

occurrence as upon the theory of physiological selection we should have antecedently expected. Looking to the great sensitiveness of the reproductive system, to the many and the varied causes which affect it, to the frequency with which these causes must have been encountered under Nature, to the fact that whenever a collective variation occurs of the kind which induces physiological selection it must almost certainly leave a new species to record the fact—looking to all these things, the only real difficulty is to explain why, if physiological selection has ever acted at all, it should only have done so at such comparatively rare intervals, and therefore have produced such a comparatively small measure of result. If my critics had adopted this line of argument I should have experienced more difficulty in meeting them. But, as the case now stands, it seems enough to remark that I do not know of any way in which an adverse criticism admits of being more thoroughly exploded, than by showing that the difficulty which it undertakes to present is the precise opposite of the one with which an author is in his own mind, and at that very time, contending.

"Seeing how remarkable has been the misunderstanding displayed by such competent readers as Mr. Wallace and Mr. Seebohm—a misunderstanding on which they both found their only objection to my theory—I should have been compelled to suppose that my paper failed in clearness of expression, were it not that (as above shown) they have disregarded the literal construction of my sentences. Nevertheless, it is probable enough that I may not have sufficiently guarded against a misunderstanding which it never occurred to me that any one was likely to make. For I supposed that all readers would have perceived at least that the main feature of the theory is what my paper states it to be—namely, that sterility with parent forms is one of the conditions, and not always one of the results, of specific differentiation. But, if so, is it not evident that all causes which induce sterility with parent forms are comprised by the theory, whether these causes happen to affect a few individuals sporadically, a number of individuals simultaneously, or even the majority of an entire species?"

GEORGE J. ROMANES

Meteor of December 28, 1886

THE meteor referred to by your correspondent "J. M. H." (NATURE, January 6, p. 224) was also observed at Bristol at 10h. 28m. The path was from $95^\circ + 9\frac{1}{2}^\circ$ to $106\frac{1}{2}^\circ - 6^\circ$. A train of sparks was thrown off from the nucleus as it slowly fell.

Comparing the apparent course of the meteor as recorded at Sidmouth and Bristol, it is evident that its radiant-point was at about $77^\circ + 30^\circ$, near β Tauri. It belonged to a shower which appears to have a very extended duration, and has been specially referred to, with diagrams, in NATURE, vol. xxxi. p. 463.

This recent meteor affords unmistakable proof that the radiant near β Tauri continues active until the end of the year. The relative paths at Sidmouth and Bristol show that the meteor was about 97 statute miles high at its first appearance over a point in the English Channel some 28 miles off the Isle of Wight. Moving with a very slight inclination west of north, it disappeared 10 miles south-west of Niton, Isle of Wight, when 39 miles high. It traversed a path of 62 miles at an inclination of 69° to the earth's surface.

The duration of the meteor was about three seconds, so that its velocity appears to have exceeded 20 miles per second, which is greater than that of a body moving in a parabola, though the difference may quite possibly have been induced by observational errors. As regards visible effect, the meteor can lay no claim to the dignity of a fire-ball, but it is one of considerable interest as belonging to the remarkable display of β Taurids.

Bristol, January 7

W. F. DENNING

The Production of Ozone

I SHALL be much obliged if you can inform me through your paper—

(1) What apparatus would be most conveniently and easily worked by ordinary persons for the production of ozone in a room? I have tried a four-cell Smee's battery with a Siemens' ozone tube. This produces the required quantity of ozone, and works well in the hands of people used to scientific apparatus, but the general manipulation (especially as regards keeping the battery in working order) is above most people.

(2) Is there any battery you know that would give good

results and be easily worked by people wholly unused to scientific apparatus (domestic servants for instance)? The quantity required is what would keep the air of an ordinary sitting-room, say $18 \times 16 \times 11$ feet so charged, that ozone would be always just sensible to the smell.

I see by the advertisements of the hotels in the Engadine, that the air in their corridors is kept constantly ozonised. (3) Could they adapt their electric light dynamos for this purpose? (4) If so, how?

I may say I have no "trade purpose" in making these queries. I am a sufferer from phthisis, and find relief in the inhalation of ozone, but I want an apparatus that I could leave to my servants to manage.

W. H.

"Brading," Madeira Road, Bournemouth

JOHN ARTHUR PHILLIPS, F.R.S.

