THE

ANNALS

OF

PHILOSOPHY.

NEW SERIES.

JULY TO DECEMBER, 1826.

VOL. XII.

AND TWENTY-EIGHTH FROM THE COMMENCEMENT.

London:

Printed by C. Baldwin, New Bridge-street;

FOR BALDWIN, CRADOCK, AND JOY,

PATERNOSTER-ROW.

1826.

most azote,* and more than animal bodies; nevertheless it does not, under any circumstances, undergo the putrefactive fermentation, which seems to indicate that the difference which exists between azotized vegetable and animal matter, the putrefying property which the latter possesses does not depend upon the greater quantity of azote, but upon a peculiar arrangement of the compound molecules; crystalline force alone might suffice to preserve this stability of the elements in cafein and some other azotized products of the vegetable kingdom. Even in animal substances, it may be observed that those which crystallize, such as urea and uric acid, though much azotized, are the least susceptible of putrifying.

Article VII.

Account of an improved Electro-magnetic Apparatus. By Mr. W. Sturgeon.†

The science of electro-magnetism, although so generally interesting, yet (comparatively speaking) appears to be very little understood. This latter circumstance is probably, in a great measure, owing to the difficulty of making the experiments, and the great expense attending the process; for, besides the first price of a large battery, considerable expense in acid must always attend its excitation, whenever an experiment is attempted. Large batteries are always attended with difficulty of management, and the great quantity of hydrogen evolved during the process renders the use of them extremely inconvenient to the operator. These are evidently great obstacles to the experiments being often repeated, and to the science being generally known. Another, and perhaps no less obstacle to the advancement of this interesting science, is, that the experiments being hitherto exhibited on so small a scale, are by no means calculated to illustrate the subject in public lectures; for when the experimenter succeeds even to his wishes (which is not frequently the case), the experiment can only be seen by a very near observer, and the more distant part of the auditory are obliged to take for granted what they hear reported (from

* Cafein is composed of

Carbon	46·51	Albumen contains of azote	15·705
Azote	21·54	Gelatine	16·998
Hydrogen	4·81	Fibrin	19·934
Oxygen	27·14	Urea	43·400
	100·00		

Cafein then contains less azote than urea only, and urea putrifies less readily than fibrin, &c.

