Strange Method of Crossing a Torrent

HAVING seen something very like, if not quite identical with, the following in the Himalayas, I am anxious to know if it is not a commoner device under similar conditions than is generally supposed everywhere. The story occurs in Gerard Boote's (Doctor of Physick) "Inland's Natural History," p. 59, and is related on the authority of "one Theophilus Buckworth, a Bishop of Dromore," in whose presence the feat was performed. His description of it runs as follows. After mentioning that the brook or river "that passeth by that town was greatly risen," he adds that "A country fellow who was travelling that way having stayed three days in hope that the water would fall, and seeing that the rain continued, grew impatient, and resolved to pass the brook whatever the danger was, but to do it with the less peril and the more steadiness he took a great heavy stone upon his shoulders, whose weight, giving him some firmness against the violence of the water, he passed the same without harm and came safe to the other side, to the wonderment of many people who had been looking on and given him up for a lost person." W. CURRAN

Warrington

Intellect in Brutes

NOT having seen any reference to Cowper's famous hares in any of the notices under this heading that have appeared in NATURE, I am induced to refer to them, the more so as the creature is rarely credited with much gratitude or intelligence. My information is from Tegg's edition of "The Life and Works of William Cowper," p. 633. Describing, at this place, the capers of his favourite hare named "Puss," who "would suffer me to take him up and to carry him about in my own arms," our poet adds that "he was ill three days, during which time I nursed him, kept him apart from his fellows, . . . , and by constant care, &c., restored him to perfect health. No creature could be more grateful than my patient after his recovery, a sentiment which he most significantly expressed by licking my hand, first the back of it, then the palm, then every finger separately, then between all the fingers, as if anxious to leave no part of it unsaluted; *a ceremony which he never performed but once again upon a similar occasion.* Finding him extremely tractable, I made it my custom to carry him always after breakfast into the garden. . . . . I had not long habituated him to this taste of liberty before he began to be impatient for the return of the time when he might enjoy it. He would invite me to the garden by drumming upon my knee and by a look of such expression as it was not possible to misinterpret. If this rhetoric did not immediately succeed, *he would take the skirt of my coat between his teeth and pull it with all his force.*" He "seemed to be happier in human society than when shut up with his natural companions," and if these traits do not *betoken* something more than instinct, it is hard to say where this ends and intellect begins.

Warrington W. CURRAN

Anchor-Ice

HAVING lately read with much interest several letters to NATURE on the subject of the formation of anchor- or ground-ice, I beg leave to inform your readers that it forms here every season in the Rock Island rapids of the Upper Mississippi River; any one desirous of studying its mode of formation would here have a good opportunity. Some observations of mine upon this phenomenon may be found in vol. ii. of the *Proceedings* of the Davenport Academy of Natural Sciences, p. 349.

Davenport, Iowa, U.S., July 10 R. J. FARQUHARSON

Depraved Taste in Animals

WHILE in Australia I kept at different times several koalas—all taken young. Of these three were inordinately fond of tobacco in any form. They would chew and swallow the strong Victorian black tobacco with the greatest gusto, and one, to which I gave a foul clay pipe saturated with tobacco oil, devoured the whole of the stem. Sitting on the nape of my neck, his usual place when I was writing or reading in the evening, "Ka-koo" would frequently stretch out one hand, take the pipe from my mouth, and begin to chew it if not promptly interfered with. During the day he passed most of his time rolled up on the rafters of the roof, bush houses being devoid of a ceiling, and on hearing the clinking of glasses, which betokened the preparation of the evening glass of grog, hurried down from his perch to receive his modest share of whisky and water. If a spoon were dipped in the raw spirit and given to him, he would take it in both his paws and lick it dry with manifest appreciation, and could only be prevented from making a raid upon every glass on the table by being tied with a handkerchief by the leg to the back of a chair. No ill effects ever followed these indulgences. ARTHUR NICOLS

