MR. SOPWITH'S ISOMETRICAL PROJECTION OF THE MINING DISTRICT OF ALSTON-MOOR

Was exhibited; and, being called upon by the Chairman, Mr. Sopwith gave the following explanation:—

He observed, that the general subject of plans and sections of mines and mineral districts was one of great importance to the community, and especially deserving the notice of Societies like the present. The preservation of such plans is requisite, in order to preserve a knowledge of what has been done in subterranean works; and, with this object in view, it is important that such representations should be as clear and explanatory as the circumstances will admit of. The usual drawings employed in connexion with mining, are what are well known by the name of Ground Plans and Sections; the one representing all horizontal objects, the other all vertical objects. Every object, therefore, which departs from a parallelism with these planes, must be, to a greater or less extent distorted; and this imperfection is common to all plans or drawings which are confined to the representation of one plane only. This description of plan and section, however, from its great simplicity and universal adoption, is that on which we must be chiefly dependent for perpetuating a knowledge of mining operations. Mr. S. stated that Government had established an office in connexion with the Museum of Economic Geology, for the purpose of preserving mining records. Draftsmen would then be employed to copy, on an uniform scale, all such plans and sections as may be deemed of sufficient interest to be thus preserved; and, by this means, he trusted that a body of information would be collected which would prove of the utmost value in carrying on the future operations of this and of all other mining districts. With respect to the want of accurate maps, Mr. S. trusted that some important data might be obtained from the Board of Ordnance, whose rough
maps, or, at all events, the main features, he believed, were laid down on a scale sufficiently large to admit of the principal mineral features being sufficiently delineated. Mr. S. exhibited a number of small hand models, by which the nature of plans and sections were illustrated, and from which it appears how difficult it is to obtain a correct projection of the contour of objects, varying so much in curvature and inclination as the outcrops of strata usually do. He explained the mode of constructing such hand models, which, he believed, might prove of considerable use in extending a general knowledge of geological features; for there were many phenomena which could not be clearly comprehended by the mere use of planes only. He would instance the V form which strata present in valleys; the point of the V being in some places up the valley, and at other places down the valley. Now this was believed by many persons to indicate a different inclination of the strata; but by the two models which he exhibited, it was apparent that in both cases the inclination was the same, and that the V assumed these positions accordingly as the strata were more or less steep than the descent of the valley. The great perplexity frequently caused by slip dykes, and by axes of elevation, could thus be presented at once to the eye; and the simplicity of constructing such models, combined with their extensive utility, would doubtless lead to their being more generally used. The Isometrical Drawing which he had presented to the Society was a medium between the common ground plan and the model.—Mr. S. then stated, that to the late Professor Farish, of Cambridge, the merit of originating this beautiful method of projection was due. That gentleman had frequent occasion to construct rude drawings, to enable his workmen to put models of machinery together; and it was this that suggested to him the adoption of a method of drawing which, instead of only shewing one side of a cube, should present three sides at once to view; and this Mr. S. showed, by a
diagram, was at once effected by inscribing a hexagon in a circle, and uniting the angles. By means of a protractor, constructed for the purpose, any angle might be at once projected on any one of the three sides of the cube thus presented to view; and, keeping in mind the cube, as the type and origin of this method of projection, it would easily be understood, that every plane surface parallel to any one of these three sides could be at once correctly delineated, by principles exactly similar to those on which the common ground plan and section are constructed.—Mr. Sopwith exhibited a diagram of faint blue lines, by which the process of Isometrical Projection is greatly facilitated; and also an instrument which he had contrived, by means of which the principal points of a common plan could be transferred to the respective positions required in isometrical drawing. Mr. S. then described the principal geological features of the Isometrical drawing, which was exhibited, and which represents an interesting portion of the mining district of Alston Moor. Several vertical sections are combined with a pictorial representation of the surface, on which the roads, fields, houses, trees, &c., are delineated.

Mr. Sopwith also exhibited a section of the Carboniferous or Mountain Limestone formation, from Hownes Gill to the summit of Crossfill Mountain, a distance of 28 miles. This section formed part of a larger one, across the island, from Whitehaven to Monkwearmouth, near Sunderland, which had been divided into four parts. The first comprised the Whitehaven Coal Field, and was to be executed by Mr. Williamson Peile. The second contained the Cambrian Rocks, and was undertaken by Professor Sedgwick. The third was the one now shown, representing the Carboniferous Limestone; and the fourth exhibited the Newcastle Coal Field, and would be executed by Mr. Buddle.
Mr. Sopwith's Model of the Forest of Dean.

