

FOG FORMATIONS.

BRIEF reference has already been made (vol. lxiii. p. 161, December 13, 1900) to some interesting observations and photographs of fog made by Mr. A. G. McAdie on Mount Tamalpais, a little to the north of San Francisco. Several articles upon the subject have been contributed by Mr. McAdie to the U.S. *Monthly Weather Review*, and the particulars given below have been derived from one in the issue of November, 1900. We are fortunate in being able to reproduce one of Mr. McAdie's striking photographs of fog, through the courtesy of Prof. Cleveland Abbe.

Fog is very prevalent on the central coast of California, especially in the vicinity of the Bay of San Francisco. The topography of the district is remarkable, because of the close juxtaposition of ocean, bay, mountain and foothill. A valley, level as a table, 450 miles long and 50 miles wide, having afternoon temperatures of 100° or over, is connected by a narrow water passage with the Pacific Ocean, the mean temperature of the water in this locality being 55°. Thus within a distance of 50 miles in a horizontal direction there is frequently a difference of 50° in temperature, while in a vertical direction there is often a difference of 30° in an elevation of half a mile. High bluffs, ridges and headlands are at such an angle to the prevailing strong westerly surface air currents that an air stream is forced with increased velocity through the Golden Gate, and there must of necessity be considerable piling up of

An attempt has been made at the Mount Tamalpais station to correlate the surface pressure conditions with fog. There are, however, many different types of fog. The conditions prevailing in winter, when tule fog, formed in the great valleys, drifts slowly seaward, are very different from those prevailing in summer, when the sea fog is carried inland. A typical pressure distribution accompanying sea fogs has been recognised. In general, a movement southward along the coast of an area of high pressure in summer means fresh northerly winds and high temperatures in the interior of the State, with brisk, westerly winds, laden with fog, on the coast.

Direct cooling by contact or radiation is shown by von Bezold to be more efficient as a cause of rainfall than cooling by mixture, but in the production of fog it is probable that cooling by mixture (except in the case of ground fogs) is the most important factor to be considered. It is to be noted that reverse pressures should also be studied, for perhaps a close watch upon the conditions prevailing when fog is rapidly dissipating might conversely throw light upon the order and relative importance of the three ways of cooling, viz., mixture, expansion and radiation.

Von Bezold's deductions may be thus summarised: More vapour condenses when a stream of air and vapour at low temperature impinges on a mass of warmer air than with reversed conditions. Ocean fogs, as a rule, form when cool air flows over warm, moist surfaces, but in the case under discussion, where the ocean surface temperature is 13° C. (55° F.) and the air temperature may reach 27° C. (80° F.), it is evident that the above



FIG. 1.—Lifted fog. Height above the ground, about 500 metres. View from U.S. Weather Bureau Observatory, Mount Tamalpais.

both air and water vapour at this point. The locality may indeed be considered as a natural laboratory, in which experiments connected with cloudy condensation of water vapour are daily wrought, and it is therefore of more than passing interest to the meteorologist.

Much faithful work has been done in physical laboratories on the behaviour of water vapour at varying volumes, pressures and temperatures. Regnault, Thomson, Broch, Aitken, Kiessling, R. von Helmholtz, Hertz, Rayleigh, von Bezold, Barus, Marvin and others have worked upon the change of state from vapour to liquid and from liquid to solid, and while many irregularities are noted in the behaviour of water vapour, the general problems of decreasing volumes and increasing pressures until condensation points are reached have been solved; and it is well understood that the vapour-liquid and liquid-solid condensations are in themselves but two phases in a chain of condensation phenomena. The problem of fog is therefore a limited one. It may be considered as a special case of cloud development, occurring in the first and second stages of Hertz, viz., the unsaturated and saturated stages. Condensation in the free air, as in these fog formations, takes place under conditions different from those obtaining in the laboratory. There are no fixed restraining walls, though the strongly stratified outlines suggest sharply limited air streams. Again, saturation as it occurs in free, constantly changing air and true adiabatic saturation are not identical. Saturation in the free air must be studied in disadvantageous circumstances, for the work must be done at a distance, with instruments neither sufficiently delicate nor accurate, and there is no control of conditions possible.