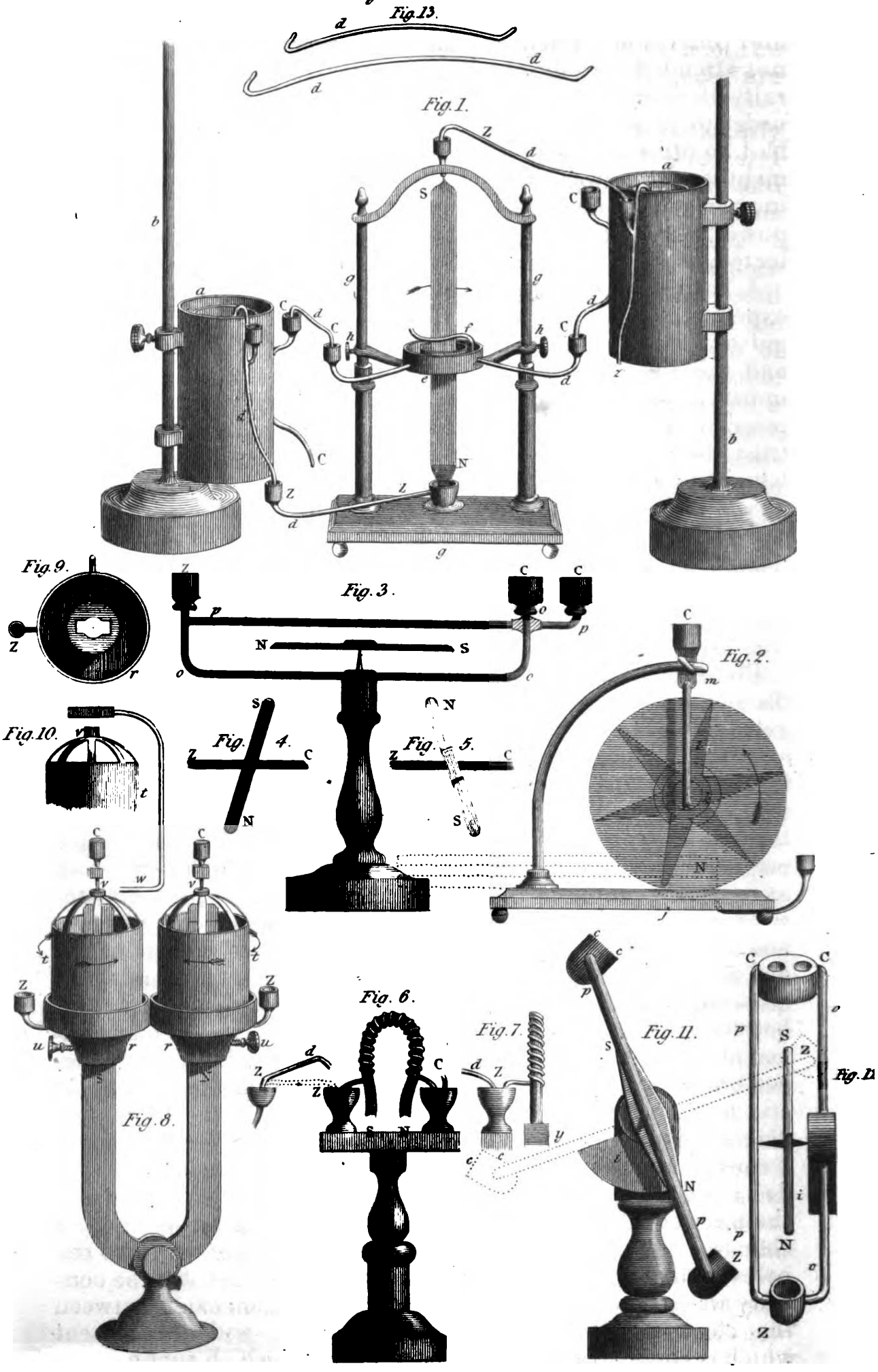
† Abstracted from the Transactions of the Society for the Encouragement of Arts, &c.

those persons who are more favourably situated), of some of the most interesting facts, which they, from their distance, are unable to witness.

With a view of removing, in some measure, these apparently formidable obstacles in the progress of this infant science, I have devoted a considerable portion of time, labour, and expense, in repeating several of the experiments, under various circumstances, and with various forms and sizes of batteries. I have likewise instituted a series of experiments, for the purpose of discovering, if possible, if any particular ratio of galvanic and magnetic power was absolutely necessary to be observed in the process of electro-magnetism. If no particular proportion of those two powers was essential, then it appeared highly probable that an increase of magnetic power might compensate for a deficiency of the galvanic, and thereby render the use of large galvanic batteries quite unnecessary, an object which I considered both interesting in its nature, and, by reducing the expense, and facilitating the process, exceedingly desirable to the experimenter; and I am happy to state, that my labours were no ways abortive, for instead of electro-magnetic phenomena depending on powerful galvanic, and feeble magnetic force, as had till then been practised, I found, during that inquiry, that the galvanic force may be reduced to almost any degree, provided the magnetic be sufficiently powerful. This discovery led me to the use of powerful magnets, and small galvanic batteries, for with small magnets the experiments can never be made on a large scale, although the galvanic force be ever so powerful; and as minute and delicate experiments are not calculated for sufficiently conspicuous illustration in public lectures, I considered that an apparatus for exhibiting the experiments on a large scale, and with easy management, would not only be well adapted to the lecture room, but absolutely valuable to the advancement of the science. Upon this principle I have constructed a complete set of instruments, which, from their superior magnitude, and peculiar arrangement, are, in my humble opinion, and by the certificates I have been honoured with, are, in the opinion of gentlemen whose judgment I presume will ever be held in the highest estimation, well adapted for the illustration of the subject, either in the private study or public lecture room.