THUNDERSTORMS[1]

WHEN I was asked to give this lecture I was also asked to give a short list of subjects from which your directors might select what they thought most fit. I named three. Regarded from the scientific point of view, one of them was to be considered as fully understood in principle, and requiring only additional experimental data to make it complete. This was the *Conduction of Heat in Solids.* Another was to a certain extent scientifically understood, but its theory was, and still is, in need of extended mathematical development. This was the popular scientific toy, the *Radiometer.* The third was, and remains, scarcely understood at all. Of course it was at once selected for to-night. I might have foreseen that it would be. You may well ask, then, why I am here. What can I say about a subject which I assert to be scarcely understood at all? A few years ago no qualified physicist would have ventured an opinion as to the nature of electricity. Magnetism had been (to a certain extent, at least) cleared up by an assumption that it depended on electric currents; and from Örsted and Ampère to Faraday and Thomson, a host of brilliant experimenters and mathematicians had grouped together in mutual interdependence the various branches of electro-dynamics. But still the fundamental question remained unsolved, *What is electricity?* I remember Sir W. Thomson, eighteen years ago, saying to me, "Tell me what electricity is, and I'll tell you everything else." Well, strange as it may appear to you, I may now call upon him to fulfil his promise. And for good reason, as you shall see.

Science and Scotland have lately lost in Clerk-Maxwell one of their greatest sons. He was, however, much better known to science than to Scotland. One grand object which he kept before him through his whole scientific life was to reduce electric and magnetic phenomena to mere stresses and motions of the ethereal jelly. And there can be little doubt that he has securely laid the foundation of an electric theory—like the undulatory theory of light admirably simple in its fundamental assumptions, but, like it, requiring for its full development the utmost resources of mathematical analysis. It cannot but seem strange to the majority of you to be told that we know probably as much about the secret mechanism of electricity as we do about that of light, and that it is more than exceedingly probable that a ray of light is propagated by electric and electro-magnetic disturbances. It is one of the most remarkable advances made during this century.

But to know what electricity is, does not necessarily guide us in the least degree to a notion of its source in any particular instance. We might know quite well *what* is electricity and yet be, as I told you at starting we *are*, almost entirely uncertain of the exact source of *atmospheric* electricity.

To come to my special subject. I am not going to try to describe a thunderstorm. First, because I am certain that I could not do it without running the risk of over-doing it, and thus becoming sensational instead of scientific; and secondly, because the phenomenon must be quite familiar, except perhaps in some of its more singular details, to every one of you.

Science has to deal with magnitudes which are very much larger or smaller than those which such words as huge, enormous, tiny, or minute are capable of expressing. And though an electric spark, even from our most

[1] Abstract of a lecture, delivered in the City Hall, Glasgow, by Prof. Tait.

powerful artificial sources, appears to the non-scientific trifling in comparison with a mile-long flash of lightning, the difference (huge, if you like to call it) is as nothing to others with which scientific men are constantly dealing. The nearest star is as much farther from us than is the sun, as the sun is farther from us than is London. The sun's distance is ninety-three millions of miles. If that distance be called enormous, and it certainly is so, what adjective have you for the star's distance? Ordinary human language, and especially the more poetic forms of it, were devised to fit human feelings and emotions, and not for scientific purposes. A thoroughly scientific account of a thunderstorm, if it were possible to give one, would certainly be at once ridiculed as pedantic.

Let us therefore, instead of attempting to discuss the phenomenon as a whole, consider separately some of its more prominent features. And first of all, what are these features when we are *in* the thunderstorm?

