

the field of coffee presents a sheet of white. These flowers are frequented by immense numbers of bees, of two kinds, one about three-quarters of an inch long and black, the other smaller and with white bands round its abdomen. The stigmas now are covered with pollen, and the anthers bursting, and the larger of these bees may be seen buzzing from flower to flower sweeping up the grains of pollen between its front legs, and rolling them into balls. Long before evening all the anthers are exhausted of pollen, and the insects have departed. Besides bees some butterflies visit coffee, such as *Hypolimnas bolina*, *Papilio Polymnestis*, and two or three *Danaïda*.

The coffee plant by being protogynous is intended by Nature to be cross-fertilized, but owing to all the plants in one clearing being usually grown from seed of a single estate, there must be a great deal of interbreeding, more especially as all the coffee of Ceylon and most of South India is supposed to be descended from a single plant introduced into Batavia about two centuries ago. This may have something to do with the manifest deterioration in stamina of the younger coffee.

While on this subject I may mention the curious alteration in the position of the organs of *Clerodendron infortunatum* when flowering. This plant is proterandrous: at first the style hangs



First position.

Second position.

down, while the stamens are erect: as soon as the pollen is shed the stamens drop, while the style rises, and the stigma becomes receptive. The chief carriers of pollen in this plant are small ants.

T. F. BOURDILLON.

Quilon, S. Travancore, India, September 13.

Pearls of *Jasminum Sambac*.

DR. RIEDEL tells us in NATURE of September 15 (p. 461), that he possesses in his collection two melati pearls of *Jasminum Sambac*. I beg to say that, as in the case of tabasheer (see NATURE, vol. xxxvi. p. 30), and in that of cocoa-nut pearls (*ibid.* p. 158), Rumphius, in the almost inexhaustible treasure of his "Herbarium Amboinense," has already mentioned the pearls found also in the flowers of *Jasminum Sambac*. He gives in his fifth volume, in the 30th table, a good picture of that plant, and says in the description that a "dendrites" found in its flower in 1672 was sent to him two years after. It had the shape of a bud of the same vegetable, and was white-coloured and hard like silica or alabaster; moreover, it must have been without doubt a carbonate of calcium or some other alkaline earth, for Rumphius remarks that when the pearl was imprudently moistened with citric acid part of it was consumed by the acid. He also tells us that the common name given to all stone-concretions in fruits, wood, and animals by the Malayan people is "mestica," which corresponds well with Dr. Riedel's name of "müstica." ["In Celebe, ac præsertim in Macassarâ in cunctis sæpe fructibus dendrites quædam reperiuntur, ubi inter alia in hoc quoque frutice (*Jasminum Sambac*) talis detecta fuit, quæ loco floris inventa fuit anno 1672 in horto quodam Germani ibi habitantis, quæque mihi biennium post transmissa fuit. Formam habebat capituli, seu instar veri floris Bonga Manoor, nondum aperti, eratque alba et dura instar silicis seu alabastris; inventa autem fuit in tubo veri floris atque petiolum habebat ex ligno et lapide sensim compositum; quique hanc invenerat, imprudenter in mensa deposuerat, limonum succo commaculata, qui subito eius portionem consumserat."] Frankfurt a. Oder.

E. HUTH.

Action of River Ice.

In the year 1854 the Yellow River burst through its left embankment near Kaifung-fu, and took a new course to the sea through the province of Shantung, occupying in its lower course the bed of the Tatsing-ho, which it scoured out and widened. Prior to the change the Tatsing-ho had been crossed at Tsiho-

hien, about seventeen miles above Tsinan-fu, the provincial capital, by a stone bridge, seven arches of which remained standing in 1868 when Mr. Ney Elias visited the river (see Journal Roy. Geog. Soc. vol. xl. p. 6). Owing to the increased width of the channel, this bridge only reached about three-quarters of the distance across the river, and formed a serious impediment to the navigation.

Crossing the river myself at this site in April last, I made inquiries regarding the old bridge, but, as customary in China, could elicit nothing definite; the bridge had gone, and no visible obstruction existed in the channel.

