half the former amount of water; the stock now consumes the reeds and marsh-grass, exposing the water to the direct rays of the sun, thereby promoting evaporation, so that by midsummer even the mud in their basins has dried to a hard crust, and a change in the temperature during the heated term brings, as a rule, a cool, dry atmosphere instead of rain, as in former years. Mr. Sawyer goes on to describe the large increase in the consumption of water by domestic animals. In this State at the present time there are at least "three million horses, cattle, and mules, and five million hogs and sheep, and they will consume not less than *seventy million gallons* of water every twenty-four hours—quite a lake of itself." This, surely, must be a misprint, or American animals are very thirsty beings!

A CORRESPONDENT of the *Aberystwith Observer*, the Rev. James Lewis, of Llanilar Vicarage, writes as follows to that journal:—"Whilst returning from service at the parish church of Rhostie, about 8.15 P.M. on Friday, the 24th ult., in company with two members of the congregation, my attention was called to a remarkably strange phenomenon. In walking across a field on the farm of Cwmclyd, it was noticed that our footsteps were marked by a peculiar light, which could be traced back for several yards, each footprint being as distinctly marked on the ground as when one walks in snow. When we got into the adjoining field the light disappeared until we came near to the end of it, when it was observed that our footsteps were again marked by the same luminous appearance. In colour the light was similar to that of phosphorus rubbed on a wall in a dark room, or a mass of glow-worms, of which insect, however, there was no trace on the surrounding ground."

IN the *Bulletin International* of the Paris Observatory for the 21st inst. appears an interesting note by M. de Lagrenè on the thunderstorms which have occurred in the department of Haute-Marne during the seven years ending 1874. In this department the average annual number of thunderstorms is 87, of which 25 occur in July, 20 in May, and 14 in June. During the six months from October to March inclusive the mean annual aggregate is only six. The geographical position of Haute-Marne is an important one as regards these electrical phenomena, about which so very little is yet known, and this Departmental Meteorological Commission is doing good service in contributing its share in the work of collecting data on the origination, intensity, and rate of propagation of thunderstorms, and the manner in which they are influenced by the winds prevailing at the time, by the contour of the ground, and by forests.

WE have received the first number of the *Iowa Weather Review*, September 1875 (pp. 20), which has just been started by Dr. Gustavus Hinrichs, from which we learn that the system of rain observations set on foot by him, as explained in a recent notice in NATURE, is only the beginning of a more complete system by which it is hoped that the whole meteorology of this important State will be adequately and systematically observed and turned to practical account in the interests of the people. There is an idea shadowed out in the prospectus by which, if gone into and developed, the United States will be divided into meteorological districts or regions similar to what is now being done in France, and which is really the only means by which many highly important questions can be properly investigated. Dr. Hinrichs gives the monthly rainfall for the months of past years' observations, as well as the monthly means, at six places in the State, and sends a carefully compiled monthly report of his own observations made at the laboratory of the Iowa State University at Iowa City, the amounts and averages of each month being compared with the results of previous years' observations.

THE additions to the Zoological Society's Gardens during the past week include a Binturong (*Arctictis binturong*) from Malacca, presented by Captain A. R. Ord; a Wood Owl (*Syrnium aluco*), European, presented by Mr. F. Brannd; a Missel Thrush (*Turdus viscivorus*), European, presented by Mrs. Watson; a Grey Wagtail (*Motacilla boarula*), seven Picked Dog Fish (*Acanthias vulgaris*), European, purchased; a Cape Buffalo (*Bubalus caffer*) born in the Gardens.

ON THE VARIATIONS OF THE ELECTROMOTIVE FORCE OF A NEW FORM OF LECLANCHÉ'S CELL

A NEW form of Leclanché's cell has been constructed by Dr. Muirhead, and is supplied by Messrs. Warden, Muirhead, and Clark.

In this form the carbon and black oxide of manganese are packed in the outer case around a glazed porcelain jar perforated with holes about one-eighth of an inch in diameter, the jar containing a zinc plate bent into the form of a cylinder.

The advantages gained are that a much larger surface of zinc is exposed and the perforations of the jar are in no danger of being choked up by deposition of chloride of zinc.

The following results may be of some interest as showing how the electromotive force of this cell varies when it works for a considerable time through circuits of various resistances.

A circuit of known resistance was formed, through which the battery worked, and two points in this circuit were attached to the poles of a sawdust Daniell's cell, so as to form a branch circuit in which a galvanometer was included; one of these two points was then moved along the circuit until the galvanometer showed that there was no current through the Daniell; when this is the case the E.M.F. of the battery is to that of the Daniell in the same ratio as the resistance of the whole circuit to that of the part between the points of attachment of the Daniell.

A set of coils was used by which the resistance could be adjusted to ·05 ohm, and by adding one of these coils to the common part of the circuit (so that the resistance of the whole circuit did not remain quite constant) a very small change in E.M.F. could be measured.

The current through the Daniell was always very small, and as it passed sometimes in one direction and sometimes in the other, the difference between the potentials of its poles must have remained very nearly constant.

