aurora is present ; the stars shine quite bright in this dark sky above them.

Prof. Smyth considers that the night after the aurora of the 27th the twilight extended over the region "aurora-blackened" the evening before. Would not this be owing to the brightness of the aurora preventing the twilight from being seen so high then simply by contrast? The fact that the dark sky was luminous in the spectroscope seems to bear out this.

I do not understand Prof. Smyth's suggestion why these clouds should never be seen in winter, for any night in the year there is a time when the sun is at the same distance below the horizon as it is when the bright clouds are well seen.

Sunderland, August 18 T. W. BACKHOUSE

Cloud Effect

A VERY unusual cloud effect was noticed here on the 18th inst. at 7.45 a.m. The whole sky, especially to the east or south-east, was at that time covered with a widespread field of mackerel cloud. This field was cut from north to south with a strongly defined cleft or narrow line showing the blue sky beneath. It was like a crack in the cloudy tissue, and formed a perfect arch, whose greatest altitude was not many degrees above the sun's apparent place. It lasted nearly half an hour. There was little wind at the time, only a slow motion from the north, but a change took place shortly after, when it veered to the south-west. E. BROWN

Further Barton, Cirencester, August 20

The Crag Deposits on the North Downs

To students of Tertiary geology, the interest of Mr. Clement Reid's verification of Prof. Prestwich's judgment of many years ago as to the Pliocene age of certain outlying deposits at Lenham is so great that I must crave permission for space for a line or two with reference to other similarly situated deposits on the North Downs, which have been described as belonging to an horizon "so newhere between the Chalk and the moon." The deposits to which I refer were described by Prof. Prestwich in the *Q.J.G.S.*, vol. xiv., and of his paper Mr. Whitaker made free use in preparing the account of these outliers in vol. iv. of the "Memoirs of the Geological Survey" (pp. 336-42). The idea has been for some time growing up in my own mind, with reference to these unfossiliferous outliers, that some of them will have to be recognised as remnants of the once more widely extended Upper Bagshot Sands. This conclusion is at present based mainly on three facts : (1) the literal application of Prof. Prestwich's description of their lithological character to portions of those beds ; (2) the occurrence of "similar beds on the Chalk Downs on the opposite side of the Channel, between Calais and Boulogne"; (3) the superposition of "analogous strata" on the top of Cassell Hill in French Flanders upon the *Calcaire grossier* series, the equivalent of our Middle Bagshot (so-called Bracklesham) Beds. I hope to deal with this more at length during the next session of the Geological Society, and only draw attention now to the suggestion which I threw out several years ago (*Proceedings* of the Geological Association, vol. viii. p. 170) for reasons assigned, that the oldest plateau-gravels of the London Basin are probably of Pliocene age. This may possibly have escaped Mr. C. Reid's notice. A. IRVING

Wellington College, Berks, August 17

Actinotrocha on the British Coasts

IN answer to Mr. Cunningham's letter on the distribution of Tornaria and Actinotrocha, I may state that I took Actinotrocha in the tow-net at the mouth of this bay on July 31. I believe I have found it more than once before on the west coast during the last few years, but, not having my note-books with me, I cannot say definitely where and when. If I am not mistaken, *Phoronis* was found by Dr. Strethill Wright in the Firth of Forth, and is therefore known as a British animal.

Loch Ranza, Arran, August 21 W. A. HERDMAN

GEORGE BUSK, F.R.S.

A SINGLE-MINDED, true-hearted man, a warm friend, and an able and accomplished naturalist, has just passed away from the midst of his family, his friends, and his fellow-workers.

George Busk was the second son of Mr. Robert Busk, of St. Petersburg. He was born in 1807, and at an early age gave promise of those tastes and of that aptitude for research which, developing with his years, gained for him the high position which he was destined to hold among the scientific workers of his time.

After completing his medical education he was appointed surgeon to the seamen's hospital-ship *Dreadnought*, a post which he continued to hold for about twenty-five years. It is these twenty-five years which constitute the strictly professional period of his life, and which gained for him a place among the most distinguished members of his profession as an able, clear-sighted, and enlightened surgeon.

In 1856 he resigned his appointment to the *Dreadnought*, and at the same time decided on retiring from professional practice and on devoting himself to scientific work.

Having now leisure for the cultivation of those studies which were always dear to him, he threw himself warmly into biological work. An excellent and cautious observer, it was chiefly to researches on the structure of the lower members of the organic world that he now devoted himself, and scarcely a month passed without the periodical literature of biology receiving from his labours the record of some new and interesting fact.

