men would at least have done their duty in urging its claims and pointing out whereby it might be protected and augmented. It unfortunately happens that up to the present time scientific men have brought no definite scheme or proposition of this kind directly before Government; and the onus of neglect may consequently in a certain sense be said to rest now at their door.

The honour of removing this responsibility lies directly within the scope of the newly-formed Society for Biological Investigation; for naturally no other body of men could more readily put themselves into communication with the various kindred societies throughout the kingdom, and thus obtain a unison of views upon this important subject. The next step would be to elect an influential representative deputation from the Society to wait upon the Prime Minister for the purpose of urging the appointment of a Parliamentary Commission to inquire exhaustively into the various subjects pertaining to a Zoological Survey.

THE ELECTRICAL CONGRESS OF PARIS, 1884

THE first Congress of 1881 has borne good fruit. It has not only brought about an *approchement* between electricians of all countries, but it has led to the adoption of an international system of measurement which will be in universal use. It is satisfactory to find that there are questions which can be amicably settled internationally. The Congress was divided into three Commissions which dealt with (1) electrical units, (2) atmospheric electricity and earth-currents, (3) standard of light. The first Commission virtually dealt with the length of a column of mercury of one square millimetre section which represented the ohm—it having been decided at the Congress of 1881 that this should be the unit of resistance. Many physicists had been working on this in different countries and on different methods. M. Mascart grouped the results in the following useful table:—

Methods	Experimenters	Column of Mercury in Centimetres
1. B.A.	British Association	104·83
	Rayleigh-Schuster	106·00
	Rayleigh (1882)	106·27
	H. Weber	106·16
2. Weber (I.) ...	Kohlrausch	105·81
	Wiedemann	106·19
	Mascart	106·33
3. Kirchhoff ...	F. Weber	105·02
	Rowland	105·79
	Glazebrook	106·29
	Mascart	106·33
4.	Ròiti	105·9
5.	Fr. Weber	105·33
6. Lorenz	Lorenz (first)	107·1
	Rayleigh	106·24
	Lenz	106·13
	Lorenz (second)	106·19
7. Weber (II.) ...	Dorn	105·46
	Fr. Weber	105·26
	Wild	105·68
	Baille	105·37
8. Heat	Joule	106·22

From this it appears that the figures obtained by the different methods were—

B.A.	106·21
Weber's I.	106·14
Kirchhoff's	105·93
Lorenz	106·19
Weber's II.	105·47
Joule	106·22

The mean of which was 106·02, but 106 was taken as a round figure sufficiently near the truth for all practical and useful purposes. Hence the Congress decided that "the legal ohm should be the resistance of a column of mercury of one square millimetre section and of 106 cm. of length at the temperature of freezing," and a resolution was passed desiring the French Government to transmit this resolution to the different Governments, with a view of making its adoption international. It was decided that primary standards should be constructed in mercury, but that secondary coils should be made of solid alloys, which should be frequently compared among themselves and with the primary standard.

It was resolved that the ampère should be exactly 10^{-1} C.G.S. electromagnetic unit of current, and that the volt should be the electromotive force which maintained an ampere in a conductor whose resistance was the new ohm.

We can now congratulate ourselves upon having a scientific system of electrical units independent of any particular instruments or of any particular process. It is not absolutely exact. That is, the new ohm is not 10^9 C.G.S. units, but it is the nearest approach to it that can be practically attained. It will probably be known as the *Congress ohm*, to distinguish it from the true ohm (10^9 C.G.S.) or the B.A. ohm of 1864.

One subject of regret is that Prof. Rowland's measurements in Baltimore are not completed, and will probably not be ready before the end of the year. The United States Congress voted a large sum of money to enable this to be done. He is using a Planté secondary battery and employing three methods, viz. Kirchhoff's, Joule's, and Lorenz's. His well-known experimental skill has given much interest to this investigation of Rowland's.

The second Commission dealt with atmospheric electricity and earth-currents, and recommended that it was desirable to send each year to the Bureau International des Administrations Télégraphiques in Berne the reports that were collected in the different countries, so that they might be distributed to the different Governments.

The third Commission dealt with the standard of light, and it was decided, not without considerable opposition, that the unit for each simple light should be the quantity of light of the same kind emitted in a normal direction by a square centimetre of surface of fused platinum at the temperature of solidification, and that the practical unit of white light should be the total quantity of light emitted normally by the same source. This is a very unsatisfactory standard. It was accepted because there was virtually none other before. But it was obtained by only one observer (M. Violle); it is not portable; it is not even reproducible except at great expense, and it is so eminently impracticable that it is scarcely likely to be generally adopted. It is to be regretted that the British Association Committee on a Standard of White Light has not yet finished its work, but we may hope that at Montreal Capt. Abney will be able to give some results which will give us a better and more practical standard.

