ment worked by a lever at the side of the grate. The coal is thus coked before it comes into the fire, the only escape for the gases being through the glowing coals. Somewhat similar in some respects to this is the "Wonderful" grate of Archibald Smith and Stevens. In this the fireplace is closed by an iron plate, in which are three rectangular openings one above the other. To the lowest, which is about the floor-level, the grate is fitted; this, made of a basket shape, can be mounted on a pivot in the plane of the plate, so that more or less of the grate may project into the room. Between the top hole in the plate and the upper half of the bottom hole is a flat-sided tube, which curves backwards into the fireplace. This is the hopper for the fuel; it is shut at the top by a close-fitting door, and the curved shape causes the fuel to descend easily into the fire. The centre opening of the plate is provided with a register door, and in some instances is covered with a hood. The arrangement of the hopper causes the gases evolved by the fresh coal to pass through more or less of the live coal before they can escape, and by closing the centre opening the whole draught is made to go down through the lower half of the bottom opening, causing a rapid combustion. Four of these grates are shewn in action, with different sorts of fuel. They seem to require little or no attention for hours together, as the feeding arrangement appears to act well.

A grate of the pattern which has been in use in barracks for the last two or three and twenty years is exhibited. This grate was devised by Capt. Douglas Galton. It consists of a cast-iron stove, entirely open in front, which is fitted to the chimney opening, leaving a considerable space between the stove and the brickwork at the back. Into this space air is admitted from the outside of the building. From the top of the fireplace recess proceed two flues; one, the ordinary chimney-flue, receives the covered smoke pipe from the stove, the other delivers into the room through a lowered opening a little below the ceiling level, the air which has been warmed in the chamber behind the stove, the back of which has iron plates projecting from it, so as to increase the heating surface. The cast-iron stove is entirely lined with fire-brick, in the manner to be described, so that the air does not get unduly heated.

A little above the level of the fire the stove is gathered in towards the room so as to form a kind of baffle. The actual grate is formed as follows:—two fire lumps are placed on the hearthstone with a space between them of six inches or so, over which is a cast iron grid; the cheeks and back, all of fire-brick, rest on these first lumps; another lump of fire-brick of curved section underneath fits on the top of the back and cheeks, and underneath the gathered in part of the stove. Between the back fire-lump and the iron back is a space, and there is also a small opening between the back piece and the top piece, through which air heated at the back plays on the top of the fire and helps to consume the smoke. This stove is, we understand, found to be very economical in action, and is very highly spoken of in the work of the late General Morin on Heating and Ventilating. It will not, however, be tested in this Exhibition, as it is not shown in competition.

Messrs. Barnard and Bishop, of Norwich, have pushed the "baffle" principle still farther in their "glow" stove. Instead of coming only about half over the fire as in the Galton grate, the baffle consists of a fire-brick which projects nearly to the plane of the front bars of the grate, and slopes down slightly towards the front. The bottom of the grate, which slopes upwards, and the back which slopes backwards, are made of fire-brick in one piece, the front bars being the only ironwork about the grate. A flue which goes up behind the back opens to the fire just under the back edge of the baffle, the space under which and over the fire is thus converted into a combustion chamber in which the gases from the coals are burnt, and as these have to pass over the front of the baffle before going up the chimney the radiant heat from them comes into the room.

Several grates are shown by different makers, in which the combustion of the gases is accomplished with a down draught. But in these cases the radiant heat evolved in the process cannot come into the room directly, as it does in the case of the "glow," it is therefore lost in the case of a grate set in a fireplace unless it be utilised to heat air which is admitted to the room. A small open-fronted stove on this principle is shown by Mr. T. E. Parker, in which the combustion appears to be very perfect. The internal arrangement is too complicated to describe without a drawing, but the essential point is that the draught from the fire is led away at the back of the bottom of the grate into a flue lined with fire-brick, where it meets a draught of fresh air which has been warmed by contact with the underside of a ribbed plate which forms the bottom of the grate.