When I arrived in Tientsin in July, the Yellow River was a frequent subject of conversation, and an old friend and well-known resident, Mr. J. G. Dunn, gave me the following account of a curious phenomenon witnessed by him when crossing the river in January 1883, on his way overland to Shanghai. The winter was a severe one, and the ice on the Yellow River at this spot was about three feet in thickness. Most of the ordinary traffic of the district was carried across the ice in carts and wheelbarrows; a space was, however, kept open for the ferry, by which usually the entire traffic of the high-road from the capital crosses the river, the ice being broken up every morning so as to leave a clear passage. Mr. Dunn preferred crossing the river by the ferry, as seeming to him more convenient and safer. From the boat he witnessed the extraordinary sight of a stone bridge floating on the upper surface of the ice; the piers had apparently been lifted bodily up, some of the arches were standing, still supported at one end by an abutment, but some had fallen, and were resting as they fell in order on the surface of the ice. The bridge had apparently floated some distance down; Mr. Dunn thought, from the confused answers of the people, a considerable distance, but from a comparison of the site it could scarcely have been more than a hundred yards or so. Strong westerly winds had been blowing for some time, and probably had, combined with other causes, induced a slight rise in the level of the water sufficient to break the connexion of the ice-sheet with the banks; the space kept open for the ferry had enabled it to move downwards by degrees under the influence of wind and current, and as the piers of bridges in China are usually built without cement they offered little obstruction to the movement.

From my own experience of the people in the district I can understand Mr. Dunn's mistake as to the distance the bridge was carried, and there can be no doubt that the bridge seen was the original one described by Mr. Elias.

The fact of a bridge lifted bodily off its piers by the floating power of river ice is probably unique, but in any case is sufficiently interesting to be worthy of record. I may add that the latitude of Tsiho is approximately 36° 40' N., and the width of the river about 2000 feet.

THOS. W. KINGSMILL.

Shanghai, August 26.

Unusual Rainbow.

A RAINBOW after sunset is probably a somewhat unusual occurrence, but on the evening of September 11 I witnessed a very beautiful one from the band-stand in the Alfred Park, which is about the highest ground in Allahabad. Just before sunset the sky was more or less covered with high cirro-stratus, and promised one of the very highly-coloured sunsets common in the rainy season, while at the same time a slight storm, heralded by distant thunder, was coming up from the east. After spending a few minutes in the Public Library near the band-stand, I came out, and found the sun had set behind a bank of what Abercromby calls "rocky cumulus," or some other lumpy form of cloud, and was sending long shafts of alternate light and shadow across the southern half of the sky, while towards the north and overhead the clouds were lighted up with the most gorgeous colours. On turning to the east to see whether the flutings of the cloud-shadows appeared to meet in that quarter, as they usually do, I saw on the approaching shower, which was towards east-south-east, a beautiful double rainbow, both arcs being some 20° long, but stopping short of the horizon by 1½° or 2°, to which height the earth-shadow already extended. Both bows seemed to the eye to be somewhat narrower than usual, and between and beyond them the fluted cloud-shadows appeared, by the illusion of perspective, to converge towards the anti-solar point. The bow must therefore have been produced by the light from a portion only of the sun's disk, shining through a hollow on the top of the western bank of cloud, and doubtless

the same portion which illuminated the clouds directly overhead at the time of observation. The rainbow suffered no diminution of brightness where it was apparently crossed by the fluted shadows, the latter being far away in comparison with the bow-producing raindrops, which, of course, were in sunshine.

I regret that I am unable to send a photograph or sketch of the phenomenon, which was a most beautiful one, and must be of rare occurrence. I have never before seen anything similar, nor have I read anywhere a description of a rainbow after sunset.

Allahabad, India, September 18.

S. A. HILL.

Occurrence of *Sterna anglica* in Belfast Lough.

It may possibly interest some of your ornithological readers to know that towards the end of September a specimen of the gull-billed tern (*Sterna anglica*) was shot in Belfast Lough. The bird was placed in the hands of Mr. Darragh, of the Museum of that town, and brought by him to me for determination. On consulting the last edition of "Yarrell," I find that it does not appear to have been previously recorded from Ireland.

ROBERT O. CUNNINGHAM.

Queen's College, Belfast, October 8.

MODERN VIEWS OF ELECTRICITY.¹

PART II.

III.

WE have now glanced through electro-static phenomena, and seen that they could be all comprehended and partially explained by supposing electricity to be a fluid of perfect incompressibility—in other words, a liquid—permeating everywhere and everything; and by further supposing that in conducting matter this liquid was capable of free locomotion, but that in insulators and general space it was as it were entangled in some elastic medium or jelly, to strains in which electro-static actions are due. This medium might be burst, in a disruptive discharge, but easy flow could go on only through channels or holes in it, which therefore were taken to represent conductors; and it was obvious that all flow must take place in closed circuits.