does not hold. It is more probable that condensation is the result of the sharp temperature contrasts at the boundaries of certain air currents having different temperatures, humidities and velocities, and that the contours of the land play an important part in the originating and directing these air currents. The summer afternoon fogs of the San Francisco Bay region, then, are probably due to mixture more than radiation or expansion. The winter tule fogs of the Sacramento and San Joaquin valleys are probably pure types of radiation fog, where the process of cloud building is from the cooled ground upward. Occasionally in summer, when the warm air has been pumped out of the valleys and there is rapid radiation, ground fog forms. An illustration of this is given in the accompanying figure, where fog covers a number of valleys.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof. Townsend, the new Wykeham professor of physics, delivered an inaugural lecture at the Clarendon Laboratory on Friday, April 26, upon the recent developments of electro-optics.

Mr. N. V. Sidgwick, of Christ Church, has been elected to an official Fellowship in Natural Science (Chemistry) at Lincoln College.

Mr. A. S. Hunt has been elected to a research fellowship at Lincoln College in order to enable him to prosecute his researches upon Egyptian papyrus.

The degree of D.Sc. has been conferred upon Prof. A. H. Church, F.R.S., in recognition of his contributions to chemical and mineralogical science.

No honorary degrees will be conferred at the Encænna this year.

Mr. J. L. Myres and Dr. H. R. Mill have been appointed examiners for the newly-instituted diploma in geography.

The following grants have been made from the Craven University Fund:—100*l.* to Mr. D. G. Hogarth to enable him to continue his researches in Crete; 80*l.* to Mr. T. Ashby towards the cost of publishing the results of his researches in the Campagna Romana.

Mr. J. Passmore Edwards has given to the University the sum of 1675*l.* for the promotion of the study of English literature in its connection with the classical literatures of Greece and Rome.

Scholarships in natural science are advertised for Merton College, New College and non-collegiate students on June 18.

The new Radcliffe Library (presented to the University by the Draper's Company) and the new Pathological Laboratory are approaching completion. The latter and the pathological collections deposited in the University Museum will be, probably, placed under the charge of the reader in pathology, Dr. Ritchie.

The Junior Scientific Club held their 224th meeting on Wednesday, May 1. The papers read were: "Experiences in South African Hospitals," G. H. H. Almond (Hertford); "Organic Compounds of Phosphorus," S. P. Grundy (Balliol).

CAMBRIDGE.—The new Board of Agricultural Studies in their annual report give a favourable account of their first year's working. The number of students attending the special courses of instruction is thirty-nine. The experimental farm is in working order, and no less than thirty-two special experiments on crops, stock, manures, &c., are being conducted in various local stations at the instance of neighbouring county councils. The Board of Agriculture has this year made a grant of 1000*l.* in aid of the work of the department. The special examination in agricultural science for the B.A. degree, and the examinations for the University Diploma in Agriculture, begin on May 29 and extend to June 8.

The Vice-Chancellor will represent the University at the meeting of universities and learned societies in connection with the millenary commemoration of King Alfred the Great at Winchester, to be held this summer.

Prof. Allbutt and Prof. Sims Woodhead will represent the University at the British Congress on Tuberculosis to be held in London next July.

THE following external examiners, among others, have been appointed by the Council of the University of Birmingham. We notice with regret the absence of Astronomy from the subjects. Mathematics, Prof. Horace Lamb, F.R.S.; Physics, Prof. J. J. Thomson, F.R.S.; Chemistry, Prof. H. McLeod, F.R.S.; Zoology, Dr. S. F. Harmer, F.R.S.; Botany, Prof. Reynolds Green, F.R.S.; Geology, Prof. T. G. Bonney, F.R.S.; Anatomy, Prof. Alex. Macalister, F.R.S.; Physiology, Prof. J. G. McKendrick, F.R.S.; Pathology, Prof. G. Sims Woodhead; Medicine, Dr. Donald MacAlister; Public Health, Dr. George Reid.