In the circuits of small resistance it became necessary to take account of the internal resistance of the cell. This was found (for these circuits) to be generally between ·45 and ·46, it was subject to slight variations between these limits, but rarely exceeded them when the battery was worked for only two or three hours, although on leaving the battery circuited through 30 ohms for 20 hours it rose as high as ·525. The lowest resistance observed was ·420 when working through 10 ohms.

The following tables give the E.M.F. of the battery in terms of the Daniell:—

When the cell had been circuited through 10 ohms for 2 min., the E.M.F. was 1·320; for 3½ min., 1·314; for 5½ min., 1·304; for 13 min., 1·292; for 23 min., 1·283; for 34 min., 1·277. For 1h. 1m., 1·266; for 1h. 31m., 1·256; for 1h. 56m., 1·254; for 2h. 11m., 1·253.

When circuited through 20 ohms for 2½ min. the E.M.F. was 1·3465; for 4 min., 1·3420; for 5½ min., 1·3385; for 13 min., 1·3315; for 18 min., 1·3270; for 30 min., 1·3215; for 46 min., 1·3155. For 1h. 1m., 1·3095; for 1h. 22m., 1·3045; for 1h. 31m., 1·3035.

When circuited through 30 ohms for ½ min. the E.M.F. was 1·3702; for 2 min., 1·3608; for 3 min., 1·3585; for 4 min., 1·3562; for 10 min., 1·3500; for 20 min., 1·3446; for 26 min., 1·3404; for 28 min., 1·3391. For the next four minutes the E.M.F. was very unsteady. For 32 min., 1·3411; for 33 min., 1·3398; for 39 min., 1·3364. For 1h. 3m., 1·3318; for 1h. 14m., 1·3292; for 1h. 28m., 1·3211; for 23h. 30m., 1·2810.

When circuited through 100 ohms for 7 min. the E.M.F. was 1·4415; for 10 min., 1·4417; for 20 min., 1·4423.

No further change was observed at the expiration of one hour.

When the cell (after being insulated for 21 hours) was circuited through 3,200 ohms, after 1 min. the E.M.F. was 1·448; after 3 min., 1·450; after 18 min., 1·454; after 38 min., 1·459.

When the cell was short circuited through itself for two minutes the E.M.F. fell from 1·407 to 1·235. (These measurements were taken with the cell working through 3,500 ohms.)

On being circuited through 3,500 ohms for 23 min., the E.M.F. rose to 1·383.

More observations were made than those here recorded, readings being taken in some cases every minute, but the only irregularity observed was that noticed when working through 30 ohms.

In these experiments we may notice that when the battery was short circuited through 10 ohms, the E.M.F. after the first two minutes fell ·4¼ per cent. in 1½ hours; through 20 ohms it fell 3 per cent.; and through 30 ohms, 2¾ per cent., in the same time. But when circuited through 100 ohms and upwards, the E.M.F. increased with the time,* the percentage increment increasing with the resistance. Hence it appears not unlikely that there may be some resistance through which the E.M.F. will remain absolutely constant; should this be found to be the case, and should this resistance always remain the same, the battery will be very valuable when required to work through such a circuit.

It may be remarked that, in accordance with the usual rule, the E.M.F. of the battery increases with the external resistance.

The cell was insulated for a considerable time previously to commencing each set of experiments. S. A. SAUNDER

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OUR BOTANICAL COLUMN

EXOTIC TIMBER-TREES IN MAURITIUS.—Amongst useful plants that have been introduced into countries distant from their native habitats, the timber-trees are of some interest, inasmuch as beyond the proof of their establishment in foreign climates and soils, some time is needed to prove what effects the change may have on the quality of the timber itself, for on this alone depends the value of the experiment in a commercial point of view. It is, however, satisfactory to learn that some well-known timber-trees that have been introduced into Mauritius through the instrumentality of the Royal Gardens, Kew, are in a flourishing state. Thus, the mahogany (*Swietenia mahagoni*), one of the oldest and most valued of furniture woods, has made a very rapid growth, forming, in three or four years after the sowing of the seeds, trees about twenty feet in height, with stems from three to six inches in diameter. In India, likewise, the mahogany thrives well, and as a proof that the wood is valuable, it may be stated that a tree blown down in the Calcutta Botanic Gardens during the great cyclone realised over 1,000 rupees. Logwood (*Hæmatoxylon campeachianum*) is reported also to grow well in Mauritius, and it moreover makes excellent hedges, far superior, it is said, to hawthorn. It has been quite naturalised on the hills and waste lands in the vicinity of Port Louis, and annually produces large quantities of seeds.