To day I want to consider the circumstances of this flow more particularly: to study, in fact, the second division of our subject (see classification on page 532), viz. *Electricity in locomotion*.

I use the term "locomotion" in order to eliminate rotation and vibration: it is translation only with which we intend now to concern ourselves.

Consider the modes in which *water* may be made to move from place to place; there are only two: it may be pumped along pipes, or it may be carried about in jugs. In other words, it may travel *through* matter, or it may travel *with* matter. Just so it is with *heat* also: heat can travel in two ways: it can flow *through* matter, by what is called "conduction," and it can travel *with* matter, by what is called "convection." There is no other mode of conveyance of heat. You frequently find it stated that there is a third method, viz. "radiation"; but this is not truly a conveyance of *heat* at all. Heat generates radiation at one place, and radiation reproduces heat at another; but it is radiation which travels, and not heat. Heat only naturally flows from hot bodies to cold, just as water only naturally flows down hill; but radiation spreads in all directions, without the least attention to where it is going. Heat can only flow one way at any given point, but radiation travels all ways at once. If water were dissociated on one planet into its constituent gases, and if these recombined on another planet, it would not be water which travelled from one to the other, neither would the substance obey the laws of motion of water—water would be destroyed in one place, and repro-

duced in another; just so is it with the relation between radiation and heat.

Heat, then, like water, has but two direct modes of conveyance from place to place. For *electricity* the same is true. Electricity can travel with matter, or it can travel through matter; by convection or by conduction, but in no other known way.

Conduction in Metals.

Consider, first, conduction. Connect the poles of a voltaic battery to the two ends of a copper wire, and think of what we call "the current." It is a true flow of electricity among the molecules of the wire. If electricity were a fluid, then it would be a transport of that fluid; if electricity is nothing material, then a current is no material transfer; but it is certainly a transfer of electricity, whatever electricity may be. Permitting ourselves again the analogy of a liquid, we can picture it flowing through, or among, the molecules of the metal. Does it flow through or between them? Or does it get handed on from one to the next continually? We do not quite know; but the last supposition is often believed to most nearly represent the probable truth. The flow may be thought of as a perpetual attempt to set up a strain like that in a di-electric, combined with an equally perpetual breaking down of every trace of that strain. If the atoms be conceived as little conductors vibrating about and knocking each other, so as to be easily and completely able to pass on any electric charge they may possess, then, through a medium so constituted, electric conduction could go on much as it does go on in a metal. Each atom would receive a charge from those behind it, and hand it on to those in front of it, and thus may electricity get conveyed along the wire. Do not, however, accept this picture as anything better than a *possible* mode of reducing conduction to a kind of electrostatics—an interchange of electric charges among a series of conductors. If such a series of vibrating and colliding particles existed, then certainly a charge given to any point would rapidly distribute itself over the whole, and the potential would quickly become uniform; but it by no means follows that the actual process of conduction is anything like this. Certainly it is not the simplest mode of picturing it for ordinary purposes. The easiest and crudest idea is to liken a wire conveying electricity to a pipe full of marbles or sand conveying water; and for many purposes, though not for all, this crude idea suffices.

Leaving the actual mode of conveyance as unknown, let us review how much is certainly known of the process called conduction.

This much is certainly known:—

(1) That the wire gets heated by the passage of a current.

(2) That no trace of a tendency to reverse discharge or spring back exists.

(3) That the electricity meets with a certain amount of resistance or friction-like obstruction.

(4) That this force of obstruction is accurately proportional to the speed with which the electricity travels through the metal—that is, to the intensity of the current per unit area.

About this last fact a word or two must be said. The amount of electricity conveyed per second across a unit area is called the intensity of current; and experiment proves, what Ohm originally guessed as probable from the analogy of heat conduction, that this intensity is accurately proportional to the slope of potential which causes the flow; or, in other words (since action and reaction are equal and opposite), that a current in a conductor meets with an obstructive electromotive force exactly proportional to itself. The particular ratio between the two depends upon the particular material of which the conductor is composed, and is one of the constants of the material, to be determined by direct

¹ Continued from p. 571.