THE Association of American Universities has recommended the fourteen universities in the United States to extend the Christmas vacation every year to include the first week in January, in order to permit scientific men to attend annual meetings then instead of in the summer. *Science* says: "Columbia University has the honourable distinction of being the first to adopt the important innovation, and has already changed its calendar for 1901-1902, setting free the week of January first for convocation purposes. It is expected that several other universities also will soon announce their adherence to the plan, and it is hoped that in a short time the majority of American and Canadian universities will adopt the recommendation under consideration."

THE Technical Education Board of the London County Council is offering for competition five senior county scholarships of the value of 60*l.* a year for three years, together with payment of tuition fees up to 30*l.* a year. The scholarships are open to young men and young women who are resident within the administrative County of London, and whose parents are in receipt of an income not exceeding 400*l.* a year; and they are tenable at Universities, University colleges, or technical

colleges, whether in England or on the Continent. Candidates must be under twenty-two years of age on May 1, preference being given to those who are under nineteen years of age. In addition to the senior county scholarships the Board offers a limited number of free places at University College, King's College and Bedford College, London. The scholarships and grants of free places are awarded, not on the result of an examination, but on a consideration of the past record and achievements of the candidates. Application forms may be obtained from the secretary of the Technical Education Board, 116, St. Martin's Lane, W.C., to whom they should be returned not later than Monday, May 13.

THE Education Bill of the Government was introduced into the House of Commons on Tuesday, and was read a first time. The object of the Bill is to establish in every part of England and Wales a local education authority for the supervision of educational work of all grades; and it is hoped that this authority will ultimately have control over all schools within its area of influence, whether elementary, secondary or technical. The proposal of the Government is to make county and borough councils, acting through statutory committees, the educational authorities, and it is hoped that small counties will combine to form an education area. The new education committee will have no power of rating, but will merely spend the money placed at its disposal by the county council. This money will be derived chiefly from the local taxation receipts, so that the committees will become the successors of those at present responsible for technical instruction. A county council will also have the power of levying a rate, limited to 2*l.*, either upon the whole county or upon any part of it for which it might be desirable to make provision, and the sum so raised will be entrusted to the education committee. School Boards and School Board rates are not touched by the Bill, but their ultimate absorption by the new educational authorities is contemplated.

THE Report of the U.S. Commissioner of Education for the year 1898-99 has been received. Much of this bulky volume is taken up with tables referring to the condition and progress of various branches of education, but there are also a number of interesting articles and summaries. A detailed statistical account is given of the institutions for higher education in the United States. A table is given showing the number of students in higher education to every million persons in the United States. In the year 1872 there were 852 of such students to 1,000,000 people, and in 1898-99 the proportion had risen to 1874 college students per million. In the year 1898-99 the total number of students in collegiate, graduate and professional departments of institutions for higher education and in professional schools was 147,164, of which 43,913 were enrolled as professional students in law, medicine and theology, leaving 103,251 students reported as pursuing studies in the liberal arts and applied science. The number of degrees conferred on men after passing through a recognised course was 10,794, and on women 4293. The total value of property possessed by institutions for higher education amounted to more than seventy million pounds. The endowment funds amounted to thirty-one million pounds, and the remainder represented the value of grounds, buildings, &c., used for instruction and research. The total income for the year covered by the report, excluding benefactions, amounted to about six million pounds. The gifts and bequests reported as having been received during the year reached the magnificent total of nearly five million pounds.

