to all parts of the United States, as far west as New Orleans, between the hours of ten in the morning and six in the evening, and consequently at a period in the twenty-four hours extremely convenient to the astronomer, it afforded the best opportunities for determining the times of contact, and all the physical peculiarities of the phenomenon. In some parts of the country, on the east, indeed, the morning was threatening and boisterous, so as to prevent good observations on the ingress; and in other parts, on the west, clouds prevented observations on the egress; but so far as we have heard, all observers enjoyed the satisfaction of seeing at least either the ingress or the egress. At New Haven, New York, West Point, Philadelphia, Cincinnati and Charleston, the sky was cloudless throughout; at New Haven the covering of clouds, which had overspread the morning

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