Several examples of grates with down draught and chambers for heating air to be admitted to the room are to be found in the exhibition, as well as some in which the heating chamber or flues are applied to grates with ordinary up-draught. The warm air inlets are usually placed close to the fire, which is, in our opinion, a mistake, as the general circulation of air in the room is not so much promoted by this arrangement as when the inlets are at some distance from the fire; there are, however, difficulties in so placing them in an ordinary living-room.

A stove of a peculiar, and we believe quite novel, construction is shown by Mr. James B. Petter. The recess of the fireplace is lined with white marble; in each jamb is a circular hole from which a pipe leads round to the chimney. The fire-box is mounted on legs with castors, so that it can easily be rolled in or out of the fireplace, and is provided with horizontal exit flue pipes at the sides which are connected with the openings in the jambs by sliding pieces. A vertical section of the fire-box from front to back is of open spiral or Nautilus form. The box is made of iron and lined with fire-brick from the lip to the top of the back, there being no bars either in the front or bottom. The coal is put on thinly at the lip, and gradually pushed back, as in stoking a steam-boiler. A rather sharp draught is produced over the red hot fuel towards the back, and the convolution of the box appears to form a kind of combustion chamber. It would seem that the difficulty of lighting the fire would be considerable, but it appears to work well.

We have endeavoured in this notice to give a slight sketch of such grates, &c., as present any salient features. We may have overlooked some which were deserving of notice, but we would earnestly recommend our readers to pay a visit to this very interesting exhibition, and to form their own opinion of the merits of the various apparatus shown.

We may mention that representatives have been accredited to the Exhibition by the Governments of Austria-Hungary, France, Prussia, Saxony, and the United States; and that the interest taken in it has encouraged the Committee to entertain the idea of holding an International Exhibition in about three years' time of such further developments of smoke-abating appliances as may be produced either in this or other countries during the interval.

THE CHEMISTRY OF THE PLANTÉ AND FAURE ACCUMULATORS

PART I.—*Local Action*

AMONG the important discoveries of late years, few have claimed so much attention, or have been so full of promise for practical use, as the accumulator of

Planté and its modifications. Our attention was very naturally directed to the chemical changes that take place in these batteries, especially as it appeared to us that there must be certain analogies between them and some actions which we had previously investigated. In the present communication we propose to treat merely of one point—that of local action, leaving the fuller discussion of the subject to some future occasion.

It is well known that metallic zinc will not decompose water even at 100° C., but we found that zinc, on which copper had been deposited in a spongy condition, was capable of splitting up the molecule even at the ordinary temperature, oxide of zinc being formed and hydrogen liberated. If placed in dilute sulphuric acid, it started a very violent chemical action, sulphate of zinc and hydrogen gas being the result. We termed the two metals thus conjoined, the *copper-zinc couple*, and this agent was fruitful in our hands in bringing about other chemical changes which neither metal singly would effect. Electricians will readily understand the nature of this agent, and will recognise in its effects only a magnified form of what we are all familiar with under the name of *local action*. Now the negative plate of a Planté secondary battery is a sheet of lead, upon which finely-divided peroxide of lead is distributed. It is well known that the electromotive force of lead and lead peroxide in dilute sulphuric acid is nearly three times that of zinc and copper in the same liquid. We were therefore induced to think that the plate must act in the same way as our copper-zinc couple. We found such to be the case. If a plate so prepared be immersed in pure water, the decomposition of the liquid manifests itself by the reduction of the puce-coloured peroxide to the yellow monoxide. There could be little doubt therefore that the lead peroxide couple, if we may call it so, would decompose sulphuric acid, with the production of sulphate of lead. This also was found to be the case.

As the destruction of peroxide of lead means so much diminution of the amount of electric energy, it became interesting to obtain some definite knowledge as to the rapidity or extent of this action.