WE are glad to notice another movement for the extension of facilities for higher education. A short time ago a council was formed to consider the possibility of establishing a University College for North Staffordshire, and to promote interest in the educational needs of the district. The executive committee now report that the chairman of the council, Mr. Alfred S. Bolton, has purchased, as a site for the College, about three acres of land in a good position at Stoke-on-Trent, and has thus given generous aid to the educational cause of North Staffordshire. Principal Oliver Lodge has become a vice-president of the council in order to show that the scheme has the sympathy and good wishes of the University of Birmingham. It was pointed out by the committee which first started the inquiry into higher education in North Staffordshire that "The nature of the local industries demands special scientific instruction of a more systematic and thorough character than is at present provided anywhere in the district, and foreign competition by nations recognising the practical advantages of such instruction will

prove disastrous to the district if the matter is continually neglected." The district is at present remarkably deficient in opportunities for higher education. With a population approaching half a million within easy reach of the centre, there is no institution where young people who have left the secondary school can obtain higher instruction nearer than Manchester (thirty-seven miles) or Birmingham (forty-five miles). Evidently there is room for further provision of educational facilities by the establishment of an institution of the rank of a University College; and it is satisfactory to know that another locality is being aroused to a sense of its educational deficiencies.

SCIENTIFIC SERIAL.

Bulletin of the American Mathematical Society, April, 1901.—Prof. F. N. Cole opens with an account of the proceedings at the February meeting of the Society in New York City, and, in addition to the titles of the nineteen papers communicated, gives an abstract of several of them. Three of the papers are printed. Their titles are: (1) Green's functions in space of one dimension, by Prof. M. Bôcher. The results arrived at are given, but the proofs and further developments are reserved; (2) Possible triply asymptotic systems of surfaces, by Dr. L. P. Eisenhart. This supplements a note by the author, in the January *Bulletin*, entitled, "A demonstration of the impossibility of a triply asymptotic system of surfaces." Instead of the general negation previously given, the author now gives the qualified one: The only triple systems of surfaces cutting mutually in the real asymptotic lines of these surfaces are composed of properly associated families of hyperboloids of one sheet and hyperbolic paraboloids; (3) Note on Hamilton's determination of irrational numbers, by Dr. H. E. Hawkes. The purpose of the note is to call attention to Hamilton's use of the partition (Schnitt) in his definition of certain irrational numbers (*Trans. of the R. Irish Academy*, vol. xvii, 1837, p. 293).—On a system of plane curves having factorable parallels, by Dr. V. Snyder, was read before the December meeting of the Society. The type of scrolls contained in a linear congruence, and having factorable asymptotic lines, gives rise to a class of plane curves whose parallels have a similar property (cf. a paper by the author, in the *American Journal of Mathematics*, vol. xxiii., on a special form of annular surface). Mr. Bromwich gives a very useful analysis of Dr. P. Muth's "Theorie und Anwendung der Elementartheiler" (1899, xvi. and 236 pp.), and hopes that the book may induce its readers to take up the special part of invariant theory treated in it. Mr. Bromwich has done good work in this direction (see *Proc. of London Math. Soc.* vol. xxxii. 1900, p. 98), where he gives a list of papers on the subject.—Short notices follow of Dr. R. Fricke's "Kurzgefasste Vorlesungen über Verschiedene Gebiete der höheren Mathematik, mit Berücksichtigung der Anwendungen" (1900), and Dr. R. Böger's "Ebene Geometrie der Lage" (1900), both by Prof. H. S. White.—The notes are very copious and interesting, giving account of the courses of lectures in the Continental and home Universities, and the usual new publications close the number.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 28.—"A Preliminary Account of the Development of the Free-swimming Nauplius of *Leptodora hyalina* (Lillj.)." By Ernest Warren, D.Sc. Communicated by Prof. Weldon, F.R.S.

March 14.—"On the Preparation of Large Quantities of Tellurium." By Edward Matthey, A.R.S.M. Communicated by Sir George Stokes, Bart., F.R.S.

March 28.—"On the Enhanced Lines in the Spectrum of the Chromosphere." By Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall, A.R.C.S.

In the recently published account (*Ast. Phys. Journ.* vol. xii. p. 307, 1900) of the spectroscopic results obtained by members of the expedition from the Yerkes Observatory during the solar eclipse of May 28, 1900, Prof. Frost claims to have established a close relationship between the bright lines in his eclipse spectra and the stronger lines of the Fraunhofer spectrum, and states that "61 per cent. of the latter were measured as bright on the plates."

