THURSDAY, AUGUST 5, 1886

THE BOOK OF DUCK DECOYS

The Book of Duck Decoys; their Construction, Management, and History. By Sir Ralph Payne-Gallwey, Bart. (London: John Van Voorst, 1886.)

IN the year 1812 appeared the first instalment of what its eccentric author intended to be a sketch of the local history of the Lincolnshire Fens; therein "Fen-Bill Hall" declares his set purpose of devoting a portion of the work to the "life of a low Fen-man," and of descanting largely upon the subject of decoys, adding that he had never seen but one rational writer on the subject, and that he (the said writer) manifested that he knew "nothing of the theory." Hall's book came to an untimely end with the third part, and the author therefore had not the opportunity of writing "rationally" upon a subject which would have proved so interesting in the present day and upon which so much irrational writing has been lavished. Failing "Fen-Bill Hall" so well did the decoymen keep their secret and so securely were the decoys guarded from intrusion that in all the numerous subsequent so-called descriptions, with one or two partial exceptions, the writers showed an utter want of acquaintance with both the theory and practice of decoying, and in the exceptional cases named such experience was of a very limited character, the deficiency being in all probability supplied by intentionally misleading information on the part of the guardian of the decoy. It was not till the year 1845, when the Rev. Richard Lubbock published his well-known "Fauna" of Norfolk, that the first really reliable account of the art of constructing and working a duck decoy, the result of actual experience acquired by the writer, was given to the public. Since that time various more or less accurate papers on the same subject have appeared, but it remained for Sir Ralph Payne-Gallwey (than whom no more competent authority could be found) to collect the literature of the subject, and with his own practical experiences added, to publish the first "Book of the Duck Decoy" in the form of the handsome volume now before us.

From very early times tunnel-nets appear to have been used for taking water-fowl, and there is no doubt much importance was attached to the privilege of using such engines, as appears from frequent litigation on the subject, dating back even as long ago as the reign of King John. These tunnel-nets were used for the purpose of securing young birds yet unable to fly, which with the old birds when moulting were *driven* into them. Sir Ralph Gallwey gives a curious woodcut of such an arrangement, as used in the sixteenth century, which represents in a somewhat diagrammatical way a phalanx of boats driving the birds before them into the nets fixed at the head of a bay, much as the Orkney fishermen drive a "school" of ca'ing whales on to the beach. This method of driving was found so destructive that it was prohibited by law, and was probably succeeded by a device called a cage-decoy, into which the ducks were enticed by feeding, and then secured by dropping a framework of netting which closed the entrance. Such a decoy is still worked at Hardwick Hall in Derbyshire, but it seems probable that decoys proper as used in the present day were not introduced into England till the commencement of the seventeenth century,—whether by Sir William Wodehouse as so often stated, on the authority of Sir Henry Spelman, Sir Ralph Gallwey appears to think doubtful. The decoy erected by Charles II. in St. James's Park in the year 1665 is doubtless the first arrangement on the Dutch plan for *alluring* ducks of which we have any exact account, and it is even possible that a curious old woodcut which occurs in a copy of "Æsop's Fables," dated 1665, and which Sir Ralph Gallwey reproduces at p. 9 of his book, may have been taken from this identical decoy; but should it, as seems more probable, have been sketched from a still earlier decoy, it would tend to prove that Sir William Wodehouse really had the honour of taking precedence of Charles II. in adopting the Dutch method of decoying.

For the successful working of a decoy a site must be chosen far from the busy haunts of men, secluded by a screen of trees, all the approaches to which should be under the control of its owners; at the commencement of the present century such spots were easy enough to find, and decoys abounded yielding large profits to those who worked them. Unfortunately very little is now known of the results of the working of these decoys, but we have it on the authority of Pennant that one celebrated group of ten decoys in Lincolnshire produced in a single year 31,200 ducks. There are also some published statistics of the Ashby decoy, showing that in thirty-five years 95,836 fowl were there taken; and a famous decoy in Essex produced in thirteen years 50,787 birds. Sir Ralph Gallwey estimates that 100 decoys which formerly existed in the Eastern Counties averaged 5000 ducks each yearly, or half a million of birds, and this without firing a shot, and adds, "during the last dozen years I have waged constant warfare against wildfowl, with all imaginable contrivances in the way of yachts, punts, and guns, in various parts of the world, as well as at home, at a cost of—I should be afraid to say how much time and money—yet I can account for but six or seven thousand ducks. Now, in *one* winter alone, it was in our grandfathers' days a usual thing for a decoyman to catch from five to ten thousand birds, at an annual outlay of perhaps 50*l.* spent in keeping up a pond and its netting, its pipes, and its reed screens." The price realised by the fowl at the commencement of the present century seems trivial enough as compared with that produced in the present day, but many decoys then made a return of from one to four hundred pounds per annum, perhaps even more, could the secrets of the decoymen be ascertained. In 1714 about 9*s.* 6*d.* per dozen birds seems to have been the price (it must be remembered that the smaller species of duck were counted as "half-birds," and went at twenty-four to the dozen); from thence the price appears gradually to have increased to 16*s.* per dozen in 1726. In 1765-66, 13,160 "whole-birds" (representing 18,000 fowl), captured at the Dowsley decoy, sold for 385*l.* 18*s.* 10*d.*

As might be expected of men exercising such an exceptional calling, the decoyman was clannish in the extreme; and Sir Ralph Gallwey gives some very interesting particulars of a family of typical decoymen named Skelton, who originally migrated from Firskney in Lincolnshire, where they had long followed the same occupation, into

Norfolk, in which county they remodelled most of the then existing decoys and constructed others. Descendants of the same family, having since removed to other counties, are some of them still celebrated for the skill with which they exercise the talent inherited from their forefathers. When "Old George Skelton" first came into Norfolk he found the decoy-pipes simply grouped around the margins of the "Broads," a plan which did not at all accord with his ideas of propriety, the great extent of water rendering it difficult if not impossible to have the fowl under what he considered proper control. He therefore selected a small piece of water of about two acres in extent on the banks of which to construct his decoy, much to the amusement of the local decoymen; but their derision was soon changed to amazement when in one week he captured 1100 teal in his "two-acre puddle" as they derisively termed it. The son of this man, also known as "Old George Skelton," was equally celebrated for his skill as a decoyman, and left his mark upon many of the Norfolk decoys. This man, says Sir Ralph Gallwey, is described as a "very peculiar man, short of stature, web-footed like a duck, very strongly built, particularly kind in disposition, perfectly indifferent to cold and hardship, well-informed, and unequalled in skill in the construction and management of decoys."

In the space at our disposal it would be impossible even to epitomise the full and elaborate instructions for erecting and working a decoy, given so clearly and precisely that the thirty-two plans and illustrations are scarcely necessary for their elucidation. But with such assistance there should be no difficulty in erecting the decoy, and by following the ample instructions experience would be gained in a season or two sufficient to enable almost any one to work the pipes with tolerable success; but the art of decoying is only to be acquired in perfection by careful and continued study of the habits of the frequenters of the decoy pond with practice added. We quite agree with Sir Ralph Gallwey that there cannot be a more interesting adjunct to an estate than a duck decoy, if even it be only worked on occasions to obtain a supply of fowl for the table of the proprietor and as acceptable presents to his friends; but should he be a naturalist and fond of the study of birds, a peep through the screen of his decoy at the fowl disporting themselves in a state of perfect unconsciousness under his very eye and almost within his grasp will go far towards repaying him the trifling outlay the decoy will entail. Nor need the fact of the decoy being worked preclude the proprietor from the occasional use of the gun: if not persistently disturbed the fowl will speedily return, and although it is undoubtedly to the advantage of the decoy to be perfectly secluded, a very successfully worked decoy is known to the writer in so exposed a situation that the fowl on the water may be seen from a public road which passes close by; it is astonishing how soon wildfowl become accustomed to sounds and sights which are not sudden or unexpected.

Sir Ralph Gallwey enumerates forty-four working decoys, and traces with more or less success the history of 149 others which have ceased to be used in England, and three active and nineteen disused decoys in Scotland; the sister island, so far as he can ascertain, never having possessed a decoy. Of this large number Lincolnshire possessed thirty-nine, only one of which is still worked; Essex thirty, three of which are still worked; Norfolk twenty-six, with five still worked; and Yorkshire fourteen, with two only still in use. The history of these decoys as given by Sir Ralph Gallwey will be found replete with antiquarian interest as well as with abundant matter for the consideration of the naturalist, and his chapter on the Lincolnshire Fens is especially interesting.

A short account is given of the decoys existing in Holland, from which country enormous numbers of fowl are exported annually, and which probably indicates the state of affairs which existed in this country in the palmy days of the duck decoy. A small woodcut on p. 200 shows a form of nesting basket used by the Dutch for their tame decoy ducks, and which would probably prove an excellent contrivance for inducing wild birds to nest in our own shrubberies and pleasure-grounds.

We cannot speak too highly of the plates and plans with which this handsome volume is illustrated, and we cordially recommend it to the perusal of all lovers of field-sports.

COMETARY AND PLANETARY ORBITS

Traité de la Détermination des Orbites des Comètes et des Planètes. Par le Chevalier Théodore d'Oppölzer, &c. Édition Française. Par Ernest Pasquier. (Paris: Gauthier-Villars, 1886.)

THIS is a translation from the second edition of the first volume of Prof. Oppölzer's laborious and truly classical work in German, on the theory and practical determination of the orbits of comets and planets. It has been made with the full assent and co-operation of the author, and with the assistance of Dr. Schram and others who greatly aided in the production of the original work. The volume comprises nearly 500 pages of text and 200 pages of tables, and is an excellent specimen of typography throughout. Oppölzer's first volume is divided into two parts, the first termed *preparatory*, the second treating of the determination of orbits in the various conic sections In the preparatory part we have chapters on the transformation of co-ordinates; on co-ordinates in their relation to the time and the relation between the position of the celestial body in its orbit and the corresponding epoch; likewise on the relation between a number of positions in the orbit. There is a chapter on aberration, and an important one on the theoretical determination of the formulæ of precession and nutation. The second part commences with the treatment of parabolic orbits, of which the numerous cometary discoveries of the present day necessitate so frequent application, and there are fully-worked numerical examples referring to the comets 1869 III. and 1881 III. This section is followed by a chapter, which will have much interest, on the determination of the orbit of a swarm of meteors by means of its radiant point, a problem which is reduced within a very small expenditure of time and calculation: a numerical example is worked out for one of Prof. Weiss's radiants. The next section treats of the calculation of the orbit where no assumption is made with respect to the excentricity: (1) from three observations only, as is more usually the case; (2) where four observations are introduced. The well-known general method of Gauss was published early in the present century, and has been used in determining the orbits of a large number of the minor planets, and of the comets of short period. Oppölzer substitutes for it in his second edition one of his own, which, from extensive application he has found to be much superior to all other methods, both as regards the precision of the results and the rapidity with which the computations may be performed. In the case of the planet *Ceres* he obtained results on a first approximation more exact than those given by the method of Gauss after three approximations. Further, it is pointed out that, where four observations are employed, Gauss's method is not applicable, except when the excentricity is small. There is a chapter on the modifications of Oppölzer's method necessary in the determination of cometary orbits; also a numerical example for the orbit of the minor planet *Eudora*, and one for the first comet of 1866, or the comet of the November meteors, as well as a comparison of the new method with that of Gauss, by an example taken from the *Theoria motûs*. So far, three observations are employed. Similar examples follow for the case of four observations. A succeeding section deals with the calculation of circular orbits, and it is shown that an ephemeris deduced from a circular orbit, which admits of comparatively rapid and easy calculation, may be made of service in following for a time a newly-discovered minor planet. In an appendix are collected all the formulæ usually required in the first determinations of orbits, with reference to those parts of the volume where the analysis and other details are to be found—a *résumé* that possesses great value in so extensive a work. The tables which follow are on a greatly extended and refined system, more especially that for the calculation of the true anomaly in the parabola

The great work of Oppölzer, of which Prof. Pasquier has presented astronomers with so admirable a translation, is not one suited to a beginner; but the student with a certain knowledge of the differential and integral calculus, and of analytical mechanics, may initiate himself with its aid, as the translator remarks in his preface, "à l'un des problèmes les plus hardis que se soit posés l'intelligence humaine."

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Silver-Blue Cloudlets again

FROM your last week's issue, p. 264, it would seem that the silver-blue clouds and cloudlets seen at midnight low down over the northern horizon both in this, and last, year's July are attracting much attention among your correspondents; but have not yet had the spectroscope directed to them.

Now there was a remarkable display of those bright blue clouds on the night of Tuesday, July 27, though with some variations on their exact mode of appearance in the *earlier* part of the month; but not necessarily removing them into a different category. The day had been cold but clear, especially in the northern direction, from which the wind was blowing, bar. = 29·60, night temp. = 48° F., depression of wet-bulb = 4°·0 F It was therefore just such a night as at this season of the year and in this high latitude is certain to show a coloured twilight over the sun's place beneath the northern horizon, if ordinary thick fogs, and low cloud-banks do not interfere.

On issuing, then, that night, close upon twelve o'clock, from the Observatory computing-room, upon the Calton Hill, I was surprised and even startled, not at seeing a low-down coloured twilight in the north, but at the excessive strength, and glittering brightness of its colours. You might indeed have, at first sight, imagined that some great city, spread abroad over the plains of Fife was in a fierce state of extensive conflagration, so burning red was the first and lowest stratum extending along nearly 20° of the horizon. But that awful kind of redness passed quickly into lemon-yellow clouds in the stratum next above the red; and then came the silver-blue cloudlets just above the lemon-yellow, and even brighter still; but with an innocence of colour and gentleness of beauty, which at once exorcised the horrid idea of malignant flames devouring the works of man; and showed it must be something very different.

But still what was it, that made that low level strip far away in the north, just then so brilliant in its light and intense in its colours,—that it, and it alone seemed for the time, to be illumining the otherwise pitchy darkness of night? At the same time a few stars were faintly visible; while a long streamer, of apparently white cirrus cloud, trailed over half the sky from west, to east-north-east, and passed across the Polar region at a considerable altitude, having the silver-blue cloudlets and their gorgeous red basement far below, but within, its wide-inclosing sweep.

On reaching home, I got a large spectroscope to bear on the brightest part of the low level streak of richly coloured light, its red, and yellow, and light blue, both collectively, and separately; but with no other decided effect than a short continuous spectrum in the green; which, as I have elsewhere long ago shown, is the spectrum of ordinary twilight always. For even though red and yellow be present to the eye at large, these colours rapidly fade out in any slit-formed spectrum, leaving the maximum of faint twilight placed by the prism as above described.

On this occasion, however, I did remark that that short continuous spectrum began in its citron, or commencing, region rather abruptly: in fact I even imagined a bright line there; and after several independent measures of spectrum-place, duly tested by reference both to a hydrogen tube, and the micrometer readings,—made out, that it was in the very position of the aurora line; or that, in fact, aurora was at that moment assisting, though to a very small extent, in that low streak of merely, but yet so intensely coloured, solar and Scottish, midsummer-midnight, northern, twilight.

Going next to the window, with a hand spectroscope, and examining the long ribbon of supposed white cirrus at some immense elevation,—it was startling as well as delightful to find it to consist of hardly anything but aurora; and to see aurora's chief line thin, sharp and positively brilliant along its whole extent; even appearing, if that could be, several times brighter, than its parent white streamer itself looked to the naked eye.

Nor did the identification, as aurora, of this fair white arc (transverse to a line leading to the magnetic pole), depend on the spectroscope alone: for, about 1 a.m., it began to form luminous, and rather yellowish, abutments to both its western and eastern terminations. Then its original singleness of curvature began to mould itself in the north-west into several curves of shorter radius; and after that, many thin arrows and shafts of light began to shoot out at right-angles from some parts of the great arc, and towards the zenith; and then, after a few minutes, died away. In fact it was to the eye a very fair auroral display, though the papers next morning said nothing about it.

But luminous manifestations were by no means the whole of what the aurora was doing; for presently I could conceal from myself no longer that the whole space below that long and high vaulting, white, upper arc was darkened, as compared against the sky elsewhere, with a brown-black hue; which moreover darkened still further and deepened in obscuration as it descended, until it suddenly ended sharply above, and quite close to, the silver-blue cloudlets of the low coloured twilight on the northern horizon.

Here then was a key at once to the apparently supernatural brilliance of the silver-blue cloudlets and the other colours below them; viz., all the broad expanse of ordinary further, or outer, twilight, extending in reality to far beyond and above the place of the said cloudlets, was on this occasion painted, or blocked, out by dark dun colour. Nearly half the heavens were so obscured, and the earth below was as dark. No wonder then that the residual strip of untouched twilight shone so conspicuously in contrast.

But what is that darkness below an auroral arc?

It has been compared to the dark space under the negative pole of a highly rarefied gas-tube, when an electric spark is passed through it. And if we add in idea that it extends downwards to a certain angular distance from the sun, say 20°, and keeps to that,—the suggestion may explain why the silver-blue cloudlets were seen higher over the northern horizon in the end of June and beginning of July, than at the end of the latter month; and also why they are never seen in the winter. But a still greater instrumental curiosity manifested itself in this, that the bright auroral citron-coloured line was also given in the spectroscope out of every part of that large expanse of auroral *shade;* and almost, though not quite, as well as from the bright track along its outer and upper edge; just as if, however dark to the unassisted eye, the black-brown space was yet somewhat luminiferous to the peculiar power of the prism.

On the next night after this interesting midnight experience, there was no aurora, and the twilight extended faintly to many degrees higher than the position of the blue clouds of the previous night, and in fact spread into and over the region which was before so decidedly "aurora blackened."

But the next night after that again, viz. two nights after the display, there was a wet drizzling mist which continued through the early hours until more than a quarter of an inch of rainfall had been gathered. Admirably confirming therefore the late Sir Robert Christison's often strongly expressed opinion that 48 hours after a great aurora, abundant rain is sure to follow,—an opinion too which I have only just heard was formed quite independently in Canada by my friend Mr. R. S. Haliburton, who is even now introducing it into his theory of "the aqueous origin of the aurora," so far as that can be carried; but without explaining either the citron line in the spectrum; or the effect on the magnetic needle.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, July 31

The Bright Clouds

THE bright cirrus-like clouds are very common here this summer. I have seen them here on the nights of the 12th, 18th, 20th, and 24th of last month, and on the 1st inst., also at Gilsland on the 27th ult., in fact I do not know that in the last fortnight there has been a single night on which the northern sky has been quite free from lower clouds on which they have not appeared more or less; sometimes, however, they appear but for a short time, and in a very limited area of the sky. I have tried to keep a watch to see them in the day-time, but have not succeeded as yet; the nearest approach to success was on the 20th ult., when I saw them as early as 9.22 p.m., at which time they were visible over the greater part of the sky, but in the south-east were not strikingly bright.

There is one peculiarity with respect to them that I have not seen mentioned in NATURE, and that is their motion; on the above dates, except the 20th, I took notice of this, and in every instance the motion was from a northerly or easterly direction, whereas I have not noticed any ordinary cirrus moving from that quarter lately. Last night at from 10 to 10.15, when there were small patches of these curious clouds, there was also at the same time a great deal of ordinary cirrus moving from the west. This circumstance appears to indicate that there is quite a different current of wind in the upper atmosphere from that blowing at the lower elevation of ordinary cirrus.

I have no hesitation in saying that these extraordinary clouds do not shine with their own light, but with the direct light of the sun.