It will be understood from what I have already stated, as well as from an inspection of the instruments, that the mode which I have taken for the production of electro-magnetic phenomena is more simple in its management, less expensive in the process, better calculated for the illustration of the subject, and the reverse of that which has hitherto been used, and which, by its almost entire dependence on the tedious and expensive process of galvanism, has considerably retarded and obscured this new

Mr. W. Sturgeon's
Electro-Magnetic Apparatus.



J. Shury Sculp.

Engraved for the Annals of Philosophy. Published by Baldwin, Cradock and Jon. November 1st 1826.

and interesting science; for whenever an experiment was not attended with the anticipated success, the failure was generally attributed to an insufficiency of galvanic power; and in order to increase the effect, it appears that the experimenter had no other means of accomplishing his object, than by augmenting the power of his battery, or by reducing the size and increasing the delicacy of his other apparatus, the magnetic power being either entirely lost sight of, or regardlessly neglected, as if no ways materially concerned in the process.

I have found, however, by the above-mentioned course of experiments, that the magnetic force is as essential as that of galvanism to the development of electro-magnetic phenomena; and the apparatus which I now submit to the attention and impartial consideration of your valuable Society, acting on the principle of powerful magnetism and feeble galvanism, will, I trust, be found more eligible and efficient than any other that has yet been brought before the public.

Reference to the Engraving of Mr. W. Sturgeon's Electro-magnetic Apparatus. (Plate XLI.)

Plate XLI. fig. 1. A perspective view of an apparatus to show the revolution of a magnet round its own axis. *a a* the two galvanic apparatuses on their stands *b b*, they are acting on the magnet N S, by means of the connecting wires *d d d d*; both their copper poles c c are applied to the equator *e* of the magnet, while the zinc pole z of one is applied to the north pole N, and the zinc pole z of the other is applied to the south pole s of the magnet. A wire *f* is soldered on to the magnet, and bent down at one end to dip into the circular trough *e* to form the equatorial connexion: and as all the connexions are made by mercury and amalgamated wires, the end of this wire is amalgamated, and mercury put into the trough: all the little cups z and c are also amalgamated at the bottom, and contain mercury; the bottom wires of the zinc and copper poles are likewise amalgamated to dip in connecting cups when wanted. The magnet has brass wire centers on which it turns, that at the north pole stands in a cup z with mercury; and the other at the south pole enters the amalgamated hollow in the screwed end of the upper connecting cup z. When the connections are made, as above described, on pouring dilute nitric acid into the troughs *a a*, the magnet will revolve in the way shown by the arrow; but on changing the connexions, by applying the copper wires to the poles, and the zinc ones to the equator, it will revolve the contrary way; here the magnet only forms the connexion between the electric poles, and revolves around, or with the current which is conducted by it. *g g g* is the stand which supports the

magnet; the equatorial trough *e* is made moveable on the pillars *g g*, and is fixed by the screws *h h*.

Fig. 2. A view of a circular metal disk, made to revolve between the poles of a horse-shoe magnet; the disc is amalgamated round its edge, and dips into a little mercury contained in a hollow *j* of the stand, the centers *k k* on which it turns, and the hollows that receive them in the forked support *l l* are amalgamated; the screw *m* allows the disc to be adjusted, and fixed so as only just to touch the surface of the mercury. A horse-shoe magnet N or N S shown by dotted lines, is laid on the stand, then one of the troughs *a* of fig. 1 is to be adjusted on its stand *b*, till its bottom wire z dips into the connecting cup z, forming the zinc communication, and a connecting wire *d* with bent ends is to dip into the copper connecting cup c of the trough, and into the cup *c* of the disc; the communication of the poles being thus made (the current passes from z, through the mercury *j*, into the edge of the disc, and through its centers *k k* into the fork *l l*, and up to the cup *c*) the disc will then revolve as shown by the arrow. By reversing either the poles of the magnet, or the electric poles, the revolution of the wheel is reversed; but if both are reversed, the revolution will continue in the same way as at first. The six rays are painted on the disc, merely to render the revolution visible at a greater distance.

