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Land Drainage.

THE heavy rainfall and snowstorms of last month, culminating in the overflow of the Thames in London on Jan. 7, with grievous loss of life, has brought vividly before the nation the subject of the control and disposal of surplus water. In Great Britain, the problems, although serious, are not of the same magnitude as elsewhere. The disastrous Mississippi floods of last summer, and the extensive damage done around Bagdad when the Tigris broke its banks about two years ago, are illustrations of a menace the full force of which is happily spared us. In these cases the fundamental cause is the gradual raising of the river bed in its lower reaches by the suspended material brought down from the uplands and deposited when the speed of the current is reduced.

In the absence of measures of control, the river will frequently change its course, and may build up an extensive delta in the estuary. The difficulty is met by dredging, which is rarely able to meet the case completely, especially in extensive river systems, and reliance is placed mainly on embankments or levees for confining the river to its course. The embankments must be raised from time to time to keep pace with the silting up of the river bed, and eventually the normal water level may be several feet above the level of the surrounding land. In such conditions a break in the defences is disastrous, and the longer the catastrophe is in coming, the greater it is. The effect is felt most in the lower reaches of the river, but the causes extend over the full region of the catchment area. Every little stream, every small trickle of surface water, is contributing its small quota of suspended material to the main stream, and the engineer is in reality struggling against Nature's ceaseless modification of the topography of the land over the whole of the drainage area discharging into the river. The battle can never be won; an armed truce is all that can be hoped for, and man's energies are or should be directed towards postponing the evil day.

The necessity for co-ordination in such efforts is self-evident: it is worse than useless for the protection of one part of the area to be carried on as an isolated problem, independent of the conditions in adjacent areas; and yet in Great Britain this piecemeal method is still the rule rather than the exception. For a long time past, the problem of land drainage has been growing steadily more acute, and the enforced neglect during the years of the War brought matters to a head. Attempts were

made in the Land Drainage Acts of 1918 and 1926 to secure improvements in co-ordination and grouping of the multitudinous drainage authorities, each of which is more or less a law unto itself. These acts were not satisfactory, quite apart from the question of lack of funds, and a Royal Commission was appointed in March 1927, with the Right Hon. Lord Bledisloe as chairman, to inquire into the present law and its administration, and to suggest any improvements that would lead to an efficient arterial drainage system without placing undue burdens on any particular section of the community. The Commission was ordered to report as soon as possible, and it has obeyed this instruction with commendable zeal: the Report¹ was issued last month.

The main recommendation is that a catchment area shall be regarded as one unit, and be under the control of its own elected central authority, that shall be responsible for the main channel of the river, the upkeep of which shall be a rating charge on the whole catchment area. The numerous drainage boards existing within any catchment area are to be reorganised and grouped as internal drainage authorities, which will levy their local rates for internal drainage, and be supervised by the catchment authority in order to secure co-ordination of effort. The Thames is regarded as a special case, and it is recommended that beyond constituting the Conservancy a drainage authority for the whole of the catchment draining into its present area of jurisdiction, no change should be made; the Port of London Authority would therefore continue to exercise control from below Teddington weir to the Crowstone. This suggestion may need modification in view of the recent floods in London.

The recommendations of the Commission are simple, and indeed obvious, but they are none the less sweeping in their effect. They reduce to a logical scheme the confusion that now exists. There are more than 360 drainage authorities of various types in England and Wales, many of them of great age. The earliest appears to be the Commission of Sewers for Romney Marsh, appointed in the reign of Henry III., and it covers the period when the land was settled in more or less isolated and self-supporting communities. Much of the low-lying part of the country, now occupied, was then wastes of marsh or fens that provided, until reclaimed in their turn, a ready and convenient accommodation for the drainage water from the

settled areas. The fens of East Anglia provide the best example of this process. Reclamation on an extensive scale was begun in the seventeenth century in spite of the determined opposition of the fenmen, whose attitude can be judged from the following verse of a doggerel poem of the period:

“The feather'd fools have wings to fly to other nations,
But we have no such things to help our transportations;
We must give place (oh, grievous case!) to hornéd beasts
and cattle,
Except that we can all agree to drive them out by
battle.”

It is not surprising that these difficulties, together with the lack of engineering resources, and the absence of much of the interdependence that now marks British agricultural life, should have resulted in the construction of many independent reclaimed areas, the drainage authorities of which would say, with Chesterton, “I don't care where the water goes, if it doesn't get into”—my land. This very natural attitude was reinforced and protected by the powers granted by law and custom to each area. The recommendations of the Commission, if adopted, will enable the catchment authorities appropriately to modify the constitutions of these areas. Further, the upland districts, the drainage water of which increases the difficulties of dealing with the lowland areas, will be under their jurisdiction.

It is asserted that the drainage of upland agricultural districts by pipe and mole drains has shortened the time taken for this surplus water to reach the main stream. As a result, flood water that formerly slowly percolated by undefined channels is now discharged much more rapidly, and has forced the lowlander to increase his embankment protections and to enlarge the outfall facilities of the main stream.