T. W. BACKHOUSE

Sunderland, August 2

Aurora

THE following is a record of aurora observed on July 27 at Ramelton, co. Donegal:—

9.30 p.m.—From west to east there were occasional pencils of reddish lights shooting up, while from east to west there were continuous pencils of yellowish and reddish lights, with intermittent clouds and columns of reddish light, rising between the north-east and north-north-west. The pencils were very steady, but increasing and decreasing in length, at times assisted by the clouds of red forming a corona at the zenith round the star Capella (?), at such times as pencils shot up from the southward, on a rude irregular cross. The corona and cross appeared and disappeared quite rapidly. The clouds and columns of reddish light were succeeded by flashes and pencils of bright silver light, they being most frequent and brilliant between the north and west, the flashes being sometimes in long narrow wavy clouds that rapidly ascended, or narrow sheets that appeared and disappeared nearly instantaneously. They became more and more brilliant, especially to the north-north-west, till the display was greatest between 10.30 and 10.45.

10.45 p.m.—About this hour the continuous pencils of yellow and reddish lights between the east and west disappeared with the other lights, but about five minutes afterwards, to the northward, silver pencils and sheets appeared, veering from thence gradually towards the north-east and east. Some of the sheets hung at times in clouds that formed small arcs, that slowly rose obliquely, and moving eastward till about 11 o'clock, when all the lights disappeared, except that at long intervals faint pencils or flashes might shoot up on a small arc of silver clouds; but at 11.25 there was another brilliant display. First there appeared an arch of silver light, its centre being about north-north-west, then two arches that began sending up horns and pencils of light. The upper arch was a little below the North Star, while the lower one went through the Pointers of the Plough; these two arches were succeeded by one at 11.35. The crown of the arch was very unsteady, moving from north to north-north-west and back again, its shape and the accompanying horns and pencils continually changing, the most brilliant and highest pencils being those that shot up to the north-westward. This display continued more or less brilliant till 11.45, when clouds came up and prevented further observations; but at midnight the position of an arch was distinctly defined behind the clouds. At 1 a.m. the clouds had cleared away and no lights were visible. The night was not favourable for seeing an aurora, as it was very light and clear, yet at times the lights were very brilliant. Although the arches were of the same class of silver light as those seen from the North Atlantic or the Canadian Lakes, yet they were not steady like those, as they were continually shifting their positions or disappearing and reappearing. During the previous day there was a northerly wind with at times intensely cold squalls of misty rain.

G. H. KINAHAN

ABOUT 11.15 p.m. July 27, 1886, I observed an incipient stage of the aurora borealis, and about c. 10 a.m. of the 28th a considerable display of auroral colour commenced; but between 0.30 a.m. and 1 there was a vivid display of huge auroral sheets and columns; indeed, it did not require much to entitle the golden scene to the epithet—magnificent. There was a prismatic arc, not unlike a rainbow, which spanned from the north-west to the east, and measured about 70° from its centre to the horizon. All under this arc was a flood of white light, which the aurora did not in the least degree invade. From this arc developed a brilliant aurora borealis to a few degrees south of the zenith; and, with other constellations, Cygnus, Lyra, and the Northern Crown were overwhelmed in a golden flood. In this part of our northern latitude there are at present highly favourable conditions for phenomenal refraction of solar light. On the morning of the 27th and 28th the earth-shine on the moon was very bright, and I have no doubt but that these atmospheric conditions are also favourable to auroral displays. Every vestige of the aurora borealis disappeared about 2.30.

I do not think that an aurora as early as July is on record; in the Culloden meteorological records there is not one recorded so early as July from 1841 to 1880; indeed August is reckoned unusually early for an aurora borealis. I recollect a most magnificent one about the beginning of August in 1882, in the upper reaches of Lanarkshire; the huge vivid sheets and columns reached from the west all along the horizon to the east, and up the vault of heaven to the zenith, and with their fleet shifting flashes and bursts of prismatic coruscations, they lighted up the earth with ineffable glory.

DONALD CAMERON

The Academy, 22, Argyll Street, Paisley, July 28

Halos and Mock Suns

ON Tuesday, July 20, about 5.15 p.m., I saw from this neighbourhood a most remarkable series of halos and parhelia, the general appearance of which is represented in the accompanying figure. (The parhelia at 120°, P^{iii} and P^{iv}, cannot be represented in the figure.)

As I happened to have a theodolite near at hand, I measured the altitudes and azimuths of the parhelia and contact arches, and also of two points on the larger halo, with the following result:—

	Azimuth by back angle	Altitude.	
Sun	320°	25°	
Parhelia			Angular distance from sun
P^{i}	347	25	27
P^{ii}	293	25	27
P^{iii}	80	25	120
P^{iv}	200	25	120
Contact-arch to inner halo			Radius of large halo from mean of two observations
Left extremity (A^{ii})	285	39	
Right extremity (A^{i})	353	39	63° 30′

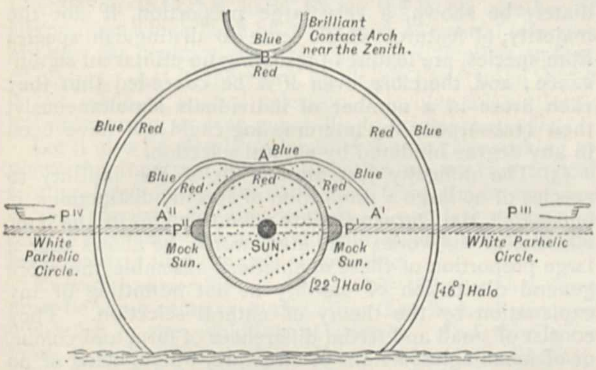
The positions of the two parhelia P^{iii} P^{iv} (or more properly speaking, *anthelia*) at 120° on either side of the sun, exactly accord with what is given in the text-books, but the solar longitude of the parhelia on the primary halo 27°, and the dimensions of the larger halo 63½°, usually given as 46°, are greater than those usually recorded.

The following features were observed:—

(1) The parhelion, P^{ii} 27°, to the left of the sun, was very brightly visible before that on the right appeared at all.

(2) The parhelic circle appeared to encircle the entire sky, and to be everywhere of the same altitude—25°—as that of the sun.

(3) The contact arch, B, at the top of the larger halo, was remarkably brilliant, being red on the side adjacent to the sun,



and blue on that furthest from it, and appeared to be almost exactly at the zenith, thus supporting the somewhat rough measurements of the outer halo, which made it considerably larger than the traditional 46°.[1]

(4) The contact arches A^{i} A^{ii} were also very brilliant, and the space within them as well as that within the inner halo *h h* was much darker than that outside.

(5) The colours of the outer halo, H H, were similar to those of the inner halo, *h h*, viz. red inside and blue outside, but fainter.

(6) The parhelia attached to the inner circle P^{i} P^{ii} were similarly red inside and blue outside, while those at 120° were perfectly white.

The whole phenomenon lasted about twenty minutes, and was one of the most beautiful sights I ever saw. I was experimenting with a captive balloon at the time, or should have been able to make more detailed observations. I hear that on Monday night a deluge of rain of a tropical character fell at Dieppe. The cloud which caused these unusual optical phenomena appeared to be of the type termed by Poëy globo-cirrus. I shall be glad to hear if any corroborative measurements were made by other observers. E. DOUGLAS ARCHIBALD

Tunbridge Wells, July

P.S. No parhelia were visible at the junction of the larger halo H H with the parhelic circle. Also there were no signs of the rare 90° radius halo. The radius of the inner halo was not measured, but as the lateral deviation of the parhelia P^{i} P^{ii} from the points in which it intersected the parhelic circle for a solar altitude of 25° should be about 2° 7′, this would make the radius of the inner halo 24° 53′ instead of 22° 30′ as is generally the case.

[1] Sun's altitude = 25°, radius of halo = 63½°, which would make the lower extremity of the top contact-arch 88½° above horizon.

ON Tuesday afternoon, 20th inst., while sketching near Cranbrook, in the Weald of Kent, I saw a magnificent example of mock suns and solar rainbow circles.

From an early part of the day the sky had been, I think, more splendid in its cloud arrangements of cirro-cumulus than I have ever seen in this or any other country, though I have always been a delighted student of these phenomena. From 10 a.m. to about 4 p.m. there was an incessant change of loveliness in the forms and positions of the clouds and the remarkable perspectives thereby produced, to the intense admiration of myself and wife. But about 4 o'clock one half of the heavens from the horizon to the zenith became nearly covered with a thin stratum of dark clouds, which resembled more than anything else innumerable long bundles of cotton fibre, placed in every possible direction. The other half of the sky was of the richest and most delicate ultramarine as a background, and the fleecy *mare's tail* and *flocks of sheep* cloudlets as the subjects. On the dark strata of clouds the mock suns made their appearance, the real sun shining through the clouds with great intensity.

The whole phenomenon did not fade out till nearly 6 o'clock. As I saw it for some time reflected in a large sheet of water, I had good opportunities of studying it.

The setting of the sun that night was the most gorgeous pageant—myriads of golden streamers, in groups, being sent up from purple and scarlet clouds. ROBERT H. F. RIPPON

Jasper Road, Upper Norwood, July 28

N.B. The clouds in the vicinity of the sun were slightly opalescent.—R. H. F. R.

A Singular Case

ON March 2 last a small fishing-boat engaged in trawling at about 20 kilometres from the coast, off Monte Argentaro (Tuscan Maremma), captured a specimen of the Mediterranean Red Mullet (*Mullus barbatus*) tightly incased in a large colony of *Pyrosoma atlanticum*. The head of the fish had reached the bottom of the social cylinder, which fitted it to a nicety. The *Pyrosoma* measures 0·112 millimetre in length and 0·032 millimetre at its greatest transverse diameter; the mullet is 0·152 millimetre long, so that only 0·040 millimetre of its tail projects beyond the tightly-fitting *Pyrosoma!* The fish was taken *alive*, but how it could have lived in such conditions or how it got into its tight jacket is to me most enigmatical. Even admitting a certain amount of elasticity in the tight-fitting tube in which its head, body, and fins are incased, its movements could only have been very limited, and a very incomplete respiration and perhaps nutrition might have come to it through the orifices of the zooids.

Young fish, especially Scomberoids, are often found under the shelter of Medusæ and *Physalia*—the case of *Fierasfer* getting into the visceral cavity of *Holothuria* is well known; but it is the first time I have seen or heard of so singular a case of imprisonment as the one related above, and I therefore thought it worthy of the attention of the readers of NATURE. The specimen is preserved in alcohol in the rich ichthyological series of the collection of Italian Vertebrata in the Florence Royal Zoological Museum. HENRY H. GIGLIOLI

Florence, July 29

The Weather at Caracas

THE following notes on the weather at Caracas during the remarkable storm from May 11 to 15 may not be void of interest:—

We had a rather low barometer on May 8 (10 a.m., 682·93 mm.; 4 p.m., 681·99 mm.), but then it rose gradually till May 18 (685·42 and 683·17 mm. respectively). There had been no rain in the first twelve days of the month, but from

May 13 to 16 there fell 106 mm. rain, about *one-ninth* of our total yearly quantity; on the 13th, 26 mm.; 14th, 27·6; 15th, 22·4; 16th, 30. These heavy rains were undoubtedly due to the northern storm, although they came two days later.

Caracas, June 29 A. ERNST

The Indivisibility of Certain Whole Numbers

ANOTHER exception has been found to Fermat's assertion regarding the indivisibility of whole numbers of the form $2^{2^m} + 1$ (see several notices in NATURE, vols. xviii. and xix.). The matter now stands as follows:—

$2^{2^5} + 1$	divisible by	$5 \cdot 2^7 + 1$	(Euler)
$2^{2^6} + 1$	,,	$1071 \cdot 2^8 + 1$	(Landry)
$2^{2^{12}} + 1$	,,	$7 \cdot 2^{14} + 1$	(Pervouchine)
$2^{2^{23}} + 1$	,,	$5 \cdot 2^{25} + 1$	(Pervouchine)
$2^{2^{36}} + 1$	,,	$5 \cdot 2^{39} + 1$	(Seelhoff).

M.

A Quadruped Duck

IT may interest some readers of NATURE to hear that there is at present living in Bardsea a duck which has four feet. The two abnormal feet, which are webbed like the others, and of the same shape and size, spring from one leg, which is about the same length as the normal legs, but rather thicker. This leg grows from a point just beneath the tail. Its bone does not seem to be directly connected with the other bones of the bird, as it can be freely moved in any direction. This duck is more than a month old, and is healthy. EDWARD GEOGHEGAN

Bardsea, August 3

PHYSIOLOGICAL SELECTION: AN ADDITIONAL SUGGESTION ON THE ORIGIN OF SPECIES[1]

I.

THERE are three cardinal difficulties in the way of natural selection, considered as a theory of the origin of species.

(1) The difference between species and varieties in respect of mutual fertility. Many of our domesticated varieties differ from one another to an extent greater than that which distinguishes many natural species: yet they continue perfectly fertile *inter se*, while the natural species are nearly always more or less sterile. The difficulty is not met by pointing to the fact that sterility between natural species is neither absolutely constant nor constantly absolute; for the question still remains, Why are the modifications of organic types supposed to have been produced by natural selection, so generally attended with some more or less pronounced degree of mutual sterility, when even greater modifications of such types produced by artificial selection so generally continue mutually fertile? That this question does not admit of any answer by the theory of natural selection Mr. Darwin himself acknowledges, and therefore suggests a wholly independent hypothesis by which to explain the fact. This hypothesis is, that varieties occurring under nature "will have been exposed during long periods of time to more uniform conditions than have domesticated varieties, and this may well make a wide difference in the result." Now, whatever we may think of this hypothesis, it is certainly quite distinct from the theory of natural selection; and, therefore, any one who adopts the supplementary hypothesis is, so far, confessing the inadequacy of that theory, considered as a theory of the origin of species. For my own part, I deem the hypothesis wholly insufficient to meet the facts. When we remember the incalculable number of species, living and extinct, we immediately feel the necessity for some much more general explanation of their existence than is furnished by supposing that their mutual sterility, which constitutes their most general or constant distinction as species, was in every case due to some incidental effect produced on the generative system by uniform conditions of life. To say nothing of the antecedent improbability that in all these millions and millions of cases the reproductive system should happen to have been affected in this peculiar way by the merely negative condition of uniformity, there remains what seems to me the overwhelming consideration that, at the time when a variety is first forming, the condition of prolonged exposure must necessarily be absent as regards that variety: yet this is just the time when we must suppose that the infertility with its parent form arose. Because, if not, the incipient variety would have been reabsorbed into its parent form by intercrossing.

(2) For the swamping effects of free intercrossing upon an individual variation constitutes the next, and perhaps the most formidable, difficulty with which the theory of natural selection is beset. The only answer which Mr. Darwin has to make in this case is that a number of individuals inhabiting the same area may vary in the same way at the same time. Of course, if this assumption were granted, there would be an end of the present difficulty; for if a sufficient number of individuals were thus similarly and simultaneously modified, there need no longer be any danger of the variety being swamped by intercrossing. But the force of the difficulty consists in the very fact of this assumption being required to meet it. The theory of natural selection trusts to the chapter of accidents in the matter of variation; and in this chapter we read of no reasons why the same beneficial variation should arise in a number of individuals simultaneously. Moreover, if it does so, the fact of its doing so cannot be attributed to natural selection, which thus again fails as a theory of the origin of species. Lastly, as will immediately be shown, a very large proportion, if not the majority, of features which serve to distinguish species from species, are features presenting no utilitarian significance; and, therefore, even if it be conceded that they each arose in a number of individuals simultaneously, their reabsorption by intercrossing could not have been in any degree hindered by natural selection.

(3) The difficulty just alluded to of the inutility to species of so large a proportion of specific distinctions, is one which Mr. Darwin frankly acknowledges in the later editions of his works. In other words, he allows that a large proportion of these distinctions resemble the more general distinction of sterility in not admitting of any explanation by the theory of natural selection. They consist of small and trivial differences of form and colour, or of meaningless details of structure, which, being of no service to the plants or animals presenting them, cannot have arisen through the agency of natural selection. If it be suggested that all such distinctions are of disguised utility, the answer is that to offer this suggestion is to reason in a circle. For the only evidence we have of natural selection as an operating cause in any case is derived from the utility of the observed results: therefore, in cases where utility is apparently absent, we may not assume that it must be present only because, if it were not present, the results must be due to some cause other than natural selection. Observe, the case would be different if the great majority of specific distinctions—like the great majority of higher distinctions—were of obvious utilitarian significance; for in this case we might reasonably set down the exceptions as proof of the rule, or hold that they appear to be exceptions only on account of our ignorance. But it is certainly too large a demand on our faith in natural selection to appeal to the argument from ignorance when the facts require that the appeal should be made over so very large a proportion of instances. But it is needless further to insist upon this

[1] Abstract of a Paper read before the Linnean Society on May 6, by George J. Romanes, M.A., LL.D., F.R.S. &c.

point, since, as I have already observed, its force has been fully recognised by Mr. Darwin and his followers. Here again, therefore, the theory of natural selection fails as a theory of the origin of species.[1]

In view of these three grave disabilities under which the theory of natural selection lies, I feel entitled to affirm that the theory has been misnamed. Natural selection is not, properly speaking, a theory of the origin of *species*: it is a theory of the origin—or rather of the cumulative development—of *adaptations*, whether these be morphological, physiological, or psychological; and whether they occur in species only, or likewise in genera, families, orders, or classes. These two things are very far from being the same; for, on the one hand, in an enormously preponderating number of instances, adaptive structures are common to numerous species, while, on the other hand, the features which serve to distinguish species from species are, as we have just seen, by no means invariably—or even generally—of any adaptive character. If once it is thus clearly perceived that the theory of natural selection is not a theory of the origin of species, but a theory of the development of adaptive structures—whether these happen to be distinctive of species or of higher taxonomical divisions—if once this is clearly perceived, the theory is released from all the difficulties which we have been considering. For these difficulties have beset the theory only because it has been made to pose as a theory of the origin of species, whereas in point of fact it is nothing of the kind. In so far as natural selection has had anything to do with the genesis of species, its operation has been, so to speak, incidental: it has only helped in the work of originating species in so far as some among the adaptive variations which it has preserved happen to have constituted differences of merely specific value. Many other such differences there are with which natural selection has had nothing to do—particularly the most universal of all such differences, or that of mutual sterility—while, on the other hand, by far the larger number of adaptations which have been the work of natural selection are now the common property of genera, families, orders, or classes. Let it, therefore, be clearly understood that it is the office of natural selection to evolve adaptations: not necessarily, or even generally, to originate species.

Let it also be clearly understood that in thus seeking to place the theory of natural selection on its true logical footing, I am in no wise detracting from the importance of that theory. On the contrary, I am but seeking to release the theory from the difficulties with which it has been hitherto illegitimately surrounded.

Enough has now been said to justify the view that there must be some cause or causes other than natural selection operating in the evolution of species. And this is no more than Mr. Darwin himself has expressly and repeatedly stated to have been his own view of the matter; nor am I aware that any of his followers have thought otherwise. Hitherto the only additional causes of any importance that have been assigned are use and disuse, sexual selection, correlated variability, and yet another principle which I believe to have been of much more importance than any of these. Yet it has attracted so little attention as scarcely ever to be noticed by writers on evolution, and never even to have received a name. For the sake of convenience, therefore, I will call this principle the Prevention of Intercrossing with Parent Forms, or the Evolution of Species by Independent Variation.

