



## L. New outlines of chemical philosophy

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L. *New Outlines of Chemical Philosophy.* By EZ. WALKER, Esq.  
of Lynn, Norfolk.

[Continued from vol. xlvii. p. 97.]

M. DE LUC has favoured the philosophical world with a new instrument, which he calls The Electric Column. The effects of this instrument are very wonderful; for, if we look upon it merely as a philosophical toy, it excites our astonishment nearly as much as either magnetism, electricity, or galvanism did, when they were first discovered: but when the electric column is used as a philosophical instrument, it may tend to enlarge the bounds of chemical philosophy; for it has happened, and not unfrequently, that improvements in science were at a stand, until some new improvement was made in the arts.

When we investigate the properties of physical elements, which produce such an infinite variety of physical effects, we should be very circumspect in our operations, and not content ourselves with a single experiment, which may seem to support a favourite hypothesis, but vary our experiments; and if a great number of them, made with appropriate instruments, prove the truth of the same hypothesis, that hypothesis may be deemed a theory, and used as such in all our future investigations.

The only means we have of investigating physical causes, is by experiment and observation; for physical certainty does not admit of mathematical demonstration; it is entirely obtained by our senses. We see the sun, and feel his effects,—we view the moon and all her various changes; but the existence of those objects cannot be mathematically demonstrated: all the knowledge we have of their existence is wholly derived from our senses. Hence all our experimental knowledge comes under the denomination of *physical certainty*.

“In ascending from effects to causes we must ever arrive, upon whatever hypothesis we proceed, at some first cause, which does not admit an explanation from mechanical principles\*.”

Now the first causes or elements, by which the various phenomena in nature are produced, are three; that is to say, gravity, magnetism, and electricity:—gravity is a simple element, but the other two are compounds. Each pole of a magnetic bar contains a different element. In two bars homogeneous poles repel, and heterogeneous poles attract each other. And the same law obtains in electricity; for, what have been called positive and negative electricity are two distinct elements;—electrical

\* Watson's Chemical Essays, vol. i. p. 163.

elements of the same kind repel, and contrary elements attract each other.

In a former paper I described some improvements that I had made in electrometers, and in the modes of insulation. As these improved instruments are highly necessary in conducting the following experiments, I shall give an account of them here, to save the reader the trouble of turning to my former paper.

The electrometer which I make use of consists of an eight-ounce phial with a stopple of sealing-wax fitted into its mouth; through this stopple a piece of thin music wire passes, and extends down the axis of the glass about  $2\frac{1}{2}$  or 3 inches; the top of the wire standing 3 or 4 inches above the top of the phial. The lower end of the wire is turned into a small ring, from which two slips of Dutch metal are suspended; these are about  $\frac{3}{4}$ ths of an inch in length and  $\frac{1}{10}$ th in breadth. The wire is fixed into the stopple; but the stopple itself is not made fast into the mouth of the phial, but left so as to take out occasionally.

My insulating stands are made thus:—A piece of thermometer tube five inches long is fixed to the bottom of a wine-glass (the top being broken off) with black sealing-wax, and a piece of a stick of the same kind of wax, about an inch and an half in length, is fixed upon the top of the tube. The top of the wax being made soft, is formed into a proper curve for glass tubes to rest upon. This form is very convenient for making experiments with electric columns; but a circular piece of glass, having its upper surface gilt with gold-leaf, fixed upon the top of the wax, is more convenient for many other experiments\*.

#### *Description of a Silver-leaf Electrometer.*

The object of this instrument is to investigate some properties of M. De Luc's electric column. The electric machine collects two elements by friction; the Galvanic apparatus produces the same two elements by a chemical process; but the electric column, by some unknown process, produces these elements without either friction or chemical action.

In fig. 1. *ab* represents part of a thermometer tube fixed into the base of the instrument at *a*. *bc* a cylinder of black sealing-wax, rather thicker than the tube; and *cd* a strip of thin crown glass, about an inch and a quarter in length and a quarter of an inch in breadth. To the lower end of this glass, a slip of silver-leaf† *dp* is fixed with gum-water; *rq* is another slip of silver-

\* See Phil. Mag. vol. xlv. p. 210. for a further account of these insulating stands.

† There is an article manufactured in imitation of silver-leaf, which answers much better for this purpose than that which is genuine.

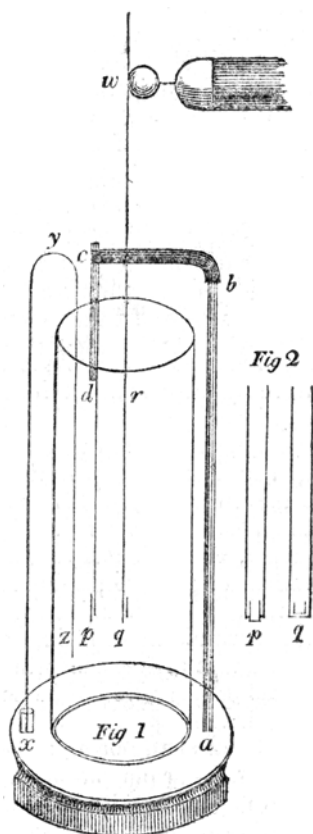
leaf of dimensions equal to the former, suspended from the lower end of the wire  $wr$ .  $xyz$  is a piece of thick music wire, one end of which is fixed into a peg of hard wood inserted into the base of the instrument at  $x$ ; but the rest of the wire is detached, and vibrates freely with the least force impressed upon it. The glass cylinder, standing in a groove turned out of the foot of the instrument, protects the pendulums  $dp$  and  $rq$  from being disturbed by currents of air.

