

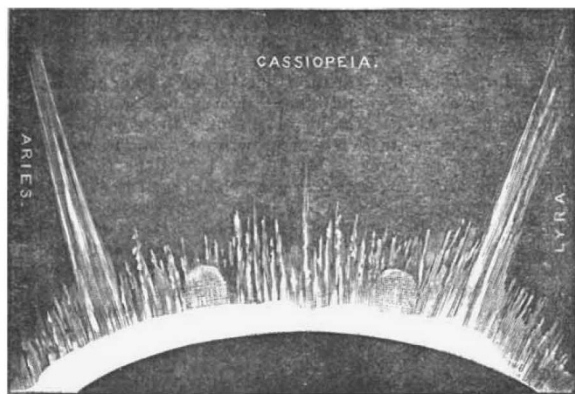
region of facts to that of laws," are no less applicable to physiology than to physics; although Whewell himself (in his "History of the Inductive Sciences") had maintained the contrary. The full acceptance of the doctrine of evolution as our highest expression of the order of creation seems to me to lead to a much nobler conception of the Intelligent Cause of that order than any accumulation of such individual adaptations as might be made by the "mechanic-god" of Paley.

WILLIAM B. CARPENTER

56, Regent's Park Road, N.W., November 14

The Aurora and its Spectrum

YOU have already illustrated in NATURE the aurora and electric storm of January 31. Though somewhat tardily, another drawing with a description of this fine display has found its way into my hands, of sufficient interest, I think, to be added to those already published. It comes from Mr. C. L. Prince, the well-known meteorologist of Crowborough Beacon, Tunbridge Wells, who says, "I inclose a photo of my sketch on a slate." I had a splendid sight of the aurora at about 9h. 15m. It soon became very hazy, but I saw it again at 11h. 15m., when I made the sketch (see drawing). The arch was exceedingly well defined, and extended about 80° along the horizon. At 11h. 20m. some more brilliant streamers shot up along the whole convexity of the arch, and the two patches of light became very tremulous, almost shifting a little from right to left; but I particularly noticed that they did not vibrate *simultaneously*, i.e. if one indicated motion the other was quiescent until the first had ceased to show excitement, and this action was alternating for nearly an hour. At 11h. 40m. the arch had much contracted, and by midnight had nearly faded away. The whole phenomenon was



free from colour. I noticed a few small meteors. The night was quite calm; wind south-west."

This account seems to me interesting in connection with an observation made by my friend Dr. Vogel of Potsdam, that during the aurora of April 9, 1871, certain lines in the spectrum alternated in intensity with the character of the discharge, some brightening as others faded.

Mr. Prince does not mention any spectroscopic observations, and while noting this will you permit me to make a few remarks on the "spectrum of the aurora," an old hobby of mine. I notice that Dr. Spottiswoode, P.R.S., in his lecture delivered before the British Association at York on September 5 last (NATURE, vol. xxiv, pp. 572, 3, "On the Electric Discharge, its Forms and Functions,") has referred to the aurora in connection with experiments showing that the discharge in rarefied gases differs from that at higher pressures, and that the difference corresponds to that observed between the flickering play of the aurora and the crashing spark of the lightning-flash. After then referring to the questions of height and colour of the auroral discharge, Prof. Stokes' theoretic view of the connection of earth-currents, disturbances of the magnetic needle, and solar radiation is dwelt upon. In NATURE, vol. xxiv, pp. 613-18 (lecture by Prof. Stokes, Sec.R.S., in the South Kensington Theatre, on "Solar Physics"), this theoretic view is set forth,

I commend this method of sketching to other observers, the slate pencil showing white on the dark slate being readily photographed with good effect, displaying the aurora light on a dark ground.—J. R. C.

and the aurora is described as a flash of lightning passing through the higher regions of the atmosphere where the air is rarefied. There are, I think, some objections to this theory founded upon certain circumstances of the aurora itself, such, for instance, as the well-authenticated cases of auroræ seen close upon the surface of the earth.

The passage, however, in Prof. Stokes' lecture which particularly struck me is this: "But what of the auroræ? It has long been recognised that the aurora is an electrical phenomenon. It has been supposed to be imitated, and there can be no doubt that the supposition is a correct one [the italics are mine] by sending an ordinary electric discharge through a highly exhausted tube."

Now it may be true that the aurora is thus imitated so far as external appearance is concerned, and it has long been a favourite idea that this imitation in some way extended to the aurora's actual composition; but what does that Ithuriel spear, the spectro-scope, say upon that point—a point which gains the more importance from the fact that such an instrument is mentioned by Prof. Stokes (p. 614) as the true touch-stone for the aurora? It says positively that Prof. Piazzi Smyth's citron line, the one true test of the aurora, has never yet been seen in any electric discharge whatever which we have yet produced, whether in air at ordinary pressure, or rarefied; that the red line (its companion in some auroræ) is equally noticeable for its absence therefrom; and that of the remaining faint and less marked lines one or two only have with doubt and uncertainty been by some referred to the air spectrum as excited by the electric spark or glow. The late Prof. Ångström endeavoured to place some of these fainter lines in accord with the spectrum bands of the violet pole in Geissler air-tubes, but the comparison failed on critical examination. Prof. Vogel has also considered the aurora might probably be an air-spectrum modified by conditions of temperature and pressure. The Professor's actual line comparisons, however, quite failed as to the citron and red lines, and could hardly be called a success as to the fainter ones. In fact any analogy between the aurora spectrum and the spectrum of the electric discharge in air is all but hypothetical, and the aurora still maintains that mysterious quality which distinguishes it from electric discharges of all sorts, and indeed everything else, viz. its peculiar spectrum.

I therefore again plead the necessity for spectrum observations in connection with the aurora, a point from which Prof. Stokes' lecture, I am afraid, owing to its absence of any remarks on the subject (save that before referred to) is somewhat calculated to draw them away. It is certainly possible that some special gas may exist in the upper regions of the atmosphere here giving rise to the citron, perhaps the red, lines; but then (as Prof. Smyth remarks) if so, why, being an emission spectrum in the aurora, does it not, according to the theory of exchanges, appear as an absorption spectrum or dark lines in the solar spectrum? Even, too, could this be shown, it would still remain an unexplained fact that such a gas has hitherto failed to be recognised in any other body, celestial or terrestrial.

To sum the matter up, the electric discharges in vacuum-tubes, as tested by Prof. Stokes' prism and slit, no more represent the aurora than did the cirrus cloud illuminated by the light of the moon, mentioned by him, which also simulated it.

Upon reliable authority the spectrum of lightning may be considered that ordinarily given by a spark in air; but when we come to rarefied discharges and the aurora, the same comparison does not hold good; and where the electrician has to leave the matter, the spectroscopist has yet to take it up.

To aid in solving the aurora's mystery I would invite all spectroscopists, armed with suitable instruments, persistently to aim at accurate micrometer readings of the aurora spectrum. The approximate places of the lines are pretty well established, but their actual wave-length positions are much wanted, for so only may we hope to master one of the remaining riddles of science.

J. RANDCAPRON

Guildown, November 1

Arctic Research

"PROGRESS of Arctic Research since the Foundation of the British Association," by C. K. Markham, C.B., F.R.S. Such is the title of a very able and instructive paper read before the Geographical Section of the British Association at York on September 6 last, and published *in extenso* in the November number of the *Proceedings* of the Royal Geographical Society. The casual reader of this history may suppose it to be a fair and correct record of half a century of Arctic exploration, and that