BY the sudden death of this chemist and metallurgist on the 5th inst. geology loses one of its ablest leaders in a department where the labourers are not very numerous here, and at the same time one of the kindest and most helpful among the students of science. Mr. Phillips was born in Cornwall, and among the metalliferous rocks of that county began the scientific researches which he has since prosecuted with so much success. Having early shown his taste for mining and metallurgy, he was sent to obtain his training in these subjects at the École des Mines of Paris. As far back as 1841 he began to contribute papers to the scientific journals. His early essays were almost wholly devoted to chemical and metallurgical subjects. His studies among the Californian gold-fields, however, led him to investigate wider questions in physical geology. By degrees he turned into the domain of petrography, and for the last sixteen years it has been mainly in that branch of science that his original researches have been carried on. His papers on the eruptive rocks of the south-west of England are admirable illustrations of the value of the union of chemical and mineralogical qualifications in petrographical inquiry. Most of his time during the last two or three years had been devoted to the production of large and important treatises. Of these his volume on "Ore Deposits," published in 1884, has taken its place as a standard English work of reference. At the time of his death he was busy with the preparation of a new edition and expansion of a work on "Metallurgy," which he had published when still a young man. In this task he had associated Mr. Bauerman with himself, in whose competent hands the volume is sure to see the light in a form worthy of its author's reputation. Those who were personally acquainted with Mr. Phillips, while they lament the loss to science which his sudden death has inflicted, mourn still more the extinction of a life of singular simplicity, earnestness, and kindness. He was a large-hearted and open-handed man, fond of taking every chance that came in his way of doing a good deed and helping every one to whom his help could be of service.

BOTANICAL FEDERATION IN THE WEST INDIES

IN the nearest of our tropical colonial possessions, which comprise the group of islands generally known as the West Indies, the dominant industry for the last hundred years has been that of the sugar-cane. Sugar and rum are indissolubly connected with these islands, and, under the circumstances which existed fifty years ago, there is no doubt that lowlands in the West Indies were better suited for the remunerative culture and growth of the sugar-cane than any other plant. Owing to a variety of causes, among which the abolition of slavery and the extension of sugar plantations in other lands are the chief, sugar-growing in the West Indies has suffered numerous reverses of fortune. Latterly, the difficulties of planters

have been greatly increased by the improved production of beet-sugar in Europe.

The chief sugar islands at present are Barbados, Antigua, St. Vincent, Trinidad, St. Lucia, and Tobago. At Jamaica, sugar and rum are still the staple industries, and form 39 per cent. of the exports, the balance being made up by other industries, such as coffee, fruit, and dye-woods. At Trinidad cacao is largely grown, and the export value of this article is nearly two-thirds that of sugar. Grenada, once a large sugar-growing colony, is now almost entirely devoted to cacao. Montserrat is becoming noted for its lime plantations, and exports of lime-juice; while Dominica exports concentrated lime-juice, cacao, cocoanuts, and tropical fruits. The Bahamas have a large tropical fruit trade with America, supplemented by the export of sponges, to the value of £60,000 annually. In spite of these smaller industries, however, there is no doubt that the chief business of the West Indies is still that of sugar. A capital of something like fifty millions sterling is invested in it, and the people are naturally reluctant to relinquish an industry which has, in the course of a century, become thoroughly established, and which is familiar in its details to all classes of the community. But, after all, it is impossible to overcome the logic of facts: and it is admitted on all sides that sugar, under present circumstances, can with difficulty be grown and manufactured to pay a profit. Hence it is not surprising that there is a strong desire to enter upon other cultivations; and it is well for the future prosperity of the West Indies that this should be so. The depression in the past and the comparative poverty of the present are no doubt due to the exclusive cultivation of one plant; for under such circumstances, when the sugar-market is depressed, everything is depressed. If improvements in cultivation were adopted, and if such high scientific skill as is applied to the manufacture of beet-sugar were applied to the manufacture of cane-sugar, it is the opinion of many that the planters would again become prosperous. But something more is necessary. With the exception of two islands in the whole group—namely, Antigua and Barbados—it is estimated that more than one-half of the actual surface of the West Indian Islands is suitable for other cultivations than sugar-cane. This being so, the people injure their best interests by neglecting the resources at their disposal.

In purely sugar islands, such as Barbados and Antigua, permanent improvement is to be sought in more economic and improved systems of cultivation, added to which there should be a concentration of all purely manufacturing processes under what is known as the *Usine* system. This latter system is already in existence at Trinidad, St. Lucia, British Guiana, and in the French island of Martinique; and it is proved beyond question that where the manufacture of sugar is treated as a highly specialised industry, finer and better qualities are produced, and the expenses are considerably diminished. Planters are therefore recommended to confine themselves as much as possible to the cultural operations of a sugar estate. Under such a division of labour there would follow a more careful trial of different varieties of the sugar-cane, adapted to the different soils, a more scientific application of special manures, and such general regulation of all cultural operations as would produce canes of the highest saccharine richness. In Barbados, Trinidad, and Jamaica, there are already Government analytical chemists, who are qualified to give valuable information to planters as regards soils and manures; and from a report recently prepared at Barbados by Prof. Harrison it is evident that much good would result from a larger utilisation of chemical knowledge as applied to sugar cultivation, both in the interest of the individual and of the general community.