By far the most striking, at least if the thunderstorm come on during the day, is the extraordinary darkness. Sometimes at mid-day in summer the darkness becomes comparable with that at midnight, very different in kind as well as intensity from that produced by the densest fog. Objects are distinctly visible through it at distances of many miles, whether when self-luminous or when instantaneously lit up by lightning. The darkness, then, is simply intense *shadow*, produced by the great thickness and great lateral extension of the cloud-masses overhead. Seen from a distance, the mass of cloud belonging to the storm usually presents a most peculiar appearance, quite unlike any other form of cloud. It seems to boil up, as it were, from below, and to extend through miles of vertical height. The estimated height of its lower surface above the ground varies within very wide limits. Saussure has seen it as much as three miles; and in one case noticed by De l'Isle it may have been as much as five miles. On the other hand, at Pondicherry and Manilla it is scarcely ever more than half a mile. Haidinger gives the full details of an extraordinary case, in which the thundercloud formed a stratum of only twenty-five feet thick, raised thirty yards above the ground. Yet two people were killed on this occasion. Other notable instances of a similar extreme character are recorded.

Careful experiment shows us that the air is scarcely ever free from electricity, even in the clearest weather. And even on specially fine days, when large separate cumuli are floating along, each as it comes near produces a marked effect on the electrometer. Andrews obtained by means of a kite, on a fine clear day, a steady decomposition of water by the electricity collected by a fine wire twisted round the string. Thanks to Sir W. Thomson, we can now observe atmospheric electricity in a most satisfactory manner. I will test, to show you the mode of proceeding, the air inside and outside the hall. [The experiment was shown, and the external air gave *negative* indications.]

On several occasions I have found it almost impossible, even by giving extreme directive force to the instrument by means of magnets, to measure the atmospheric potential with such an electrometer, and had recourse to the old electroscope, with specially long and thick gold-leaves. On February 26th, 1874, when the sleet and hail, dashing against the cupola of my class-room, made so much noise as to completely interrupt my lecture, I connected that instrument with the water-dropper, and saw the gold-leaves discharge themselves against the sides every few seconds, sometimes with positive, sometimes, often immediately afterwards, with negative electricity. Such effects would have required for their production a battery of tens of thousands of cells. Yet there was neither lightning nor thunder, and the water was trickling from the can at the rate of only two and a half cubic inches per minute. Probably had there not been such a violent fall of sleet steadily discharging the clouds we should have had a severe thunderstorm. Falling rain-drops are often so strongly charged with electricity as to give a spark just before they touch the ground. This "luminous rain," as it has been called, is a phenomenon which has been over and over again seen by competent and trustworthy observers. In the *Comptes Rendus* for November last we read of the curious phenomenon of electrification of the observer's umbrella by a light fall of snow, to such an extent that he could draw sparks from it with his finger.

In calm clear weather the atmospheric charge is usually positive. This is very commonly attributed to evaporation of water, and I see no reason to doubt that the phenomena are closely connected. [A few drops of water were sprinkled on a heated crucible, insulated, and connected with the electrometer.]

There can be no doubt that, whatever be the hidden mechanism of this experiment, the steam has carried with it a strong charge of positive electricity, for it has left the rest of the apparatus with a strong negative charge. We will now try that form of the experiment in another way. [High-pressure steam escaping from a little boiler was made to play upon an insulated conductor furnished with spikes, and connected with the electrometer, which then showed a strong positive charge.]

There are many substances which produce on evaporation far greater electric developments than water does, some of positive, others of negative, electricity. By far the most remarkable in this respect to which attention has yet been called is an aqueous solution of sulphate of copper. (*Proc.* R.S.E., 1862.) The smallest drop of this solution thrown on a hot dish gives an intense negative effect—so great, in fact, that it may be occasionally employed to charge a small Leyden jar. But this, like the smaller effect due to water under similar circumstances, is not yet completely explained.