When the peroxide of lead on the metal is very small in quantity, its transformation into the white sulphate goes on perceptibly to the eye, but when the coating is thicker, the time required is, as might be expected, too long for this kind of observation. In one experiment, following the procedure of Planté, we formed the peroxide on the plate by a series of seventeen charges and discharges, or reversals, each operation lasting twenty minutes, and the time was further broken up by seven periods of repose, averaging about twenty-four hours in length. After the last charge we watched the local action taking place, and found that the whole of the peroxide passed into white sulphate within seventeen hours. In another experiment the two plates formed according to Planté's method were immediately joined up with the galvanometer, and the deflection noted. They were then at once disconnected. After the repose of one hour they were joined up again, and another observation taken with the galvanometer. This was repeated several times, with the following results :—

Initial strength of current	100
After 1 hour's repose	97
,, 2 ,,	40
,, 4 ,,	14
,, 17 ,,	1·5

It results from this that during each of the long periods of repose recommended by Planté the peroxide on the lead plate is wholly, or almost wholly, destroyed by local action, with the formation of a proportionate amount of sulphate. But this is not, as it would seem at first sight, a useless procedure; for, in the next stage, the sulphate is reduced by electrolytic hydrogen, and, by a process which we hope to explain when discussing the complete history of the reaction, the amount of finely divided lead capable of being peroxidised is increased. That this is actually the case is shown by the following experiment. The peroxide formed on a lead plate by first charging was determined and called unity: it was allowed to remain in a state of repose for eighteen hours, charged a second time, the peroxide again determined, and so on :—

Separate periods of repose.	Charge.	Amount of peroxide.
—	First	1·0
18 hours	Second	1·57
2 days	Third	1·71
4 ,,	Fourth	2·14
2 ,,	Fifth	2·43

In other trials, following the procedure of Faure, we employed plates in which the peroxide was formed by the reduction of a layer of red lead (containing 51 grains to one square inch of metallic surface) and subsequently completely peroxidising the spongy metal so produced. In one series of experiments we left the peroxidised plates to themselves for various periods and determined the amount of sulphate formed. This gave us the amount of peroxide consumed.

Experiment I.	after 2 hours	7·2	per cent.
,, II.	,, 3 ,,	15·1	,,
,, III.	,, 4 ,,	19·8	,,
,, IV.	,, 5 ,,	30·0	,,
,, V.	,, 24 ,,	36·3	,,
,, VI.	,, 7 days	58·3	,,
,, VII.	,, 11 ,,	67·3	,,
,, VIII.	,, 12 ,,	74·3	,,

The last experiment was tested with the galvanometer during its continuance, as in the case of the plate formed by Planté's method, with the following results :—

Initial strength of current	100
After 1 days' repose	92
,, 3 ,, ,,	79
,, 4 ,, ,,	34
,, 5 ,, ,,	24
,, 7 ,, ,,	11
,, 9 ,, ,,	8
,, 12 ,, ,,	1

It is evident from these observations that a lead-peroxide plate gradually loses its energy by local action, and that the rate varies according to the circumstances of its preparation.

Two difficulties will probably present themselves to any one on first grasping the idea of this local action :— 1. Why should a lead plate covered with the peroxide and immersed in dilute sulphuric acid, run down so slowly that it requires many hours or even days before its energy is so seriously reduced as to impair its value for practical purposes? In the case of the copper-zinc couple immersed in the same acid, though the difference of potential is not so great, a similar amount of chemical change would take place in a few minutes. 2. In a Planté or Faure battery the mass of peroxide which is in contact with the metallic lead plate expends its energy slowly. How comes it to pass that if the same mass of peroxide be brought into connection through the first lead plate with another lead plate at a distance, it expends its energy through the greater length of sulphuric acid in a tenth or a hundredth part of the time?

The answer to these two questions is doubtless to be found in the formation of the insoluble sulphate of lead, which clogs up the interstices of the peroxide and after a while forms an almost impermeable coating of high resistance between it and the first metallic plate.

The following conclusions seem warranted by the above observations :—

In the Planté or Faure battery local action necessarily takes place on the negative plate, with the production of sulphate of lead.

The formation of this sulphate of lead is absolutely 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.