During the last five or six years efforts have been made to increase the efficiency of West Indian industries by a wider and more general application of scientific

methods not only to the sugar-cane but to all other plants which may be found suitable to the circumstances of the several islands. Hitherto two botanical establishments have been maintained for the West Indies—one at Jamaica and the other at Trinidad. From these centres, but especially from that of Jamaica, economic plants and information by means of annual reports and other publications have been regularly furnished, and such agencies have greatly assisted in enlarging the scope of experimental culture.

In the Report of the Royal (West Indian Finance) Commission, appointed in 1883, it was stated that there was a growing inclination on the part of the planters in other West Indian colonies to apply for seeds and plants to the Botanical Establishment in Jamaica, which could supply each island with what it required in the most economical manner. Sir Joseph Hooker, commenting on this report, expressed the opinion that there could be no doubt that the future prosperity of the West Indies would be largely affected by the extension to other islands, unprovided with any kind of botanical establishment, of the operations so successfully pursued in Jamaica. And it was suggested by Mr. Thiselton Dyer that, in addition to the distribution of plants, there might be organised a regular system of botanical bulletins, containing practical hints as to the treatment of economic plants, and the conditions under which they might be best utilised as objects of remunerative industry.

At the instance of the Secretary of State for the Colonies, it was ultimately decided that the whole of the West India Islands should be asked to co-operate in a systematic endeavour to promote and extend the cultivation of economic plants, and thus to develop more fully than heretofore their natural resources. This proposition was duly laid before the Governments of Barbados, the two groups of the Leeward and Windward Islands, and the colony of British Honduras. On account of the want of direct and regular communication, it was found impossible to include the Bahamas, while British Guiana is already supplied with its own botanic garden. The conditions on which the islands lying within the West India group were asked to join in this industrial federation were, first, the provision of an annual grant for the maintenance of a local station to discharge the functions of a scientific outpost and a nursery; and secondly, the contribution of small sums towards the support of operations at the central establishment. These small sums were intended to cover the special expenses incurred in behalf of each island in maintaining a depot for seeds and plants, and to pay the cost of publishing the botanical bulletins, which were intended to form an important feature in the scheme. The Legislative Council of Jamaica has recently expressed its willingness to give effect to the principle of the scheme as regards making the Botanical Establishment in that colony one of the central points of action; and it is anticipated that, while granting valuable aid to the smaller islands, Jamaica itself will derive, both directly and indirectly, considerable benefit from such vigorous and systematic working as would naturally arise in its own area, as well as from a larger interchange of plants and seeds with the neighbouring islands.

It is hardly necessary to observe that, in reply to the Secretary of State's despatch, the smaller islands were not slow to express their desire to be included in the scheme, and steps were taken in several to give effect to this desire by the establishment of local stations. Barbados was fortunate in possessing favourable means for starting a botanical station in connection with the Boys' Reformatory at Dods, where land was already under experimental cultivation in canes and in food-plants suitable to the district. This station is now at work, under a committee whose business is to supervise operations, and to communicate directly with the central establishment.

Grenada, which is in a fairly prosperous condition, has enlarged the original idea of a botanic station by making provision for a small botanic garden, which is now in course of being laid out under the charge of a trained superintendent (originally from Kew, but with Jamaica experience) at the Paddock, within easy reach of the town of St. George. At St. Vincent the proposal to utilise the old botanic garden of the colony as a botanical station has been adopted, but the provision at present made is insufficient for the purpose, and will require to be slightly increased.

St. Lucia, to the north-west of Barbados, has shown a spirit of commendable energy in taking up the idea, and has given practical effect to it through the operations of its well-organised agricultural society. An experienced curator, also from Jamaica, has recently been appointed to the charge of the station, and good results are anticipated. At Dominica the botanical station has not yet assumed a practical form owing to the depressed state of the finances; but there is little doubt that ultimately such a station will be established, and the resources of this fertile island more largely developed.

Further north, Antigua, more especially concerned in the cultivation of the sugar-cane, has joined the scheme, and apparently is only waiting the completion of final arrangements at the central establishment. British Honduras, which has already benefited by its intercourse with the Botanical Establishment in Jamaica, has the site for a station, and a managing body has been appointed to begin operations at an early date.

To give a certain cohesion and uniformity of action to these several agencies, it was thought very desirable that a visit should be made to the islands concerned by the head of the Jamaica Department. This was accomplished in the early part of last year by the writer of these notes, who was happy to devote a short holiday, on retirement from Jamaica, in visiting the islands at his own expense.