He also states that "these plates give no evidence of any relationship between the bright lines and the 'enhanced' lines, or lines distinctly more intense in the spark than in the arc spectrum, although Sir Norman Lockyer has attached much significance to a supposed connection between them." He quotes specially the cases of titanium and iron lines, and of 48 enhanced lines of the former element acknowledges that 29—or 60 per cent.—correspond with lines in his eclipse spectra

The authors of the present paper show that if a difference of 0.3 tenth-metres be allowed between the wave-length of an eclipse line and that of the corresponding metallic line (and in some cases Prof. Frost accepts a difference of 0.35 or more between his adopted wave-length and Rowland's wave-length of the corresponding Fraunhofer line), there are 38 of the 48 enhanced titanium lines—or 80 per cent.—which have corresponding lines in the eclipse spectra, thus showing a closer relationship between the enhanced lines of titanium and the eclipse lines than that claimed by Prof. Frost between the latter and the stronger of the Fraunhofer lines.

To show the difference in behaviour in the eclipse spectra of the enhanced and unenhanced lines, several tables have been compiled. The first contains all the Fraunhofer lines in the region covered by Frost's eclipse spectra which have an intensity of 2 or greater, and which Rowland has ascribed to titanium only. These are 53 in number, 20 are enhanced lines and 33 are not. The comparison table indicates that 19 of the 20 enhanced lines have corresponding lines (nearly all prominent) in the eclipse spectra, the remaining one being probably masked by H γ . Of the 33 unenhanced lines, 23—or 70 per cent.—do not correspond with eclipse lines. Of the nine eclipse lines which do agree in position with unenhanced titanium lines, three are nearly certainly due to other metals, and the remainder are lines of insignificant intensity.

The second table gives the enhanced lines of titanium which are recorded by Hasselberg in the arc spectrum, and a comparison is made with Frost's eclipse lines. This table shows that though the "arc" intensities of the enhanced lines vary from 2 to 7 (max. = 8), they have nearly all corresponding lines in the eclipse spectra, the majority of the latter being quite prominent.

The third table contains all the strongest lines (Int. 7 and 8) in Hasselberg's list of arc lines which are unenhanced. It is shown that only 7 out of 20 have corresponding eclipse lines. To three of these Frost gives no origin, to the others he gives compound origins, three of them involving titanium. In no case is the eclipse line as strong as the majority of those which are the representatives of the enhanced lines.

In the case of iron a similar analysis is given, but only over a limited region of the spectrum (λ 4500 to λ 4600) owing to the great number of lines in the iron spectrum. The same results are arrived at, viz., that the enhanced lines, though insignificant in the iron spectrum so far as intrinsic intensity is concerned, are, in the main, represented in the eclipse spectra by lines of abnormal intensity, whereas many of the stronger iron lines are either not represented at all, or only by weak lines.

"On the Arc Spectrum of Vanadium." By Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall, A.R.C.S.

In this paper the authors give a list of lines in the arc spectrum of vanadium which have been measured from photographs taken at Kensington with a Rowland concave grating of 21½ feet focus and 14,438 lines to the inch. The region of the spectrum investigated extends from λ 3887 to λ 4932. The sources of the spectrum were (1) vanadium chloride, and (2) a pure sample of vanadium oxide supplied by Sir Henry Roscoe. These were volatilised in the arc between poles of the purest silver obtainable, and which were furnished by Sir W. C. Roberts-Austen.

The lines are compared with those published previously by Rowland (*Ast. Phys. Journ.* vol. vii. p. 273, 1898) and Hasselberg (*Svenska-Vetenskaps. Akad. Handl.* vol. xxxii. No. 2, 1899). The three records contain many lines in common, but there are also many differences between any two of them. The lines special to any one list have been analysed with the object of either properly establishing their claim to be accepted as true vanadium lines, or possibly tracing them to their true origin. Lines in the Kensington spectra which are due to impurities have been eliminated, as far as possible, by comparing the vanadium spectrum directly with those of forty-three other elements. They are twenty-nine in number, and are traces of the strongest lines only of Fe, Mn, Cr, Co, Ca, Al, Sr and Ag.