

and the author then passes on to the laws of flow, as determined by the length, shape and number of the openings between particles. In the mechanical analysis of soils, the mean diameter of the grains is known as the *effective size*, and is such that if all grains were of that diameter, the soil would have the same transmission capacity that it actually has. The effective size is determined from the dimensions of the mesh of a sieve which will permit 10 per cent. of the sample to pass through it, but will retain the other 90 per cent. That is, in any soil, 10 per cent. of the grains are smaller than the effective size and 90 per cent. are larger. It is remarked that the velocity of flow through porous strata is much less than might at first be supposed. In the sands of the Dakota formation, from which remarkable artesian wells draw their supply, the flow does not exceed a mile or two a year.

Underground waters are divided into three principal zones:—(1) The unsaturated zone, (2) the surface zone of flow, and (3) the deeper zones of flow. The motion of water in the unsaturated zone is essentially vertical—downward in supplying the saturated sheet below, and upward in supplying the surface evaporation and the requirements of vegetation by means of the capillary action of the soil during rainless periods.

The surface or upper zone of flow extends from the level of the water table to the first impervious rock floor. The deeper zones of flow are those that lie below the first impervious stratum, and the direction and character of the

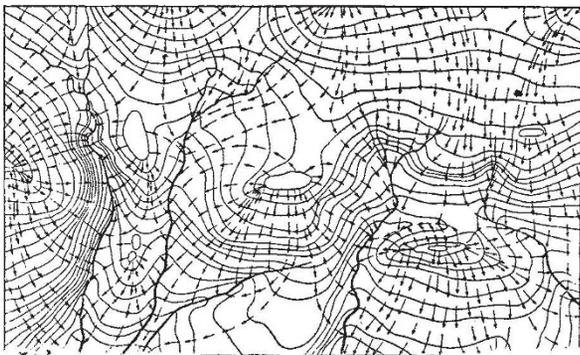


FIG. 1.—Contour Map showing position of water table (continuous lines), supposed lines of motion of ground water (arrowed lines), and the thalwegs or drainage lines (heavy lines).

flow are usually quite independent of the surface topography, being controlled by large regional and geologic conditions.

The author points out that the unit of the surface zone of flow of ground waters is the river valley, and the rate and direction of motion conform primarily to the slopes and grades of the land surface. The underground flow, in fact, follows the trend and direction of the surface drainage. The water table has a slope which is essentially similar to the slope of the surface of the ground, though less steep. The motion of the underground seepage into the streams and rivers is similar to the lines followed by the surface drainage into the same streams.

The lowest line of drainage of the valley is known technically as the *thalweg*. Topographically, it is a line upon a contour map which is a natural water-course (Fig. 1). Beneath the thalweg there is usually a similar drainage line for the underground current, in general coincident with the thalweg. For other parts of the valley the actual lines of motion of the underground water are represented by a set of curves which cut the contour lines of the water table at right angles. The similarity of the contours of the water table to those of the land surface enables one to sketch approximately the lines of underground seepage from a contour map of the surface. For the most part the lines of flow run into the surface streams or thalwegs, but between A and B, and X and Y, there is indication of an underflow or general movement in the direction of the surface streams and independent of the same.

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These views are worthy of attentive consideration and study in connection with the geological structure, for, as the author justly remarks, they must not be taken too literally. The surface topography is only one, and often not the most important, element in the control of the underground current. He points out how irregularities in the form of the first impervious layer and the amount of rainfall will influence the distribution and motion of the ground water. He directs attention also to the fact that much ground water returns to the surface in the form of seepage which is more important, though less obvious, than the springs. Much ground water, moreover, may not find its way immediately into open channels, but may even take a general course down the thalweg and flow through coarse materials toward the sea in large underground streams or moving sheets of water. This underflow is well known in the Great Plains of America, although the movement is excessively slow. Sometimes the underflows appear to be independent of the surface streams, as indicated by chemical analyses.

The deep zones of flow and artesian wells are finally discussed by the author; he deals also with common dug wells and the influence of pumping on contiguous wells, as well as the mutual interference of artesian wells. H. B. W.