There was a universal consensus of opinion that the Congress had faithfully and earnestly done its work, and that the success of its labours and the rapidity of its action was due to the energy and ability of M. Cochery, the Minister of Posts and Telegraphs. Our English representatives were Sir William Thomson, Capt. Abney,

Prof. Carey Foster, Prof. Hughes, Prof. Fleeming-Jenkin, Mr. Graves, and Mr. Preece. The full text of the resolutions is as follows:—

"I. *Electric Units*, strictly so called. First Resolution: The legal ohm is the resistance of a column of mercury of a square millimetre cross-section and 106 centimetres in length at the temperature of melting ice. Second Resolution: The Conference expresses the wish that the French Government should transmit this resolution to the different States, and recommend an international adoption of it. Third Resolution: The Conference recommends the construction of primary standards in mercury conformable to the resolution previously adopted, and the concurrent employment of scales of secondary resistances in solid alloys which shall be frequently compared amongst one another and with the primary standard. Fourth Resolution: The ampere is the current the absolute value of which is ten to the power minus one in electro-magnetic units. Fifth Resolution: The volt is the electromotive force which maintains a current of one ampere in a conductor the resistance of which is one legal ohm.

"II. *Earth-Currents and Lightning-Rods.* First Resolution: It is to be desired that the results of observations collected by the various administrations be sent each year to the International Bureau of Telegraph Administration at Berne, which will make a digest of them and communicate it to the various Governments. Second Resolution: The Conference expresses the wish that observations of earth-currents be pursued in all countries.

"III. *Standard of Light.* Resolution: The unit of each kind of simple light is the quantity of light of the same kind emitted in a normal direction by a square centimetre of surface of molten platinum at the temperature of solidification. The practical unit of white light is the quantity of light emitted normally by the same source."

DR. JOULE'S SCIENTIFIC PAPERS

The Scientific Papers of James Prescott Joule, D.C.L., LL.D., F.R.S., &c. (London: Published by the Physical Society, 1884.)

OUR benefactors are oftentimes unrecognised. The writer of the present notice of our latest acquisition in scientific literature, takes credit to himself for having been the first to propose to Sir William Thomson the reprinting of his original papers. Seized with a great desire to possess those invaluable electrostatic papers, which, in 1867, could only be read in the original by those who were fortunate enough to have access to the *Cambridge and Dublin Mathematical Journal*, he urged that there must be many others by whom a reprint would be gladly welcomed. Thus was originated the reprint of the "Electrostatics and Magnetism."

The initiative being taken, we have now a second series from Sir William Thomson—part published, part in progress—intended to include all his mathematical and physical papers. Prof. Stokes also, under the influence of pressure and good example, has produced the first half of a reprint of his classical papers. Abroad we have collections of the papers of Prof. von Helmholtz and Prof. Kirchoff. Last at the present moment, but far from the least in importance or in general interest, we have the first volume of republished papers by Mr. Joule.

But what a debt of gratitude we owe to the Physical Society for its publishing enterprise—first for the publication of Prof. Everett's "Illustrations of the C.G.S. System," a book which has been helpful to every student of physical science; then for its graceful tribute to the memory of Wheatstone; and now for this fresh and most happy undertaking.

Before looking at the papers themselves, let us unburden ourselves of one or two remarks. The form of the book is admirable. The printing and the diagrams are all that can be desired. The accuracy of the author of the papers, who has personally undertaken the editing, appears in that there is scarcely a misprint to be found in the 650 pages. One serious want, and one only, we have felt, and it is this. Throughout the book there are many back references to previous papers. These references are given in footnotes exactly as they were given in the original papers, thus, *Phil. Mag.*, ser. 3, vol. xiii. p. 268. But what the reader of the book wants, nay absolutely requires, is the reference to the page of the reprint itself where the passage alluded to is to be found. May we be allowed to suggest this as an improvement for the second volume now promised?

To come to the papers themselves, almost one hundred in number. There is a considerable number of unconnected papers on a great variety of subjects, several on meteorological phenomena, six or eight on new instruments or modifications of instruments, a mercurial pump, an improved barometer, a new dip circle, a current meter, &c., in addition to his tangent galvanometer, and one or two others to which we will immediately refer more particularly; then we have a paper on utilisation of sewage; a note on the prevalence of hydrophobia; improvements in the common kite, &c.: all of considerable value. For the most part, however, the papers are on two or three classes of subjects very closely connected, and these are of superlative interest, containing, as they do, the germs, or rather affording the foundation, of the modern theory of energy.

Mr. Joule's papers are remarkable in form as well as in substance. Of mathematics there is scarcely a line: but what clearness, and depth, and penetration into the hidden things of Nature! Thus their interest is general to an unusual degree. To those who shun the labour of arriving at results by "chasing the ρ" through mazes of equations they are the perfection of clear exposition of fundamental principles. The mathematician, on the other hand, finds in them a model of concise expression, and results of experimental investigation stated in a form ready and convenient for being represented in mathematical symbols.

It is impossible within the limits to which these lines are necessarily confined to notice exhaustively the investigations themselves, or even the results arrived at. We must content ourselves with a brief reference to some of the most important.

The first subject which seems to have attracted the attention of Mr. Joule was that of magnetism and the electro-magnetic engine. His earliest papers are taken up with the description of novel forms of the electro-magnetic engine, and of experiments in this connection. In a very early paper he investigates the laws relating to