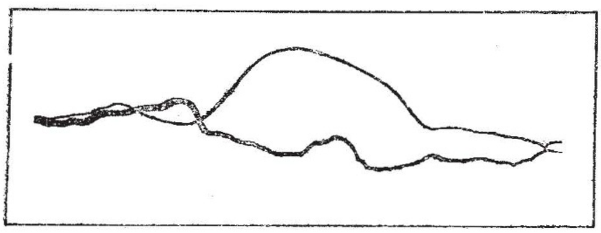
The next striking features are the flashes of lightning which at intervals light up the landscape with an intensity which must in the majority of cases far exceed that produced by the full moon. To the eye, indeed, the flash does not often appear to furnish more than the equivalent of average moonlight, but it must be remembered that it lasts for a period of time almost inconceivably short, and that the full effect of light on the eye is not produced until after the lapse of a considerable fraction of a second. Prof. Swan has estimated this interval at about one-tenth of a second; and he has proved that the apparent intensity of illumination for shorter intervals is nearly proportional to the duration. (*Trans.* R.S.E., 1849.) I can illustrate this in a very simple manner. [Two beams of light were thrown upon the screen by reflection from mirrors, each of which was fixed *nearly* at right angles to an axis. When matters were so adjusted that the brightness of the two illuminated spots was the same, one mirror was made to rotate. The corresponding light spot described a circle about the other, and its brightness became less the larger the circle in which it was made to revolve.] The lightning flash itself on this account, and for the farther reason that its whole apparent surface is exceedingly small, must be in some degree comparable with the sun in intrinsic brilliancy—though, of course, it cannot appear so. The fact that its duration is excessively short is easily verified in many ways, but most simply by observing a body in rapid motion. The spokes of the wheels of the most rapidly-moving carriage appear absolutely fixed when illuminated by its light alone. One can read by its light a printed page stuck on a disc revolving at great speed. But the most severe test is that of Sir Charles Wheatstone's revolving mirror. Seen by reflection in such a mirror, however fast it may be rotating, a flash of lightning is not perceptibly broadened, as it certainly would be if its duration were appreciable.

The apparatus which, in our laboratories, enables us to measure the time which light, moving at nearly 200,000 miles per second, takes to pass over a few feet, is *required* to prove to us that lightning is not absolutely instantaneous. Wheatstone has shown that it certainly lasts less than a millionth part of a second. Take this, along with Swan's datum, which I have just given you, and you see that the apparent brightness of the landscape, as lit up by a lightning flash, is *less than one hundred thousandth part* of what it would be were the lightning permanent. We have thus rough materials for instituting a comparison between the intrinsic brightness of lightning and of the sun.

Transient in the extreme as the phenomenon is, we can still, in virtue of the duration of visual impressions, form a tolerably accurate conception of the form of a flash; and in recent times instantaneous processes of photography have given us permanent records of it. These, when compared with photographic records of ordinary electric sparks, bear out to the full the convictions at once forced by appearances on the old electricians, that a flash of lightning is merely a very large electric spark. The peculiar zig-zag form, sometimes apparently almost doubling back on itself, the occasional bifurcations, and various other phenomena of a lightning flash, are all shown by the powerful sparks from an electric machine. [These sparks were exhibited directly; and then photographs of some of them were exhibited.]

The spectroscope has recently given us still more convincing evidence of their identity, if any such should be wanted.

The bifurcations of a flash can puzzle no one who is experimentally acquainted with electricity, but the zig-zag form is not quite so easily explained. It is certainly destroyed, in the case of short sparks, by heating the air. [Photographs of sparks in hot and in cold air were



exhibited. One of each kind is shown in the woodcut. The smoother is that which passed through the hot air. The other passed through the cold air nearer the camera, and is therefore not quite in focus.]

Now heating in a tube or flame not only gets rid of motes and other combustible materials but it also removes all traces of electrification from air. It is possible, then, that [the zig-zag form of a lightning flash may, in certain cases at least, be due to local electrification, which would have the same sort of effect as heat in rarefying the air and making it a better conductor.

