

this lighter water is raised above the level of its own basin it will naturally flow off in the direction in which it meets the least resistance."

To conclude, I argue that while the wind undoubtedly influences the direction taken by ocean currents, difference of gravity, and not wind, is the principal promoter of them. The perfect agreement between the two systems of ocean and atmospheric currents alluded to in the *Quarterly* is, in my opinion, to be accounted for from similar causes producing similar effects.

How can the winds influence ocean currents running for thousands of miles below the surface, or how can they influence the direction of the lower strata of surface currents ranging say from 50 to 600 feet in depth, the latter being the depth of the Gulf Stream off Hatteras?

DIGBY MURRAY

January 25

MR. DIGBY MURRAY (vol. xv. p. 294), in common with a great number of meteorologists, maintains that the surface-trades have come, as upper-currents, from the Arctic and Antarctic regions, and that the prevailing westerlies of the extra-tropical regions have come, as upper-currents, from the equator, without intermingling their volume in the district of the tropical calms.

He argues that this *must* be the case, because the surface-trades on the interior borders of the tropical calms differ from the westerlies on the exterior borders in their degrees of electricity, and of saturation, and in other particulars.

I regard this argument as incontestably sound, provided always that no objection can be taken to the assumption on which it rests. That assumption may thus, as I conceive, be fairly stated: "Atmospheric currents differing greatly in character must have travelled from widely distant regions of the globe."

This premise is plausible, and the objection which I have to offer to it rests upon a fact which is, unfortunately, obscure, and which has received very little attention.

Some light is frequently thrown on the more general and permanent atmospheric circulation of our globe by the analogy of the local and temporary systems of circulation which we examine in our own latitudes. Now the *most local* currents often differ very remarkably in character according to the direction in which they move: e.g., the easterly winds felt on the south border of a small anticyclone, if pursued for a very limited distance into the district in which they begin to travel from the south, are often found to have undergone complete change in their electrical conditions, in the aspect of the clouds which they carry, in their humidity, in their amount of ozone, and finally even in their effects on the animal frame. Still more extraordinary are the alterations often noticeable in the different segments of very local cyclonic circulations. In the case of the smallest secondary depressions I have, very frequently indeed, been struck by the wonderful alteration in the several atmospheric conditions, and especially by the reversal of the electrical conditions, which immediately attends the springing up of a northerly breeze, when the barometric minimum has passed to the east. This breeze, in many of these examples, occupies a very short as well as very narrow belt, and is only of a few hours' duration. What is more important, it is usually of *very limited depth*. The synchronous upper-current observations at which I have been for some years at work, prove that in many instances of very local depressions the cirrus travels from southerly or westerly points for many hundred miles on all sides of the small depression, as well as immediately over it, in some cases very slightly affected, in others absolutely unaffected, by the limited circulation at the earth's surface.

Until therefore it can be shown (in contradiction to what is indicated by this fact) that our most local currents, if differing in character, have travelled to us at a great elevation from very high and very low latitudes respectively, I cannot hitherto regard Mr. Digby Murray's reasoning as furnishing an "absolute proof" of the soundness of his position.

From Mr. Murphy's criticisms on my former argument I do not retire, as Mr. Digby Murray may possibly complain that I have done from my discussion with himself, behind a veil of cirrus, after the convenient fashion of the Homeric heroes. But as I have already stated, my agreement with his view that "the imperfection of the Arctic as compared with the Antarctic depression is due to the amount of land in the northern hemisphere" (though differing from him as to the nature of the relation between the cause and the effect), it is perhaps hardly necessary for me to say that from his proposition in *NATURE* (vol. xv.

p. 312) I am bound to dissent. I do not think that on Mr. Murphy's hypothetical globe, possessed of an atmosphere containing no aqueous vapour, the currents would "act as in our actual atmosphere," or in a manner at all analogous to that which he describes. On this point I am afraid we must agree to differ for the present.

W. CLEMENT LEY

February 7

Auroric Lights

HAVE the auroric lights been studied in regard to their relations with changes in the weather? From casual observations made during the last twenty years it would appear that there are at least two distinct kinds of light so classed. One is brilliant and transparent, of a white, yellowish, bluish, or yellowish-red colour; while the other is semi-opaque and of a bloody red colour. The latter generally seems to be considered in Ireland a forerunner of bad weather, or, to quote a Connemara shepherd, "Them bloody lights are bad." The first kind generally appear as intermittent pencils of light, that suddenly appear and suddenly disappear. Usually they proceed or radiate from some place near the north of the horizon; but I have often seen them break from a point in the heavens, this point not being stationary but jumping about within certain limits. The brilliant aurora of September, 1870, was one of the latter class, except that the centre of dispersion was not a point, but an irregular figure, sometimes with three sides, but changing to four and five-sided. It began as rays near the north horizon and proceeded up into the heavens in a south-south-east direction. Sometimes, however, these lights occur as suddenly flashing clouds of light, like those of July 16 last, which were of a white colour; but at other times I have seen them of blue and reddish yellow. If this class of lights are watched into daylight they appear somewhat like faint rays of a rising sun. One morning while travelling in West Galway, in the twilight, they were very brilliant, and quite frightened the driver of the car, who thought the sun was going to rise to the north instead of to the east.

