

admixture of human excretal refuse with their water, it has long been maintained by the local authorities of many parts of Lancashire that the evil was less in that district than elsewhere, in consequence of the system adopted there for dealing with such refuse not affording such facility for its discharge into rivers as the water carriage system. On this ground the introduction of the water system of sewerage has been strenuously opposed. The report of the Commission, however, dispels this illusion by evidence which is conclusive in proving that the use of the old form of closets with ash pits, earth closets, &c., affords no protection to rivers. From a long series of analyses of sewage from towns where such closets and middens are used, it appears that, as compared with the sewage from towns where water-closets are used, the composition of both are remarkably similar. Besides the nuisance and other inconveniences of the dry closet system, it appears that the pollution of rivers is but very slightly prevented by it. On the other hand, while the advantage gained by that system consists merely in the retention of a small proportion of the excreta in a state to be available for agriculture, the treatment to which that portion is subjected renders its value as manure very small. Moreover, this is usually effected only at the expense of great risk to public health, and at a cost which is on the average double the money return obtained. The Commissioners, therefore, come to the conclusion that the retention of solid excreta in middens is not attended with any considerable diminution in the strength of the sewage, though the volume is somewhat reduced. On that ground they consider it hopeless to anticipate any substantial reduction of sewage pollution of rivers by dealing only with the solid residue of excreta. At the same time they point out the fact that the discharge of excretal refuse into rivers is not a necessary part of the water-closet system.

As to the influence of the dry closet system on health, the Commissioners refer to the returns of the Registrar-General, and to other evidence, as showing that typhoid fever, scarlatina, diarrhoea, and other epidemic diseases, commit fearful ravages amongst the populations exposed to the pestiferous influences it exercises, and they express the opinion that to it may be attributed much of the responsibility for the high death-rate of South Lancashire towns. They have, however, been unable to obtain conclusive evidence of this owing to the incompleteness of the health statistics. They express astonishment at the frequent inability of Health Boards to inform them of the death-rate in their districts, still less to give information as to particular parts of them.

It is a very general opinion of medical men that the presence of an extremely minute amount of organic impurity may, under certain obscure conditions, render water unwholesome, and capable of causing or propagating disease, especially if that impurity be of animal origin. Sewage is the source from which such impurity is most likely to originate in a specially dangerous form, and it appears the amount capable of causing injury may be so small as to have no influence on the outward appearance of the water. To the smell, sight, and taste all may seem innocuous, and yet there may be present an infinitesimal portion of substance rivalling in potency the most virulent poison.

That water subject to such contamination is thereby rendered unfit for human use, and repugnant to every sense of decency, can, it is believed, require no arguments to be admitted. That the use of such water is, moreover, dangerous and unwholesome, would seem to be suggested by a knowledge of the changes which excretal refuse naturally undergoes, and of the circumstances attending those changes. The medical officers of Her Majesty's Privy Council, after specially studying numerous instances of the outbreak of typhoid fever and cholera, have almost invariably found that the prevalence of these and other epidemic diseases was accompanied by the use

of water that had been polluted with drainage from cess-pools or sewers. But at the same time it has been impossible to detect or demonstrate, by chemical analysis, the presence in the water of anything to which a fatal influence or the production of disease can be ascribed. This fact, however, does not in any degree, afford a ground for regarding the water as free from suspicion. Such reasoning would apply with equal force to sewage itself, for chemical analysis does not indicate the presence in it of anything specially noxious.

