requisite in order that the charge should be retained for a sufficient time to be practically available.

The rapidity of loss during repose will depend upon the closeness of the sulphate of lead and perhaps upon other mechanical conditions. These are doubtless susceptible of great modifications. We do not know how far they are modified in practice, but it is conceivable that still greater improvements may yet be made in this direction.

J. H. GLADSTONE
ALFRED TRIBE

STEUDEL'S NOMENCLATOR

ALL working systematic botanists use Steudel's "Nomenclator botanicus seu Synonymia plantarum universalis" as an indispensable book of reference. It is an alphabetical list arranged under genera of published names of plants, giving their native countries and the authors who published their descriptions. Synonyms are as far as possible given under the species to which they belong. The second volume of Steudel's work was published in 1841, and it is probably not far wrong to assume that the existing mass of described plants has since doubled.

Mr. Darwin has with equal kindness and generosity expressed the wish to aid in some way the scientific work carried on at the Royal Gardens, Kew. The attempt has been made for many years to keep up in the herbarium there a copy of Steudel with manuscript additions, for the use of persons engaged in the study of any particular group of flowering plants. By reference to the Kew Steudel it is possible to ascertain to a large extent what has been done, and so avoid the risk of describing and naming the same material twice over. But the Kew Steudel has only hitherto been posted up by the aid of funds privately supplied on intermittent occasions, and is not absolutely complete.

Mr. Darwin having had occasion to appreciate the usefulness of such a work in the botanical investigations which have of late years engaged his attention, has determined to supply the funds for preparing a new edition of Steudel's "Nomenclator," brought up to date. The work, which it is estimated will extend over about six years, will be carried on at Kew, and will be based on the limitations of genera laid down in Bentham and Hooker's "Genera Plantarum," to which it will in fact form a kind of complement. The editorial work has been entrusted to Mr. Daydon Jackson, Secretary of the Linnean Society. Mr. Darwin's munificent aid does not extend beyond supplying the means for preparing the work. The form and manner of publication will be reserved for consideration on its completion.

The Royal Gardens, Kew, have been very fortunate in from time to time receiving sympathetic aid from the outside world on behalf of the various branches of scientific work carried on in connection with them. The gifts of Mr. Bentham's library and herbarium, of the Jodrell Laboratory, of the North Gallery, and now of the means of preparing a new Steudel, are conspicuous examples.

FIRE RISKS OF ELECTRIC LIGHTING

IN an article published originally in the United States, and reprinted in our contemporary, the *Chemical News*, Prof. Henry Morton has called attention to the risks to which property is exposed from the increasing employment of powerful currents of electricity for electric lighting. The caution and the remedies suggested are assuredly timely when preparations are being made on so many hands for a vast extension of electric lighting. No fewer than five times did fire break out in the late Paris Exhibition, and in each of these cases the cause was the same, namely, defective insulation of the conducting wires. Prof. Morton divides the dangers into two kinds—those arising from the conductors, and those arising from the lamps. When naked wires are used as conductors, and when both are, as is sometimes the case, merely nailed or stapled to wall or floor side by side, there is a great chance that some stray scrap of wire, a falling nail or pin, may short-circuit the line and become red-hot in an instant. Loose wires are again a source of danger, as they may be momentarily short-circuited, and arcs set up of a dangerous nature at the point of contact. These remarks are specially cogent in such cases as those where many arc lights are being worked on a single circuit, and where there is of necessity a very high electromotive force employed. On such circuits, moreover, should some of the arcs go out, there is a risk of the others becoming excessive in power, risking the metalwork of the lamps, and thereby endangering a conflagration. Moreover, the lamps themselves are not free from danger, if so constructed that fragments of red-hot carbon can fall from them, as was the case not many months ago with one of the Siemens' lamps in the reading-room of the British Museum.

