debate; yet we find that an active discussion is now going on among Scandinavian botanists as to its eastern or western affinities. Sir J. D. Hooker, in his "Outlines of the Distribution of Arctic Plants,"[1] made a careful analysis of the species found in Greenland, and came to the conclusion that the relationship was more European than American, and this view seems to have been generally adopted by botanists. In a recent official report, contained in the valuable series of memoirs published by the Commission for the Exploration of Greenland,[2] Prof. E. Warming, however, has tried to show that the flora is American; and as this author has had access to fuller materials than were formerly available, his opinion will carry considerable weight. Prof. A. G. Nathorst, a botanist especially competent to speak on questions relating to the botany of the Arctic regions and on the relation of the recent Arctic flora to the Glacial epoch, objects altogether to Prof. Warming's conclusions, and, although dealing with the same materials, maintains the accuracy of the generally accepted view as to the European relationship of the vegetation.[3] He also critically examines the flora in a way that has never been done before, and points to its dependence on bygone conditions. To certain of Prof. Nathorst's observations and conclusions I should like to draw attention.

The principal result arrived at by Prof. Warming was that the boundary between the American and the European provinces is formed by the Denmark Strait (the strait between Greenland and America), and not by Davis Strait as botanists have generally thought. This conclusion Prof. Nathorst critically examines, and so many curious and suggestive facts relating to geographical distribution come out in this examination that I may be excused for referring to certain of them somewhat in detail. The flowering plants of Greenland include 386 species, none of which are confined to that country. Leaving out of account circumpolar forms, Prof. Warming finds in the list 36 characteristic western against 42 eastern species, but suggests that when the flora of Arctic America is better known the balance will probably be in favour of the western forms. Prof. Warming, however, includes among the eastern plants only those now living in Europe, the Asiatic-American species being classed as western on the ground that they must have entered Greenland from the west rather than from the east—a somewhat unsafe line of reasoning when we take into account former changes of climate and the local extinction of many plants.

Prof. Nathorst analyzes the list differently, and gives most suggestive tables and a map of the local distribution of the eastern and western plants in Greenland. From these we find that the coast nearest to Iceland contains European forms alone, the southern extremity contains European forms in a majority, while the part of the west coast nearest to America yields principally western species; but taking Greenland as a whole the flora is more European than American. Another curious fact noticed by Prof. Nathorst is that the American element of the flora of Greenland is not entirely cut off by the Denmark Strait, but extends eastward as far as Iceland.

Prof. Warming considers that the nucleus of the present flora of Greenland represents part of the original flora, which was able to live through the Glacial epoch on the non-glaciated areas; but Prof. Nathorst points out that the few non-glaciated mountain-tops must have been far too high for any phanerogams to exist on them, and all the lowlands were then covered with ice and snow. We must therefore consider that both eastern and western elements of the present flora of Greenland entered the country in post-glacial times. The tables of distribution show at what points a large number of the plants entered—they came from the nearest land, whether European or American. Whether in post-glacial times there was any complete land-connection between Greenland and either North America or Iceland is very doubtful, but the straits may well have been narrower. The ice-foot, also, which collects in winter beneath the sea-cliffs is placed in the best possible position to receive any seeds or masses of soil which may fall during the winter. This shore-ice is drifted away in the spring, and may easily discharge its burden on some far-distant shore uninjured, and the seeds just ready to germinate. Winds, migrating birds, and migrating mammals would all help to transport seeds across the straits.

Turning now to the British Isles, we know that a prolific temperate flora inhabited this country in pre-glacial times. We know also that this flora disappeared and was replaced by a thoroughly Arctic one, at least as far south as Norfolk, where its relics are found beneath the moraines. Then came a period when Britain north of the Thames was covered with ice and snow, and only an occasional hill-top—or "*nunatak*," as it would be called in Greenland—rose above. When the ice retreated, the Arctic phanerogams again spread over the country, for we find *Salix polaris*, *S. herbacea*, *S. reticulata*, *Betula nana*, and *Loiseleuria procumbens* in lacustrine deposits immediately above the boulder clay near Edinburgh; we have also a similar flora, with *Salix polaris*, *S. myrsinites*, and *Betula nana*, in Suffolk; and even in Devonshire the dwarf birch has been found. This stage, though its flora is still imperfectly known, apparently corresponds closely with the present condition of Greenland.