A remark is made very commonly in thunderstorms which, if correct, is obviously inconsistent with what I have said as to the extremely short duration of a flash. The eye could not possibly follow movements of such extraordinary rapidity. Hence it is clear that when people say they *saw* a flash go upwards to the clouds from the ground, or downwards from the clouds to the ground, they must be mistaken. The origin of the mistake seems to be a *subjective* one, viz., that the central parts of the retina are more sensitive, by practice, than the rest, and therefore that the portion of the flash which is seen directly affects the brain sooner than the rest. Hence a spectator looking towards *either* end of a flash very naturally fancies that end to be its starting-point.

(*To be continued.*)

OBSERVATIONS ON ARCTIC FOSSIL FLORAS WITH REGARD TO TEMPERATURE

THE first feelings of surprise caused by the discovery of remains of warmer-temperate, sub-tropical, and even tropical plants within the Arctic circle, of, geologically speaking, comparatively recent age, have now died away, and we no longer find that their presence there forms so favoured a theme for speculation. The time appears to have arrived when we may critically examine the botanical evidence upon which estimates of the past degree of warmth enjoyed by the Arctic regions have to be formed. The method open to us is very simple: we have, it seems, only to first set aside determinations that are clearly little more than guesses; then ascertain the minimum mean temperature required by the remaining groups of plants to flourish at the present day; and the sum of these temperatures should furnish reliable results for each period.

I am not yet able myself to carry this inquiry beyond the ferns and conifers, but the determinations of these are probably so very much more accurate than those of the higher orders of plants as to comprise most of the safer data, and they are sufficiently numerous for the purpose.

My present remarks are limited to the Komeschichten, a horizon supposed in the "Flora Fossilis Arctica," to represent in Greenland the Urgonian or Neocomian of Central Europe. In this Komeschichten two genera of ferns occur which deserve especial consideration, for Prof. Heer makes use of their presence to infer that at that period the Arctic regions were favoured with a sub-tropical or even tropical climate. These genera are *Gleichenia* and *Oleandra*. The correctness of the determination of the supposed Arctic Oleandra is doubtful, and it is best for the present to place them among the guesses. The very sparse indications of sori are not satisfactory, and there are no less than twelve widely-distinct genera possessing species with approximately the same venation. Oleandra is a small genus with but six species, almost confined to the tropics, but two of them grow in Northern India at altitudes of 6,000 and 7,000 feet.

It is quite otherwise with the remains of *Gleichenia*, for these preserve every characteristic of that genus. But while it is perfectly obvious that these are really fragments of Gleichenias, neither the number of species into which Prof. Heer has divided them, nor the inferences as to climate which he draws from them, can be admitted. He has quite unnecessarily, it seems to me, separated the fragments from the Komeschichten into fourteen species, and to these has added two from the Ataneschichten. The prevailing species, *G. Zippei*, if considered to represent the type in its average size, might be made to embrace eight or ten of them without even then approaching the limits of variation seen in the corresponding existing species. *G. Giesekiana* receives the rather larger pinnæ and *G. gracilis* the smaller, and many others seem separated on trifling or fancied peculiarities, as *G. acutipennis*, which is merely a small, indistinct fragment, with a few rounded depressions, conjectured to mark sori, but which, from their position on the mid-rib, could not well be such. *Gleichenia* is a particularly variable fern. Berkeley mentions (Introd. to "Crypt. Bot.," p. 516, Fig. 110, *b*) that he had seen at Kew the minute pinnules of one of them expanded to three times its normal length, and the margins unfolded by exposure to a warm damp atmosphere. In two full-grown specimens of *G. dichotoma* from Khasia, in the Kew Herbarium, the longest pinnules respectively are one and nine centimetres in length. The Arctic species are, however, closely represented by *G. glauca* (*G. longissima*, Hook., "Syn. Filicum"), and in this species the pinnules in different plants vary, from a single locality, between 25 and 2 mm. in length. In making species out of fragments of fossil plants the greater or less liability of the living forms to vary should, it seems to me, be kept in mind, and for general convenience the