The claim is undoubtedly correct; large areas were drained in the middle of last century, and except where drains were laid too deep to be of service, the condition of the land was improved. Renewed attention is now being paid to field drainage, and we hope it will be examined not only as a simple technical question of removing surplus water, but also as one of the related aspects of soil physics demanding fuller investigations in the light of recent advances in the theory and practice of this subject.

It is indeed questionable whether drainage alone is the best method of dealing with occasional surplus water. In spite of our adequate and well-distributed rainfall, foreign agriculturists visiting Great

¹ “Report of the Royal Commission on Land Drainage in England and Wales.” (Cmd. 2993.) Pp. 60. (London: H.M. Stationery Office, 1927.) 1s. 3d. net.

Britain are surprised at the susceptibility of our crops even to mild droughts; the suggestion is frequently made that our normal cultivation operations do not conserve sufficient soil moisture. The principles underlying these operations are certainly worthy of further study; they reached their present form about 1750, and were based on cheap labour and on horse power. Greatly increased labour costs have altered the situation completely, but the cultivation methods have not undergone any essential modifications to meet the new conditions, in spite of the facilities for mechanical power now available. A full examination of the effects of deeper cultivations, subsoiling, and rotary tillage on the amounts and rate of flow of percolation water, and studies of the influence of mulching on evaporation, should give valuable information on the ability of the soil to hold a greater reserve moisture supply. These problems are essentially physical, and they imply parallel studies of the physical and physico-chemical properties of the finest soil particles, the colloidal nature of which makes the soil differ in many respects from a simple porous material.

There is another aspect of the subject. This fine material is now known to exercise a controlling influence on both the inherent fertility of the soil and its ability to fall into that favourable physical condition known as good tilth. Unfortunately, this material is the most susceptible to removal by erosion and drainage to lower levels, where it silts up and intensifies outfall difficulties. In areas where it can be accumulated, it gives rise, as would be expected, to a very fertile soil. The narrow belt bordering the Nile, the warp-lands of the Humber estuary, and to some extent the polders of Holland, are well-known examples where natural forces or man's intervention have succeeded in saving some of this valuable material for agriculture.

Finally, we may point out that the above problems of drainage, tilth, and fertility are combined with peculiar force in all irrigation areas, and it is encouraging to note that those members of the recent Imperial Agricultural Research Conference most familiar with the practical problems of overseas agriculture were foremost in urging the vital necessity of fundamental research on the soil. The establishment of a Bureau of Soil Science, as suggested at the Conference, would be a distinct aid to such research by collating the results and showing the bearing which soil survey work has on problems of drainage and of irrigation in all parts of the Empire.

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The Dolomites of South Tyrol.

Das Grödener-, Fassa- und Enneberggebiet in den Südtiroler Dolomiten: Geologische Beschreibung mit besonderer Berücksichtigung der Überschiebungserscheinungen. Von Dr. Maria M. Ogilvie Gordon. 1 und 2 Teil: *Stratigraphie-Tektonik.* (Abhandlungen der Geologischen Bundesanstalt, Band 24, Heft 1.) Pp. xxiii + 376 + 26 Tafeln. 90s. 3 Teil: *Paläontologie.* Mit einem Atlas von 13 Tafeln. (Abhandlungen der Geologischen Bundesanstalt, Band 24, Heft 2.) Pp. 89. 30s. (Wien: Geologische Bundesanstalt, 1927.)

THE work under review is one exceptional for its comprehensiveness, and one that marks the conclusion of an enormous amount of labour, both physical and mental, on the part of the author, Dr. Maria Ogilvie Gordon. Begun in youth, under the ægis of two great students, Ferdinand von Richthofen and August Rothpletz, both long since dead, it was completed after she had borne with fortitude the bitter blow that fate had dealt her as a wife, and after she had devoted her energies to her country's cause during the War. By reason of the length of the period over which the work was spread, and the magnitude of the events that encompassed us all during the years of interruption, her earliest work must appear now as objective to her as to the reviewer. It must almost seem not to be her own work, but that of some stranger of a past generation. Yet underlying all her work, from those early days of 1893 up to the present time, one motive may be traced—the endeavour to unravel the tectonic structure of the Dolomites, enormously complicated in reality, albeit described as simple by some; and, on the basis of this work, to solve certain other problems, one of the most important of which is the question, first raised by von Richthofen, and since repeatedly denied or affirmed, as to the coral-reef origin of the gigantic masses of limestone and dolomite. It must, moreover, be mentioned with approbation that the author, in spite of the keenness and originality of her own perception, has adhered to the principle laid down by von Richthofen so to present her observations that they remain available for other interpretations. This remark is especially applicable to the work now under review.

The volume comprises an almost overpowering wealth of detailed observations concerning the stratigraphy, the tectonics, and the palæontology of the area studied. Nobody will ever think of starting work upon this area without availing