In Britain, however, we have now reached a later stage in the amelioration of the climate and re-settlement of the country, for the Arctic plants have either disappeared entirely or have retreated to our mountain-tops, and in their place on the lowlands we find a temperate flora now living. The British flora, like that of Greenland, varies according to the botanical character of the nearest land, though, as with Greenland, there is no reason, except the supposed impossibility of the migration of the animals and plants without a bridge, to imagine that during post-glacial times there has been any direct connection with the Continent, save perhaps at the Straits of Dover. The distribution of plants in Britain is so peculiar that I may be forgiven for pointing out to non-botanical readers that we have a southern flora opposite France, a Germanic flora on the east coast, a Lusitanian flora in the south-west, and on the extreme west there are two American plants unknown elsewhere in Europe. In the Britain of the present day I believe that we may study the re-peopling of a country over which everything has been exterminated; and until we have fuller direct evidence of the stages of the process, we may safely accept Greenland and Britain as illustrating the way in which Nature works to fill gaps in the fauna and flora, whether these are caused by changes of climate, by volcanic agency, or the submergence and reappearance of islands. CLEMENT REID.

[1] Trans. Linn. Soc. vol. xxiii., pp. 251-348 (1861); partly reprinted (with additions) in the "Manual of the Natural History . . . of Greenland," &c. (1875).
[2] "Om Grønlands Vegetation: Meddelelser om Grønland," Part 12 (1888).
[3] *Engler's botanischen Jahrbüch*, 1891, p. 183.

THE SUN'S CORONA.

SOME little time ago Dr. Schaeberle, of the Lick Observatory, was good enough to send me the following letter:—

Allow me to call your special attention to a note of mine in the forthcoming number of the A.S.P. Publications, entitled "Some Physical Phenomena involved in the Mechanical Theory of the Corona." I wish to say that, as far as the connection of this theory with the sun-spot period is concerned, there was not, at any time, any effort on my part to make an agreement with other theories, but the conclusions reached are the legitimate and inevitable results of tracing certain observed phenomena to unexpected explanations. As you will see, the logical outcome

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of the whole matter is that, unconsciously, I have actually furnished important evidence in favour of your meteoric hypothesis.

Sincerely yours,

J. M. SCHAEBERLE.

Some time after the arrival of the letter I received the number of the Publications of the Astronomical Society of the Pacific which contained the article referred to, which I have read with the greatest interest. It has been known for some time that Dr. Schaeberle has been able to reproduce the general appearance presented by the corona by means of mechanical contrivances, and that even the polar rays, which were such a noticeable feature of the eclipse of 1878, as I saw it at Separation, can be, in this way, satisfactorily accounted for.

The point of newest interest, however, is that referred to in Dr. Schaeberle's letter.

Assuming *eruptions* most active in the sun-spot zones, and an initial velocity of 380 miles a second, he obtains the following results :—

(1) All parts of a given unperturbed stream will be in a heliocentric latitude nearly equal to the latitude of the point of ejection.

(2) For a constant ejective force the periodic time t will be the same for all parts of the stream.

(3) The chance of collision of a returning with an outgoing stream varies inversely as the square of the distance of the point of collision from the sun.

(4) Near the sun, therefore, collisions must occur which tend to retard or stop the outgoing streams, resulting in a temporary increase in the heat of the combined colliding masses (causing a consequent increase in the brightness of the corona at such places, and at the same time rendering the coronal detail more confused). This heat will tend to be largely dissipated before such masses fall back into the sun, which they will then reach with comparatively small velocity and low temperature. Unretarded returning streams on striking the sun will tend to greatly raise the temperature at the points of impact: perturbed returning streams could, of course, strike all parts of the sun's surface. Unperturbed returning streams will always fall within the limits of the sun-spot zones.

