lions of microbes in various stages of 'attenuation;' and a prick from a pin-point dipped in any one of them might confer a horrible disease or future immunity from it. Yet in the midst of such dread possibilities the devoted experimentalist moves unharmed.

The closing paragraph runs as follows: "At this very moment experiments [upon the prevention of hydrophobia] are under full headway. Biting dogs and bitten dogs fill the laboratory. Without reckoning the hundreds of dogs which within three years have died mad in the laboratory, there is not a case discovered in Paris of which Pasteur is not notified. 'A poodle and a bull-dog [*bouledogue*] in the height of an attack; come!' was a telegram sent to him recently." Pasteur went, and took our author with him. The two dogs were rabid '*au dernier point*,' and it was only after some time and no small trouble that they were bound securely to a table. M. Pasteur then bent over the frothing head of the bull-dog, and sucked into a pipette a few drops of saliva. Our author remarks, in conclusion, that Pasteur never appeared to him so great as in the cellar where this took place, and while this '*tête-à-tête formidable*' was being enacted.

PLANTÉ'S RESEARCHES.

Recherches sur l'électricité, de 1859 à 1879. Par GASTON PLANTÉ. Paris, *La lumière électrique*, 1883. 5+322 p. 8°.

THE great interest taken in electric accumulators since Faure brought out his secondary battery, in 1881, has doubtless led to this reprint of Planté's researches from the text of the first edition, published in 1879, and two supplementary papers issued a few months later. These researches, extending over a period of twenty years, are characterized by a neatness and originality that make them very attractive. The writer considered himself specially fortunate in receiving a cordial invitation from M. Planté, in 1881, to witness many of the most interesting experiments described in this book. A review of them recalls vividly the pleasure experienced in Planté's laboratory, near the celebrated 'Place de la Bastille.'

A *diplôme d'honneur* was most worthily conferred on M. Planté at the Paris exposition of electricity, in recognition of his labors as the inventor of the secondary battery; for, while polarization currents had been observed by other physicists previous to the beginning of his work in 1859, no one had pursued the investigation with sufficient patience to make the principle of any special value. It is entirely safe to say now, however, — in view, too, of all that inventors have done within the past three years, — that no one can make a special study of secondary batteries, or succeed in making efficient ones, without going to these researches of Planté for the most essential part of his information. As a purely experimental series, they must take rank with the best in the domain of physics.

It is to be regretted that M. Planté has not revised those portions of his researches relating to the chemical reactions taking place during the charging of the cell and its discharge. His explanation of the formation of the peroxide of lead on one plate, and of spongy lead on the other, has the merit of simplicity at least; but, in the light of Gladstone and Tribe's[1] investigations, it must be considered as entirely too simple to accord with the facts. No mention is made, in these researches, of the formation of lead sulphate; and yet its presence is fully established, and the part it plays in local action is clearly demonstrated. The slow conversion of the peroxide into sulphate on the negative plate, with the circuit open, explains the gradual fall of electromotive force; while the residual charge appears to be fully accounted for by the two related facts of the formation of a small amount of peroxide on the positive plate during the discharge, producing electrical equilibrium before the peroxide on the negative plate is exhausted, and the subsequent conversion of this peroxide into sulphate, thus re-establishing a difference of potential. The formation of highly resistant sulphate from peroxide on the negative plate, and from metallic lead on the positive, accounts for Planté's observation that a cell long disused acquires great internal resistance, and charges again with difficulty. It seems highly probable, however, that the skill acquired by Planté in 'forming' his cells enables him to so modify the physical character of the surfaces of the lead plates that the sulphate plays a less important part in the final chemical action in his cell than it does in the experiments of less skilled physicists. Thus Professor Barker says of one of his Planté cells, "Not a trace of sulphate has been formed in it apparently, though it has been in use for six months."[2]

It would be pleasant to express as high an opinion of M. Planté's explanations of electrical phenomena in nature as of his researches: but this is impossible; for while he gives a possible explanation of ball-lightning, and other

[1] *Nature*, xxv. 221, 461; xxvi. 251, 602.
[2] *Proc. Amer. assoc.*, xxxi. 217.