First let us consider how enormous must be the number of variations presented by every generation of every species. According to the Darwinian theory it is for the most part only those variations which happen to have been useful that have been preserved: yet, even as thus limited, the principle of variability is held able to furnish sufficient material out of which to construct the whole adaptive morphology of nature. How immense, therefore, must be the number of unuseful variations! Yet these are all for the most part still-born, or allowed to die out immediately by intercrossing. Should such intercrossing be prevented, however, there is no reason why unuseful variations should not be perpetuated by heredity quite as well as useful ones when under the nursing influence of natural selection—as, indeed, we see to be the case in our domesticated productions. Consequently, if from any reason a section of a species is prevented from intercrossing with the rest of its species, we might expect that new varieties (for the most part of a trivial and unuseful kind) should arise within that section, and that in time these varieties should pass into new species. And this is exactly what we do find. Oceanic islands, for example, are well known to be extraordinarily rich in peculiar species; and this can best be explained by considering that a complete separation of the fauna and flora of such an island permits them to develop independent histories of their own, without interference by intercrossing with their originally parent forms. We see the same principle exemplified by the influence of geographical barriers of any kind, and also by the consequences of migration. When a species begins to disperse in different directions from its original home, those members of it which constitute the vanguard of each advancing army are much more likely to perpetuate any individual variations that may arise among them than are the members which still occupy the original home. For not only is the population much less dense on the outskirts of the area occupied by the advanced guard; but beyond these outskirts there lies a wholly unoccupied territory, upon which the new variety may gain a footing during the progress of its further migration. Thus, instead of being met on all sides by the swamping effects of intercrossing with its parent form, the new variety is now free to perpetuate itself with comparatively little risk of any such immediate extinction. And, in the result, wherever we meet with a chain of nearly allied specific forms so distributed as to be suggestive of migration with continuous modification, the points of specific difference are trivial or non-utilitarian in character. Clearly this general fact is in itself enough to prove that, given an absence of overwhelming intercrossing, independent variability may be trusted to evolve new species. The evidence which I have collected, and am collecting, of the general fact in question, must be left to constitute the subject of a future paper.[1]

Were it not for the very general occurrence of some degree of sterility between even closely allied species, and were it not also for the fact that closely allied species are not always separated from one another by geographical barriers, one might reasonably be disposed to attribute all cases of species-formation by independent variability to the prevention of intercrossing by geographical barriers, or by migration. But it is evident that these two facts can no more be explained by the influence of geographical barriers or by migration than they can by the influence of natural selection. The object of the present paper is to suggest an additional factor in the formation of specific types by independent variability, and one which appears to me fully competent to explain both the general facts just mentioned.

[1] Of the three cardinal objections to the theory of natural selection thus briefly stated, Mr. Darwin himself appears to have attributed most importance to the first, seeing that its consideration occupies so large a portion of his writings. The objection from intercrossing, on the other hand (which was first rendered with much force and clearness by the late Prof. Fleeming Jenkin of Edinburgh, in an anonymous article, *North British Review*, 1867), is the only difficulty in the way of his theory which Mr. Darwin can fairly be said not to have sufficiently treated. The objection from inutility was first prominently raised by Bronn. It was afterwards developed by Nägeli, Broca, Mivart, and many other writers.

[1] So far as I am aware, the first writer who insisted on the importance of the prevention of intercrossing in the evolution of species, both by isolation and migration, was Moritz Wagner. Since then Wallace, Weismann, and others have recognised this factor. The most recent contribution to the subject is an admirable collection of facts published by Mr. Charles Dixon in a work entitled, "Evolution without Natural Selection," which was recently reviewed in these columns. But I cannot find that any of these writers allude to the principle which it is the object of the present paper to enunciate, and which is explained in the succeeding paragraphs.

Of all parts of those variable objects which we call organisms, the most variable is the reproductive system; and the variations may be either in the direction of increased or of diminished fertility. Having, regard, therefore, to all the delicate, complex, and for the most part hidden conditions which determine this double kind of variation within the limits of the reproductive system, there can be no difficulty in granting that variations in the way of greater or less sterility must frequently occur both in plants and animals in a state of nature. Probably, indeed, if we had the means of observing this point, we should find that there is no one variation more common. But, of course, whenever it arises—whether as a result of changed conditions of life, or, as we say, spontaneously—it immediately becomes extinguished, seeing that the individuals which it affects are less able (if able at all) to propagate the variation. But now, if the variation should be such that, while showing some degree of sterility with the parent form, it continues to be perfectly fertile within the limits of the varietal form, in this case the variation would neither be swamped by intercrossing, nor would it die out on account of sterility. On the contrary, this particular variation would be perpetuated with more certainty than any other variation, whether useful or unuseful. An illustration will serve to render this more clear.

Suppose the variation in the reproductive system is such that the season of flowering or of pairing becomes either advanced or retarded. Whether this variation be, as we say, spontaneous, or due to any change of food, climate, habitat, &c., does not signify. The only point we need here attend to is that some individuals, living on the same geographical area as the rest of their species, have varied in their reproductive systems so that they are perfectly fertile *inter se*, while absolutely sterile with all other members of their species. By inheritance there would thus arise a variety living on the same geographical area as its parent form, and yet prevented from intercrossing with that form by a barrier quite as effectual as a thousand miles of ocean: the only difference is that the barrier, instead of being geographical, is physiological.

From this illustration I hope it will be obvious that wherever any variation in the highly variable reproductive system occurs, tending to sterility with the parent form without impairing fertility with the varietal form—no matter whether this be due, as here supposed, to a slight change in the season of reproductive activity, or to any other cause—there the physiological barrier in question must interpose, with the result of dividing the species into two parts. And it will be further evident that when such a division is effected, the same conditions are furnished to the origination of new species as are furnished to any part of a species when separated from the rest by geographical barriers or by migration. For now the two sections of the species, even though they be living on the same area, are free to develop distinct histories without mutual intercrossing, or, as I have phrased it, by independent variation.

To state this suggestion in another form. It enables us to regard many, if not most, natural species as the records of variation in the reproductive systems of ancestors. When accidental variations of a non-useful kind occur in any of the other systems or parts of organisms, they are, as a rule, immediately extinguished by intercrossing. But whenever they happen to arise in the reproductive system in the way here suggested, they must inevitably tend to be preserved as new natural varieties, or incipient species. At first the difference would only be in respect of the reproductive system; but eventually, on account of independent variation, other differences would supervene, and the new variety would take rank as a true species.

The principle thus briefly sketched in some respects resembles, and in other respects differs from, the principle of natural selection, or survival of the fittest, as I will show later on. For the sake of convenience, therefore, and in order to preserve analogies with already existing terms, I will call this principle Physiological Selection, or Segregation of the Fit.

Before proceeding to state the evidence of the particular kind of variation on which this principle depends, let it be noted that we are not concerned either with its causes or its degrees. Not with its causes, because in this respect the theory of physiological selection is in just the same position as that of natural selection: it is enough for both that the needful variations are provided, without its being incumbent on either to explain the causes which underlie them. Neither are we concerned with the degrees of sterility which the variation in question may in any particular case supply. For whether the degree of sterility with the parent form be originally great or small, the result of it will in the long run be the same: the only difference will be that in the latter case a greater number of generations would be required in order to separate the varietal from the parent form.

(*To be continued.*)

TROPICAL FRUITS[1]

THE present Colonial and Indian Exhibition has developed interest in tropical fruits to an extent not previously known in England; and whatever may be the individual merits of many of the fruits displayed in the colonial market attached to the Exhibition, no one can deny that they afford proof of numerous undeveloped resources of our colonial possessions in a direction hitherto very much undervalued or entirely overlooked. Sir Joseph Hooker, in one of his journals, has remarked that "most tropical fruits are edible, but few are worth eating." But, after all, the merits of many fruits like those of certain wines are only properly appreciated under a concourse of local circumstances which materially affect our verdict. In the tropics the desire for refreshment and for something cooling and piquant is met by a fruit which, at the moment, completely answers the purpose. Transferred to a cooler climate, the same fruit may be entirely out of place, and indeed may be condemned as valueless. As a case in point, the water of a young cocoa-nut, when clear and fresh, taken from the fruit after a long ride in the sun, is most refreshing and wholesome. The same thing tried in the climate of England, and with fruit imported from the tropics, would be nauseous and wholly unpalatable. Similar remarks would apply to the fruit of the mangosteen, the durian, and many others where it is necessary that the fruit should be eaten when just ripe, and where a long journey affects the quality and impairs the delicacy—both being of an evanescent character.

Again, it is necessary to bear in mind how to use certain tropical fruits in order to appreciate them to the best advantage. Owing to the loose manner in which tropical fruits are termed, apples, plums, pears, peaches, &c., when they are neither botanically nor intrinsically anything of the sort, there has arisen considerable confusion respecting them. Again, many tropical fruits are suitable only for salads or curries, and should not appear at the dessert table at all. Others are better when preserved or cooked, and they are then both wholesome and well adapted to the wants of the country. There is no good pear (*Pyrus communis*, L.), as known in England, grown in the tropics, yet we have the name applied to the Alligator or Avocado pear (*Persea gratissima*, Gart), the anchovy pear (*Grias cauliflora*, L.), the prickly pear (*Opuntia ficus-indica*, Webb), and the wooden pear of Australia (*Xylomelum pyriforme*, Knight). Again, the English apple, although grown in the hills in the tropics, is practically of little value, but the name is as loosely applied as in the case of the pear, and hence fruits as widely apart as the poles in their botanical classi-

[1] Lecture given in the Conference Hall, Colonial Exhibition. Revised by the Author.

fication are grouped together under the general term of apple. To select a few out of many such names, we have the sugar or custard apple (*Anona reticulata*, L.), the Kei apple (*Aberia caffra*, H. and S.), the Mammee apple (*Mammea americana*, L.), the star apple (*Chrysophyllum Cainito*, L.), the rose apple (*Eugenia Iambos*, L.), and the golden apple (*Spondias lutea*, L.). In plums there are the Caffre plum (*Harpephyllum caffrum*, Bernh.), the coco plum (*Chrysobalanus icaco*, L.), the hog plum (*Spondias mangifera*, Pers.), the Chinese date plum (*Diospyros kaki*, Lin. fil.), the blood plum (*Hæmatostaphis Barteri*, H. K.), and the gray plum of Sierra Leone (*Parinarium excelsum*, Sabine); and so with the gooseberry, essentially a cold temperate fruit, English colonists have applied the name to such widely-diverging fruits as those of *Physalis Peruviana*, L. (Cape gooseberry), *Peirescia aculeata*, Mill (Barbados gooseberry), and *Cicca disticha*, L. (Otaheite gooseberry).

The so-called Nuts of the Tropics are in a worse state of confusion as regards the common names, and hence it by no means follows that what are imported as nuts belong at all to that category of fruits. The most familiar of tropical nuts is the cocoa-nut (*Cocos nucifera*, L.), a true nut; but the Para or Brazil nut (*Bertholetia excelsa*, H. B.) is simply the seed, not nut, which is inclosed in a large globular fruit, almost as large as a 36-pound cannon-ball; exactly the same occurs in the case of the Sapucajo nut (*Lecythis Zabucajo*, Aub.) as well as in the best of these so-called tropical nuts, viz. the souari or butter-nut of British Guiana (*Caryocar nuciferum*, L.). The cashew nut (*Anacardium occidentale*, L.) is a fruit borne upon a swollen pear-like peduncle, and presents one of the most remarkable instances of growth met in the tropics. The fruit when roasted is esteemed at dessert, and passes in India under the name of "promotion nut." The Jamaica walnut (*Aleurites moluccana*, Willd) is the seed of an Euphorbiad, as also the cob-nut (*Omphalea triandra*, L.).

From the above remarks it will be noticed from what various sources, and from what a diversified range of plants tropical fruits are derived. Also that little dependence can be placed on the common English names applied to these fruits. Where obtainable little objection can, however, be made against adopting the native or aboriginal names of tropical fruits, as in many cases they are sufficiently distinct, and at the same time are associated with circumstances of a local character, which render the name of permanent value. On this account a native or aboriginal name is quite as good, locally, as the scientific name; but of course it loses its value outside its own country. We have incorporated the aboriginal name in the case of the pine-apple (*Ananas sativa*, L.), and many instances of a similar character are found in the nomenclature of Indian and Chinese fruits.

Although not strictly speaking a tropical fruit, the orange is found in both the eastern and western tropics, and it is the best known of any foreign fruit. Large increase has occurred in the importation of this fruit to England within the last few years, and the present consumption is at the rate of 4½ million bushels per annum, or equal to a consumption of sixteen oranges per head of population. Of fruits belonging to the same natural order as the orange there are the lemon (*Citrus medica*, var. *Limonum*, Brand), not largely grown in the tropics; the shaddock, or pumelo (*Citrus decumana*, L.), a fruit often 24 inches in circumference; the citron (*Citrus medica*, Riss.), chiefly used for "candied peel;" and the lime (*Citrus medica*, var. *acida*, Brand), which is chiefly known as the West India lime, and largely grown for making lime juice, raw and concentrated, for the manufacture of citric acid. This West Indian lime should take the entire place of the lemon in the English market, and when used in cooking gives a most piquant and refreshing flavour, not obtainable from any other source.

The banana generally found in the English market is the dwarf Chinese fruit (*Musa Cavendishii*, Paxt.). This is smaller and not so good as the true banana (*Musa sapientum*, L.), of which there are numerous varieties. The banana chiefly grown for export purposes in the West Indies is called the Martinique banana, a large yellow fruit about 6 to 8 inches long. The Cuban banana is a red-skinned variety, much coarser than the Martinique fruit, and only eaten when very "full," or in the ripe state of an English medlar. A variety of the banana with short thick fruits of very choice quality is called the fig banana, and this is esteemed as the best of the family, and consumed locally. The plantain (*Musa paradisiaca*, L.), is practically the tropical potato, and is used roasted, boiled, or fried, exactly as we use potatoes in England. At the present time the consumption of bananas in the United Kingdom is comparatively small. Some of the steamers trading with the West Indies are, however, being fitted with refrigerating chambers for carrying tropical fruit, and the banana should soon become as plentiful and as cheap as the orange. It has the merit of being wholesome and nutritious, and is suitable for invalids and young children as well as for dessert purposes.

The pine-apple we have already noticed. This is a deliciously refreshing fruit with healthful juices, and the demand for it is increasing daily. Hitherto, foreign pine-apples, which are gradually driving the home-grown fruit out of the market, are obtained in large quantities from the Azores. The further supply will no doubt come from the West Indies, where pine-apples can be grown in the open air as readily and as cheaply as the English farmer can grow beets or turnips. Unfortunately the choice varieties of pine-apples possess, as the growers say, "bad keeping" qualities; but with increased facilities for packing and stowing the fruit, there should be no difficulties of an insurmountable character in the way of bringing over pine-apples from the West Indies in excellent condition. At the colonial market attached to the Colonial and Indian Exhibition pine-apples from Antigua are sold at sixpence each, and we find from the Blue Book Report that the Bahamas export annually, either in a fresh or canned state, pine-apples to the value of 50,000*l*. annually. The mango (*Mangifera indica*, L.) is the apple of the tropics, and the mango tree is grown and occupies orchards as do apple-trees in England. Although an East Indian tree, it has become thoroughly naturalised in the west, where it spreads by self-sown seedlings over all waste places. Its introduction into Jamaica is thus described by Lunan ("Hortus Jamaicensis," 1814, p. 486):—"This beautiful tree was one of those brought to this island in June 1782, and taken in a French ship, bound for Hispaniola, by Capt. Marshall, of His Majesty's ship *Flora*, one of Lord Rodney's squadron. Capt. Rodney, with the approbation of Lord Rodney, deposited the mango plants and a great many others taken in the same vessel in Mr. East's garden (at Gordon Town), where they were cultivated with great assiduity and success, and have now become one of the commonest fruit-trees in Jamaica, in a great number of its varieties." As the mango ripens in July and August, and would come into the English market at a time when our own fruits are plentiful, it is possible it will not be greatly in demand. The best varieties are the Bombay sorts, while in Jamaica one of the plants deposited by Lord Rodney and having a number only, is is still known there and highly esteemed as "No. 11."

The passion fruits, of which there are several species, are highly prized. Of these there are the granadilla (*Passiflora quadrangularis*, L.), the pomme d'or, or water lemon (*P. laurifolia*, L.), the sweet cup (*P. edulis*, L.), and the calabash sweet-cup (*P. maliformis*, L.).

From the East Indies few if any fruits can be imported to England with success. In fact Ceylon and India have very few fruits which they can easily spare capable of bearing a long sea voyage, and the choice fruits of Singapore and the Malay States are still further removed by time and distance.

At the Exhibition there is shown, from India, a small dried apricot (*Prunus armeniaca*, L.), an important article of food in the Punjaub Himalayas and in the North-west Provinces, which deserves attention as a probable source of an import trade for the English market. This fruit is known in India as the mish-mush, or "Moon of the Faithful." Dr. Watt remarks that it is largely eaten by all classes, fresh or dried, but chiefly fresh, and sometimes in preserve by Europeans. Sometimes the apricots are pressed together, and rolled out into thin sheets or "moons," 2 or 3 feet in diameter, like a blacksmith's apron. From Afghanistan large quantities of the dried fruit are imported into India, and distributed by trade far into the plains of Bengal.

Kew D. MORRIS

MICROSCOPIC ORGANISMS IN AIR AND WATER[1]

THIS Report is part of the "Annuaire de l'Observatoire de Montsouris" for the year 1885, and is worthy of careful study at the present time, when bacteriology is recognised as a special and important department of science. These investigations have been carried on at Montsouris since the year 1875, and through them Dr. Miquel has been enabled to throw much light on the meteorological aspect of the subject—an aspect that has received but little attention from investigators, as compared with the pathological. Every one will acknowledge that in entering upon a new field in scientific investigation it is extremely important that the line of research should proceed upon as broad a basis as possible, and that the work of experimentation and observation should not be confined to one aspect of the new study, however important it may be. Fallacies are sure to arise when any department of science is too narrowly specialised, from want of that more general knowledge which would prevent the adoption of erroneous views. This is especially liable to be the case in bacteriology, in which the objects of study are so minute and yet so widely distributed in nature. Dr. Miquel's researches—important as they are in themselves—are doubly welcome at the present time, as tending to popularise a field in which workers are urgently needed, as well as contributing largely to our knowledge. The example of Paris—the only city in which systematic investigations of the sort are now undertaken—should stimulate other towns which possess properly equipped meteorological laboratories, to conduct observations on the bacterial organisms contained in air, rain, and soil. The results obtained at Montsouris could then be confirmed or confuted by the results obtained at other laboratories under widely different climatic and meteorological conditions, and the enunciation of general laws and principles would in time become possible. We shall endeavour to place before our readers in this article some of the more important results and deductions made from them by Dr. Miquel, from the observations at Montsouris; but it should be distinctly recognised that any conclusions arrived at by Dr. Miquel are applicable only to Paris and its neighbourhood, and cannot at present be accepted as true for other places where the climatic conditions are different.

Tables are given in the Report, showing for each week of the years 1883–84 (*a*) the average number of bacterial micro-organisms present in a cubic metre of air, (*b*) the average barometrical pressure, (*c*) the average temperature of the air, (*d*) the average state of humidity of the air [percentage of saturation], (*e*) the amount of rainfall, (*f*) the electrical state of the air, (*g*) the direction and average velocity of the wind, (*h*) the average amount of ozone present in the air. From the observations recorded in these tables, Dr. Miquel has arrived at the following conclusions:—(1) An increase in the number of bacterial organisms contained in a cubic metre of air generally takes place when the barometrical pressure is high: this rule is not absolute, but the exceptions are rare. (2) Temperature does not cause such sudden increments; very often, it is true, a large increase in the number of microbes present in the air takes place in summer, but it is important to note that a sustained high temperature causes a manifest lessening in their number. The thermometer is capable of explaining certain seasonal variations, but not the weekly variations. (3) The maximum number of bacterial organisms present in the air corresponds almost always with a low hygrometric condition of the atmosphere; this is explained by the fact that the degree of humidity is always very high during rain, and when the superficial layers of the soil are soaked in water, periods during which the air is always very poor in bacteria. (4) It would appear *a priori* that the number of bacteria should increase with the strength of the wind, but observation negatives this assumption. A maximum number of microbes is found frequently during periods of calm—when the velocity of the wind is only 5–10 kilometres per hour—and minima have been observed during periods when the velocity of the wind was more than 30 kilometres per hour. (5) The direction of the wind exercises a considerable influence at Montsouris. The greatest number of maxima are noted when the wind is N.E., and the greatest number of minima when the wind is S.W. (6) When the amount of ozone in the air is large, the number of microbes present is small. The north winds blow over from Paris and contain but little ozone. They are rich in microbes. The presence of ozone in the air appears to have the power of destroying bacterial organisms, and, on the contrary, absence of ozone and humidity of the air—unless rain is falling—allow of an increase taking place in their number.

