

case a very different thing from a sham biology which is principally, or all, zoölogy.

THE AURORA.

BY W. A. ASHE, F.R.A.S. (RETIRED), QUEBEC, CANADA.

SOME notes resulting from a study of the Aurora extending over many years, and pointing out how some of the better known theories fail to account for known conditions of the phenomena, may interest the readers of *Science*.

I regret, that after having endeavored to show how the present theories fail, that I have no theory of my own to advance. I have done a good deal of theorizing on different subjects, at intervals in a somewhat busy life, so that there are few who have a better opportunity of knowing how deceptive evidence is which is *sought for* to support a theory; in other words, how faulty—yet how plausible—the result, when the observed facts are (unconsciously) made to fit the theory, instead of the theory the facts. Argument with such a theorist is futile. To use Professor Swift's words, in *Science* of Dec. 9, “. . . auroræ frequently occur when no spots are visible on the sun, . . . sun-spots are often seen when auroral exhibitions . . . are entirely absent, . . . the advocates of the theory . . . answer to the former, that sun-spots *may* have been on the *other* side of the sun, and, to the latter objection, that there *may* have been auroræ visible in the Arctic or Antarctic regions, or in both.” I do not credit those who pin their faith to a connection between the two classes of phenomena, with having to go so far for an excuse, as they generally utterly ignore the want of coincidence, and instead of discrediting their theory (and I need not add that one failure should have very many times greater weight than one coincidence) calmly ignore it, and proceed with their cumulation. I do not wish to be understood as thinking that there are not dispassionate investigators in this matter; I am only pointing out what I believe to be a very common human peculiarity, and one which I believe does much harm in so far as permitting of the propagation of theories which had else died, still-born, on their authors' hands.

“The evidence of the correctness of a theory or hypothesis increases with the number of facts it is capable of satisfactorily explaining. It diminishes with the number of facts it does not explain, and with the number of different ways in which similar phenomena can be explained. A *single fact*, inconsistent with any theory or hypothesis, is sufficient to overthrow it,” is a statement of fact that will be most useful to us in theorizing, and serve to measure some existing theories with.

Any theory of the Aurora must account for the following, amongst other, peculiarities, which seem to me to be characteristic of the same. A.—That they most frequently occur in the colder half of the year, being limited, approximately, by the same isothermal lines as far as the southern limit, in the northern hemisphere, of their visibility is concerned, and not depending in this on latitude. It would seem, then, that temperature is a factor in the required theory. B.—Auroral displays do occur in the summer season, when their situation is more equatorial, and, perhaps as a rule, they cover a larger area than the average winter display. It would seem, then, that on the transference of the maximum winter displays from one hemisphere to the other, these displays may take place in intermediate situations. C.—From my experience in these latitudes, summer displays of limited extent seem to be concurrent with a drop in the temperature considerably below that corresponding to the average of the date in question. D.—My experience has been that auroral displays do not occur during generally unsettled weather, requiring (although the particular locality of the display may be largely overcast, permitting only of the aurora being seen behind the clouds or through the interstices) that generally elsewhere the weather should be clear. As though clouds on the horizon of the display (*not* of the observer) intercepted the influence producing the same. E.—The typical aurora, from which are many departures as pointed out by Professor Swift in the communication mentioned, is a narrow circular arch in that part of the heavens away from the sun, the concave side of which is usually well defined,

and beneath which is absolute darkness, into which streamers *do not* descend; the convex side of this arch is, generally, illy defined, from which streamers proceed and the light of which is very much less intense than that of the concave side; conveying to me the impression of the light, the visible effect of the influence, being completely cut off by the interposition of the solid mass of the earth, it being assumed to be the intercepting horizon at the altitude of the display. F.—(Speaking still of the typical auroral arch). It is on the lower and brighter side where the greatest horizontal movements and the greatest contrasts in the intensity of its light (forming, amongst other outlines, so-called “curtain-folds”) are seen. As though at the horizon of the display, our atmosphere, acting as a lense, concentrated the light (the visible effect of the auroral influence) in just such a way as a spherical, atmospherical, lense would, having its centre “stopped” out by such a body as our earth, in which the densest part being next the earth, the greatest relative variation in its homogeneity would exist and the greatest variation in the transmitted light (the visible effect of the auroral influence), resulting in just such movements as we have seen in the typical arch. G.—It has been constantly noted, that two or more observers, situated, say, 100 miles apart, view occasionally, if not always, totally distinct auroral outlines, differing, at times, radically; so that one observer may report a display differing entirely in class and details from the other at the same instant, or even reporting the entire absence of a display when the local conditions were such as would have permitted its being seen had it existed. From this, it appears to me, we must conclude that the light (the visible effect of the auroral influence) has no material existence in that part of the heavens in which it is seen, else, all observers, so situated on the earth that the point of display is above their horizon and this particular point not obscured by clouds, should see the same display, modified only in detail owing to the effects of perspective attributable to the different points of view. H.—There is an intimate relation between the aurora and magnetic storms; not sufficient to permit of our concluding the one is Cause and the other Effect, but sufficient, I think, to permit of the supposition that both are Effects of a common Cause. These appear to me to be some of the more self-evident peculiarities of the typical Aurora.