It has indeed often been alleged that if sewage be mixed with twenty times its volume of river water, the organic matter which it contains will be oxidised completely while the river is flowing a dozen miles or so. Considering the importance of the subject, it is surprising that this assertion, though confidently made in many instances, should hitherto have rested upon no more solid foundation than mere opinion. But at last the test of positive inquiry has been applied by the Rivers Pollution Commissioners. The composition of the water of the Irwell, the Mersey, and the Darwen at various points in the course of these rivers has been ascertained with due regard to complications introduced by the influx of unpolluted affluents. The results have shown that when the temperature is not above 64° F., a flow of from 11 to 13 miles produces but little effect upon the organic material dissolved in the water. Examination of the gases dissolved in water containing an admixture of sewage led to the same result. Lastly, experiments devised to augment the effect of atmospheric oxidation on such water, so as to represent a flow of from 96 to 192 miles in a river at the rate of 1 mile an hour, showed that the reduction of organic carbon in the water amounted to only 6.4 and 25 per cent., that of organic nitrogen to 28.4 and 33.3 per cent., though the temperature was 68° F. Thus whether we examine the organic pollution of water at different points of a river, or the rate of disappearance of the organic material of sewage mixed with water and agitated in contact with air, or the rate at which dissolved oxygen disappears in water polluted with 5 per cent. of sewage, we are in each case led to the inevitable conclusion that the oxidation is very slow—so slow in fact that it is safe to infer there is no river in the United Kingdom long enough to effect the complete transformation of sewage in that way.

These results are further confirmed by evidence as to the state of the rivers in the Mersey and Ribble basins; they are consistent with the opinions of chemists, and they are opposed only by dogmatic assertions destitute of proof.

To illustrate the extent to which the polluted state of Lancashire rivers is a disadvantage to manufacturers, the Commissioners state that thirty-nine of the firms who are carrying on different branches of trade in the basins of the Mersey and Ribble, estimate the benefit they would derive if the river water were fit for their use at no less than 10,157*l.* a year, while one calico-printing firm estimates the gain to them at 3,000*l.* a year. The number of manufacturers who have given these estimates form only a small fraction of the total number in the district.

#### MAGNETIC AND SUN SPOT PHENOMENA FOR FEBRUARY, 1870.

(As recorded at the Kew Observatory.)

ON February 1st about 5 p.m. there occurred a very considerable disturbance of the three magnetic elements, which lasted until about 2 o'clock in the early morning of the next day. The tendency of this disturbance was to diminish the declination and the horizontal force, while on the other hand the vertical force was increased during the first half of the disturbance and diminished during the second. The oscillations of the declination were very large. The disturbance was accompanied with

an aurora, which was widely observed, and also with earth currents affecting the telegraphic wires. From the appearance of the traces one is inclined to associate the aurora and earth currents with the oscillations of declination rather than with those of the other elements.

On February 11, a little after 6 p.m., another disturbance took place, which continued more or less for thirty hours. As in the previous case the oscillations of the declination were most marked, but these were not so excessive as for the previous disturbance. An aurora was visible at 8 50 p.m. of February 11, and one was said also to have been observed on February 12.

The following is the record of sun-spots derived from the pictures taken :—

February 5	... 4 small groups	2 large ones
" 6	... 5 "	1 rather large, 1 very large
" 8	... 5 "	2 large, 1 very large
" 10	... 3 "	4 large, 1 very large
" 11	... 4 "	2 very large
" 15	... 5 "	1 large, 2 very large
" 20	... 7 "	1 large
" 21	... 5 "	1 large
" 22	... 5 "	
" 24	... 4 "	
" 25	... 3 "	
" 26	... 4 "	

#### THE EXISTENCE OF MAN IN THE TERTIARY EPOCH

IN the *Bibliothèque Universelle et Revue Suisse* for the 15th February, M. Favre, in an article on the above subject, remarks that for some years the discovery of traces left by man of the pre-historic age on the earth have multiplied with a rapidity only explicable on the supposition that the population inhabiting a certain region of the globe was formerly abundant, and that numerous observers have recently applied themselves to the subject with extraordinary energy and zeal. He takes up the question whether the age of stone does or does not extend back to the tertiary period, and he thinks it will prove interesting to give a *résumé* of the various observations tending to show that man inhabited the earth at an epoch anterior to the great extension of the glaciers southwards, and during the tertiary epoch. On *à priori* grounds no substantial reasons can be advanced against the existence of man at the latter period. The temperate zone was then somewhat warmer than at present, and the temperature of Greenland and Spitzbergen sufficiently agreeable to be adapted to the development of terrestrial mammals. But it is difficult to represent the duration of the period that elapsed between the end of the tertiary deposits and the termination of the glacial epoch. The portion of the quaternary period characterised by the enormous extension of the glaciers was very protracted, and many ages must have elapsed before the glaciers of the Alps were so large as to be able to transport erratic boulders to the height of 1352 metres on the Jura (near Soleure), and the glacier of the Rhone approximated the Rhine, or perhaps even reached it by passing across the cantons of Valais, of Vaud, of Freiburg, of Berne, of Soleure, and of Aargau. The form of the earth's surface must have presented to the eye of such old world inhabitants a very different aspect from that exhibited at present, and if they already existed in the middle tertiary period, they would have been contemporary with the upheaval of the Alps, and with an almost entirely distinct flora and fauna. Under these circumstances man would have to be included amongst the creatures who have survived two geological periods. M. Favre then proceeds to review the evidence that has at present been collected, embracing the following points :—First, the observations of M. Desnoyers in 1863 made at Saint-Prest near Chartres, but previously (1848) known to M. Boisvilette, and (1860) to MM.