From observations at Montsouris, extending over a period of five years—1880–84—the average number of bacterial organisms in a cubic metre of air is stated to be: in winter 260, in spring 495, in summer 650, in autumn 380; the mean annual number being 445. In February the air is poorest in bacteria [the average of these five years is 165]. Towards the middle of summer the maxima present themselves [July 700].

Observations have also been conducted for a period of four years—1881-84—on the state of the air, as regards bacteria, in the centre of Paris. These observations were made on the air of the Rue de Rivoli, and afford a marked contrast in the number of micro-organisms to the far purer air of Montsouris, a suburb of Paris, and where, it is important to remember, the Observatory is situated in the centre of a park. The average of these four years' observations shows that the air of the Rue de Rivoli contains 3480 bacteria per cubic metre. The seasonal fluctuations are nearly the same as at Montsouris, the minimum being in February (1700) and the maximum in July (5010). The average number of bacteria present in a cubic metre of air, for the year 1881, was 6295, whilst the average number for 1884 was only 1830. This enormous decrease—which is observed in the intervening years to a slighter extent—is attributed by Dr. Miquel to the better drainage and scavenging of the city, and to the better cleansing of the gutters and watering of the streets in dry dusty weather, in 1884 than in 1881. The death-rate from zymotic diseases—in which are included typhoid fever, small-pox, measles, scarlatina, whooping-cough, diphtheria, dysentery, erysipelas, puerperal fevers, and choleraic diarrhœa of infants—has also fallen very considerably—27 per cent., if increase of population is taken into account—during this period. The death-rate of

[1] "Septième Mémoire sur les Organismes Microscopiques de l'Air et des Eaux," par M. le Dr. Miquel, Chef du Service Micrographique à l'Observatoire de Montsouris.

phthisis or consumptive diseases has, however, increased during the same period, although those of acute bronchitis and pneumonia have decreased. Acute pneumonia is now considered by many to be propagated by infection from specific organisms occasionally present in the air. The curves for the year 1883–84, representing the average weekly number of bacteria present in a cubic metre of the air of the Rue de Rivoli, A, and the weekly deaths from zymotic disease, B, are shown in Fig. 1. The curves are seen to present somewhat similar fluctuations except at the end of July and the first half of August, when the number of bacteria suddenly decrease—owing to the hot weather and sustained high temperature—whilst the deaths from zymotic disease undergo a large increase, owing to excessive mortality from infantile diarrhœa. The variations in the number of bacteria from week to week will be seen to be very much larger and more sudden than the variations in the zymotic death-rate. Very little can be deduced from comparisons extending over one year only, and although we are far from asserting that there can be no mutual relation between the number of micro-organisms present in the air, and the greater or less prevalence of epidemic disease among the community who breathe such air, still it is unsafe to found any arguments on such obviously inadequate data. It is only just to Dr. Miquel to say here that he recognises these diffi-

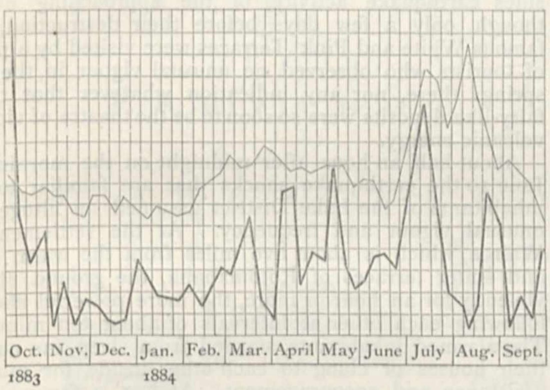


FIG. 1.

culties, and is rightly cautious in drawing any conclusions except such as are founded upon an extended series of observations.

At the commencement of June 1884, Dr. Miquel, who was then in London, made some observations on the number of bacteria contained in the air of Ryder Street, St. James's. A cubic metre of this air was found to contain only 240 organisms, but this low result was probably due to the wet weather which prevailed on four out of the five days on which the experiments were conducted—the air being remarkably free from dust. In Paris at the same time the air of the Rue de Rivoli contained 360 organisms per cubic metre. Dr. Miquel would not, however, be surprised to find that the air of London was habitually fairly pure and free from organisms, owing to the proximity of the sea, and the fact that the houses of London being generally of no great height—unlike Paris—the streets are continually being swept by currents of air. The air of sleeping-apartments is very impure as regards the number of contained micro-organisms. One such room in Paris was found to contain on the average in the winter and spring of 1882, 73,540 bacteria per cubic metre, and the air of the Hôpital de la Pitié has been observed to contain 79,000 bacteria per cubic metre. In contra distinction to these large numbers, the air over the Atlantic Ocean (Moreau and Miquel) has been found to contain from 0 to 6 bacteria per cubic metre, and the air of the higher mountains an average of only 1 bacterium per cubic metre (Freudenreich).

A considerable part of the Report is taken up with an account of researches conducted by M. Moreau into the number of organisms present in sea-air. These investigations—undertaken under circumstances of considerable difficulty on board ship, and conducted on an elaborate scale—are of much interest as bearing on the treatment of phthisis by high mountain altitudes or by sea voyages—in both cases the special object desired being to place the patient in an atmosphere free from all impurities. We will quote a few of M. Moreau's conclusions on this subject:—(1) Air taken on the coast, when the wind is blowing off the sea from a direction in which land is at a great distance, is in a state of almost perfect purity. (2) In the neighbourhood of continents, winds blowing from the land always bring an impure atmosphere; at 100 kilometres from the coast this impurity has disappeared. (3) During moderate weather the sea does not yield to the air any of its contained bacteria; during rough and stormy weather sea-air is charged with a minute quantity of bacteria. (4) The air of ships' cabins is also charged with a number of microbes incomparably greater than that of the open air at sea, but the purity of the air of these cabins increases rapidly during the first days of the voyage; later on, an equili-

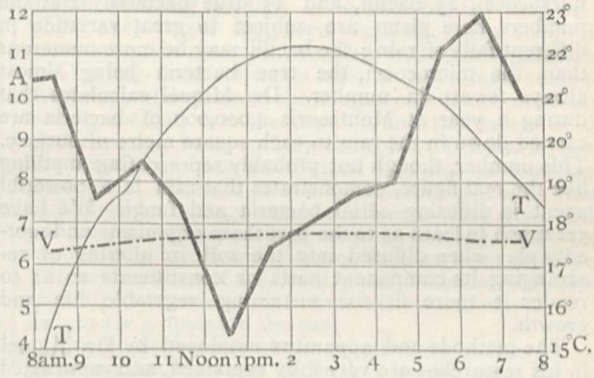


FIG. 2.

brium appears to be established, depending on the amount of purification of the air by ventilation and the number of occupants. (5) The air of ships' cabins is relatively very poor in bacteria; these probably are one hundred times less in number than the air of an occupied room in Paris.

Observations have been made at Montsouris on the hourly variations in the number of bacteria contained in a cubic metre of air. These observations go to show that, contrary to the generally held opinion, the air is less pure—*i.e.* contains larger numbers of bacteria—during the morning and evening than at midday. In Fig. 2 are shown curves corresponding to proportional figures which illustrate this phenomenon, as ascertained by forty experiments. A is the bacterial curve, T is the curve representing the temperature, and V is the velocity of the wind. The lowest point of the bacterial curve is between noon and 1 p.m., two hours before the maximum temperature is reached. From 8 o'clock in the evening until midnight the number of microbes generally remains high, but decreases rapidly from midnight to 3 a.m., two or three hours before the lowest temperature is reached, and rises rapidly from 4 a.m.—when the ground and vegetation are covered with dew—until 6 a.m., when the maximum is reached. These night observations, however, are too few in number to be depended upon to give a very correct average. Rain, as has been before remarked, rapidly purifies the air. But when the rain first commences to fall, the number of bacteria increases. This Dr. Miquel explains by supposing that many of the first drops of rain evaporate—the atmosphere not being saturated with vapour—and deliver up the bacteria they hold to the air in the neighbourhood of the earth. Later on the air is saturated with vapour, and the bacteria floating in it are carried down to the ground in the drops of rain, and by this means the air is purified.

Investigation of the organisms contained in rain show that the rain which first falls in a shower and that which falls after a period of dry weather contain far larger numbers of bacteria than that which falls at any other times. Under such circumstances 200,000 microbes per litre is not an unusual quantity. The rain which falls during the warm months of the year—in summer and autumn—contains more microbes than that which falls in winter and spring. During the year 1883-84 the lowest monthly average was 1000 per litre in November, and the highest 6980 per litre in September. As the rain derives its organisms from the air which it purifies in its descent, we should expect the seasonal variations in the number of contained organisms in air and rain to correspond closely—as in fact they do. It is important to note that the organisms exist in the rain to a larger extent in the form of germs than in the adult state. Of 100 bacteriform organisms found in rain, on an average 60 are micrococci, 25 bacilli, and 15 true bacteria. But the numbers here given are subject to great variation in different falls of rain: the bacilli may be more numerous than the micrococci, the true bacteria being almost always fewest in number. Dr. Miquel calculates that during a year at Montsouris 4,000,000 of bacteria are carried down in the rain to each square metre of surface. This number, though not probably representing anything like the real figure, demonstrates that rain is a powerful agent in diffusing aërial bacteria and fungi. We have yet much to learn as to the part these organisms undoubtedly play when diffused into the soil, in altering or rearranging its component parts or constituents so as to render it more fit for sustaining vegetable life and growth.

The methods and apparatus employed by Dr. Miquel in his researches are very fully explained, and contrasted with other methods—especially those employed by Dr. Koch and other German observers—in terms that are not exactly those which a strict regard for international courtesy would dictate. It is somewhat of a reproach to bacteriologists that their leading authorities in all countries appear unable to keep clear of controversies which are conducted with an acrimony and animus more instructive than seemly. International jealousy would appear to lie at the root of much of this evil, and is plainly discernible in the writings of some of the ablest masters of the science.

THE RECENT VOLCANIC ERUPTION IN NEW ZEALAND

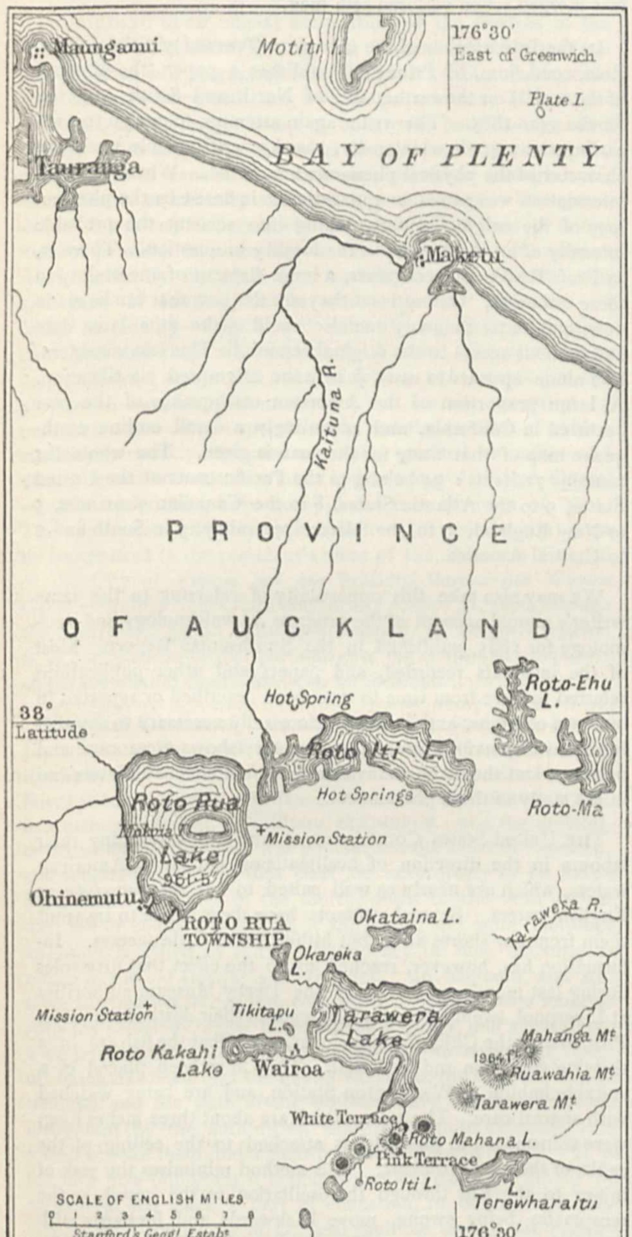
UNTIL the report of a trained geologist has been received we must be content with the narratives, often conflicting, of the surveyors and of the Press correspondents who hurried to the scene of the great catastrophe that has recently devastated the wonderland of New Zealand. In the meantime, however, it is possible from the various accounts to trace the leading features of the eruption, and to note their resemblance to those of other recorded volcanic outbursts. It is impossible not to be struck with the analogy between the phenomena exhibited last June in New Zealand and those that accompanied the great Vesuvian eruption in the first century of our era. In both instances a mountain which had never been known to be an active volcano suddenly exploded with terrific violence, filling the air with ashes and stones. At each locality there were the premonitory earthquakes, the thick black pall of volcanic cloud hanging over the mountain, the descent of dust, sand, and hot stones, the discharge of mud, with, so far as known, no outflow of lava, and the overwhelming of an inhabited district under a deep covering of loose volcanic debris.

In a region so subject to earthquake shocks as that which crosses the centre of the North Island of New Zealand in a north-east and south-west direction, it was natural that no special attention should have been given to any greater frequency or violence of the shocks before the date of this volcanic eruption. But no doubt facts bearing on this subject have been noted by local observers and will in due course be published. From the newspaper accounts, indeed, there would appear to have been various precursory indications which in the light of subsequent events may not have been without importance. It is said, for instance, that the extinct volcano Ruapehu, the highest peak in the North Island, which since the discovery of New Zealand has never been known to manifest any activity, began to steam at the top some three weeks before the eruption. A fortnight previous to the catastrophe a wave 3 feet high suddenly arose on the Lake Tarawera, lying at the foot of the mountain of the same name, and in the very focus of the subsequent disturbance, and washed the boats out of the boat-houses. Doubtless there were other premonitory symptoms, besides earthquake activity, of the approaching event, though only a few days before their destruction, the famous White and Pink Terraces were visited by a party of tourists who observed no unusual vigour in the hot springs there, nor any indication whatever that these fairy-like deposits were so soon to be the theatre of violent volcanic energy.

About half an hour after midnight on the morning of June 10 the earthquake shocks that are familiar to the inhabitants of the Lake District assumed an altogether unusual vigour and frequency. At the settlement of Wairoa, which is about five miles from the warm lake and sinter terraces of Rotomahana, the ground shook violently for an hour or more, the more powerful shocks following each other at intervals of about ten minutes. The alarmed inhabitants, startled from sleep, ran out of their houses or clung to each other inside for mutual assistance and encouragement. At last, a few minutes after 2 a.m., a shock of exceptional severity was followed by a deafening roar, and suddenly what is described as a "pillar of fire" rose up from the crest of the mountain range some five or six miles eastward on the opposite side of Lake Tarawera. The top of Mount Tarawera (about 2000 feet high) had been blown into the air, leaving a huge chasm on the flank of the mountain. The glow of the white-hot lava in the interior ruddied the sky for miles around. Thousands of blocks of glowing lava described as "fire-balls" were shot into the air. The canopy of dark ashes that soon gathered over the mountain and spread out for miles around became the theatre of a violent electrical storm. It seemed to be torn asunder with incessant flashes of lightning, and the continuous peals of thunder, mingling with the bellowing of the volcano, increased the terror of the night.

That an eruption should ever take place from the three huge truncated cones that frown over Lake Tarawera was not regarded by geologists as a future probability. They had been extinct even from the times of early Maori tradition. To their solitary and mysterious summits the natives had probably for centuries been accustomed to carry their dead. The bones of many successive generations lay bleaching on that high lonely plateau, which had thus come to possess a peculiar sanctity in the eyes of the Maoris, who would not willingly allow a white man to approach it. Not only were these great cones to all appearance extinct, but the volcanic action of the whole district was of that type of waning energy which geologists have called the "solfatara stage." New geysers might break out, rivalling or even surpassing those already active in the district, and the orifices of eruption might shift from place to place, involving considerable local disturbance in their transference; but no one anticipated that in this district a great explosion, like the most gigantic outburst of Vesuvius, was likely to occur.

The magnitude of the explosion may be inferred from



NEW CRATERS, thus

several facts which appear in the newspaper reports. An observer at New Plymouth, on the west side of the island, 150 miles from the scene of the disaster, saw the column of ashes rising far into the air, and computed its height to be not less than 22,000 feet. The noise of the explosion is said to have been heard at Christ Church, a distance of some 300 miles. The ashes fell over a vast area of land and sea to the north and east of the vent of discharge. Vessels sailing even 130 miles away found the air thick with fine dust, which settled on their decks. Near the scene of the explosion the depth of accumulated ashes, still quite hot, was found by some adventurous explorers, seeking to succour the poor Maoris, to be not less than 20 feet. At a distance of 30 or 40 miles the deposit was still several inches thick, so stupendous must have been the amount of rock blown into powder by the great explosion of Tarawera.

The materials ejected from that mountain appear to have consisted mainly of loose fragments of lava, cinders, ashes, and fine dust, with vast quantities of steam, while not improbably hot water and mud issued from the flanks of the volcano. So far as can be gathered from the narratives, there was no emission of lava, though, from the "flames" and "fire-balls" so generally referred to, it may eventually be found that molten lava flowed out somewhere on the sides of the mountain.

Not far from the base of the volcanic cone of Tarawera lay the warm lake and sinter terraces of Rotomahana. The treacherous nature of that district has been often remarked—its steam-vents, boiling pools, hot steaming soil, and eruptive geysers, not always remaining in the same places, but apt with no warning to break out at fresh points. This weird locality has been involved in the volcanic disturbances of the region. The famous terraces have been blown into the air, and fragments of their sinter have been picked up among the dust and ashes of the surrounding country. The lake on the borders of which they stood has been ingulfed. On their site scores of mud-cones are vomiting forth stones and mud, and hurling clouds of steam into the air. New vents for the escape of steam and the outflow of volcanic mud have been opened all over the country, and the aspect of the landscape has been entirely changed. A scene of fairy-like beauty has been transformed into one of loathsome desolation. Even if the volcanic activity calms down and the sinter springs can recommence their work of deposition, many generations must pass away before they can build up again such terraces as have been destroyed. The new features of the country will no doubt still prove attractive to tourists, but the marvellous staircases of Te Tarata are a dream of the past.

Among the features of the eruption on which it is to be hoped that light will be thrown by the more detailed investigations of experts are the source and behaviour of the mud that overwhelmed the settlement of Wairoa. From the narratives of the survivors, showing that the houses were crushed in from above, the mud seems to have descended through the air upon the district, mingled with ashes and stones. Rain fell during the night, but the mud could hardly have been formed in the air by the mixing of the rain and dry ashes. It appears to have come down as liquid mud and was no doubt ejected as such from some neighbouring vent. The orifice of eruption could scarcely have been the great cone of Tarawera; more probably there were many vents not only at Rotomahana, but nearer to Wairoa, by which a large amount of mud was discharged over the surrounding district.

