Geological Aspects of the Channel Tunnel Scheme.

By JOHN PRINGLE.

THE numerous advantages that will result from the making of a tunnel between England and France have long been recognised; but it may not be generally known that in support of such a scheme legislation dealing with the preliminary procedure passed both the French and British Parliaments so long ago as 1875. Less than five years later a start was actually made and headings were commenced on both sides of the Channel, but the failure of the French Channel Company, followed by an order issued by the British Government to close down the work of the British engineers, brought the

does it seem needful to do more than merely mention that the theories advanced in 1855 by Godwin-Austen, in a remarkable paper "On the Possible Extension of the Coal Measures beneath the South-Eastern part of England," gave rise to considerable interest in the problems connected with deep-seated geological structures. It is sufficient to say that most geologists were so certain of the occurrence of Coal Measures under Kent that Prestwich in 1873 maintained that these old rocks would be found sufficiently near the surface at Dover to allow submarine tunnelling. Pictur-

esque accounts of the excavations of a tunnel by working the coal made their way into the columns of the newspapers. When the boring made alongside the Channel Tunnel shaft at Shakespeare Cliff proved the presence of Upper Carboniferous Rocks with seams of coal, a great impetus was given to further exploration by the boring-tool, and since 1886 more than forty borings and shafts have been carried down to the Palæozoic rocks in East Kent.

The information obtained by many of the companies carrying out these explorations was, however, jealously guarded for commercial reasons, and had it not been necessary to seek the advice of geologists, perhaps few details of the borings would have become public knowledge. Fortunately, the advice of the officials of the Geological Survey was sought, and they were permitted to examine the cores of nearly all the boreholes. The excellent use made of these opportunities resulted, when publication was allowed, in contributions to geo-

logical science of the highest value. These borings have demonstrated that Kent, instead of being an area of simple geological structure, as was thought, is one of considerable complexity, and more geological formations have been proved underground in that county than in any other in England.

As an outcome of the work of the Geological Survey, it is now possible to map the Palæozoic platform, and to show the area occupied by the Silurian, Old Red Sandstone, and Carboniferous rocks (Fig. 1). Further, a plan can also be made of the disposition of the Jurassic rocks on the Palæozoic floor and the general arrangement they would present, if all the strata down to the base of the Wealden were removed (Fig. 2). Fig. 2 is based on that published by the Geological Survey, but certain modifications of the outcrops of the

FIG. 1.—Sketch map of the Palæozoic strata proved at depths varying from 900 ft. to 1400 ft. below Ordnance Datum in East Kent.

project to a standstill. Now that the scheme has been revived it is hoped that the undertaking will be pushed through to a successful issue. Geologists agree that the excavation of the tunnel is practicable, and no obstacles which will defeat the ingenuity of engineers are likely to arise in the course of its construction.

During the years that have elapsed since the heading was stopped at Dover, much has been learned concerning the deep-seated geology of East Kent and of the opposite shore of France; and some of the results obtained may not be without interest at the present juncture.

It seems scarcely necessary here to relate the views held by early geological observers concerning the physical identity of the coalfields of Somerset with those of the north of France, and the continuity of the higher formations in both countries; nor

mately parallel to the lines of faults and fissures. A small amount of sea-water made its way into the workings, but a hand-pump was found sufficient for dealing with the flow; the water caused no inconvenience, and was easily kept out by a ring of tubing. After an interval of nearly thirty years the heading was reported to be dry in 1912. On the French side, however, the engineers experienced much trouble in dealing with the water coming from a fault in the lower part of the shaft, and in a length of the heading driven nearly at right angles to the fissures a fair amount of water was also tapped.

The excavation of the lower part of the Lower Chalk is therefore not likely to be entirely free from water-troubles. The difficulties, in fact, may be increased if the original plans for the drainage of the tunnel are carried out. It may be remembered that it was proposed to drive a heading with an inclination of 1 in 80 down-hill from the shore at each side for a distance of two miles, and then to continue the excavations with a rising gradient of about 1 in 2000 to the centre of the Channel. This would probably mean that part of the tunnel situated under the sea would

lie within the Middle Chalk, and would, therefore, cross the fissures at a rather low angle in strata known to allow the passage of water in increased quantities. This difficulty might perhaps be overcome by driving the tunnel at each end into a lower geological formation, namely, the Gault Clay. This is a point worthy of serious consideration by the engineers. If this plan were followed, the highest point at the centre of the tunnel would probably lie within the drier Lower Chalk.

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It is probable that in earlier discussions the Gault formation was given less consideration in the belief that it was overlain by water-bearing Upper Greensand; in fact the majority of existing plans show a narrow stippled band between the Gault and the Lower Chalk to represent a supposed outcrop of Upper Greensand. Now it has been clearly shown as a result of palæontological investigation that the clay-beds IX to XIII of later classifications of the Gault at Folkestone, and their equivalents at the south end of Blanc Nez, represent in argillaceous facies the sandy beds of the Upper Greensand of the west of England. Consequently, if the headings at Dover and Blanc Nez were to be driven in the Gault at about the horizon

of Bed IX, the workings would lie in argillaceous beds, and the risk of meeting a considerable volume of water would in this way be greatly reduced.

As a final remark, it may be suggested that precautionary measures should be taken by the engineers against the possibility of meeting drift-infilled valleys in the Chalk underneath the Straits of Dover. The geological chart showing the outcrops of the subdivisions of the Cretaceous rocks

FIG. 3.

on the floor of the Channel, which was made by MM. Potier and A. de Lapparent as a result of more than 7000 soundings, certainly does not reveal any trace of former valleys in this region, nor has any recent evidence of their existence been obtained; but the fact that many such infilled valleys in the eastern counties of England have been shown to reach depths of more than 300 feet below Ordnance Datum emphasises the need for caution, since such a valley would probably carry a considerable body of water.