The thermometer tube  $ab$  and one end of the wire  $xy$  are fixed into the base on the outside of the glass cylinder: the other end of the wire  $yz$  and pendulums are suspended within it.

To the lower ends of the pendulums  $p$  and  $q$  two pieces of thin wire are attached, of the forms represented in fig. 2.

*Exp. 1.* An electric column being laid upon two insulating stands in an horizontal position, an electrometer placed in contact with the zinc end of it exhibited only a few degrees of electricity, nor was any greater effect produced on the electrometer when it was applied to the copper end. Hence it appears that the column contains very little electricity in an insulated state.

*Exp. 2.* The electrometer remaining in contact with the copper end of the column, as soon as a communication was made between the zinc end and the earth by means of a piece of wire, one end of which stood upon the table, with its other end in contact with the end of the column, the leaves of the electrometer diverged to an angle of thirty degrees. This electrometer being set aside, and another equally sensible placed in contact



tact with the zinc end of the column, it diverged to the same angle, the wire of communication having been removed to the other end. Hence it appears that the elements of electricity came either from the earth or the table, through the wire which formed a communication between the table and the column, and that the two elements are of equal mechanical forces, for the two electrometers were found to be in contrary electrical states. That element which was received from the copper end of the column was thermogen (positive electricity), the other electrometer received the contrary element from the zinc end\*.

*Exp. 3.* Having placed a silver-leaf electrometer in contact with the copper end of an insulated electric column, and a communication being made between the table and the zinc end, the pendulums vibrated 140 times in a minute. These vibrations were performed thus: As soon as the pendulum *rq* became charged by the column, through the wire *wr*, it attracted and charged the pendulum *dp*. The two pendulums being now charged with the same element repelled each other; *rq* diverged to the right, *dp* to the left, and discharged its contents into the wire at *z*, which conveyed it to the earth. The pendulum *dp* being now reduced to its natural state, was again attracted, charged, and repelled by the pendulum *rq*: thus the vibrations of the two pendulums were continued. But as soon as the wire of communication was removed from the zinc end of the column, the pendulum ceased to vibrate: hence we may conclude that the element which put the pendulums in motion ascended up the wire at the zinc end, and passed through the column to the copper end.

The electrometer being placed at the zinc end of the column, and the wire of communication against the copper end, the pendulums performed the same number of vibrations in a given time as before, but they ceased to vibrate as soon as the communication was cut off between the copper end and the table. The pendulums were put in motion at the copper end by thermogen, the element of heat; but at the zinc end, photogen, the element of light, produced an equal effect.

*Exp. 4.* Two silver-leaf electrometers, whose pendulums were of equal lengths, being placed in contact with an insulated electric column, one at each end, began to vibrate at the same time, and the pendulums at the zinc end performed the same number of vibrations in a given time, as those at the copper end.

\* Mr. Singer observes, in his Elements of Electricity, that "the electrometer connected with the zinc extremity of the column will be positive, that connected with the silver extremity will be negative."

Mr. Singer was probably led into this error by using Mr. Bennet's electrometer, which is a very imperfect instrument.

Now as these electrometers were put in motion by two different elements, which afterwards descended to the earth at each end of the column, and as I have four pendulums which have thus been kept in motion for more than a month; the question which remains to be solved is, Does the column generate these two elements as fast as they issue from its ends and descend to the earth, through the electrometers? or, are they derived from some other source?

From the third experiment it appears that the pendulums of an electrometer, placed in contact with one end of a column, do not vibrate until a communication be made between the other end and the earth; and hence we may infer, that the element which keeps one of the electrometers in motion, ascends through the other at the other end of the column, and thus a double current of the elements is passing through each of the electrometers.

This inference is not, however, a mere conjecture; for when the pendulum  $dz$  is placed without the sphere of attraction of the pendulum  $rq$ , let the end  $p$  of the pendulum  $dp$  be moved by means of a glass rod, till  $rq$  attracts, charges, and repels it. When  $p$  strikes the wire at  $z$ , it discharges the element which it received from  $q$ , and receives the contrary element from the wire. The pendulums being now in a contrary state, attract each other, and the vibrations are continued; but let the pendulum  $dz$  be touched with a piece of wire, to deprive it of the element which it received from the wire at  $z$ , and the pendulums will instantly cease to vibrate.

*Exp. 5.* An electrometer, containing two pendulums which are each about three inches in length, made as represented in fig. 2, was placed in contact with the zinc (negative) extremity of a series of columns; and as soon as another electrometer with pendulums, each about one inch in length, was placed at the other extremity, the four pendulums began to vibrate. The long pendulums vibrated 140 times in a minute, and struck the wire at  $z$  with so much force as to produce a fine musical tone, which was loud enough to be heard at the distance of 26 feet. And these pendulums vibrated an equal number of times in a minute, and produced the same strength of tone, when they were removed to the copper extremity of the series: the short pendulums being removed to the other extremity vibrated as before, about 300 times in a minute.

Lynn, Sept. 13, 1816.

EZEKIEL WALKER,

[To be continued.]