Another question that will no doubt receive careful consideration relates to the movements of the air during the time of the eruption. Barometric observations at Rotorua and at places on the opposite sides of the island will be of much interest. From the newspaper accounts it is clear that a great atmospheric disturbance accompanied the eruption. About an hour after the great explosion a gale suddenly arose in the Rotorua and Wairoa district, and blew with such fury as to uproot and prostrate immense numbers of trees, and to strip off leaves and branches from those that were left standing. At Rotorua the direction of the hurricane was towards the scene of volcanic activity, as if the air were being drawn into the vortex caused by the explosion. A few hours later the gale as suddenly ceased and then ashes began to fall, borne northwards by some upper current of air. We have yet to learn how far these atmospheric movements were connected with or independent of the eruption.

There are some excellent geologists in New Zealand who have now a rare opportunity of investigation. No mud-eruptions at all comparable in magnitude to those of this summer in New Zealand have ever been known. The connection of these with the explosion of Tarawera, the relation of the latter to the lava-reservoir inside, the nature of the so-called "flames" and "pillar of fire" so conspicuous on the night of the eruption, the sources of the "fire-balls," and many other details, offer a wide and most interesting field for the colonial observers. Geologists all over the world will await with much interest the publication of their investigations. ARCH. GEIKIE

NOTES

THE honour of knighthood has been conferred on Mr. Philip Magnus, the head of the City and Guilds Technical Institute at South Kensington.

LAST Saturday a banquet was given to M. Chevreul by French students to celebrate the one hundredth anniversary of his birth.

THE death is reported on June 22 of Dr. H. F. Hance at Amoy, at which place he was Her Majesty's consul. Although no independent work bears Dr. Hance's name, he has done more than any other man to make us acquainted with the flora of China, both of the empire and of the British colonies. His contributions to botanical literature are to be found in periodicals, very largely in Trimen's *Journal of Botany;* and the number of species described by him for the first time is very great. He was a contributor to the herbaria at the British Museum and at Kew. It is to be hoped that his herbarium will be brought to London and deposited where it can be consulted, and his types readily compared with those of other authors. A full synonymic catalogue of all the known Chinese plants is now in course of publication by Messrs. Forbes and Hemsley, and is greatly needed.

UNDER the energetic management of Dr. Adolph Bastian the Administration of the Berlin Royal Ethnological Museum has commenced to publish a series of original communications explanatory of the varied contents of that superb collection. According to the present programme four parts of about 60 large octavo pages each, with two or more plates of illustrations, will be issued yearly by the Berlin publisher, W. Spemann, at the price of 16 marks, or 4 marks each. Judging from the three parts, which have already appeared for the year 1885-86, the series promises to develop into a vast encyclopædia of anthropological subjects. Many of the communications constitute in themselves more or less exhaustive essays on special branches of ethnology, and to some of them a peculiar value attaches, because contributed by the collectors or observers themselves. Such, for instance, is the paper on funeral rites in the Pellew Islands, contributed to the first number by the traveller, Kubary, who has spent many years in the Oceanic regions, and made a special study of the Polynesian and Micronesian islanders. The same number contains a report on Richard Rohde's expedition to the Paraguay and Brazil (Matto Grosso) in 1883-84, followed by the traveller's account of the Bororo and Guato tribes in the Upper Paraguay basin. Of great value is Dr. O. Finsch's paper in Part II. on the ethnological collections from the South Sea Islands, some 3000 objects, of which more than half found their way to the Berlin Museum. The importance of securing specimens from this region before it is too late is well shown by the experience of this traveller, who on revisiting New Britain in 1884-85 was no longer able to procure several objects which were readily obtainable three years previously. Others, such as wood-carvings, are now "manufactured" in New Ireland "for the trade," the natives finding good customers amongst the crews of passing ships. This paper is followed by the explorer Grabowski's description of nearly 200 objects from South and East Borneo, many extremely rare, if not quite unique. Dr. Bastian concludes a characteristic essay at the end of Part III. with the words: "So walte ein Jeder seines Amtes,—und uns ist die Aufgabe zugefallen,—Das rechtzeitig in Sicherheit zu bringen, was morgen schon verloren sein mag."

IN the July number of the *American Journal of Science*, Prof. Rockwood, jun., of Princeton, publishes a paper (the fifteenth of the series) on the earthquakes of North and South America for the year 1885. The writer again attempts to assign to each earthquake a grade of intensity, based where possible upon the character of the physical phenomena reported. Where no such information was available the estimate is based on the phraseology of the original report, taking into account the probable intensity of an earthquake in the locality in question. There is, as Prof. Rockwood recognises, a large element of uncertainty in these estimates, "but at least they are the best that can be made now, and better than any one else could make at a later date and without access to the original reports." This last consideration alone appears to us to justify the attempted classification. A large proportion of the American earthquakes of the year occurred in California, and accordingly a small outline earthquake map of that State for the year is given. The whole list contains 71 items: 34 belong to the Pacific coast of the United States, 9 to the Atlantic States, 8 to the Canadian provinces, 5 to New England, 3 to the Mississippi valley, 5 to South and 2 to Central America.

WE may also take this opportunity of referring to the same writer's annual account of the progress in vulcanology and seismology for 1885, published in the Smithsonian Report. Most of the incidents recorded, and papers and other publications referred to have from time to time been described or reported in our own columns, and it is therefore only necessary to say that in this as in previous years the summary shows great care and industry, and should be an invaluable *vade mecum* to all interested in the study of these phenomena.

THE United States Commissioners are still continuing their labours in the direction of acclimatising flatfish to American waters, which are nearly as well suited to the *Pleuronectidæ* as English waters. Several attempts have been made to transmit them from our shores alive, but hitherto with little success. Information has, however, reached us to the effect that fifty soles during last month were sent by the Derby Museum authorities at Liverpool, twenty-five of which reached their destination alive. Prof. Baird, the Chief Commissioner, states that the fish are in a thriving condition and feed well. They have been placed in a suitable habitat at Washington Station, and are being watched with special care. The soles, which are about three inches long, were transmitted in glass globes attached to the ceiling of the cabin of the s.s. *Britannic*. This method minimises the risk of injury to the fish through the oscillation of the vessel, as the receptacles, being swung, move backwards and forwards with the motion of the steamer. The National Fish Culture Association intend forwarding to America another consignment of flatfish next month in order to assist the operations of the Commissioners. The sole is a very delicate fish, and cannot withstand the strain of protracted journeys, which makes it very difficult to transmit.

MESSRS. J. B. LIPPINCOTT AND CO. have in the press a "Manual of North American Birds," by the eminent ornithologist, Prof. Robert Ridgway, Curator of the Department of Birds, Smithsonian Institution, Washington, D.C. The author has had exceptional advantages for the preparation of a treatise of this character, arising from his own field experience, as well as his connection with the National Museum, and the free access which has been granted him to various other public and private collections of birds, both in this country and Europe. The work is to contain some 425 illustrations suitably executed, and will conform to the geographical limits, classification, numeration, and nomenclature adopted by the American Ornithological Union.

ACCORDING to an official notification of the trustees of the "Schwestern Fröhlich Stiftung" at Vienna certain donations and pensions will be granted from the funds of this charity this year in accordance with the will of the testatrix, Miss Anna Fröhlich, to deserving persons of talent who have distinguished themselves in any of the branches of science, art, or literature, who may be in want of pecuniary support either through accident, illness, or infirmity consequent upon old age. The grant of such temporary or permanent assistance in the form of donations or pensions is, according to the terms of the foundation deed, primarily intended for Austrian artists, literary men and men of science, but in which however foreigners of every nationality—English and others—may likewise participate provided they are resident in Austria. Donations will be granted to artists and men of letters and science for the purpose of completing their studies, and for the execution or publication of a certain specific work, and also in cases of sudden inability to work. Pensions are being granted to artists and men of letters and science who, in consequence of old age, illness, or other misfortunes, have been placed in a position of want. The applications addressed to the trustees (das curatorium) must be transmitted to the president's office of the Common Council of the City of Vienna (an das Präsidial-Bureau des Wiener Gemeinderathes Neues Rathhaus) before August 31, 1886, through the Austro-Hungarian Embassy in London, 18, Belgrave Square, S.W., where also further particulars of the terms and conditions of the foundation deeds, &c., can be obtained.

THE fifth Circular of Information for 1885, published by the United States Bureau of Education, is a very exhaustive treatise upon physical education. It directs attention to the four different ideas of manly excellence: the Greek, or æsthetic; the monkish, or ascetic; the military, or knightly; and the medical, or scientific. The recent war popularised the third in America, and reports of work of that class are accordingly to be found here. The teachings of the fourth, down to the most recent day, are of course the essence of the paper, and more than once attention is called to the great tendency of such teaching to return to the old standards of the first. In England, and still more in America, the oldest colleges and schools were founded with the principal object of educating a clergy, and accordingly were imbued with the spirit of the second—an important result of which has been that the games which occupy so much of the thoughts and the time of the students have hardly ever been recognised by the authorities, who have quite recently been forced to take them under their control to prevent abuse. It is felt now how important it is that games and exercises should be supervised and made a part of education, to be carefully controlled by a competent M.D., who shall be one of the Faculty on a par with the other masters. Rugby football is condemned by the great Harvard University as a "brutal and dangerous" game. Many strong objections to much that attends public games are recounted, and many careful restrictions on games generally have been agreed to by the highest authorities, both scholastic and medical. The code and the books of Mr. Maclaren, of Oxford—a prophet too little honoured in his own country—are highly praised, but Germany carries the palm for science and laborious thoroughness. The manual labour which has been so successful in the lower-grade schools is naturally not found popular in the colleges. A warning voice is raised against the high pressure at which girls live both at work and pleasure, and the necessity of more regular rest and exercise is insisted upon. A large part of the Circular consists of plans and elevations of gymnasiums, useful to both schoolmasters and architects.

THE labours of a curator who undertakes the first setting in order of the raw material of a museum in a new building are fully disclosed in the Report of the Nottingham Free Natural History Museum, which published the works of Mr. J. F. Blake, the Superintendent. And it can be no small labour to which he has devoted himself, even though extending over five years; comprising, as it does, the naming and re-naming of 11,400 specimens of every class of natural production hitherto kept with very little care; the supplementing them, as opportunity offered, with important desiderata till the total number of objects exhibited has increased to 21,960; the preparation of maps showing the geographical distribution of the animals near which they are placed; the pictorial mounting of specimens of birds and of birds' nests; and the specially important duty of a local museum of getting together as complete a local collection as possible. At the same time we regard it as a most wholesome symptom in the case that Mr. Blake is by no means satisfied with his achievements, and we wish him more rapid progress in all his present and future undertakings on behalf of the Museum.

AMONG recent contributions to natural-history literature, attention is due to an interesting work by the eminent Norwegian naturalist, Leonhard Stejneger, published in the United States under the title of "Results of Ornithological Explorations in the Commander Islands and Kamtschatka." In this work, which is illustrated by coloured plates, the author describes upwards of 140 species, all of which were collected or observed by himself during his various visits to Behring's Sea and the neighbouring coast-lands and islands. The main results of these expeditions had previously appeared in the *Bulletins* of the U.S. National Museum, in the Ornithological Department of which institution Mr. Stejneger holds the post of Assistant Curator, while he has also from time to time supplied *Naturen* with pleasantly-written popular reports of his voyages and observations, and to these we have more than once had occasion to make favourable reference. As, however, both these sources are inaccessible to the general reader, we welcome with great satisfaction the present comprehensive English exposition of Mr. Stejneger's most recent contributions to the branch of science which he so successfully cultivates. Within his own province he has, moreover, been doing good service to popular science as compiler of the ornithological portion of the American "Standard Natural History," published at Boston by Messrs. Cassino and Co. In Mr. Stejneger's original contributions to this work, which claims to be based on the most recent results of science, he has been able by his own observations to make various additions to, and corrections of, the statements of Brehm, who has hitherto been trusted as our principal authority regarding North European and American ornithology.

DURING a severe thunderstorm which passed over Central Norway last week a remarkable example of the power of lightning was witnessed. In a field at Löiten a fir-tree 80 feet in height was struck by lightning some 12 feet from the ground, with the effect that the tree was cut in halves and the upper portion—about 60 feet in length—thrown a distance of several yards. The most curious part, is, however, that the surface of the detached part is as smooth as if the tree had been sawn through, whilst that of the stump remaining in the ground is jagged, charred, and splintered to the root. The ground around the tree is furrowed in all directions, one being several feet in width and depth, and extending for some 10 yards. A spruce-tree close by shows a furrow an inch in width running from a height of 6 feet down to the root.

On Thursday night, at 11.30, M. L'Hoste crossed from Cherbourg in a balloon, alighting in the neighbourhood of London at 6.30 on Friday morning. M. L'Hoste had a small sail to assist in directing the balloon, and an apparatus for letting down into the sea to draw water into the balloon to act as ballast. He was accompanied by M. Mangot, the astronomer. The highest altitude attained was 3600 feet, and the lowest temperature observed 7° C.

The additions to the Zoological Society's Gardens during the past week include a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, presented by Mrs. Barrington; a Blue-faced Amazon (*Chrysotis æstiva*) from Brazil, presented by Mrs. J. Fletcher; an Aldrovandis Skink (*Plestiodon auratus*) from North Africa, presented by Mr. R. J. M. Teil; two Grey Parrots (*Psittacus erithacus*) from West Africa, deposited; a Sea Eagle (*Haliaetus* ——), a Masked Weaver Bird (*Hyphantornis personata*) from Africa, a Short-eared Owl (*Asio brachyotus*), European, a Hyacinthine Macaw (*Ara hyacinthina*) from North Brazil, two Blanding's Terrapins (*Clemmys blandingi*) from North America, two Indian River Snakes (*Tropidonotus quincunciatus*) from India, purchased; two Triangular Spotted Pigeons (*Columba guinea*), a Geoffroy's Dove (*Peristera geoffroii*), four Brazilian Teals (*Querquedula brasiliensis*), five Slender Ducks (*Anas gibberifrons*), two Chilian Pintails (*Dafila spinicauda*), two Wild Ducks (*Anas boschas*), a Himalayan Monaul (*Lophophorus impeyanus*), bred in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 *AUGUST* 8–14

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on August 8

Sun rises, 4h. 37m.; souths, 12h. 5m. 25·3s.; sets, 19h. 34m.; decl. on meridian, 16° 6′ N.: Sidereal Time at Sunset, 16h. 43m.

Moon (two days after First Quarter) rises, 14h. 45m.; souths, 19h. 25m.; sets, 0h. 1m.*; decl. on meridian, 16° 41′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	6 10	12 51	19 32	7 24 N.
Venus	1 57	10 3	18 9	22 4 N.
Mars	10 51	16 11	21 31	8 41 S.
Jupiter	9 5	15 7	21 9	0 25 S.
Saturn	1 58	10 4	18 10	22 4 N.

* Indicates that the setting is that of the following morning.

Variable Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·2	81 16 N.	Aug. 12,	21 49	*m*
R Arietis	2 9·6	24 31 N.	,, 12,		*M*
T Ursæ Majoris	12 31·2	60 7 N.	,, 10,		*m*
U Virginis	12 45·3	6 10 N.	,, 10,		*m*
R Camelopardalis	14 26·3	84 21 N.	,, 11,		*M*
δ Libræ	14 54·9	8 4 S.	,, 14,	20 30	*m*
S Libræ	15 14·9	19 59 S.	,, 12,		*M*
U Ophiuchi	17 10·8	1 20 N.	,, 12,	2 10	*m*
			,, 12,	22 18	*m*
U Sagittarii	18 25·2	19 12 S.	,, 12,	0 0	*m*
β Lyræ	18 45·9	33 14 N.	,, 8,	0 0	m_2
R Lyræ	18 51·9	43 48 N.	,, 13,		*m*
η Aquilæ	19 46·7	0 43 N.	,, 13,	2 0	*m*
δ Cephei	22 24·9	57 50 N.	,, 11,	0 0	*M*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor Showers

The principal shower of the week is that of the *Perseids*, R.A. 43°, Decl. 56° N. The maximum occurs on August 10, but many meteors from the same radiant are usually seen on the nights both immediately preceding and following that date. Meteors are frequently seen also from neighbouring radiants, *e.g.* near the Pleiades, R.A. 55°, Decl. 26° N.; near Capella, R.A. 68°, Decl. 46° N.; near ν Tauri, R.A. 55°, Decl. 7° N.; and from Lynx, R.A. 96°, Decl. 71° N. A radiant from α Pegasi, R.A. 345°, Decl. 15° N., is also active at this season, which is usually the most prolific of the year.

Occultations of Stars by the Moon (visible at Greenwich)

Aug.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
8	24 Scorpii	5	19 15	20 34	92 255
11	*d* Sagittarii	5	18 44	20 0	74 242

Aug.	h.	
8	14	Venus in conjunction with and 0° 1′ south of Saturn.

THE SCIENTIFIC DEVELOPMENT OF THE COAL-TAR COLOUR INDUSTRY[1]

The subject on which I propose to address you this evening has been brought under the notice of the Society of Arts on former occasions, and was only last year thoroughly treated of by Dr. W. H. Perkin, the pioneer of this branch of manufacture, in his Presidential Address to the Society of Chemical Industry. It has, moreover, quite recently furnished materials for a lecture at the Royal Institution by Sir Henry Roscoe, so that I feel in some measure obliged to apologise for again bringing forward a topic upon which it may appear to chemists that nothing particularly new remains to be said. Having, however, been intimately associated with this branch of chemical industry for many years, I have had exceptional opportunities of watching its development, and of forming ideas upon the causes of its progress, which may justify my engaging your attention upon the present occasion.

The manufacture of coal-tar products is a subject which offers distinct advantage for popular treatment, both on account of the practical utility of the products, and the striking and beautiful colour phenomena which they present. But I do not propose now to avail myself of these advantages, because I think there is a more serious aspect of the subject than the mere enumeration of the names, chemical formulæ, and mode of preparation of the recently discovered products. I must take it for granted that those present this evening are familiar with the fact that out of coal-tar there are obtained series of hydrocarbons from which are prepared nearly all the dye-stuffs at present in use; that the introduction of these artificial colouring-matters has revolutionised the tinctorial industries, and that the tar of gas-works, which was formerly a waste product and a nuisance, is now a valuable source of revenue to the gas companies. It is, doubtless, known to you also that, besides colouring-matters, there are obtained from the same hydrocarbons artificial perfumes, and drugs which rival quinine in efficiency; and that quite recently a substance has been discovered by Dr. Fahlberg, which goes by the name of "saccharine," and which is stated to possess 220 times the sweetening power of cane sugar.[2] But I must content myself by merely pointing to such discoveries as triumphs which the chemist, by his "so potent art," has achieved in recent times, because I want to bring home to English manufacturers one particular point in connection with this industry, and the Chemical Section of the Society for the Encouragement of Arts, Manufactures, and Commerce seems to me to be the right place for so doing. It cannot be denied that the coal-tar industry has for some years past been migrating from this country, the land of its birth, to the continent of Europe. Of the causes of this decline assigned by Dr. Perkin and others who have expressed opinions upon the subject, I do not now propose to touch upon those which may be considered as purely politico-economical

[1] A Paper read at the Society of Arts by Prof. R. Meldola, F.R.S., F.C.S., F.I.C., on May 13, 1886.