BAMBOO AS A PAPER MATERIAL.—A good deal of attention has of late years been directed to new materials for paper making. Esparto has been one of the most successful of modern discoveries, and now we are told that the supplies of that useful substance are decreasing and must in course of time fail altogether. Where then shall we look for our future supplies is a question that has agitated many minds, and which has been answered frequently by references to the numerous fibre-producing plants of both the East and West Indies, Australia, &c. We know that in India the fibrous barks of many trees, and notably that of *Daphne papyracea*, are used for paper making; while in China and Japan, where paper is used for a much greater variety of purposes than it is in England, the barks of *Broussonetia papyrifera* and *B. Kæmpferi* are made into paper of every conceivable and indeed inconceivable form; for some specimens are so much like leather that it takes a critical eye to detect it, and others are such good imitations of crape and muslin that the same care is needed to determine their true nature. That the Chinese and Japanese excel in paper-making cannot be doubted, when we consider all their manufactures, and more especially that fine quality of paper known as India proof paper, which they make from young bamboos. The bamboo as a paper material in this country is a comparatively modern introduction; indeed, we can hardly say that it has actually become a commercial article, but there seems no reason why the stems of the bamboo, which in tropical countries is one of the commonest and fastest growing plants, should not be converted into *half stuff* and sent to England in almost any quantity. To make this material better known has been the aim of Mr. Thos. Routledge, in a little pamphlet of forty pages, which he has just issued. Mr. Routledge is no doubt able to speak with authority on the details of manipulation of paper stock in a practical, if not in a scientific sense; but it is not our intention to follow him through the subject, but simply to refer to some facts quoted by him as an illustration of the suitability of bamboo as a paper-making material, and to endorse to a certain extent some of those facts and suggestions. Thus, with regard to supply, it is well known that in most tropical countries bamboos of various species flourish to a considerable extent and are to the people of immense value, furnishing them with numerous articles of daily necessity; then again their growth is so rapid as to form a constant supply. With regard to the rate of growth, we read that at Gehzireh, the gardens of the Khedive of Egypt at Cairo, it has been known to grow nine inches in one night. At Sion House, the Duke of Northumberland's, stems of *Bambusa gigantea* have attained the height of 60 feet in twelve weeks; while at Kew, *Bambusa vulgaris* is recorded as growing in favourable seasons at the rate of eighteen inches per day; and at Chatsworth the same species has attained the height of 40 feet in forty days. For the purpose of paper-making the stems should be cut down in a comparatively young state, before they become too woody, and reduced to pulp or half stuff before being sent to this country.

* As the coils were arranged in boxes, and so could not be kept at a uniform temperature, it was thought that this might be due to unequal heating. It was found, however, that the alteration in the ratio of the resistances due to this cause was such as to cause the E.M.F. to appear to increase less than it really did by about ·005 per cent. in one hour, which would not affect the results in the tables.

SCIENTIFIC SERIALS

American Journal of Science and Arts, October.—This number contains the following two papers read at the Detroit meeting of the American Association for the Advancement of Science.—Address of Dr. John Le Conte, the retiring president.—A comparison between the Ohio and West Virginia sides of the Alleghany coal-field, by E. B. Andrews.—There is also a reprint from the *Philosophical Magazine* of Mr. Mallet's paper on the temperature attainable by rock-crushing.—In an obituary notice of Sir Charles Lyell, there is introduced an extract of a letter from Dr. Mantell to Prof. Silliman, in 1841, describing how Mantell and Lyell first met.—The original articles in this number are: On the arithmetical relations between the atomic weights, by M. D. C. Hodges.—A note by L. F. Pourtales recording the corals found at the Galapagos Islands.—On instinct (?) in hermit crabs, by Alexander Agassiz. This records how young crabs reared without shells during their growth, "made a rush" for them as soon as they were placed in the tank where they were living.—On Southern New England during the melting of the great glacier, Part ii. We reserve our notice of this till the paper is completed.

Geological Magazine, October.—The original articles are: The Geology of Central Sumatra, by R. D. M. Verbeek (superintendent of the Geological Survey of Sumatra). This is stated to be the commencement of a series of articles on the subject, published with the authority and assistance of the Dutch-Indian Government. The oldest rocks in this part of Sumatra are granites, granite-syenites, and syenites. Then follow sedimentary rocks classed as of Carboniferous or Permian age. "This oldest sedimentary formation of Sumatra can be divided into two parts. The lower portion consists of clay-slates with auriferous quartz-veins, marl-slates and siliceous schists; the upper part consists only of limestone, with some small beds of schists." There are quartz porphyries and greenstones, the age of which is not known, but they are probably older than the tertiaries. The tertiaries themselves are divisible into five groups. The trachytic rocks are younger than the tertiaries. Three clearly drawn sections illustrate the paper, and a list of principal papers on the geology of Sumatra is given.—On the origin of Coums, by J. G. Goodchild. That many of these cauldron-like hollows are due to the eddying of ice is the argument of Mr. Goodchild.—Dr. Walter Flight continues his "History of Meteorites."—Dr. Thomas Wright records the occurrence of the genus *Cotylederma* in the middle lias of Dorsetshire.

Poggendorff's Annalen, No. 8.—This number commences with an investigation by Karl Müller as to the pitch of the transversal vibrations of bars of gypsum, when these are saturated with different droppable liquids. It appears that the liquid does not act as a weighting of the bar, but enters into union with the molecules of the substance, diminishing the co-efficient of elasticity; and this is manifested in a fall of pitch, the fall having