forms of electric discharge from the clouds, it is none the less unsatisfactory to be told that atmospheric electricity arises from the earth's possessing a constant positive charge. Again: the theory that the sun is only one of a *chapelet de grains brillants* originally fused by a powerful current like the globules formed by a melting wire, and that "the incandescence of the solar globe, prolonged during a long series of ages, is itself only a spark of short duration in the infinity of time and space" (p. 250), is not worthy to stand in connection with the account of his many remarkable investigations. These furnish no basis for such a speculation, and scarcely more for the theory that "whirlwinds and cyclones are the powerful electro-dynamic effects produced by the combined forces of atmospheric electricity and terrestrial magnetism" (p. 229).

In conclusion, M. Planté says, respecting the nature of electricity, that it "may be considered as a motion of ponderable matter, — motion of transport of a very small mass of matter, animated by a very great velocity if an electrical discharge is considered, and a very rapid vibratory motion of the molecules of matter if its transmission to a distance under the dynamic form, or its manifestation under the static form, at the surface of bodies, is considered" (p. 314). Without adopting this view, we may say that many of Planté's experiments strongly support it.

THE CHILIAN LANGUAGES.

Chilidúgu sive tractatus linguae chilensis. Opera Bernardi Havestadt. Editionem novam immutatam curavit Dr. Julius Platzmann. 2 vols. Lipsiae, *Teubner*, 1883. 952 p. 12°.

This is the general title of Platzmann's neat facsimile reprint of an important publication of the eighteenth century which had become quite scarce. Havestadt was a Jesuit, born in the environs of Cologne, on the Rhine, and a man of considerable learning, — a fact which appears not only from the fluent and elegant Latin style in which his manuals are composed, but also from the few leaves which he devotes to an autobiographic notice. The travels performed by him (1751–52) in his Chilian diocese on the western slope and in the higher valleys of the Andes are described in vivid colors by himself, and illustrated by a quaint map, which fully deserves the attention of ethnographers. The missionary's work was originally published (in 1777) with several sub-titles, which are faithfully reproduced in the reprint with all the saints' images, heraldry, etc., and embrace the following parts: Chilian grammar; three vocabularies; catechism, with Latin translation, and hymns in Chilian, to which music-notes are added; and a diary.

The phonetic system of Chilidúgu (*dúgu*, 'language') is described with laudable accuracy by the padre, who marks forty different sounds as constituting its alphabet. The language evinces some tendency towards nasalization of the consonantic elements, but is of an easy and harmonious pronunciation, and shows some general resemblance to Quichhua and Aimará phonetics. A peculiarity not very often found in American languages is the dual, which here pervades the verb and pronoun as well as the noun. According to the custom of his epoch, Havestadt arranged the forms discovered in this southern language wholly after the pattern of the Latin grammar. He found six cases in the noun; but his paradigms conclusively show that his nominative is identical with his accusative and vocative, his dative the same form as his ablative. Whether these cases are formed by postpositions, or by real case-affixes, remains to be examined. The verb inflects with remarkable regularity, forms five tenses and an intricate array of verbals (nominal forms of the verb, gerunds, etc.), has an interrogative, affirmative, negative, and passive form, together with an extensive system of transitions. A large number of suffixes serves to form derivatives, verbal as well as nominal, from verbal and nominal bases. In his rich collection of conversational phrases, the author has given a powerful and safe guide for the study of this sonorous tongue, which he extols in such a manner as to make it "surpass in excellence and graphic power all other languages of the world." The vocabularies given by Havestadt are more copious than that of Febres and the other authors who have written upon the Chilidúgu. The dialect of Chilidúgu, treated by Havestadt, is that of the Molu-che tribe.

THE IRON AND STEEL INSTITUTE.

The journal of the Iron and steel institute. Vols. i. and ii. London, *Spon*, 1883. 10+484, 405 p. 8°.

The proceedings of the Iron and steel institute cannot fail to be of interest to the general scientific public, and especially so to the workers and manufacturers of iron and steel, since the society numbers among its active members such men as Sir Henry Bessemer, Mr. Sidney G. Thomas, and Mr. I. Lowthian Bell. The late C. W. Siemens was one of the prominent members and contributors. The