As a remedy to diminish such risks, Prof. Morton makes the following recommendations, every one of which we can heartily indorse. Firstly, that both the conductors—the outgoing main and the return wire as well—should be completely insulated; and that the machines and fixtures of the lamps should also be insulated, so far as regards all ground connections. Secondly, that the outgoing and return wires, instead of being laid side by side, should be separated as widely as possible. And he also recommends that, in the case of arc lamps in series, there should be automatic adjustments, to short-circuit a part of the current in case the arc in the lamp becomes too powerful, and to diminish the electromotive force of the generators in proportion to the actual resistances in circuit. Even on those systems of electric lighting which apply the principle of incandescence, where the electromotive forces employed are, as a rule, smaller than with arc lighting, there is need of caution. And one cannot too highly admire the ingenious device with which Mr. Edison has met most of the possible obtions beforehand, by interposing automatic "cut-off" joints of lead wire at every branch of the ramified circuit of his system of supply; the thickness of the wire being adjusted according to the circumstances of each case. It would be well for Fire Insurance Companies to lose no time in laying down a code of reasonable conditions to be complied with in case of buildings lit by electric lights. Without such precautionary conditions electric lighting is at least as unsafe as lighting by gas, and that is saying a good deal. But where proper precautions are taken, we think it should be a far safer mode of lighting; and should be recognised as such by the imposition of a lower insurance premium than is fixed in the case of lighting by gas.

THE MARKINGS ON JUPITER

DURING the present winter months Jupiter will doubtless attract a large amount of attention from the possessors of telescopes. Displaying a large and varied extent of detail clearly indicating that atmospheric phenomena of stupendous character are in progress on his surface, this planet at once claims notice on account of the ease with which his chief features may be discerned, and their singular anomalies of motion and appearance made manifest.

The large red spot situated immediately south of the great southern belt, and lying parallel with it, continues to present a well-defined boundary, indeed we must attribute to this remarkable formation a good deal of the interest which has been accorded to this planet since the first apparition of the spot in the summer of 1878.

It has now been visible for a period exceeding three years, and its conspicuous and decided aspect as it nightly crosses the central meridian of Jupiter, sufficiently predicates that its existence is likely to be prolonged a considerable time yet. The spot is elliptical in form with tapering ends; it occupies about fifty-five minutes in its entire transit over the centre of the illuminated disc. No distinct alteration in its appearance has been recorded during the last two years. Minor changes have probably occurred, though too minute to be appreciable, for when we consider the perpetual state of commotion under which the other markings exist, we cannot regard this particuiar object as absolutely free from similar influences, though they may have hitherto eluded detection. One of the most recent measures of the spot give it a length of 29,000 miles, and a breadth of 8,300, so that the length is to the breadth as 7 to 2.

The telescopic history of this planet contains many instances of fairly persistent spots having been observed and utilised as a ready means of determining the period of the planet's rotation. But the records of former years can furnish no parallel to the extent and accuracy of the modern observations. The old observers were in a measure isolated, and their work often lacked corroboration. Circumstances are now changed entirely. Observers have become far more numerous, astronomical appliances have been greatly improved, and the science has become more popular with increased facilities, so that where one powerful telescope was found half a century ago, there are at least ten at the present day. The result is that all attractive phenomena, such as planetary markings, are eagerly watched and recorded, so that interesting comparisons and confirmations, impossible in former times, are often the natural outcome. In regard to the large spot on Jupiter it is certain that no previous observations can vie with it either in completeness or precision, and it must obviously supply the data for determining the rotation period of Jupiter with a degree of reliance beyond all parallel.

Proper motion in the spot itself originates a slight difficulty in adopting a period to satisfy the observations, and there is no doubt that similar independent movements in the objects observed were the cause of the differences in the periods assigned by various former authorities for the rotation which has varied from 9h. 49m. to 9h. 56m., and in truth it is doubtful whether we shall ever obtain the means of deriving the value with conclusive satisfaction. We can of course compute with nicety the periods of individual markings, but different ones have different periods. It is doubtful whether we can select the markings which are representative of the real period, for the spots are evidently influenced by a series of atmospheric currents which displace their relative positions on the disc in a very short interval of time. In the case of the great red spot, it has been surmised from its permanence and regularity of apparition that it very nearly represents the true rotating period of the planet's sphere, and it is gratifying to note that this element has been determined by several observers with excellent corroboration as follows:—