The second, or bloody-red light, usually occurs in clouds floating in one direction up into the heavens, but often depressed over a portion of the sky. I have never seen them coming from the eastward, and only on a few occasions from the southward, they generally proceeding from the west, north-west, or north. If both kinds of light occur at the same time, the second, while passing over the first, dim them. If the second class are watched into daylight they appear as dirty misty clouds that suddenly form and disappear without your being able to say where they came from or where they went to, or as a queer hazy mist over a portion of the sky that suddenly appears and disappears, or as misty rays proceeding from a point in the horizon. Generally when these clouds occur there is a bank of black clouds to the westward.

This season has been very prolific in auroric light, as there have been few nights since the 1st of October last in which they did not appear, sometimes, however, very faint. Generally they were lights of the second class, but on a few occasions there were a few rays of the first associated with them; on wet nights they made the rain-clouds or mist of a reddish purplish colour; tints of which could be seen in some of the excessively dark nights we had in November. On many occasions they were late in the night, being very common and brilliant during the "dark days" of December a few hours before dawn (about five o'clock). I have watched them carefully this season to see if we had a chance of fine weather, but each time we had a fine clear day they appeared also and the weather broke again. Last week I only saw white lights of the first class, very faint on two nights, but the weather has not cleared yet. It has, however, become seasonable, as we have had showers of sleet and snow, while previously it was like spring weather, the trees all budding out, innumerable birds singing morning and evening, and flies and wasps flying about.

G. HENRY KINAHAN

Ovoca, January 27

On the Sense of Hearing in Birds

THE sense of hearing is doubtless of much assistance in discovering the food of such birds as the scansors—to wit, woodpeckers, creepers, wrynecks and the like, which feed on insects.

On one occasion, in a Canadian forest, whilst seated close to a rotting pine trunk, I heard distinct scratchings in the interior, as if mice were nibbling the wood, and on splitting open the trunk, numerous large white larvæ of *Hylesinidae* "woodworms" were found busily employed in making their tunnellings throughout the soft substance of the decayed wood,

Now, while these sounds were audible to human ears, it may be fairly believed that they would have been readily detected by the woodpecker, which may be often observed to halt suddenly on its way up a pine trunk. This *trait* in the mode of climbing is noticeable more or less in all the insectivorous climbers, and appears to me to be caused partly by the bird listening for the sounds produced by insects either in the bark or in the wood. I noticed this particularly in the case of the great black woodpecker (*P. pileatus*) or "log-cock," as it is named in Canada. It would suddenly stop on its way up a tree trunk, and after remaining perfectly motionless for a short time, commence to attack the bark and wood with great vehemence. Every one who has travelled in North American forests will have observed how the excavations made by woodpeckers are often confined to one side of a tree, or to particular situations. And not only on decayed parts, but, as in the case of the extremely tough cedar (*T. occidentalis*), where openings of several inches in circumference have been made through several inches of perfectly fresh wood in order to reach the decaying central layers where wood-eating beetles deposit their eggs and the animal is matured. Admitting that it may have been induced to dig out the insect by tracing the external opening inwards, still in the case of the larvæ the wandering from its birth-place, and the sounds consequent on the tunnelling process, would assuredly be heard by a bird whose ears had been trained to such delicate noises through the necessities of its mode of life. I can therefore well believe that auscultation is of great service to such birds, and also to nocturnal species in discovering their prey.

A. LEITH ADAMS

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Tapeworm in Rabbits

I WOULD suggest that the tapeworm referred to by Mr. G. J. Romanes is like the *Bothriocephalus* of man—perhaps a species of the same genus. This is not supposed to have a cystic state, but to be developed from a ciliated embryo taken into the system on raw or badly-cooked vegetables, which have been watered by sewage from cesspools, in which the eggs will remain alive for months.

In the same way the eggs of the rabbit's tape-worm probably remain in the animal's droppings till set free in rain as ciliated embryos. As the rabbit feeds on the vegetation watered by such rain, there is no difficulty in understanding how the embryos would reach his alimentary canal.

R. D. TURNER

Meteor of January 7, 10.31 P.M.