The theory in connection with the aurora which appears to have the greatest hold on the investigator and the general public, is one which supposes a connection between these displays and certain disturbed—sun-spot—areas of the sun. If one were to accept the evidence that is brought forward to support this supposition, without taking into account the evidence which has, unintentionally, been suppressed, or perhaps it would be better to say, “not advanced,” it would be a very hardened sceptic who would not admit that this question had been settled for all time. In *Astronomy and Astro-Physics*¹ it is concluded that auroral displays recur at intervals which exactly correspond with that of the solar rotation, and at the instant when this disturbed area is at the eastern “limb” of the sun. Dropping for a moment the discussion of the cumulative evidence, it is interesting to note the peculiar nature of the force which proceeds from the solar area in this case. If this influence is at its maximum on the appearance of the area on the eastern limb, and not continuous to the western limb, it is evident that the maximum effects are produced horizontally and in one direction only from the sun's surface. It is not impossible that this is so, but it is an unfair assumption to make, apart from any knowledge of a similarly acting force in nature, and in direct opposition to what experience, in other matters, would suggest as the direction in which such a source of energy would produce maximum results. As to the fact of maximum auroral displays occurring at the instant when the disturbed solar area has reached the eastern limb, the coincidence cannot be as great as claimed, or else the occasions on which this has happened have been given undue prominence in collecting facts to suit the theory, for in a communication to the Royal Astronomical Society², the Astronomer Royal states, in

¹ Reprint No. 113.

² “Monthly Notices,” March, 1892.

discussing sun-spots and associated magnetic disturbances over the period 1880-92, "Most of these magnetic disturbances occurred when an exceptionally large spot was visible on the sun near the centre of the disc, or about the time of some great change in a sun-spot." It should be quite evident, then, that this marvellous coincidence between certain positions of the disturbed solar surface and auroral displays is, to say the least, not such a hard-and-fast rule as the exponents of the theory claim. Even did we admit that the evidence put forward was not as discordant as pointed out, and accepting the statement that, "Under the physical conditions existing in interplanetary space" (a matter admitting of considerable discussion even yet), "cosmical dust and debris, there sufficiently abundant to shine by reflected sunlight as the zodiacal column, furnish a conducting medium well fitted to convey by induction these solar electro-magnetic impulses to vast distances."¹ The single fact, as explained under section "G," that different observers see unlike auroras at the same instant at their several points of observation, is conclusive proof, to my mind, that this "cosmical dust and debris," either without or within our atmosphere, have not been made luminous by the conveyance of the "solar electro-magnetic impulses," as the visible aurora under this theory would require.

NOTES AND NEWS.

A PRINTING Exposition is to be held at the Grand Central Palace, New York City, from May 1 to June 1 next. It is intended to show, by object lessons on a magnificent scale, the history, and progress of the printing trade since the establishment of the first press in this city 200 years ago by William Bradford. The aim is to show in operation the first rudimentary press, and the latest perfected web press; also type-setting and moulding, electrotyping, stereotyping, and photo-engraving processes, color work, etc.

—Professor J. Mark Baldwin of the University of Toronto has accepted the position recently offered to him as Stuart Professor in Psychology in Princeton University. A suite of rooms in North College have been set apart for a laboratory for experimental psychology, and a liberal appropriation made for its equipment in time to begin work next September. Professor Baldwin intends to offer advanced courses, both graduate and undergraduate, in all the departments of psychological work.

—An interesting discovery of the rare trout, *Salvelinus oquassa*, in a mountain lake in the vicinity of Ottawa, Canada, the capital of the Dominion, is recorded in the last number of the *Ottawa Naturalist*, by Mr. J. F. Whiteaves, zoölogist of the Geological Survey. *S. oquassa*, the blue-backed trout, sometimes called the "Rangeley Lake Trout," is stated by Jordan and Gilbert ("Synop. Fishes N. America," 1883, p. 318) to be the smallest and handsomest of our trouts, and as yet known only from the Rangeley Lakes in western Maine. In 1891, Mr. V. C. Nicholson of Ottawa visited a small lake known as Lac de Marbre, lying in the Laurentian Hills, in the Township of Wakefield, Province of Quebec, a few miles from Ottawa. He noticed the difference between some trout he there took and the ordinary brook trout (*S. fontinalis*) which occurred plentifully in adjoining lakes and streams. Mr. Nicholson was so impressed with the fact that these were of a different species that he procured a living specimen, which is now to be seen alive in one of the aquaria of the Government Fisheries Department Exhibition at Ottawa. The specimen was referred to Mr. Whiteaves, who determined it to be the above species. The occurrence of this rare fish in Canada will be of interest to ichthyologists.