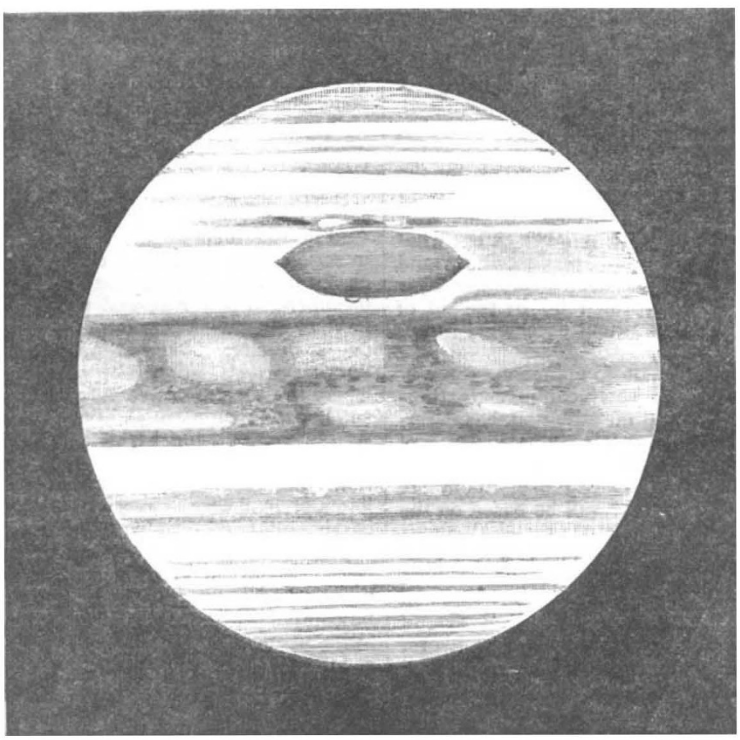

FIG. 1.—The great red spot in Transit, December 7, 1881, 10h. 40m. There was a large white patch near the equator under the following side of the red spot. Immediately south of the red spot is a narrow belt with light and dark ovals upon it.

	h.	m.	s.	
Prof. G. W. Hough	9	55	35·2,	Sept. 79 to Jan. 27, 1881
A. Marth	9	55	34·47,	1878–81
J. F. J. Schmidt ...	9	55	34·42,	1879–80
H. Pratt...	9	55	33·91,	1879, July to December

These values are all within one second of the mean =9h. 55m. 34·5s. Several observers have remarked that the motion of the spot has slackened somewhat since 1879.

Turning now to the equatorial region of Jupiter, we shall find here not only a large extent of detail, but marked evidences of great and rapid changes. Immediately north and south of the equator there is a very well-defined dark belt, and between these are a series of curious irregular shadings interspersed with brilliant white spots and light patches, which seem to be influenced by some abnormal phenomena. Watched from night to night, and their relative positions carefully determined, they are seen to vary considerably, and to travel much swifter than the red spot. The bright spots, which generally lie very slightly south of the equator and on the north border of the great south belt, are influenced by a rapid proper motion on the surface of the planet. In a single rotation of Jupiter they are displaced relatively to the red spot, to the extent of $3\frac{1}{4}°$, their period being $5\frac{1}{2}$ minutes less. In 1880 these white and generally oval spots were observed with a good deal of attention, and in a few marked cases the times of rotation were derived as follows:—

	h.	m.	s.
J. F. J. Schmidt	9	50	0
A. Marth	9	50	6·6
Prof. G. W. Hough	9	50	0·56
" "	9	50	9·8
W. F. Denning	9	50	5

One bright spot in particular arrested attention as the most conspicuous of its class, and this object continues visible at the present time. Its independent motion enables it to make a complete circuit of Jupiter, relatively to the red spot, in $44\frac{1}{2}$ days. One of the most interesting points of observation is to note the changes in the relative positions of the spots on successive nights, and to watch the bright equatorial markings as they overtake and pass the red spot. In four days the white spots traverse an equivalent extent of longitude to that covered by the red spot, so that during this interval they travel from the *f.* end to the *p.* end of the latter object. The independent motion of the equatorial markings is the same in direction as that of the satellites and of the planet on its axis, namely, from west to east.

In the southern hemisphere of Jupiter there are several narrow dusky bands outlying the red spot, and a few dusky streaks or short belts of distinct form are manifest. In the north hemisphere there is a conspicuous double belt in about lat. 25°; the south side of this belt was