About this time he became one of the editors of the *Microscopical Journal*, and the numerous communications which appeared from his pen in the pages of that periodical contributed largely to its popularity and success.

There were few departments of biological science which Busk did not enrich by his researches, and we now find following one another in rapid succession a long series of papers containing the results of his studies among the lower groups of the animal and vegetable kingdoms. He was a skilful microscopist, an acute and conscientious interpreter of the optical expressions of organic form presented by the microscope to the observer, and his contributions to the transactions of our leading scientific societies and to various natural history journals have advanced our knowledge of some of the simple unicellular plants, of the Infusoria, the Hydroida, the lower Vermes, and above all of the Polyzoa, to an extent which those who have worked in the same fields can fully appreciate.

In 1856 appeared his article "Polyzoa" in the English Cyclopædia. In this admirable article we have an exhaustive account of the structure of the Polyzoa, while it contains the first satisfactory attempt at a scientific arrangement of the group, and proposes for the first time the employment of certain systematic characters which are now universally accepted as offering the only legitimate bases of a philosophical classification.

Soon after this he undertook the labour of drawing up an illustrated descriptive catalogue of the Polyzoa contained in the collection of the British Museum, and brought to bear on the descriptions and systematic arrangement of the species those principles whose soundness he had already established. There was thus placed in the hands of the student a work of great value, with which no investigator of the group can afford to dispense.

On the return of H.M.S. *Rattlesnake* from its explorations in the Australian seas under Capt. Owen Stanley, the collections of Polyzoa and Hydroids made during the voyage were placed in Mr. Busk's hands for examination and description. His report on the new species thus obtained is published in the narrative of the voyage, and forms an important addition to our knowledge of these animals.

Among the facts of anatomical interest which have been successfully worked out by Busk in the organisation of the Polyzoa, his demonstration of the structure of the *avicularia* and *vibracula* deserves special mention. He has given by far the best account which had been hitherto

published of the structure and functions of these remarkable and enigmatical bodies, while he insists on their value in affording characters for classification. His very instructive and expressive figures form part of the illustrations of Polyzoal morphology contained in the morphological atlas of Victor Carus.

It was about this time that Busk undertook, for the Palæontographical Society, a monograph of the fossil Polyzoa of the Crag,—a task for which his knowledge of the recent species had eminently fitted him. But his geological work was by no means confined to researches among these lower forms of life. In 1864 he made a journey to Gibraltar along with Dr. Falconer, for the purpose of investigating the ancient fauna which had been preserved in the caves of that region. The results of the joint labours of the two explorers were embodied in a report read at the Norwich Meeting of the British Association in 1868, and more fully in a complete monograph on the subject subsequently published. Among other palæontological contributions may be mentioned his observations on certain points in the dentition of fossil bears, as affording good diagnostic characters, and on the relations of *Ursus priscus* to *Ursus ferox;* also his descriptions of three extinct species of elephant, the remains of which were collected by Capt. Sprat in the ossiferous caverns of Zebbung in the Island of Malta; his report on the animal remains in the Brixham Cave; and a report on the animal remains found by Col. Lane-Fox in the High and Low Terrace-gravels at Acton and Turnham Green. All these communications bear evidence of his skill in recognising palæontological characters and in detecting their relations with those of living forms, while his study of fossil mammals, and his comparison of these with existing species, suggested to him an ingenious method of graphically representing the dimensions and proportions of mammalian teeth.

It was somewhat later than this that his attention was largely given to ethnology, and the Anthropological Society not only owes to his pen many valuable memoirs, but bears evidence of judicious management and administrative capacity in his labours as its President and as a member of its Council. Along with Dr. Carpenter and Dr. Falconer he formed one of a Commission which visited France in order to take part in the Conference which was held there for the purpose of inquiring into the circumstances attending the asserted discovery of a human jaw in the Gravel at Moulin Quignon, near Abbeville. Among his other anthropological work will be found many interesting comparisons of crania belonging to various nations. These investigations were carried on chiefly by means of a systematic method of measurement, which he advocated as affording a uniform basis of comparison, by which anthropological studies might be facilitated and the data of comparison rendered more definite and precise.

At a time when the German language was much less understood in this country than it is at present, Busk performed an important service by giving to the English student an excellent translation from the German of Steenstrup's famous treatise on the alternation of generations, and, in collaboration with Huxley, a translation of Kolliker's valuable manual of human histology.