Langel and Lartel. Here, in a pliocene formation, were found the bones of the *Elephas meridionalis*, *Hippopotamus major*, *Equus arvensis*, *Cervus carnulorum*, and two other species of *Cervus*, *Bos*, *Trojanotherium Cuvieri* (a kind of large beaver), striated in such a manner as to convince M. Desnoyers that the markings were the effects of the handiwork of man. This conclusion has, however, been contested by Sir C. Lyell; but in 1867 arrow or lance-head flint instruments were found in this spot by M. l'Abbé Bourgeois, one of which appeared to have been subjected to the action of fire, though this might have resulted from exposure to forests burning by the action of lightning. Soon afterwards M. Delaunay discovered markings of an analogous nature to the former, on the bone of a *Halitherium* at Pouancé (Maine et Loire) in a miocene formation containing the bones of *Dinotherium*. About the same time M. Bourgeois found similar flints in a still older formation (the calcareous strata of Beauce) at Thénay, and at Billy near Selles-sur-Cher. Some differences of opinion exist as to whether these flints are really worked by the hand of man; but the majority of those who have seen them, and are competent to judge, is decidedly in favour of that view. Nevertheless, M. Fraas observes that he has himself seen a lamina of siliceous shale detached from a mass by the action of the sun's rays alone in Egypt; Livingstone and Dr. Wetzstein seem to have observed similar phenomena; and a point that now demands intelligent observation is the greater or less similarity such fragments detached by natural causes bear to the flint instruments or the masses from which they have been detached. He refers also to two fragments of the jaw of a *Rhinoceros pleuroceros* found in the lacustrine chalk of Limaque, and which appear to have been grooved by man, which, however, he admits to be doubtful; and to the observations of Whitney in California, which tend to show the existence of man anterior to the glacial epoch and to the period of the mastodon and elephant, at an epoch since which vertical erosion of the surface has taken place to the extent of two or three thousand feet of hard and crystallisable rocks. Finally he refers to the observations of M. Issel in Piedmont.

#### MODIFICATIONS IN THE CONSTRUCTIONS OF THE NEST OF THE SWALLOW

IN the tenth number of the *Comptes Rendus* for the present year, is a paper by M. Pouchet, on the Modifications of the Nests constructed by the common Swallow, (*Hirundo urbica* Linnæus,) in which he remarks that it is evident the mode of life of certain animals, far from being persistent and invariable, undergoes modifications under different terrestrial conditions, and that, in many instances, their habits are different from what they were in former ages. Spallanzani indeed remarks in one of his remarkable memoirs on the swallows, that the shape and structure of the nests of birds are interesting features in their history, and that each species constructs its habitation on a plan peculiar to itself, which never changes, and is continued from one generation to another. And this opinion is shared by many naturalists; observations, however, when sufficiently close and attentively made, show that it is erroneous. We do not indeed see any modifications of those of their habits which are associated with their biology, so that the arboreal species seek to form for themselves a subterranean nest, or rear their young ones in dwellings adherent to the coigns of our houses, but it nevertheless is ascertained that in a succession of years, each learns to improve the construction of his residence. Certain birds work up only the products of our own handiwork, and would necessarily employ natural substances if these were deficient. Thus, as may be seen in the museum of Rouen, the Lorient of Europe sometimes forms its nest with thread ends under the