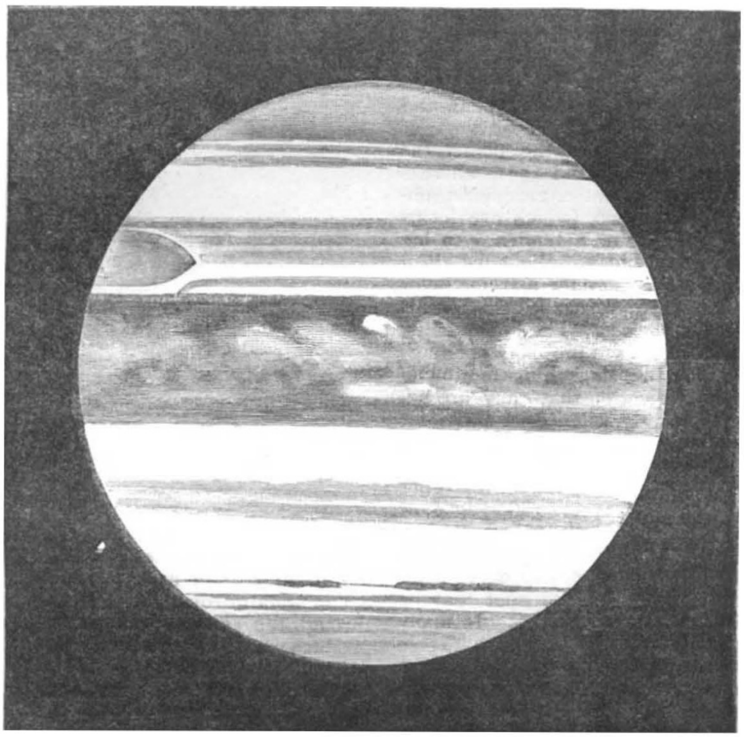

FIG. 2.—The bright spot in transit, December 18, 1881, 6h. 12m. The following side of the red spot is seen on the western limb. To the east of the light spot, and in nearly the same latitude, is a dark mass emerging from the great southern belt.

formed by the outbreak and subsequent rapid development and dispersion of a series of dark spots during the months of October, November, and December, 1880. At first appearing as well-defined and almost as plain as the shadows of satellites in transit, they increased in numbers, or became greatly extended longitudinally, but gradually lost their decided character until they were eventually dispersed around the planet, and formed a dusky girdle considerably north of the equator. In fact the formation of a new belt on Jupiter had been going on under the eyes of observers.

As to the bright equatorial spot, it came to conjunction with the red spot on November 10, 1881, and the same objects were noted in conjunction on November 19, 1880, at 9h. 23m.. when crossing the central meridian of Jupiter. In the meantime the behaviour of the two objects has been very remarkable, for the red spot during the interval of 356 days has performed 861 rotations, while the light spot has completed 869, and has in fact travelled round the sphere of Jupiter eight times relatively to the position of the red spot! The two objects were again observed in the same longitude on December 24, 1881, at 9h. 43., having completed 967 and 976 rotations respectively. The next two conjunctions will occur on February 6, 1882, and March 23, 1882, after which they will not be well seen until the ensuing summer, when Jupiter again becomes visible in the morning sky, and the two spots, should they continue to be presented on the disc of the planet, will occupy nearly the same longitude on August 3, September 17, October 31, and December 14, 1882.

The diameter of the white spot is very variable, sometimes it is fully 2″, which corresponds to more than 4600 miles, but it is occasionally much contracted by encroachments of the dark masses on the great northern belt. The spot is also liable to become very faint. I have carefully noted these variations, and though the observations are not sufficiently full to determine the period, if any, they show that the spot becomes faint almost to invisibility at intervals of about 56 days, and that increased brightness of the spot is accompanied with accelerated motion. I believe this particular object is a permanent feature on the planet, and that it lies far below the level of the dusky belts. Mr. Marth has determined from a discussion of the observations of 1880 and 1881 (to November) that the mean motion of the spot has been uniform, and this is important as a proof of its stability. My own numerous observations have led me to conclude that:—

1. It is self-luminous and light-emitting.
2. That it is a part of, or projection from, the actual surface of the planet.
3. That therefore it indicates the real rotation period of Jupiter, which is 9h. 50m. 6·6s. (= daily rate 878°·48), as deduced by Mr. Marth. The motion of the red spot shows a decided slackening, so that we cannot accept it as a reliable and invariable indication of the motion of the Jovian sphere with which probably it has no material connection.