The last piece of work which devolved on him was the preparation of a Report on the Polyzoa collected during the voyage of the *Challenger*. The first part of this important work was completed in 1884, and has been already reviewed in NATURE. It forms an admirable exposition of the additions made to our knowledge of these animals by the great exploratory voyage; and amply realises all that had been expected from one who had made the Polyzoa the subject of so much careful and philosophic study.

The second and concluding part of the Report he left behind him in a condition nearly ready for the press, and under the judicious supervision of the proofs by his eldest daughter—through whose loving care during his last months of suffering he was enabled to carry on his work to completion—is now quite ready for publication.

The many-sidedness of Mr. Busk's mind was one of the most striking features of his clear and comprehensive intellect, and naturally obtained for him distinctions and honours in many and various departments of science. He was early elected a Fellow of the Royal Society, of which he was afterwards nominated one of the Vice-Presidents, and on the Council of which he served on several occasions. He was more than once President of the Microscopical and Anthropological Societies, was Zoological Secretary of the Linnean Society, and would have been made its President were it not that, notwithstanding the warmly expressed solicitations of the Council of that body, he felt that the labour of the Presidential chair was greater than he believed himself justified in undertaking.

In recognition of the eminence he had attained as a surgeon during the professional period of his life, and of the interest he had always continued to take in the welfare of his profession, he was elected in 1871 to the Presidency of the Royal College of Surgeons. He was one of the Trustees of the Hunterian Museum of the College, and continued for three years to hold in connection with that Museum the Hunterian Professorship of Comparative Anatomy. He was a Member of the Senate of the University of London, for many years Treasurer of the Royal Institution of Great Britain, and had more recently been nominated one of the Governors of Charterhouse School.

For his researches in zoology, physiology, and comparative anatomy the Royal Society in 1871 awarded to him the Royal Medal, while for his palæontological researches he afterwards received from the Geological Society the Lyell and Wollaston Medals.

On the passing of the Cruelty to Animals Act, intended to regulate the performance of experiments on living animals, he was appointed by Government inspector of the various medical schools and physiological laboratories registered under that Act in England and Scotland; and the judgment and skill with which he performed the difficult duties of the office bear ample testimony to the wisdom of his appointment. Abhorring the infliction of unnecessary pain, he saw that for the advancement of knowledge which might tend to the alleviation of human suffering such experiments were not only permissible but called for, while at the same time he set himself strenuously against the infliction of pain which might be avoided, and against the institution of experiments which did not hold out obvious promise of the results which alone would justify them.

He was a genuine lover of Nature, deriving unalloyed pleasure from all that was beautiful in the external world; and the writer of this notice can well remember the enthusiasm with which he would recall the vegetation of the lower reaches of the Thames—amid which his early work on board the *Dreadnought* lay—with its rich growth of Sagittaria, and Butomus, and Sedges, and picturesque water-weeds, long since swept away before the spread of manufactures and the encroachments of civilisation.

Generous and liberal to his fellow-workers, with his rich store of material always at their disposition, his loss will be long and deeply felt by the many who profited by his friendship. Free from all selfish and personal ambition, and pursuing his investigations for the sake alone of the truths which might result from them, he cared little about asserting his claims to discovery, and would rest satisfied with the belief that, whoever may be the discoverer, human knowledge would be the gainer.

And yet, though he had no ambitious longing for reputation, Busk was no cynic. He could appreciate the esteem of those whose esteem was worth having, and few

men had a larger number of genuine admirers, or gathered around them a wider circle of sincere and attached friends. And not alone to the fields in which he himself worked did he extend his interest and sympathies. Amid the labourers in very different departments of thought he found some of his most cherished friends—frequent and always welcome guests at his hospitable home. For these, and for all who had enjoyed the privilege of his friendship, the sorrow at his loss will be softened by the ennobling memory of his life.

GEO. J. ALLMAN

BRITISH ASSOCIATION, SECTION B: DISCUSSION ON THE NATURE OF SOLUTION

IT may perhaps be convenient to those chemists who have announced their intention of joining in the proposed debate in Section B, at the approaching meeting of the British Association, that, having accepted the invitation of the President to open the discussion, I should indicate briefly the general nature of the subjects upon which I shall offer some remarks, and the order in which I shall probably take them.

After an historical sketch of the theories which have been framed with the object of explaining the constitution of saline and other solutions, the phenomena of solution will be dealt with somewhat as follows :—

Thermal and volume changes occurring in the act of solution and their mutual relations. How far and under what circumstances are thermal and volume changes to be considered as indicating chemical change?

The molecular volumes of salts in solution. The specific heat and vapour pressures of salt solutions. The relation of solubility to molecular volume, to fusibility, and to the composition of the liquid.