During this visit sites for stations were examined and discussed, and suggestions made for their working on the lines best suited to local circumstances. As a practical instance of the feasibility of a botanical federation of the West Indies, it may be mentioned that recently an inquiry has been made, by general consent of the local Legislatures, into the condition of the indigenous forest growths of these islands, by Mr. E. D. M. Hooper, of the Madras Forest Department.

The Reports on Jamaica and St. Vincent are already published, and they are of such a practical and useful character that they cannot fail to have an appreciable effect upon the treatment and management of the forests both as reserves of timber to supply future wants, and as a means of maintaining a due humidity of climate and protecting the sources of springs and rivers. These Forest Reports, when completed, will add greatly to our knowledge of West Indian timbers, their nature, extent, and distribution; and they will also afford for the first time in history the actual economic and meteorological conditions of the interior of several islands beyond the confines of the present areas under cultivation.

In many instances the natural forest trees, as at Barbados, the Virgin Islands, and some of the islands of the Grenadines, have been nearly exterminated; those once very common, and represented largely in collections of botanical travellers of the last century, are now almost unknown. If the botanical stations are carried on with due regard to the industrial wants of the community, and are not allowed to degenerate into mere nurseries for ornamental plants, they will indirectly do much to enlarge knowledge as regards local floras, and bring to light many indigenous plants likely to prove useful on account of such medicinal and economic properties as they may possess. In the year 1824 it was laid down as one of the objects of the then Botanical Garden, at Jamaica, that it should devote

attention "to the investigation of many unknown native plants of the island, which, from the properties of those already known, it is reasonable to infer would prove highly beneficial in augmenting internal resources by supplying various articles either for food, for medicine, or for manufacture, . . . by means of which great commercial advantages might be obtained; among others, the various vegetable dyes claim particular attention, as promising a fruitful field of discovery." As indicating the direct bearing which this one field of inquiry (vegetable dyes) among many others had upon the future of Jamaica, it is interesting to note that while no dye-woods whatever were exported from the island in 1824, a small trade of the value of 1859*l.* was started in 1833, which since that time has steadily increased, until now it has assumed relatively large dimensions. The exports of dye-woods in 1870 reached a gross value of 112,313*l.* ("Jamaica Handbook," 1884-85, p. 375).

Similar results in more recent times have attended the increased attention given to the cultivation of fruits that had been neglected in Jamaica. The export of these in 1875 amounted to 14,912*l.*, in 1884 the total value had increased to 273,534*l.*

Results such as these, although obviously of a special character, justify any attempt that may be made to improve the circumstances of the West India Islands; and they afford also a striking instance of what is capable of being accomplished in these islands when careful investigation and judicious and enterprising effort are made to fit local circumstances to the demands of the outer world.

As regards the carrying out of a scheme of local enterprise in the West Indies, it may be mentioned that the recent appointment of Mr. William Fawcett, a highly-qualified botanist, to the post of Director of the Botanical Department in Jamaica, and the transfer of Mr. Hart, late senior Superintendent at Jamaica, to the post of head of the Botanic Garden at Trinidad, appear to offer every hope of success to a botanical federation of the West India Islands. Jamaica and Trinidad, as the two foci of operations, could very well group round them the lesser islands, and the full realisation of such a scheme as is here indicated only requires such working out of details as may well take place at an early period.

It is important, however, to bear in mind that the success of the Jamaica Botanical Department, which has acted for several years as the centre of botanical and economical operations in the West Indies, has been in a great measure due to the valuable suggestions and the moral and material support which for many years it has received from Kew. It was from Sir William Hooker that Jamaica received its first supplies of seed of the several species of *Cinchona*, which have laid the foundation of the only English *Cinchona* enterprise in the New World. It was from his illustrious son and successor at Kew, Sir Joseph Hooker, that Jamaica received its tea plants and seeds, india-rubber plants, coca plants, fibre plants, and regular and large supplies of all the economic and medicinal plants which have flowed through Kew for distribution to various portions of the British Empire. Few can realise the eminent services which have been rendered by Kew in this direction, both by its correspondence and contributions, but there is every reason to believe that the results will ultimately be apparent in the greater prosperity of the inhabitants of the West Indies, and in the larger development of their rich and varied resources.

D. MORRIS

ART AND SCIENCE IN A NEW LIGHT

MR. BRETT is an artist of reputation and of remarkable industry. His pictures are popular, and meet with appreciative purchasers. He is enrolled among the Associates of the Royal Academy, and no doubt looks forward to be in due time raised to the dignity of Acade-