These conclusions are supported by the fact that we cannot admit the idea of an object as permanent and conspicuous as the white spot, rushing on in advance of the already swift axial movement of the planet (as computed from the positions of the red spot) whereas we can more readily understand that atmospheric objects, such as the belts and red spot (which are forms of identical phenomena), would show a tendency to lag behind the rapid motion of the sphere. We must allow that there will be a failure of objects on the extreme outer envelopes of Jupiter, to keep pace with the tremendous velocity of objects on his real surface. The dusky belts, the red spot, and similar markings, are probably openings in the Jovian atmosphere, and the slackening motion of these objects is simply the indication that they are becoming more shallow than formerly, whence we may infer that the motion will continue to decrease until they are finally dissipated.

A comparison of my recent observations with those made by Gledhill and Welb in the years 1869-72, show that many of the features which they described and delineated (in the *Astronomical Register* and *Popular Science Review*) are still visible or have reappeared after an interval of obscuration. The great red spot may be the same object as Gledhill's ellipse of 1869-71. In many of the details visible then and now there is a remarkable similarity both in aspect and position, and the observers of Jupiter should further carefully investigate the physical appearance of the planet with a view to obtain more distinct evidence on the question of periodic variations. In this connection I may quote a remark by the late Mr. Lassell (*Monthly Notices*, vol. xxxiv. p. 310), where, in referring to round light spots he saw on Jupiter in March, 1850, and March, 1874, he says: "I believe the appearance of these spots is very rare, as I have not seen them for many years, and the general similarity of the aspect of the planet now [1874] and then [1850] suggests the idea that the various phases return in cycles, which I think more probable than that absolute secular changes occur in the heavenly bodies within the limit of time of any human records."

W. F. DENNING

LITTLE ELECTROMOTORS

THE probability that within a few months almost every large town and city will be supplied with electricity on a large scale for the purpose of lighting, has brought into prominence the question of utilising the same supply for the purpose of producing power on a small scale for sundry domestic purposes. There are a number of objects for which machinery is employed, though on so small a scale that it would not be worth while to set up a steam-engine or gas-engine to drive it, to say nothing of the inconvenience of a steam- or gas-engine in a private house. To drive a sewing-machine, for example, or to work a light turning-lathe, requires a comparatively small power, and usually only for a limited time. It is natural then to think that when the power of electricity is available in the wires which supply electric light, such a power, especially as it is so simply and readily controlled, might be economically employed for such purposes.

But to drive machinery by electric currents necessitates the employment of the appropriate electric engine or "electromotor," which, as its name implies, is an engine which, by the expenditure of electrical energy, does mechanical work. Such engines have been known since 1831, when Prof. Henry first constructed a rotating engine driven by electromagnets. Ritchie, in 1833, independently constructed an electromagnetic apparatus for producing continuous rotation. Fig. 1, which we borrow from Prof. S. Thompson's "Lessons in Electricity and Magnetism," shows a modification of Ritchie's electromotor frequently found in collections of electrical apparatus. It consists simply of an electromagnet, C D, poised upon a

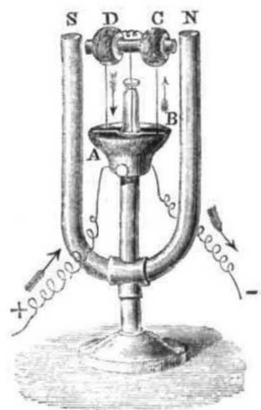

FIG. 1.

pivot between the poles, N S, of a steel horseshoe magnet, and fitted with an arrangement of mercury cups, A B, as a commutator, by means of which the current arriving through the wires is so directed through the coil as to produce motions, in one sense, only round the axis. The pole C of the electromagent is attracted round toward S until, just as it nears S the wire beneath C passes from one mercury-cup to the other, so reversing the current and causing C to be repelled from S and attracted to N.

To speak of the further developments of these machines in the hands of Jacobi, Sturgeon, Froment, and others, would be to traverse ground too wide for the scope of an article like this. Paccinotti's discovery of the ring-armature, which in 1869 he applied to the construction of an electromagnetic motor which was also capable of being used as a generator of currents, dropped strangely out of sight. And the subsequent discovery of M. Gramme that his generator would work as a motor was only the beginning of a new epoch in the history of electromotors. We know that all the magneto-electric and dynamo-electric machines used to generate continuous currents of electricity, whether of Gramme, Siemens, Brush, or Edison are *reversible*. If we drive them by mechanical power they yield electric currents, and if on the other hand we supply them with currents of electricity, they can run backwards and do work for us. Sawing and ploughing are now done every day by this means. We have Siemens' electric railway and tramway, and many other useful applications of the same principle, of which