Action of solids and especially of porous bodies on solutions. Phenomena of supersaturation.

What is chemical combination, and is there any criterion by which it may be distinguished from adhesion or mechanical combination?

In consequence of the very wide-reaching character of the subject, it will not be possible to take up the question of solution except as relating chiefly to solids, and especially salts, in water. For the same reason I cannot fully discuss the phenomena of absorption-spectra nor generally the action of solutions upon light, but I hope some of those chemists who have worked on this part of the subject will be present, and will give us the benefit of their experience.

There will of course be a great number of questions incidentally touched upon in my opening, which may well form the basis of remarks from other speakers, such as—

How is saturation to be explained, *i.e.* why is there generally a limit to solubility?

Is there any general connection between solubility and atomic weight in a series of compounds in which only one constituent varies?

What becomes of water of crystallisation when a salt containing water is dissolved in water?

WILLIAM A. TILDEN

The Mason College, Birmingham

THE RECENT VOLCANIC ERUPTIONS IN NEW ZEALAND

WE have been favoured by Dr. Hector, F.R.S., Director of the Geological Survey of New Zealand, with a copy of a Preliminary Report drawn up by him for the New Zealand Government regarding the volcanic eruptions of last June in the North Island. It is gratifying to find that the hope expressed in NATURE (p. 322) has been so promptly fulfilled, and that the investigation of the remarkable phenomena has been undertaken by so competent an observer as Dr. Hector. The following is his Report, but it is merely a preliminary outline, and will no doubt be followed by much ampler details.

"*Colonial Museum of New Zealand, Wellington, June* 23, 1886

"According to instructions from Government, I proceeded to Tauranga on the evening of Thursday, the 10th instant, in the colonial gunboat *Hinemoa*, and arrived there on Saturday afternoon. At Tauranga I engaged the services of Mr. Spencer, a skilful landscape photographer, and on Sunday our party, seven in number, drove to Rotorua by the Oripi Road, the ordinary route by Te Puke being blocked On Monday I proceeded to Wairoa with Captain Mair, who joined the boat expedition which had been organised to search the Native settlements on Tarawera Lake. On the same day I sent my assistant, Mr. Park, to the south of the disturbed area by way of Kaiteriria; and on Tuesday, following the same route, I examined the vicinity of Rotomahana. Mr. Spencer, with his camera, accompanied me everywhere, so that a series of well-selected views of the eruption and its effects was obtained. On Wednesday we started for Taupo, feeling anxious to complete the general view of the whole line of volcanic activity from Ruapehu to White Island, as alarming rumours were in circulation as to the extent of country that had been affected. By this route we also obtained a distant but interesting view of the newly-raised cones of Tarawera from the eastward. The incidents of the eruption have been so fully described by the Press that it is unnecessary for me to refer to them in this preliminary report, the chief object of my rapid inspection having been to ascertain the exact locality, nature, and extent of the outbreak, and its probable consequences to the district. A complete geological examination of the district has therefore been deferred until a more favourable season for field-work, and until the volcanic activity has sufficiently subsided to admit of accurate observation.

"The focus of the disturbance was ascertained to be in a line extending from seven to ten miles in a north-east to south-west direction from the north end of the Tarawera Range to Okaro Lake (see plan.) The northern part of this line is occupied by the Tarawera Range. This range has three summits, the northernmost being Wahanga; the central, Ruawahia, 3606 feet alt.; and the southernmost, Tarawera Mountain proper. The southern part of the line previous to the outburst was a depression occupied by Rotomahana Lake, surrounded by low undulating country composed of pumice-sands and overspreading deposits of siliceous sinter, most of which were connected with active geysers, amongst which the most famous were those at the Pink and White Terraces.

"From the most reliable evidence it appears that the outbreak commenced at ten minutes past two on the morning of the 10th, by an eruption from the top of Wahanga, attended by a loud roaring noise, and slight earth-shocks. In a few minutes this was followed by a similar but more violent outburst from the top of Ruawahia—the middle peak of the range, and after a short interval this phase of the eruption culminated in a terrific explosion from the south end of Tarawera Range, north-east of Lake Rotomahana. For nearly two hours this was the only phase of the eruption, and was accompanied by the ejection of vast quantities of steam, pumice-dust, and hot stones, forming huge towering clouds, illuminated by lightning flashes.

"It was at this time also that a great crack or fissure (A C on plan) was formed along the east face of the Tarawera Range. I only had a distant view of this fissure from the eastward, but Mr. Percy Smith, the Assistant Surveyor-General, who had a near view from the sides, reports that the whole east end of the mountain