Fig. 3. A stand supporting a needle between two conducting wires *o o* and *p p*, to show the different effect of electricity on the needle when passing above or below it; the cup *z* is common to both, but the other ends have each a separate cup c c: when the electric current passes along the upper wire, *p p* the needle takes the position as shown in fig. 4; but on lifting the connecting wire out of the cup *p* c, and putting it into the cup *o* c, the current passes through the under wire *o o*, and the needle immediately goes round to the position indicated in fig. 5; then if you watch the motion of the needle, and keep alternately transferring the wire out of one cup into the other, keeping time with the needle, you may bring it into the most rapid revolution that you can possibly keep time with.

Figs. 6 and 7. A front and side view of a stand with two connecting cups z and c made of wood, in which the bent iron wire wound round with copper wire is supported by the two copper wire ends. On making the galvanic connexion through the copper wire, the iron wire becomes a strong horse-shoe magnet, and will support a heavy bar of iron as *y* fig. 7; but on lifting the connecting wire *d*, fig. 6, out of the cup z, the weight immediately drops, and on restoring the connexion, the power is restored; then if you change z for c, it will change N for s, or if you only wrap the copper wire about the iron wire, as a right threaded screw instead of a left one, as in the Plate, it will change N for s. This is explained by what takes place in figs 3, 4, and 5.

Fig. 8, a horse-shoe magnet, mounted with two mercurial troughs *r r*, (fig. 9 shows one separate) *t t* two cylinders suspended on the ends of the magnets, by points within their crowns under the cups *v v*; their bottom edges are filed away, leaving only four points (as fig. 10) to touch the mercury, by which means the friction is much lessened. The troughs are adjusted by the screws *u u* so as to bring the mercury just in contact with the points of the cylinder; the screw points of the upper cups *c c* just touch the mercury in the cups *v*. Upon making the communications as before with the cups z z and c c, the cylinders will revolve as shown by the arrows.

Figs 11 and 12 show a front and back view of a dipping needle, mounted between two wires, *o* and *p*; they are here placed in the direction of the dip, but the quadrant *i* allows them to move one quarter round, or to the equator of the magnet, as shown by dotted lines. In their present position the needle will deviate, as figs 4 and 5; and it will be seen the needle cannot take a position quite at right angles to the wire, owing to the terrestrial magnetism drawing it on one side; but when the wires are carried round to the dotted position fig. 11, the needle remaining as it was, so as to be at right angles to each other, then on passing the current from z through the wire *o o*, no effect will appear to take place, the needle is only more confirmed to its position, but on passing it through *p p*, the needle goes round, and dips with its south pole. The wire passes through the wooden cup z, but the two ends of it *p* and *o* only just enter their respective wooden cups c c; these wooden cups are placed at an angle of 45° to the horizon, so that in either position they are similar, and will hold mercury enough to make the contact.

Fig. 13 shows two of the connecting wires separate, three or four pairs of each of these are required.

These figures are nearly one-fifth of the real size, and it will be seen that the magnetic power is very great in proportion to the galvanic power.

Article VIII.

Further Observations on the Genus Hinnites, with the addition of another recent Species, indigenous to Great Britain. By J. E. Gray, Esq. FGS.

(To the Editors of the *Annals of Philosophy*.)

GENTLEMEN, *Paris, Oct.* 16, 1826.

In the number for August last, p. 103, I described a recent species of the genus Hinnites of Mr. De France, which I had discovered in the collection of the British Museum. A few days