[2] The substance referred to is an anhydro-derivative of orthosulphamine-benzoic acid having the formula

$$C_6H_4 < {}^{CO}_{SO_2} > NH.$$

For details, see a paper by I. Levinstein, *Journ.* Soc. Chem. Ind., Feb. 1886, p. 75. Also the original communications in the *American Chemical Journal*, vol. i. pp. 170 and 426, and vol. ii. p. 181. For an investigation of the physiological action see the *Archivio per le scienze mediche*, vol. ix. No. 22, p. 407 (Turin, 1886).

ones, such as Free Trade, the Patent Laws, or the available energy of a British as compared with a German workman under the stimulus of a certain amount of weekly wage. These and kindred questions—such as the cost of railway carriage, or the relative ideas of "making a manufacture pay" which may exist in the British and Teutonic minds—have, doubtless, a most important bearing upon the main subject, but their discussion would occupy far too much time, and would, moreover, be out of place in this Section. I might even go so far as to express a private belief that if this portion of the subject were handed over for legitimate treatment by economists, the conclusions arrived at (if any) would hardly be commensurate with the amount of discussion which would be evoked. In fact, it appears to me that although, in a general way, each of the causes mentioned must be a factor in determining the success of any branch of manufacture, it is quite impossible to assign its true value to each of these factors; and in the case of the present industry I am persuaded that it is now a question of chemical and not of economic science that is pressing for consideration.

It will, I think, be conceded that the manufacture of coal-tar products is *par excellence* the most scientific of the chemical industries. This high position may fairly be claimed for the industry when we consider the number and complexity of the products, the delicacy of many of the reactions employed, the special arrangements of plant required, and the intimate knowledge of the chemistry of the aromatic compounds which the colour chemist must at the present time possess. Moreover, the industry is of comparatively recent growth—it has been born and has reached its present development within the last thirty years, so that the successive phases of its evolution can be clearly traced. For these reasons the subject is well calculated to throw light upon the general question of technical chemical education, a question of which the importance to the country at large now bids fair to become duly recognised.

In treating of the industrial development of a branch of chemical manufacture, it is important that we should begin with a distinct idea of the products themselves. I must claim the indulgence of chemists if at this stage I find it necessary to go over somewhat old ground, and to state facts with which so many are familiar. It would, of course, be quite impossible to give, on the present occasion, anything like a complete chronological list of the various colouring-matters, and it would be equally impossible for me to enter into the discussion of the chemical structure of the beautiful compounds which are now to be met with in the market. If, later on, I find it necessary to enter into questions of chemical constitution, it will be chiefly with the object of illustrating general principles by appealing to particular cases. In the brief historical sketch which I now propose to lay before you, I shall mention only those discoveries which may be considered to mark distinct commercial epochs in the development of the industry. The successive steps in this development will furnish us with one of the most striking illustrations of the utilisation of scientific discovery for industrial purposes, and the reaction of industry upon pure science.

Commencing in the year 1856, the foundation of the coal-tar colour industry was laid by Perkin, by the discovery of mauve, a violet dye, obtained accidentally in the course of an investigation having for its object the preparation of quinine by an artificial synthesis. In 1860, magenta, which had formerly been made in small quantities by expensive processes, was rendered a product of the first order of commercial importance by the discovery of the arsenic acid process by Medlock and E. C. Nicholson simultaneously. During this same year phenylated blues were first produced by Girard and De Laire, by the action of aniline upon magenta base at a high temperature. These blues had but a limited application owing to their insolubility, and their value was enormously enhanced by Nicholson's discovery, in 1862, that these colours could be converted into soluble sulphonic acids. The first azo-colour, amidoazobenzene, a basic yellow dye, was introduced in 1863 by the firm of Simpson, Maule, and Nicholson, under the name of "aniline yellow." In this same year the methylic and ethylic derivatives of magenta were manufactured by the same firm under the name of "Hofmann violets," in honour of their discoverer. "Azodiphenyl blue," the first of the colouring-matters now known as indulines, and Manchester yellow, appeared in 1864; and in 1866 "Bismarck brown" (triamidoazobenzene) was first manufactured at Manchester. The same year (1866) was marked by the introduction of Coupier's nitro-benzene process for the manufacture of magenta. In 1868 Graebe and Liebermann gave to the world their great discovery of the chemical constitution of alizarin, and in the following year the manufacture of this colouring-matter from anthracene was commenced. The first members of the great family of the "phthaleïnes," viz. galleïn and fluoresceïn, were discovered by Baeyer in 1871; and the first technical application of this discovery was made in 1874 by Caro, who introduced the beautiful pink tetrabromfluoresceïn into commerce, under the name of "eosin." Diamidoazobenzene was discovered by Caro and Witt independently in 1875, and was introduced into commerce by the latter as "chrysoïdine." A great impetus was given to the technical production of azo-colouring matters by this discovery, the naphthol oranges and other "tropœolines," fast-red, the ponceau scarlets, &c., appearing in 1878. Methylene blue and acid magenta were introduced by Caro in 1877, and in the same year the old and fugitive "aniline yellow" was converted into a valuable acid yellow by Grässler, who patented a process for converting the base into a sulphonic acid. Malachite green was introduced in 1878, and in 1879 the first member of the now important group of secondary azo-compounds appeared under the name of Biebrich scarlet. It is these secondary azo-scarlets, and especially the "croceine scarlets" (discovered in 1881) which are exterminating the cochineal industry. The year 1880 was marked by the brilliant discovery of the constitution of indigo, and the synthesis of this colouring-matter by Baeyer, a discovery which is none the less a triumph of synthetical chemistry because the manufacture is not at present successful from a commercial point of view. Indophenols were introduced by Koechlin and Witt in 1881, and in 1883 appeared Caro's first patent for the production of colouring-matters of the rosaniline group by the method of "condensation" with phosgene gas, in the presence of suitable condensing-agents.

This chronological record comprises nearly all the chief colouring-matters from coal-tar which are, or have been, of industrial value. It is important to note that the list, even as it stands in the form of a bald statement of facts in chemical history, reveals the existence of that fundamental law of the "survival of the fittest." Old products have been displaced by newer ones, as fresh discoveries were made, or processes improved, and to the chemist it is of interest to observe how this development of an industry has gone on *pari passu* with the development of the science itself. The moral conveyed to the manufacturer is sufficiently obvious. If we are to recover our former supremacy in this industry, we must begin by dispelling conservative ideas—we must realise the fact that no existing process is final, and that no product at present sent into the market is destined to survive for an unlimited period. The scientific manufacturer must be brought to see that present success is no guarantee for future stability, and unless he realises this position in its fullest significance, he may find the sale of his standard products gradually falling off, or be compelled to wake up to the unpleasant fact that his competitors are underselling him, owing to improved methods of manufacture.

It may appear to many that I am here simply preaching the doctrine of progress, and that the remarks which I have offered are mere truisms. Unfortunately, the facts of the case render this appeal necessary. It must never be forgotten that the coal-tar colour industry is essentially of English origin. It was Faraday who first discovered benzene in 1825; it was Mansfield who, in 1847, first isolated this substance in large quantities from coal-tar, and showed how nitro-benzene could be manufactured therefrom. The beginning of the colour industry was Perkin's discovery of mauve; and the introduction of the new colour into dyeing establishments was due to the example set by Messrs. Pullar, of Perth, in 1856. The manufacture of magenta on a large scale was the result of the discovery of the arsenic acid process by Medlock and Nicholson; and the phenylic blues were made commercially valuable by Nicholson. The first azo-colours, "aniline yellow" and "Manchester brown," as well as "Manchester yellow" (dinitro-α-naphthol) were manufactured in this country. We may thus fairly lay claim to have given to the commercial world the types of all the more important colouring-matters of the present time. If, as is certainly the case, the development of these typical products has been allowed to take place in other countries, it behoves us, as a practical nation, to inquire closely into the cause of this success abroad—a success which will appear all the more remarkable when we bear in mind that we are the largest European producers of the raw material, gas-tar, out of which the colours are manufactured, as well as being among the largest consumers of the dyes themselves. It is estimated that the amount of tar distilled annually in this country is about 500,000 tons, and it is certain that we distil at least one-half of the whole amount of tar produced in Europe. The present state of affairs is that our competitors can afford to import the raw materials from us, to manufacture and return the colours so as to compete with us successfully in our own markets, and to undersell us in the foreign markets. The bare mention of these facts will be sufficient to indicate the existence of something requiring radical reform in our manufacturing system.

Before submitting to you the statistics of this industry which I have been able to collect, I think it desirable to make an attempt to show the inner mechanism by which chemical science has been and is being so successfully adjusted to commercial wants by our Continental neighbours. I regret exceedingly that my predecessors on this and other platforms have not left me the chance of giving a general sketch of the chemical development of the different groups of colouring-matters. In fact, I find myself suffering here from several distinct disadvantages, but I hope, with your forbearance, to make the best of the situation. It will serve my purpose equally well, or perhaps even better, to confine my illustration to one particular group of colouring-matters. The more striking achievements, such as the syntheses of alizarin and indigo, are now so familiar to chemical audiences that their repetition would be unnecessary. Equally instructive, from the present point of view would be the history of the colouring-matters of the rosaniline group, and I can only express a passing regret that time will not permit me to recapitulate the steps in the beautiful series of investigations which led to the establishment of the structural formula of rosaniline and its derivatives by E. and O. Fischer, and then to the synthesis of these colours by Caro from ketone bases. The principle which I wish to bring out may seem a strange one to a "practical" people, but I am convinced that the whole secret of success abroad is the spirit of complete indifference to immediately successful results in which the researches are carried on. I say "immediately successful" because it would of course be absurd on the part of an investigator not to take advantage of any discovery which happened to be of commercial value. But, as a general principle, the question of practical utility does not in the first place enter into the work. The great development of this and many other industries is mainly due to the complete and thorough recognition, on the part of our competitors, of the vital importance of chemical science. In this country, where the word "practical" threatens to become a reproach, we put science into the background, and attach all importance to the mere *technique* of our manufactures. If I might venture to offer an aphorism to the English manufacturer, it would be to the effect that he should look after the science, and leave the *technique* to take care of itself.

After these considerations, you will see that it is a matter of perfect indifference whether I take by way of illustration products which have been successful from a financial point of view or not. In order to give greater emphasis to the principle, I propose, however, to consider the history of some colouring-matters which have found a market value, and I select this group with the more readiness because, on the one hand, it was not treated of last year by Dr. Perkin, and, on the other hand, it furnishes a splendid illustration of the way in which these coal-tar products are being scientifically developed in the foreign laboratories.

In 1863, Mr. E. C. Nicholson discovered a basic orange colouring-matter among the by-products formed during the manufacture of magenta by the arsenic acid process. The method of isolating this substance in a state of purity was very skilfully worked out by Messrs. Simpson, Maule, and Nicholson, and the colour was introduced into the market under the name of "phosphine." This dye was the first basic orange discovered, and the advantages which it possessed for certain kinds of dyeing enabled the manufacturers to sell it at a price which helped to cheapen the cost price of magenta to an appreciable extent. The chemical composition of the substance was established in 1863 by Hofmann, who assigned the formula $C_{20}H_{17}N_3 . H_2O$, and described the base under the name of chrysaniline. Although other and cheaper basic orange colouring-matters have since been discovered, chrysaniline still finds a distinct use; and I am informed by Messrs. Brooke, Simpson, and Spiller that the amount of this colour now sold is not appreciably less than at the time of its introduction by their predecessors. The chemical constitution of chrysaniline remained unknown till about two years ago, when the problem was solved by O. Fischer (*Berichte*, 1884, p. 203). In order to be able to follow the steps in the investigation, it will be necessary, in the first place, to go back to the discovery of another colouring-matter, called flavaniline, of which the existence was made known by O. Fischer and C. Rudolph in 1882 (*Berichte*, 1882, p. 1500). Flavaniline was produced by the action of dehydrating agents, such as zinc chloride, upon acetanilide, this fact having been observed by Rudolph in 1881, and the practical manufacture of the colour having been carried on under a patent by Messrs. Meister, Lucius, and Brüning, of the Hoechst colour-works.[1] Supplied with a large quantity of the pure crystalline material by the manufacturers, Messrs. Fischer and Rudolph established the formula of flavaniline, $C_{16}H_{14}N_2$, and showed that its formation from acetanilide might be expressed by the equation:—

$$2C_6H_5 . NH . C_2H_3O - 2OH_2 = C_{16}H_{14}N_2.$$

By the action of nitrous acid upon flavaniline a diazo-compound was produced which, by the usual method of decomposition by water, gave a phenolic derivative termed flavenol, and possessing the formula $C_{16}H_{12}N . OH$, thus proving that flavaniline contained a displaceable NH_2 group. By heating flavenol with zinc dust, a base was obtained having the formula $C_{16}H_{13}N$, and termed flavoline. This base had an odour resembling that of quinoline, and all its properties suggested to the authors that flavaniline was in reality a quinoline derivative. That flavaniline was amido-flavoline was proved by nitrating the latter base, and reducing the nitro-compound, when flavaniline was obtained. In a later publication by Besthorn and Fischer (*Berichte*, 1883, p. 68) it was announced that flavenol, when oxidised by potassium permanganate in an alkaline solution, gave an acid which, on distilling with lime, furnished a base having all the characters of lepidine. By the continued oxidation of flavenol with excess of alkaline permanganate, another acid was obtained, which proved to be picoline-tricarbonic acid, and the latter, on further oxidation, gave picoline-tetracarbonic acid (*Berichte*, 1884, p. 2925).

So much for the facts; now for their interpretation. The production of flavenol from flavaniline by the diazo-reaction shows that the respective formulas of these substances are:—

$$C_{16}H_{12}(NH_2)N \qquad C_{16}H_{12}(OH)N.$$

Flavenol gave, as the first product of oxidation, lepidine-carbonic acid, of which the formula is $C_{10}H_8N(CO_2H)$, and by further oxidation it gave picoline-tricarbonic acid, of which the formula is $C_6H_4N(CO_2H)_3$. Now the C-atoms oxidised by the breaking down of the 16-carbon atom flavenol into 11-carbon atom lepidine-carbonic acid, are those C-atoms which in flavenol are associated with the hydroxyl group, because this group is no longer contained in the product of oxidation. Thus the formulas of flavaniline, flavenol, and flavoline are better expressed as:—

$$\begin{array}{l} C_{10}H_8N . C_6H_4(NH_2) \\ C_{10}H_8N . C_6H_4(OH) \\ C_{10}H_8N . C_6H_5. \end{array}$$

From this it appears that flavaniline is amidophenyl-lepidine, flavenol hydroxyphenyl-lepidine, and that flavoline is phenyl-lepidine.

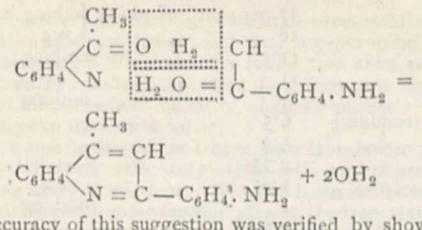
The central nucleus of flavaniline having thus been shown to be lepidine (which is methylquinoline), the next question to be settled was the mode of formation of the colour base from acetanilide. The authors suggest that at the high temperature of the reaction, acetanilide, in the first place, becomes transformed into the isomeric orthoamidoacetophenone:—

$$\begin{array}{c} H \;\; CH_3 \\ C_6H_5 . \dot{N} . \dot{C} : O \end{array} \qquad\qquad C_6H_4\left\langle\begin{array}{l} \dot{C}H_3 \\ C : O \\ NH_2 \end{array}\right.$$

Acetanilide. Amidoacetophenone.

By the condensation of two molecules of the amidoacetophenone with the elimination of two molecules of water, flavaniline would be produced in a manner analogous to the formation of mesitylene by the condensation of three molecules of acetone under the influence of dehydrating agents:—

[1] I am indebted to this firm for having kindly supplied me with specimens of these products for exhibition.



The accuracy of this suggestion was verified by showing that orthoamidoacetophenone is present in small quantity when the reaction is arrested as soon as the formation of colouring-matter commences; and conversely, when pure orthoamidoacetophenone was heated with zinc chloride, flavaniline was produced in small quantity.[1]

We may be permitted to pause at this stage of the investigation, before proceeding to consider the connection of this work with the constitution of chrysaniline. These results cannot but be regarded by chemists as a very beautiful piece of investigation; but the person of a "practical" turn of mind may possibly want to know what bearing they have upon the question of market value—the question which the manufacturer but too frequently considers as the only one of importance. Now it is the essence of chemical science—as indeed of all other sciences—that every discovered fact is related to other groups of facts, and although the relationship may not at once be apparent, it is only a matter of further development that is necessary in order to reveal relationships which are at present obscure on account of our imperfect knowledge. Thus, the policy of looking at a chemical product from the narrow point of view of immediate utility is not only unscientific, but it is detrimental to the interests of the manufacturer himself. Every new compound or process discovered—every structural formula established by legitimate investigation, may have an enormous influence, directly or indirectly, upon the market value of products at present sent into commerce. Our manufacturers must realise this if they wish to recover their position in the coal-tar industry, or in fact in any other chemical industry. There is no branch of manufacture so perfect as not to be open to further improvement, and until the broad spirit of scientific development is made to replace the suicidal policy of immediate utility, our position as a manufacturing nation is not likely to be improved.

In order to justify this digression by the particular instance now under consideration, we must return to the work of Messrs. Fischer and Besthorn. The discovery that flavaniline was a quinoline derivative was of importance as a principle, quite apart from any immediate value attaching to the dye-stuff itself. Up to the time of this discovery, the quinoline derivatives, with the exception of alizarine blue, had been practically of no importance in the tinctorial industries, but as a consequence of the present investigation, the question at once suggested itself whether the analogous bases of high boiling-point, which are present in coal-tar, such, for example, as acridine, might not be utilised as sources of colouring-matters. I may remind you that the fact of quinoline being an aromatic compound was first established by the researches of our Chairman this evening, Prof. Dewar, who obtained aniline from this base. In a subsequent paper on chrysaniline (O. Fischer and G. Körner, *Berichte*, 1884, p. 203), it was pointed out that in the course of his investigations upon rosaniline Fischer had observed that the former base, like rosaniline, was capable of furnishing a diazo-compound. An observation made by Claus is also mentioned, viz. the conversion of chrysaniline into a phenol (chrysophenol) by heating to a high temperature with hydrochloric acid in accordance with the equation:—

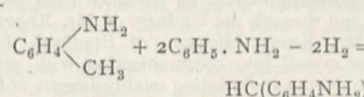
$$C_{19}H_{15}N_3 . HCl + H_2O = C_{19}H_{15}N_2O + NH_4Cl.$$

Chrysaniline hydrochloride. Chrysophenol.

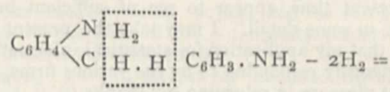
The investigation of flavaniline appears to have given an impetus to the ideas respecting chrysaniline, because of the general similarity in the properties of these two substances. In confirmation of this impression, it was found that by the oxidation of chrysophenol an acid was obtained which, on distillation with lime, gave a pyridine base. I need hardly remind you that picoline, which was obtained from the acid resulting from the extreme oxidation of flavenol, is methylpyridine. It was thus established that chrysaniline was a derivative of a quinoline base.

The next step in the investigation is a very important one. By decomposing the diazo-compound of chrysaniline with alcohol according to the Griess reaction, phenylacridine was obtained. Acridine is a base belonging to the quinoline series, having the formula $C_{13}H_9N$. It was discovered by Graebe and Caro in 1872 in crude anthracene. Phenylacridine accordingly possesses the formula $C_{13}H_8N . C_6H_5$; and chrysaniline appears as diamidophenylacridine, $C_{13}H_7(NH_2)N . C_6H_4(NH_2)$, because two amido groups are replaced by H by the diazo reaction. Thus the formula $C_{20}H_{17}N_3$ (first assigned by Hofmann to chrysaniline) is really the formula of the higher homologue, chrysotoluidine.