LONDON FOG INQUIRY, 1901-02.¹

IN November, 1901, the Meteorological Council appointed Captain Carpenter, R.N., D.S.O., a member of the council of the Royal Meteorological Society, to conduct an inquiry into the occurrence and distribution of fog in London, initiated, with the assistance of a grant from the County Council, in response to requests for more detailed forecasts of the occurrence of fog. Captain Carpenter at once put himself into communication with Captain Wells, R.N., the chief officer of the Metropolitan Fire Brigade, and made arrangements for the systematic observation of fogs at some of the river stations and at other stations of the Metropolitan Fire Brigade. He also arranged for supplementary observations to be taken at certain of the Metropolitan Police stations, at Battersea Park and Regent's Park, at a number of coast-guard stations in the Thames estuary, and by one or two private persons. Observations of temperature and other meteorological conditions were obtained from a number of the stations and from the parks; self-recording thermometers were installed on the Victoria Tower at Westminster, the Golden Gallery at St. Paul's, on the roof of the Meteorological Office and at a private house at Banstead. Regular records of fog in accordance with a conventional scale distinguishing the kind and intensity of the fog were thus obtained from a series of points in or round London. By arrangement with Captain Wells, special observations were made during fog or when fog was anticipated by the forecast branch of the Meteorological Office.

Attention may be called to the following points in Captain Carpenter's report, which is now issued:—

(1) The first result of the inquiry is the suggestion of a scale of fog intensity, arranged according to the interference with traffic upon road, rail, river, or sea, and represented by the serial numbers 0 to 5.

(2) Next it appears that on account of smoke the extreme limit of visibility in winter from an elevated position in London, in most favourable circumstances, is set at $1\frac{1}{2}$ miles. That limit is diminished as the tendency to form fog is developed until the well-known effects of dense fog are reached.

(3) No evidence has been obtained of any special connection between fogs and geological conditions.

(4) The commencement of a fog is not identified with any particular locality; it seems to be a general process depending upon general atmospheric conditions. There is no evidence that fogs formed outside invade or drift into London. The London fogs are produced in London; they do not come from the country.

(5) The meteorological conditions for the formation of fog are set forth and illustrated by charts and diagrams. An interesting point brought out is a tendency to indraught

¹ Report to the Meteorological Council by Captain Alfred Carpenter, R.N., D.S.O.

of air from all sides to the central parts of London during dense fogs.

(6) No severe fog occurred with an air temperature above 40° F. The minimum air temperature prior to fog coming on averaged 9° below the normal mean temperature for the day. The relation between the occurrence of fog and the minimum temperature in November and December, 1901, is shown in Fig. 1.

(7) During the period of observations, in twenty-two cases out of twenty-five during the nights preceding days of fog, a thermometer on the grass at Regent's Park fell much below the river temperature, the amounts of difference on these occasions varying from 6° to 25° F.

Attention is called to one point of special importance in connection with temperature observations, which requires to be followed up. On March 7, during fog, the temperature in the streets of London was nearly 10° F. below that on the roof of the Meteorological Office, the elevated stations, and the surrounding country on the southern and western sides.

The outstanding parts of the inquiry are:—

(1) To ascertain whether the proposed scale of classification of fogs puts the observations of locality upon a more satisfactory footing, and whether additional observations throw any further light on local distribution.

(2) The further investigation of temperature conditions, including temperature observations in the early morning (5 a.m.), and vertical distribution of temperature.

With regard to the last point, we learn that an opportunity was recently afforded for determining the conditions

The council of Owens College, Manchester, has, under a scheme of the Board of Education, resolved to establish a scholarship and exhibition in zoology and botany out of the accumulations of the Robert Platt fund, which has hitherto been applied only to physiology. The scholarship will be of the yearly value of 50*l.*, will be open for competition to persons who have studied zoology or botany in any university or college laboratory, and will be awarded to the candidate who shows most promise and ability for the prosecution of research in zoology or botany.