(5) So long as the incoming streams are very numerous, the outgoing ones will, in a great measure, be stopped, so that, after the interval t, there will be comparatively few returning streams : a direct result of this state of things is to allow free passage for the outgoing streams, which, since there are now but few collisions, results in (1) an apparent diminution in the brightness of the corona, (2) more regular and sharply defined detail, and (3) in general a more uniformly illuminated solar surface might be expected, when there are but few or no returning streams. The periodic character of this intermittent motion can be well illustrated by means of a fine vertical jet of water. The vertical vibratory motion of a light ball, often to be seen in water fountains, is also a good illustration.

(6) If the ejective force is such as to make t about five years, a complete cycle of changes will take place in the time $2t$, and after the same manner as is observed in the sun-spot cycle. It is rather remarkable that the aphelion distance of the streams corresponding to this value of t is nearly the same as Jupiter's distance from the sun ; so that the perturbations produced by this planet may have more to do with the regularity of the period than the assumed constant force of ejection. The initial velocity required to just carry a particle from the sun to Jupiter is but little less than a parabolic velocity. For an initial parabolic velocity, Saturn, alone considered, would, on the same hypothesis, cause a complete cycle of less marked changes in twenty years, Uranus in sixty years, and Neptune in one hundred and twenty years. The comparatively insignificant planets inside of the orbit of Jupiter would cause minor variations, corresponding to cycles, which, even for Mars, would be of less than two years' duration.

(7) The chance of the earth passing through one of these outgoing streams, which have a mean latitude of 15°, is less than it is for an incoming perturbed stream.

(8) A phenomenon similar to the observed zodiacal light would result from the projection of many such streams in space, and the observed extent of this light proves that the matter which causes this illumination extends to greater distances from the sun than the earth's distance.

It is evident from the foregoing that the complete statement which is to appear shortly will be looked forward to with interest.

For myself, I am glad to think that the views I put forward in the concluding chapter of my "Chemistry of the Sun" will now be looked at from a new point of view. Time will show what the "falls" which take the first place in my scheme, and the second in Dr. Schaeberle's, really are. Certainly I have seen no cause lately to alter the view I expressed in 1887, that the primary cause of solar disturbance is the *descent* of matter on to the photosphere.

J. NORMAN LOCKYER.

NOTES.

ON Monday the Prince of Wales presented the Albert Medal of the Society of Arts to Mr. W. H. Perkin, "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilization of large quantities of a previously worthless material"; and to Sir Frederick Abel, "in recognition of the manner in which he has promoted several important classes of the arts and manufactures by the application of chemical science, and especially by his researches in the manufacture of iron and steel, and also in acknowledgment of the great services he has rendered to the State in the provision of improved war material and as Chemist of the War Department." The medal awarded to Mr. Perkin was for the year 1890; that to Sir Frederick Abel was for the present year.

WE are glad to hear that in consequence of the deputation which waited upon Sir Michael Hicks-Beach on June 5, the Board of Trade have registered the British Institute of Preventive Medicine as a limited liability company, with the omission of the word "limited."

IT seems as if the introduction of large engineering views may soon produce a very marked effect upon the future of Egypt. Mr. Willcocks, one of the Inspectors of Irrigation, has communicated an interesting letter to the *Times*, from which we select the following remarks on the engineering importance of Dongola :—"The summer supply of the Nile is lamentably deficient for the existing cotton and sugar-cane crops of Egypt, so that all extensions of these valuable crops are out of the question under existing conditions. The Nile Valley in Nubia is eminently suited for storage of water, but up to the present all projects for storing the muddy flood waters of the Nile below the junctions of the Blue Nile and the Atbara have been condemned, as the construction of solid dams would have resulted in the silting up of the reservoirs themselves. This difficulty has disappeared now that it has been discovered that open dams can be constructed which will allow the muddy flood waters to flow through, and store the clear winter supply for use in summer. The construction of these dams has been rendered possible by the great success of Stoney's patent roller-gates, which can be worked under heads of 70 feet of water on a scale sufficient to pass the full flood supply of the Nile. At any time now Egypt

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