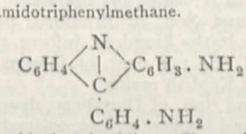
In order to explain the formation of chrysaniline during the oxidation of the materials (aniline and toluidine) in the "red melt" still, several suggestions were put forward, of which the most probable appeared to be that the base was derived from triamidotriphenylmethane, the latter compound resulting from the condensation of two molecules of aniline with one of orthotoluidine:—



Triamidotriphenylmethane.



Triamidotriphenylmethane.



Diamidophenylacridine = Chrysaniline.

The relationship of chrysaniline to the colouring-matters of the rosaniline group is thus indicated; but, tempting as is this theme, time will not admit of further digression into this field. The main point, so far as we are at present concerned, is that by means of the present investigation, we have now arrived at a knowledge of the parent substance, acridine, of which a colouring-matter more than twenty years old proves to be a derivative. By such results new fields of investigation are opened up, and direct methods for the production of chrysaniline suggest themselves. Even the practical requirements would be satisfied if it could be shown that the colour could be manufactured cheaply by a direct synthesis, instead of depending, as heretofore, upon the small and capricious secondary product of the magenta manufacture. As a matter of fact several syntheses of chrysaniline have been effected, one of which forms the subject of a patent (German Patent, 29142, April 1884) by Messrs. Ewer and Pick, of Berlin. Into the mode of preparation by this patented process I cannot now enter any further than by merely stating that nitrodiphenylamine and nitrobenzoylchloride form the starting-points, and that the specification bears the title—"Preparation of chrysaniline and other colouring-matters of the phenylacridine group." If an elaborate scientific investigation culminates in a patent, its utility will, I know, be conceded by many for whom the work would otherwise have possessed no particular interest.

The illustration which I have given is a typical example of the kind of scientific development which is being carried on by our chemical colleagues abroad, and which is being taken advantage of in the Continental factories. I do not wish to give you the impression that the particular colouring-matters dealt with are of supreme importance industrially—they are of considerable importance, but the modern history of any other colouring-matters would have been equally instructive. The beautiful researches of Bernthsen upon the constitution of methylene blue, would have done equally well had time permitted of my making use of them. It seemed to me more appropriate to this Section of the Society of Arts to give a somewhat detailed account of one particular series of investigations, rather than to take a skim over the mere surface of the enormous field which the coal-tar

[1] Just after writing this paper, a new contribution to the chemistry of flavaniline was published by O. Fischer (*Berichte*, 1886, p. 1036), from which it appears that the condensation is really between one molecule of *ortho*- and one molecule of *para*-amidoacetophenone, the latter being produced by the isomeric transformation of the ortho-compound at the high temperature employed. The constitution of flavaniline is thus definitely established as para-amidophenyl-γ-lepidine.

colour industry now offers. The case considered at any rate presents the advantage of not being too hackneyed, and this will be sufficient excuse for having made use of it.

It was stated at the commencement of this paper that there is reason to believe that our supremacy in the coal-tar colour industry has, for some years, been declining, and I have further expressed my belief that the chief cause of this falling off is the subordinate position given to chemical science in this country as compared with the status of this science abroad. Whether this explanation be accepted or not, the fact of the decadence of the manufacture remains, and I am in a position to bring this unpleasant truth home to our countrymen by a strong body of evidence. It must be borne in mind that the decline of any industry cannot be measured by the absolute weight of the products turned out annually, because the demand for the products in question may be on the increase, and we may be actually producing a greater weight of colours now than we were during our most successful period. The whole question is a relative one—it is simply how much material are we now turning out as compared with the amount produced by our competitors—what proportion of coal-tar products do we supply for our own and foreign consumption? In order to answer this question with some approach to numerical exactness, it occurred to me that the most trustworthy information could be obtained from the consumers themselves; and through the kindness of Mr. Robert Pullar, of Perth, and Mr. Ernest Hickson, of Bradford, I have been enabled to put myself into communication with several of the representative dyeing and printing establishments of this country. The facts obtained, as showing the actual state of the industry at the present time, appear to me of sufficient interest to be given here in some detail. I may take the present opportunity of stating that my application for statistical information has been most courteously responded to by the various firms, to whom I have great pleasure in returning my thanks.

Edward Ripley and Son, of Bradford, perhaps the largest dyers of piece-goods in the kingdom, inform me that during the year 1885 they used 86½ per cent. of foreign coal-tar colours, and 13½ per cent. of English make.

Walter Walker and Son, of Dewsbury, dyers of wool for rugs, mats, carpet yarn, and blanket stripes, estimate that during 1885 they used 80 per cent. of German dyes. They state that the exact proportion is difficult to estimate, so that the figure given is only approximative. Referring to their larger consumption of foreign colour they state:—"It is very discouraging to have to do this and send the trade out of our country, but to our own interest and advantage we have to do it."

John Newton, silk dyer, Macclesfield. Mr. Walter Newton, F.C.S., informs me that during 1885 they used 80 per cent. of foreign colour. He adds:—"The rapid advancement in the improved manufacture of some of these dyes by the Germans is the only cause of our desertion from the English colour-manufacturer."

G. W. Oldham, silk dyer, of Netherton, near Huddersfield, informs me that during 1885 he used 2000 lbs. of German dyes, 1100 lbs. of English dyes, and 800 lbs. of doubtful origin.

James Templeton and Co., of Glasgow, state that they dye as much as 30,000 lbs. of yarn (chiefly worsted) weekly, but they use only a small proportion of coal-tar dyes, all of which are of German manufacture.

Messrs. Leckie and MacGregor, of Paisley, inform me that in the west of Scotland, including Glasgow and Paisley, they are certain that at least 90 per cent. of the dyes used come from the Continent. Their own consumption of English colour only reached 6·8 per cent.

Alexander Harvey and Son, of Glasgow, yarn dyers, state that during 1885 they used 60 per cent. of German and 40 per cent. of English dyes. These figures do not include alizarin, of which they state that they used about equal quantities of German and English make. The English supply is chiefly made up of one article, "aniline salt." They add:—"We find the German makes in general of better value than the British, as our rule is, *cæteris paribus*, to give the home-make the preference."

Messrs. Manson and Henry, Glasgow, yarn dyers, state that they use only German dyes, adding that they find it to their advantage "for both cheapness and quality."

Among the largest consumers of coal-tar colours in this country are the jute dyers. As representing this department of the tinctorial industry, Messrs. James Stevenson, of Dundee, inform me that during 1885 they used only 7·7 per cent. of English colour. They have been good enough to supply the following analysis of their consumption:—

Scarlet	37 per cent.,	of which nothing is English.
Crimson	16 ,,	6·4 ,,
Blues	11·5 ,,	nothing ,,
Oranges	11 ,,	·05 ,,
Greens	7 ,,	nothing ,,
Magenta (residues)	6·5 ,,	,, ,,
Maroon	5·5 ,,	,, ,,
Pink	2·75 ,,	,, ,,
Brown	1·25 ,,	1·25 ,,
Violet	1 ,,	nothing ,,
Various	0·5 ,,	,, ,,
	100·0	7·7

Messrs. Cox Bros., of the Camperdown Jute Works, Lochee, state that practically the whole of the "aniline" colours used by them are of Continental manufacture.

With reference to the calico printers, the following facts have been collected:—

Messrs. Z. Heys and Sons, of Barrhead, state that during 1885 they used over 10,000 lbs. weight of colours (exclusive of alizarin), of which 700 lbs. only were of English make.

Messrs. James Black and Co., of Bonhill, Dumbartonshire, state that in their belief more than one-half of the colour used by calico printers is of foreign manufacture.

In the course of the present inquiry, it seemed desirable to obtain information concerning the consumption of alizarin, with reference to which the following statements have been received:—

Messrs. Walter Crum and Co., of Thornliebank, Glasgow, are of opinion that "the great bulk of what is used in this country is manufactured in Germany." They do not profess to be able to give actual figures having any approach to accuracy.

Mr. John Christie, of the Alexandria Turkey-Red Works, Dumbartonshire (John Orr, Ewing, and Co., states that they use only artificial alizarin in their establishment, their consumption being considerably over 2,000,000 lbs. weight of 10 per cent. paste annually. Their consumption was, in—

1880	... 98 per cent. German	...	2 per cent. English
1881	... 99 ,, ,,	...	1 ,, ,,
1882	... 100 ,, ,,	...	0 ,, ,,
1883	... 77 ,, ,,	...	23 ,, ,,
1884	... 56 ,, ,,	...	44 ,, ,,
1885	... 47 ,, ,,	...	53 ,, ,,

Messrs. William Stirling and Sons, of Glasgow, state that their relative consumption of English and German alizarin for Turkey-red dyeing varies so much from year to year that they have no means of directly supplying useful data. This firm has, however, been good enough to make inquiries for me from a competent authority, who has furnished the following report:—

"In 1883 and 1884 I estimate that the sales in the United Kingdom amounted to a monthly average of about 530 tons, 10 per cent. (say 6360 tons, 10 per cent. per annum). Of this quantity I estimate about 30-33 per cent. was manufactured in this country. Taking 1884 alone, the figures are estimated at 566 tons, 10 per cent. per month (say 6800 tons, 10 per cent. per annum). Proportion manufactured in Great Britain, say about 30-35 per cent. In 1886 the consumption may be estimated at 550-600 tons, 10 per cent. per month (say 6900 tons, 10 per cent. per annum). Proportion manufactured in this country probably now very considerably more than 35 per cent."

This estimate of the total consumption (550-600 tons, 10 per cent. per month) is confirmed by my friend Mr. Thomas Royle, F.C.S., of the British Alizarin Company's works at Silvertown, but he is of opinion that 50 per cent. of this is of English manufacture.

By way of further confirmation, it appeared to me to be desirable to get the opinion of manufacturers themselves, and although this has been a matter of considerable difficulty, I am able to give some kind of an estimate. Mr. Ivan Levinstein, of Manchester, estimates that Germany produces:—

Colours derived from benzene and toluene, six times more than England.

Colours derived from naphthalene, seven times more than England.

Colours derived from anthracene, five times more than England.

The average production of Germany is thus about six times that of this country. Mr. W. A. Mitchell, of the firm of W. C. Barnes and Co., Phœnix Works, Hackney Wick, informs me that of some 159 tons of "aniline" dyes which passed through their hands as agents last year, 95 per cent. were of Continental make. With reference to the two chief raw materials, benzene and aniline, this same firm estimates that about 75 per cent. of the whole quantity of these products made in England goes to the Continent.[1]

The facts and figures which I have now laid before you must be left to tell their own story—time will not permit me to attempt any analysis of them. The evidence collected will at any rate give a much more forcible idea of the true state of the coal-tar colour industry in this country than has hitherto been attempted, and if this evidence goes against us as a manufacturing nation, it is all the more desirable that our true position should be realised. I find that it is almost impossible to give a correct numerical expression in pounds sterling for the annual value of this industry to the country, as the estimates vary within very wide limits. According to Dr. Perkin, whose opinion on this matter will perhaps carry the greatest weight, the value of the annual output is between 3,000,000*l*. and 4,000,000*l*. That the industry is one of considerable importance on the Continent may be gathered from the official returns relating to the German exports. For the following figures I am indebted to Dr. H. Caro, of the "Badische Anilin und Soda Fabrik," Ludwigshafen on Rhine:—

Exported from Germany, from January 1 *to December* 31, 1885

Alizarin paste (? per cent.)	4283 tons
Aniline and intermediate products ...	1713 ,,
Aniline, &c., colours	4645 ,,

Dr. Caro adds that it is generally believed that about four-fifths of the entire German production are exported.

The magnitude of this branch of chemical industry abroad will be gathered from the fact that a German factory of about the third magnitude consumes at the present time between 500 and 600 tons of aniline annually. According to information recently furnished to me from the two largest of the German factories, the Badische Company employ 2500 working men and officials, and the Hoechst Colour Works (formerly Meister, Lucius, and Brüning) 1600 working men and fifty-four chemists. It must, of course, be borne in mind that in these factories the products are not "aniline" colours only, but alizarin, acids, alkalies, and all chemicals required in this branch of manufacture.

The industry which has been selected for this evening's topic is thus not only an important one in itself, but for us, as chemists, its development is fraught with meaning both scientifically and educationally. In taking up this subject it has not been my desire to exalt the coal-tar colour industry to a position of undue importance, nor do I wish it to be inferred that the remarks which I have made concerning its decadence, or at any rate stagnation, in this country are applicable to this manufacture only. The failure on our part to grasp the true spirit of chemical science in its relation to our manufactures makes itself felt in every industry in which chemistry is concerned. The strength of our competitors is in their laboratories, and not, as here, upon the exchanges. It is only by showing up our weakness in each industry that the state of affairs can be remedied, and our prestige as a manufacturing country restored. If each specialist would do for his industry what I have here attempted to do broadly for the coal-tar colour industry, we should get together a body of evidence which the Royal Commissioners on the depression of trade would do well to take into consideration. We have heard a great deal of late years about the subject of technical education, but the talk has been rather one-sided. We have had utterances from those who, recognising the enormous importance of this subject to the country, have munificently endowed those institutions for the promotion of technical education which are springing up around us; we have had all kinds of schemes from those who are taking upon themselves the duties of technical educators, but it appears to me that we have not heard with sufficient distinctness the voices of those who may be presumed to suffer most from the want of technical education, viz. the manufacturers themselves. I have heard rumours of the existence of a certain class of manufacturer—let us hope a rare species—who declares that science is no use to him, and that he can get along better without it. I must confess that I never met this individual in the flesh, but I know that he exists in some of our manufacturing centres. As a species he is, however, doomed to extinction in the struggle with his competitors, and we may consider him out of court in the discussion of schemes of technical education. It is now generally admitted that the days of empiricism have passed away, and most manufacturers admit that present success and future development depend upon a proper recognition of technical, *i.e.* of applied science. But unless the manufacturers themselves speak loudly on this question, the voices of those who wish to promote scientific education may be drowned by the clamour of mere theorists.

In no other department of our manufactures is the want of technical science more felt than in the chemical industries. We not only see this in the greater development of these industries abroad, but in some of our most successful factories here—and this applies more especially to the coal-tar colour industry—foreign chemists are employed, and as I have lately been informed by a well-known manufacturer, it is even impossible to get the necessary plant properly made in this country. There is no doubt that the recondite character of the truths of chemical science, as compared with the more obvious truths of mechanics and physics, has much to do with the want of popularity of this branch of knowledge, and is responsible for the circumstance that our science is regarded with comparative indifference until some branch of manufacture is *in extremis*. In our national characteristic of being "practical," we are apt to become short-sighted in our manufacturing policy, and to recognise only actualities, to the exclusion of the potentiality conferred upon a nation by a broader scientific culture.

In conclusion, I have to express my thanks to Messrs. Brooke, Simpson, and Spiller; Messrs. Burt, Bolton, and Haywood; and to the British Alizarin Company for the fine series of specimens now exhibited. For the beautiful specimens illustrating the Continental manufacture, I am especially indebted to the Badische Anilin and Soda Fabrik, of Ludwigshafen on Rhine, and to the Hoechst Colour Works. The series of patterns dyed with known weights of fifty distinct coal-tar colours were prepared by Mr. Ivan Levinstein for the lecture recently delivered at the Royal Institution by Sir Henry Roscoe, to whom I am indebted for being able to show them on the present occasion.

[1] According to a later estimate, kindly supplied by Mr. Ivan Levinstein, the quantity of benzene and toluene used in this country amounts to about 500,000 gallons, and that used in Germany to about 2,000,000 gallons annually. About half the English production is, however, exported as aniline, toluidine, and aniline salt, while Germany converts into colouring-matters at least 1,600,000 gallons of these hydrocarbons.

DRYING UP OF SIBERIAN LAKES

THE rapid drying up of lakes in the Aral-Caspian depression, in so far as it appears from surveys made during the last hundred years, is the subject of a very interesting and important paper contributed by M. Yadrintseff to the last issue of the *Izvestia* of the St. Petersburg Geographical Society (vol. xxii. fasc. 1). Two maps, which will be most welcome to physical geographers, accompany the paper. One of them represents the group of lakes Sumy, Abyshkan, Moloki, and Tchany, in the Governments of Tobolsk and Tomsk, according to a survey made in 1784. The other represents the same lakes according to three different surveys made during our century, in 1813 to 1820, in 1850 to 1860, and finally in 1880, and it shows thus the rapid progress of drying up of these lakes. There are also earlier maps of Lake Tchany, which represent it as having very many islands (Pallas estimated their number at seventy), but they are not reliable. As to the map of 1784, no cartographer, accustomed to distinguish "nature-true" maps from fancy ones, would hesitate in recognising it as quite reliable as to its general features. It is also fully confirmed by the ulterior detailed surveys dating from the beginning of our century. It appears from this series of four maps, dating from different periods, that the drying up has gone on at a speed which will surely appear astonishing to geographers. The group of lakes consisted of three large lakes—Sumy, Abyshkan, and Tchany, with a smaller lake, Moloki, between the two latter. Lake Tchany (the largest of the three) has much diminished in size, especially in its eastern and southern parts; but the greatest changes have gone on in the other lakes. Whole villages have grown on the site formerly occupied by Lake Moloki, which had a length of twenty miles at the end of last century, and now is hardly three miles wide. Of Lake Abyshkan, which had a length of forty miles from north to south, and a width of seventeen miles in the earlier years of this century, and whose surface was estimated at 530 square miles, only three small ponds have remained, the largest of them being hardly one mile and a half wide. The drying up has been going on with remarkable rapidity. Even twenty-five years ago there were several lakes ten and eight miles long and wide, where there are now but little ponds. Lake Tchebakly, which was represented in 1784 as an oval forty miles long and thirty miles wide, has an elongated irregular shape on the map of the beginning of our century; it measures, however, still forty miles in length, and its width varies from seven to twenty miles; while several small lakes to the east of it show its former extension. Thirty years later we find in the same place but a few small lakes, the largest of which hardly has a length and width of three miles; and now, three small ponds, the largest of them having a width of less than two miles, are all that remain of a lake which covered about 350 square miles a hundred years ago. The same process is going on throughout the lakes of West Siberia, and throughout the Aral-Caspian depression. No geologist doubted upon, but we cannot but heartily thank M. Yadrintseff for having published documents which permit to estimate the rapidity of the process. P. K.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

WE understand that Mr. Granville Cole has been appointed to the Professorship of Geology at the Bedford College, London, and Miss C. A. Raisin to the Demonstratorship in Botany at the same institution.

SCIENTIFIC SERIALS

THE *Journal of Botany*.—The number for July commences with the first part of an important article (illustrated), by Messrs. Roy and Bisset, on Japanese Desmids, chiefly obtained from a lake in the Island of Yesso. The majority of the forms obtained are cosmopolitan, but some of them of great rarity in Europe. There are also some new species. Papers follow on British *Rubi*, on the *Rubi* of Somersetshire, and on the flora of St. Kilda.