AN interesting ceremony took place at the gardens of the Royal Botanic Society on Wednesday, April 1. The Earl of Aberdeen presided, and Mr. Alfred James Shephard, chairman of the Technical Education Board of the London County Council, declared the newly erected laboratory open for botanical and horticultural work. Instruction on the lines of the syllabus of the Board of Education will be given in botany, and attention will also be paid to horticultural chemistry, elementary and advanced, in connection with the practical gardening school. Other classes will, if necessary, be carried on and research work undertaken. The school of which the laboratory is the outcome was, as Dr. C. Adams pointed out at the opening ceremony, started five years ago with nine students; now there are thirty-five—of whom twenty-one are boys and fourteen girls. Some 200*l.* has been spent over the undertaking, of which the Technical Education Board has provided 85*l.* The work has been very successful, and no difficulty has been found in obtaining appointments for the students who have been through the

three years' course. Mr. Shephard in his speech pointed out that to endeavour to grow plants with only practical knowledge was like attempting to cure the sick after the fashion of a quack doctor, without having mastered the science of medicine. Miss Shephard presented diplomas to successful students at the school, and Dr. Kimmins, Dr. Garnett and Mr. Brinsley Marlay also spoke. The Royal Botanic Society is decidedly to be congratulated upon adding theoretical instruction to the practical teaching already carried on, though it seems advisable that the special principles underlying horticultural practice should figure in the syllabus as well as pure botany.

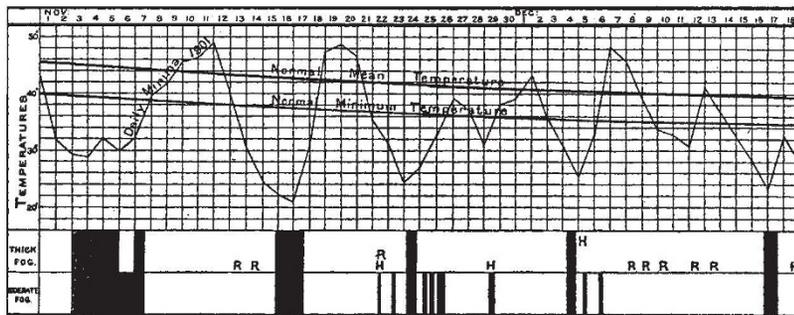


FIG. 1.—Part of diagram showing the occurrence and duration of fog in London and the daily minimum of temperature at Kew. H signifies "high fog," R a rainfall of 0.05 inch or more.

under which such investigation could be carried out in London by the loan of a captive balloon and self-recording instruments. Captain Carpenter was himself unable, on account of his health, to continue the conduct of the inquiry beyond the close of the winter of 1901-2. The conclusions drawn in his report are based exclusively upon observations during that period, and are expressly subject to possible revision in the light of further observations. At his suggestion the observations were recommenced in September, 1902, and have been continued during the winter; they include a number of special observations of temperature at 5 a.m. The continuation of the inquiry has been under the superintendence of Mr. R. G. K. Lempfert, of the Meteorological Office.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE annual exhibition of scholars' work from the Board Schools of London will be held at the Examination Hall, Victoria Embankment, W.C. (adjoining Waterloo Bridge), on Saturday, May 9, and on the following Monday, Tuesday and Wednesday (May 11-13). The exhibition will be opened by Lord Reay (chairman of the Board), and will include among the exhibits specimens of modelling, science apparatus and metal-work from the day and evening schools, and also work from the schools for the blind, deaf, special instruction, truant, and industrial schools.

THE Education Bill for London was introduced in the House of Commons on Tuesday. It is proposed to make the London County Council the education authority, so that the London School Board will disappear. The new education committee will contain ninety-seven members, this total being made up as follows:—Representatives of the borough councils—one for each borough and two each for Westminster and the City of London—31; London County Council, 36; representatives (including women) of various secondary schools, the University of London, technical institutions and bodies contributing to the maintenance of education, 25; and (for the first five years) representatives of the London School Board, 5—total 97. The object of the Bill is thus to abolish the School Board, and to link education in London with municipal government. The County Council, as the education authority, is to have the rating powers of a county borough under the Education Act of 1902. The management of public elementary schools is to be entrusted to the borough councils, subject to the general direction of the education authority, which is to have complete financial control. The borough councils are to have the right to appoint and dismiss teachers, the custody of the buildings, and the right to select the sites for new schools in their prescribed areas. These powers, however, do not apply to secondary schools and technical institutions.

A BIRMINGHAM correspondent describes in the *Times* for April 2 the four great German commercial high schools, those namely at Aachen, Cologne, Frankfurt, and Leipzig. There is a special appropriateness just now about such a