THE fine meteor mentioned in *NATURE*, vol. xv. p. 244, and also seen by Mr. W. H. Wood, p. 295, was observed by many other persons; and as your correspondent asks for another observation of it, the following may be useful:—"J. L. M'C., writing from Putney Hill, London, says: "As near as I could judge, it appeared between the stars Castor and Pollux (α and β Geminorum), and its course lay almost due north-east, passing over the stars λ and ψ Ursæ Majoris, and disappearing a little beyond the latter star. It was of great brightness, left a tail of fire in its wake about two degrees in length, and was visible some ten seconds." This account, compared with the other two referred to, stands as follows:—

Place.	Meteor.		Ended.		Length of path.	Duration in seconds.
	Begun R.A.	Decl.	R.A.	Decl.		
London	153 + 43	...	200 + 31	...	39	Very slow.
W. H. Wood, Birmingham	130 + 5	...	182 + 16	...	52	5½
J. L. M'C., Putney Hill, London	113 + 31	...	170 + 46	...	46	10

From these paths the radiant point comes out near γ Eridani, R.A. 58°, Decl. S., 12°, and I can confirm this position from other meteors seen in January, including one as bright as Venus, on the 4th, 8.51 P.M., which exhibited the same slow, halting motion as that noted in regard to the fine one seen on the 7th. I have read other accounts of the latter, but they are mostly vague. At Bermondsey it was seen at 10.30, and described as large and remarkably brilliant, closely resembling in size and colour the meteor which appeared on September 24, 1876. It was of a bluish colour, left a long tail or streak of light in its wake, and its course in the heavens was from south-west to north-east. At 10.37 on the same evening a very large, brilliant meteor was seen at Lower Clapton, and this, no doubt, refers to the same object.

Mr. Barrington (*NATURE*, vol. xv. p. 275) notes another bright meteor, at 6 P.M., on January 19, but its apparent path shows it to have been different to the one seen by a correspondent at Wolverhampton, at 6.27, January 19, who writes that he witnessed a meteor of "unusual magnitude and brilliancy. It moved almost perpendicularly, in a southerly direction, very slowly, the time occupied in its passage being about seven or eight seconds."

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W. F. DENNING

THE UNITED STATES GEOGRAPHICAL AND GEOLOGICAL SURVEY OF THE WESTERN TERRITORIES UNDER DR. F. V. HAYDEN

Explorations in 1876.

WE have been furnished with some early notes upon the results of the work of Dr. Hayden's survey during the past year, from which we make the following extracts:—

"For reasons beyond the control of the geologist in charge, the various parties composing the United States Geological and Geographical Survey of the Territories did not commence their field-work until August. Owing to the evidences of hostility among the northern tribes of Indians, it was deemed most prudent to confine the labours of the survey to the completion of the Atlas of Colorado. Therefore the work of the season of 1876 was a continuation of the labours of the three preceding years, westward, finishing the entire mountainous portion of Colorado, with a belt of fifteen miles in width of northern New Mexico, and a belt twenty-five miles in breadth of Eastern Utah. Six sheets of the Physical Atlas are now nearly ready to be issued from the press. Each sheet embraces an area of over 11,500 square miles, or a total of 70,000 square miles. The maps are constructed on a scale of four miles to one inch, with contours of two hundred feet, which will form the basis on which will be represented the geology, mines, grass, and timber lands, and all lands that can be rendered available for agriculture by irrigation. The areas of exploration of the past season are located in the interior of the continent, far remote from settlements, and among the hostile bands of Ute Indians that attacked two of the parties the previous year."

The force was divided by Dr. Hayden into four parties. The first, for primary triangulation, under Mr. A. D. Wilson, with Mr. Holmes as artist and geologist, accomplished the survey of an area of about 1,000 square miles. The second, or Grand River party, under Mr. Garnett as topographer, and Dr. Peale as geologist, surveyed about 3,500 square miles. The third, or White River Division, with Mr. Chittenden as topographer, and Dr. Endlich as geologist, spent forty-eight days in absolute field-work, and reports a surveyed area of 3,800 square miles, in the accomplishment of which 1,000 miles of traverse were made, while forty-one main topographical stations and sixteen auxiliary ones were established. The fourth, or Yampah party, conducted by Mr. Bechler, topographer, assisted by Dr. White, geologist, surveyed about 3,000 square miles. Thus, during the two months of last autumn, these active explorers surveyed about 11,300 square miles of territory (that is more than the whole of the southern or lowland part of Scotland) with sufficient accuracy and detail to permit of the construction of a general map on this scale of four miles to an inch, and with contour lines at successive elevations of 200 feet to mark the main topographical features. Fortunately the geological structure is of extreme simplicity, otherwise such rapid and useful work would be impossible. Dr. Hayden and his associates are doing good service by making known in this way the main features of those vast territories, leaving the details to be worked out at a later time.

Among the most interesting geological results obtained last year are some additional particulars regarding the brackish water-beds lying at the base of the tertiary rocks of these western territories. Three new species of