American Journal of Science, July.—Memorial of Edward Tuckerman, by Asa Gray. This botanist, who was born in Boston, December 7, 1817, and died March 15, 1886, was distinguished especially in the field of lichenology, to which he devoted most of his life. He was the author of a "Synopsis of the Lichens of New England, the other Northern States, and British America," of "Lichenes Americæ Septentrionalis exsiccati" (3 vols.), and many other papers on this branch of botany, in which he has left behind him no superior.—Notes on American earthquakes (No. 15), by Prof. C. G. Rockwood, jun. This fifteenth paper of the series gives a summary of such information as the author has been able to gather on the earthquakes of North and South America during the year 1885. It tabulates seventy-one shocks, classed according to their intensity as very light, light, moderate, strong, severe, or destructive. Of these as many as thirty-four occurred on the Pacific coast of the United States, where the Bay of San Francisco appears to be a chief centre of seismic disturbance.—Observations on the Tertiary and Grand Gulf of Mississippi, by Dr. Otto Meyer. The author finds no place where Grand Gulf strata overlie the Marine Tertiary, although there are two districts where strata undistinguishable from unquestioned Grand Gulf are overlain by Marine Tertiary. The Grand Gulf is not, generally speaking, a marine formation, for it contains fresh-water shells. In Eastern Mississippi occurs a thick and extended marine greensand formation parallel to the strata immediately below the Claiborne profile. Its fauna is Claibornian, but approaches the Jacksonian.—Notes on the volcanic rocks of the Republic of Salvador, Central America, by Arnold Hague and Joseph P. Iddings. This study is based on specimens gathered by Mr. W. A. Goodyear in the course of his explorations in Salvador. They are of a highly diversified character, ranging from very basic to highly acidic forms, from rocks rich in olivine to others abounding in quartz, and may be classified under the heads of basalt, pyroxene-andesite, hornblende-pyroxene-andesite, hornblende-mica-andesite, dacite, and possibly rhyolite, basalt and dacite being best represented. Nearly all have their counterpart in Nevada, although there occur many varieties in Nevada not found in the limited series from Salvador.—The genus Strephochetus: distribution and species, by Henry M. Seely. Since reporting last year the presence of the fossil sponge, *Strephochetus occellatus*, at one or two places in Vermont and New York, the author has traced it to many other districts in those States. To the type of the genus, *S. occellatus*, he now also adds three new species—*S. brainerdi*, *S. atratus*, and *S. richmondensis*.—Preliminary report on the geology of the Cobscook Bay district, Maine, by N. S. Shaler. This paper, published by permission of the Director of the U.S. Geological Survey, gives a portion of the general results of two months' exploring work on the shore-line of Cobscook Bay during the summer of 1884. The fossiliferous strata have a special interest as throwing light on the position of the shore-line in past times. A conglomerate apparently of the Clinton or Niagara age on the west side of South Bay seems to show that the shore in this district was not far away during a portion of the time when the Cobscook series was forming. In the age of the Perry section there is also evidence that the coast was near its present position and that the rocks exposed to erosion were chiefly of the Laurentian epoch.—On the well-sperometer, by Alfred M. Meyer. The instrument here described, with numerous illustrations, has for the last ten years been used by the author in his laboratory for the purpose of measuring the radius of curvature of a lens of any linear aperture.—On some general terms applied to metamorphism and to the porphyritic structure of rocks, by James D. Dana. The three recognised forms of metamorphism are described and characterised as (1) crystallinic; (2) paramorphic; (3) metachemic. A full terminology of porphyritic varieties is given, based in plan on such terms as *orthophyre*, *augitophyre*, &c.

Bulletin de l'Académie Royale de Belgique, May.—On the transparency of platina, by Ed. van Aubel. After ascertaining by experiment that a sheet of cobalt, iron, or nickel obtained by electrolysis on a transparent sheet of silver, is not really transparent, as is now generally assumed, the author here endeavours to settle the question as regards mirrors of platina chemically produced, that is, by a deposit of platina on a sheet of glass, and the transparency of which is admitted by Kundt. Working with a large mirror supplied by Paul Lohmann of Berlin, from whom Kundt also obtained those used by him, M. van Aubel found, by means of spectroscopic observations, that the metal of these mirrors is not really transparent, the light merely filtering through the interstices left between the particles of platina deposited on the surface.—A contribution to the study of the salts of platina, by M. Eugène Prost. The author deals especially with the action of nitric acid and of perchloric acid on platinic hydrate, and with the action of nitric acid on the precipitated bisulphuret of platina, his object being to form the so-called normal platinic nitrates, perchlorates, and sulphates. Failing to obtain these substances, he endeavoured to get double salts of normal composition by combining them with alkaline salts having corresponding acids. The results show that all the compounds thus obtained still correspond with basic platinic salts, so that it would so far appear that a normal platinic nitrate cannot be obtained.—On the unstable equilibrium of the surface-layer of a fluid, by G. van der Mensbrugghe. The absolute instability of surface-layers exposed to the free action of the atmosphere is demonstrated on theoretical grounds. From this theory the author proposes in another paper to deduce the existence of superficial tension on the free surface of a fluid, or on the surface common to two fluids, or to a fluid and solid, thence deriving a rational explanation of the phenomenon of evaporation.—On the heat of the alloys of lead and tin, by W. Spring. Continuing the researches of Ermann, Rudberg, Regnault, Wiedmann, and others, the author seeks to determine for restricted intervals of temperature the total heat of these alloys relatively to that of their constituents. Further light is thus thrown both on the constitution of these bodies, and on the question why their point of fusion is lower than that of their constituents.

Rendiconti del Reale Istituto Lombardo, June.—On some unconscious intervals in a co-ordinate series of psychic acts, by Tito Vignoli. The object of this essay is to ascertain experimentally whether in the co-ordinate exercise, or logical sequence, of thought, it sometimes happens that some of the connecting links of the argument are supplied unconsciously. Several instances are quoted, together with the author's personal experience, showing that this really is the case. It is incidentally argued that, in its complexity, the brain is a large organ of compensation, so that, if any of its parts in which special functions are localised become disturbed or injured, these may, within certain limits, be replaced by others, immediately if the lesion be slight, gradually if serious.—A contribution to the theory of quadratic forms, by G. Morera.

July.—A case of extraordinary hirsuteness, by Prof. Giovanni Zoja. The author refers briefly to a Spanish girl observed by him at Pavia in 1881, who was above the average height, yet whose hair, when unbound, swept the ground by several centimetres. Some of the tresses measured 180 to 187·3 centimetres. —Meteorological observations made at the Brera Observatory, Milan, during the month of June.

SOCIETIES AND ACADEMIES

Sydney

Royal Society of New South Wales, May 5.—Annual Meeting.—Prof. Liversidge, F.R.S., President, in the chair.—The President stated that 27 new Members had been elected during the year, and the total number on the roll April 30 was 492. The Clarke Medal for the year 1886 had been awarded to Prof. L. G. de Koninck, M.D., of Liége, in recognition of his distinguished scientific attainments, and more particularly of his valuable contributions to our knowledge of the Palæozoic fossils of New South Wales. During the year the Society held eight meetings, at which the following papers were read:—Presidential Address, by H. C. Russell, B.A., F.R.A.S.—Notes on flying-machines, by L. Hargrave.—On a system of accurate measurement by means of long steel ribands, by G. H. Knibbs. —Local variations and vibrations of the earth's surface, by H. C. Russell, B.A., F.R.A.S.—Some causes of the decay of the Australian forests, by Rev. P. MacPherson, M.A.—The history of floods in the Hawkesbury River, by J. P. Josephson, A.M.I.C.E.—The Ringal of the North-Western Himalaya, by Dr. Brandis, F.R.S. (communicated by Baron von F. Müller, K.C.M.G., F.R.S.).—Notes on experiments in mounting the *Amphipleura pellucida* in media having a higher refractive index than Canada balsam, by Dr. W. Morris, F.R.M.S.—Notes on the characters of the Adelong Reefs, by S. H. Cox, F.C.S., F.G.S.—Stone implements of the aborigines of Australia and some other countries, by Rev. P. MacPherson, M.A.—On a form of flying-machine, by L. Hargrave.—On a new form of anemometer, by H. C. Russell, B.A., F.R.A.S.—The Medical Section held eight meetings, at which eighteen papers were read, and the Microscopical Section eight, at which three papers were read. The number of donations received was 1420 volumes and pamphlets, and 310*l*. expended in the purchase of books, &c., for the library. The Society has issued the following list of subjects, with the offer of the Society's bronze medal and a prize of 25*l*. for each of the best researches if of sufficient merit:—Series vi. to be sent in not later than May 1, 1887; (No. 20) on the silver ore deposits of New South Wales; (No. 21) origin and mode of occurrence of gold-bearing veins and of the associated minerals; (No. 22) influence of the Australian climate in producing modifications of diseases; (No. 23) on the Infusoria peculiar to Australia. Series vii., to be sent in not later than May 1, 1888: (No 24) anatomy and life-history of the Echidna and Platypus; (No. 25) anatomy and life-history of Mollusca peculiar to Australia; (No. 26) the chemical composition of the products from the so-called Kerosene Shale of New South Wales.—The following Officers and Council were elected for the ensuing year:—President: C. Rolleston, C.M.G.; Vice-Presidents: H. C. Russell, B.A., F.R.A.S.; Dr. Leibius, M.A.; Hon. Treasurer: R. Hunt, F.G.S.; Hon. Secs.: Prof. Liversidge, F.R.S.; F. B. Kyngdon, F.R.M.S.; Council: Hon. Dr. C. K. Mackellar, A.M., M.L.C.; C. Moore, F.L.S.; P. R. Pedley, Dr. J. Ashburton Thompson, C. S. Wilkinson, F.G.S.; Dr. H. G. A. Wright.

Paris

Academy of Sciences, July 26.—M. Jurien de la Gravière, President, in the chair.—On the quantitative analysis of ammonia, by M. Th. Schlœsing. The author's process of analysis, based on distillation in presence of magnesia, having been questioned by M. Berthelot and others, he has made some fresh experiments, here described, which fully confirm the accuracy of the results already obtained.—Observations on the oldest sedimentary groups in the north-west of France, by M. Hébert. The region here dealt with is the northern section of Brittany and Normandy, where the most ancient sedimentary rocks are the clay-slates of Saint-Lô and the widely diffused purple conglomerates. The former, which are quite distinct from the mica-schists, gneiss, and other primitive crystalline schists, form the fundamental feature throughout the department of La Manche, stretching far eastwards into Calvados, and westwards into Brittany. They assume almost everywhere a vertical or nearly vertical disposition, and are remarkably homogeneous, being almost totally destitute of any organic remains. The whole system seems to be posterior to the granitic pudding of Granville.—On the meteorological station of l'Aigoual, by M. F. Perrier. Since the beginning of July this station has been in full activity, and has been furnished by M. Houdaille, of Montpellier, with maxima and minima thermometers, a psychrometer, an evaporometer, and a registering hygrometer. In the neighbourhood other instruments have been fitted up, including Tonnelot and Richard barometers, a large pluviometer, and a Campbell heliograph. Regular observations have already begun to be taken on this peak, which stands at an altitude of 1567 metres above sea-level, on the water-parting between the Atlantic and Mediterranean basins. The present temporary erections will soon be replaced by a solid structure, for which a grant of 4800*l*. has been made by the Minister of Agriculture.—Remarks accompanying the presentation of vol. xii. of the "Mémorial du Dépôt de la Guerre," by Col. F. Perrier. The first part of this volume describes the instruments and apparatus employed in the various geodetic operations connected with the new measurement of the meridian of Paris, with an exposition of the methods of observation. In the second are embodied all the observations taken from 1871 to 1884 between Perpignan and Paris by MM. Perrier, Bassot, and Defforges, at seventy-two stations belonging to the meridian of France.—Note on Gen. Meusnier's projected aërostatic machine, by M. Létonné. The album here referred to is a photographic reproduction of an atlas now in the military aërostatic establishment of Chalais (Meudon), and containing sixteen plates of designs relative to a projected aërostatic machine prepared by Gen. Meusnier between the years 1784 and 1789. Eight tables are added, giving the coefficients of resistance of various substances suited for the construction of this machine.—On the pressure that exists in the contracted section of a gaseous current, by M. Hugoniot. This paper is supplementary to that inserted in the *Comptes rendus* of June 28, showing that the results of M. Hirn's experiments on the flow of gases are in harmony with the laws of hydrodynamics and with the formula of Weisbach or Zeuner, which is a direct consequence of those laws. Some objections raised by M. Hirn himself are here disposed of, and the general conclusion confirmed by fresh argument.—On the velocity of light in the sulphuret of carbon, by M. Gouy. The experiments here described have been carried out with a revolving mirror analogous to that of Foucault, and capable of 800 revolutions per second by means of compressed air. The results correspond with those recently obtained by Mr. Michelson (*American Journal of Science*, and NATURE, March 11 and April 22, 1886).—Note on the construction of an absolute electrometer adapted for the measurement of very high potentials, by MM. E. Bichat and R. Blondlot. By an improvement introduced into the construction of their already described electrometer, the authors have produced an instrument possessing absolute sterility and capable of measuring potentials corresponding to explosive distances of 2·5 centimetres. A model of the apparatus has been constructed by M. D. Gaiffe, of Nancy.—On the slow decomposition of the chlorides in their extended dissolutions, by M. G. Foussereau. Further experiments with the chlorides of aluminium and magnesium, with the double chloride of rhodium and sodium, the bichloride of platina and the sesquichloride of gold show that the recently described phenomenon of decomposition probably extends to a numerous class of chlorides.—On the definition of the coefficient of self-induction in an electro-magnetic system, by M. G. Cabanellas. —On the numerical laws of chemical equilibria, by M. H. Le Chatelier. The formula for the numerical law of the chemical equilibrium of a gaseous system,

$$\log p^{n} p'^{n'} \ldots p''^{-n''} \ldots - \frac{273}{0{\cdot}542} \int \frac{Q}{T^2} dT = \text{const.},$$

announced by the author in the *Comptes rendus* for November 16 and December 28, 1885, is here established by rigorous demonstration.—Fresh experiments on the decomposition of hydrofluoric acid by an electric current, by M. H. Moissan. These experiments show conclusively that the gas separated by electro lysis from anhydrous hydrofluoric acid or from the hydrofluorate of fluoride is fluor, as already anticipated.—On the separation of antimony from tin, by M. Ad. Carnot. This difficult process has been successfully accomplished by a method analogous to that already employed by the author for the separation of zinc and cadmium. It is based on the simultaneous employment of oxalic acid and of the hyposulphide of soda.—On the manganites of soda, by M. G. Rousseau.—On the determination of the absolute acidity of the fluids present in the organism, and on some phenomena connected with the saturation of orthophosphoric acid, by M. Ch. Blarez. From the experiments here described it is inferred that the exact determination of the absolute basic property of phosphoric acid is impossible, there being nothing absolute in this property itself; also that it is impossible to determine the absolute acidity of the animal fluids, of whose constituent principles phosphoric acid and the phosphates form part.—On some thermic data relating to the chromates, by M. Paul Sabatier.—Thermic researches on the seleniures, by M. Charles Fabre. The author here deals with the heat of formation of the seleniure of dissolved ammonium, and with some problems connected with the seleniures of lithium.—Researches on some crystallised basic sulphates, by M. Athanasesco. By employing the process used by Friedel for the artificial reproduction of brochantite, the author has succeeded in obtaining fine crystallised subsulphates of cadmium, zinc, alumina, iron, and uranium. By a slightly modified process he afterwards obtained some subsulphates of nickel, cobalt, mercury, and bismuth.—Researches on some crystallised arseniates, by M. Coloriano All these arseniates, except the bibasic, are insoluble in water, and resist the acids. They were obtained by the various processes of Debray, Friedel and Sarasin, Verneuil and Bourgeois.—On a nitrated camphor and its saline and alcoholic combinations, by M. P. Cazeneuve.—Discussion on the reactions of pilocarpine, by MM. E. Hardy and G. Calmels.—Physiological function of the pulmonary tissue in the exhalation of carbonic acid, by M. L. Garnier.—On a universal chromatometer, by M. L. Andrieu (de l'Etang). The apparatus here described and illustrated is intended to define and measure the colours of liquids by giving them numerical expression.—On the Anguillules of smut, by M. G. Pennetier. From his recent experiments the author concludes that these parasites preserve the vital spark for a period of fourteen years, but no longer.—On the milky secretion of pigeons during incubation, by MM. Charbonnel-Salle and Phisalix.—Researches on the structure of the brain of the Myriapods, by M. G. Saint-Remy.—Researches on the Miocene vegetation of Brittany, by M. Louis Crié.—On the picturesque group of rocks collectively known by the name of Montpellier-le-Vieux (Aveyron), by M. E. A. Martel.

Berlin

Physiological Society, July 2.—Dr. Joseph reported on the results of experiments instituted with a view to ascertaining the influence of the nerves on the skin. Following up the experiments of Waller, he had excised a somewhat large piece of the second cervical nerve peripherically from the ganglion, and a few days thereafter had observed behind the ear of the side operated upon a perfectly circumscribed place on which the hairs had fallen out, but which, beyond the baldness, showed no symptom of change. The cutting through of the posterior root of the cervical nerve had not the same effect, but the extirpation of the second cervical ganglion had that result. The microscopical examination of the hairless spots showed absence of hair papillæ and of the hair root, while the other constituents of the skin remained unchanged. No abnormal vascularisation of the spots in question nor of the ears generally was observed. Seeing that the protected situation of the depillated spot and the presence of sensibility went to disprove the idea of a mechanical removal of the hairs, while the result of the anatomical examination attested that the hairs were exclusively affected without the vascular system having undergone any essential alteration; the speaker was therefore of opinion that the results of his investigations might be taken as demonstration of the existence of trophical nerves. After the separation of the peripherical nerve no change in the ganglion was ever observed, whereas the dissection of the posterior root gave rise to atrophy.—Dr. H. Virchow next demonstrated four drawings representing the incurvations of the vertebrate columns of different human types and manifesting the surprisingly great differences obtaining among the normal vertebrate columns of a Russian, an Italian, a male German existing in model, and a pregnant German wife. From these figures it was to be concluded that the breadth of the normal fluctuations of these incurvations was great. On the study of the vertebral column it was to be observed that it was indeed comparable to an elastic rod which became expanded by lateral pressure, and compressed by pressure from the top, but that it was composed of several parts independent of one another (the lumbar, pectoral, and cervical parts) which were adapted to the special functions of the respective sections of the rump. By a simple model he made these differences among the different sections apparent. On a second model he showed that very marked displacements in the centre of gravity at the uppermost part of the body were equalised, not by compensatory incurvations, but by bendings in the undermost joints. The speaker then demonstrated by curves rendered in paste the incurvations shown by the vertebral column of dead bodies when the ligaments of the vertebrate bodies in front or behind, in the dorsal or lumbar vertebræ, were cut through. The curves became more marked after the elastic ligaments of the upper vertebræ were cut through, but they hardly changed at all when the lowest tendinous ligaments were cut through. The intesticular ligaments consisted of a soft elastic kernel and of distended ligamentous fibres compressing the kernel. The action of the expending kernels, which made the vertebral column firmer, was illustrated by a third model. The speaker had taken exact measure of the situation of the kernel in each disk on vertebrate columns sawn through, and when he combined together these points on a drawing, he obtained a more marked incurvation than that possessed by the vertebral column. Thus altogether apart from the muscular activity, the different forces acted on the incurvation of the vertebrate column, which for the rest appeared to be different in the different races.

BOOKS AND PAMPHLETS RECEIVED

"Indigenous Fodder Grasses of North-West India" (Roorkee).—"Die Ergebnisse der Untersuchungsfahrten, S. M. Knbt." "Drache" (Mittler und Sohn, Berlin).—"Russland," by Von Waldeck (Freytag).—"Der Ozean," by Dr. O. Krümmell (Freytag).—"Die Schweiz," by Dr. Z. Z. Egli (Freytag).—"Vital Statistics of the City of Glasgow," by Dr. J. B. Russell (Macdougall).—"Beiträge zur Biologie der Pflanzen," Vierter Band, Zweiter Heft (Kern, Breslau).—"Transactions of Vasser Brothers' Institute and its Scientific Section," vol. iii. part 1.—"Partiality in Unity" (Wyman).—"Bulletin of the U.S. Geological Survey," Nos. 24, 25, 26 (Washington).—"Speculations from Political Economy," by C. B. Clarke (Macmillan).—"Annalen der k. k. Universitäts Sternwarte in Wien," ii. iii. Band, 1883, by E. Weiss (Wien).—"Report on the Migration of Birds," 7th Report, 1885 (Macfarlane and Erskine).

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