—Mr. G. W. Lichtenhaler, one of the most earnest, energetic, and eminent of American conchologists, died at San Francisco Feb. 20. For twenty years he has done nothing but travel and collect, and his vast collection embraces 6,000 or 8,000 species of shells, 1,000 species of marine algæ, and 500 species of ferns, besides many thousands of duplicates. This entire collection he bequeathed to the Illinois Wesleyan University at Bloomington,

Ill., the city which has been his home for most of his life. In addition to this valuable collection he bequeathed \$500 to put it in suitable shape for preservation. This gives the Illinois Wesleyan University one of the most valuable conchological collections of the country. The ferns and algæ are from every part of the world, and the ferns have a complete collection of those of the Sandwich Islands, and nearly a complete collection of those of North America. The entire collection will be arranged as speedily as possible, and will be accessible to all students of the subjects, as well as to others.

—The series of Saturday lectures, complimentary to the citizens of Washington, given for some years under the auspices of the Philosophical, Anthropological, and Biological Societies of Washington, was discontinued two or three years ago. It is now proposed to resume the series under the auspices of the Anthropological Society, and to arrange the lectures in such manner that each course will serve as a logical introduction to the study of the Science of Man in some of its various aspects. The lectures will be delivered in the lecture room of the U. S. National Museum, at 4.30 P.M., on the dates specified. Citizens of Washington and their friends are cordially invited to attend. The course provisionally fixed for the present season (1892-'93) of the Anthropological Society is as follows: Saturday, Mar. 25, The Human Body, by Dr. D. S. Lamb; Saturday, Apr. 1, The Anthropology of the Brain, by Dr. D. Kerfoot Shute; Saturday, Apr. 8, Status of the Mind Problem, by Professor Lester F. Ward; Saturday, Apr. 15, The Elements of Psychology, by Major J. W. Powell; Saturday, Apr. 22, The Earth, the Home of Man, by W. J. McGee; Saturday, Apr. 29, The Races of Men, by Dr. Daniel G. Brinton; Saturday, May 6, The Evolution of Inventions, by Dr. Otis T. Mason; Saturday, May 13, Primitive Industries, by Thomas Wilson.

—In the summer of 1892, courses of instruction were offered by professors and instructors of Cornell University in botany, chemistry, mathematics, philosophy, physics, English, French, German, drawing, and physical training. The Summer School has now been made an integral part of the university, and, for the summer of 1893, courses are offered in the following subjects: Greek, Latin, German, French, English, elocution, philosophy, pedagogy, history, political and social science, mathematics, physics, chemistry, botany, drawing and art, mechanical drawing, and physical training. Without excluding others qualified to take up the work, these courses are offered for the special benefit of teachers. They afford a practical scheme of university extension, by which the teachers themselves are taught under university instructors, by university methods, and with access to university libraries, museums, and laboratories. The courses are open to women as well as to men, and the same facilities for work are extended to these students as to the regular students of the university. The amount of work implied in these courses is so great that students are advised to confine their attention to one or two subjects. Opportunity will be given for original research under the guidance and with the assistance of members of the instructing corps. Inquiries regarding these courses should be addressed to those in charge of the several departments. The Sage College for Women, a spacious and well appointed dormitory on the university grounds, will be open during the session of the Summer School to women students and to gentlemen with their wives. Inquiries regarding board and rooms may be addressed to Professor Geo. W. Jones; or applications for board and rooms at Sage College, to the manager, Mr. E. P. Gilbert.

—Messrs. D. Appleton & Co's list of spring announcements includes "The United States," by Elisée Reclus, which forms the third volume on North America in Reclus's great work, "The Earth and its Inhabitants;" "Appleton's Annual Cyclopædia for 1892," which will be issued immediately, and, like Reclus, is sold by subscription; "The Principles of Ethics," Vol. II., by Herbert Spencer; "The Laws and Properties of Matter," by R. T. Glazebrook, a new volume in the "Modern Science Series"; "Appleton's Guide-Book to Alaska and the Northwest Coast," by Miss E. R. Scidmore, which will be uniform with "Appleton's Canadian Guide-Books."

¹ Reprint Astronomy and Astro-Physics, No. 113.