Mr. Sopwith said, he regretted that he could not exhibit the model on the table, so that it might be well seen by all present, but he would endeavour to explain it. It represented the Forest of Dean, in Gloucestershire, on a scale in which each five inches represented a mile. The surface was divided into square miles, to measure the extent, and shew the relative position of the places. The various colours represented the enclosures, the villages, towns, &c. The ends and middle were parted, to represent the sections of the strata. They shewed the old red sandstone, of which the thickness was considerable, and which was overlaid by the mountain limestone and coal beds, of which the commencement was here seen. To shew the structure of the forest from North to South, Mr. Sopwith exhibited the section of the centre of the model, where the beds of coal were represented by black lines. The outcrops of the various seams of coal were shewn on the surface, and the sections of them in the North and South position. In constructing drawings, two portions were made apparent; but from above the model, they might see the stratification on both sides. The surface of the model was made to come off, to shew the situation of the different seams of coal. The portion first taken off represented the part of the surface, with the rocks down to the first vein of coal. When this portion was removed, the upper seam of coal was disclosed. The first seam being taken off, disclosed another seam under it, which also was removed, and so on to the lowest bed of coal, where was shewn the outcropping and under strata, with the lines of the water levels. This exhibited a continuous bed, about six miles in one direction, and three or four miles in the other, forming a basin of coal. He would now say a few
words on the mode of constructing the model. Plans were frequently inadequate to convey a correct idea of the state of the case, and that was particularly so in the Forest of Dean, owing to the steepness of the beds, and the position of the coal. The highest veins in geological position could not, in some places, be worked without pits, while the lowest coal, in other places, could be worked by levels. With a view of explaining these phenomena, this model was constructed for the Commissioners of Woods and Forests. It might at first appear to be a matter of mechanical difficulty to obtain the required shapes without carving. The method resorted to was a simple one, and he hoped would be adopted in other districts, where gentlemen possessing the necessary information might combine, and with little trouble, might produce a model like this. First, the information of such gentlemen must be collected from a great number of places in the district, of which it could with certainty be said, there are certain seams of coal at such a depth; and then, by combining such information, relating to different points, and reducing it to direct lines, the sections of the principal parts might thus be drawn on slabs of wood one-eighth of an inch thick. These were "half-lapped" together, to form a sort of network, or skeleton of the model. What was known having been marked on these, the parts must be filled up with judgment by those acquainted with the district. Having a certain number of facts, they must draw their inferences from them, so as to shew the bearings in a tangible form, where they had not been ascertained by workings. When these had been drawn on the blocks by a draftsman, the slabs must be taken to pieces, and sawn in portions, having been previously numbered, so that they might again be put in their proper positions. They might then be put together again by a workman, and the interstices filled up with pieces of solid wood. When any particular phenomenon occurred,
such as variations or irregularities in the surface, or subordinate basins, or ridges, they could be introduced by means of small cross sections, in such a way, that the whole method was reduced to two simple operations. The strata having been delineated on the wood, it then became the province of a workman to put the material together, to form the wood the proper shapes, and the whole must be afterwards painted, under the superintendence of a draftsman. Upon the surface objects were painted as on a map. The information given by a model like this was varied. It contained information from the pits in different places. The various steepness of the strata it was almost impossible to bear in mind; but when the various known points were reduced to shape in this manner, the rest of the work assumed a degree of probability which could not be attained without a model. This model was the first attempt of the kind, and, notwithstanding the difficulty of instructing the workmen, for the first time, the whole expense, including the case, was not more than £28 or £30. That cost was trifling, compared with the interest of the subjects represented; and he conceived that it was deserving of the attention of this Society, to attempt to form similar models of the districts, or portions of the districts, in which they reside. He was not aware of anything that could give greater interest to geological study than such models; and many gentlemen of experience had expressed the opinion, that the more frequent construction of such models would tend greatly to the increase of geological knowledge. Geology, at the present time, was a science of facts. They had now arrived at the extent of knowing their ignorance. When first Geology attracted attention, it was a science of theory. Theories were propounded in which the formation of the world was attempted to be explained: some saying that fire, and some that water, had been the principal agents employed by the
Creator. Many were the disputes on these subjects. But now a different feeling prevailed. It was now the universal impression that, by a patient accumulation of facts, by observing and recording what they saw, without endeavouring to account for how these things came to pass, by aiming to state things in the clearest manner, they could alone expect to arise to any considerable improvement in Geology. The construction of models of this kind would enable persons at once to understand the details of a district of which they viewed the representation. Interesting as were the papers they had listened to in the morning, no ordinary plans and sections could enable a person, without considerable time and attention, fully to comprehend them. But if a model had been exhibited, they would have been far better understood. Suppose that here and there an hiatus had occurred, yet if, with respect to a number of particular points, they had certain information, then such a model would be a very great means indeed of enabling persons, at one glance, to understand the general relations of the strata; and it was probable that persons who had travelled in the district, and observed the strata in different situations, might be able to make valuable suggestions, which might not occur to those whose time and attention had been chiefly occupied with the details of one particular district. Hence, he conceived that the construction of models of interesting geological districts was a subject so important, that he hoped it would engage the attention of all societies formed for the promotion of geological objects. He should be happy to answer any inquiries which gentlemen present might suggest, and to give all the information in his power on the subject, now or at any future time. In answer to a question, Mr. Sopwith stated that the surface of the model was formed on the scale of five inches to a mile; but the vertical scale was enlarged in the proportion of three to one, which gave a tolerably
correct idea of the undulations of the country. If the height had been on the same scale as the surface, it would give the idea of a country flatter than was really the case. But, making the vertical scale three times more, gave a tolerably accurate idea of the proportions.

Mr. Birami's and Mr. Morton's papers are unavoidably deferred till the next Report.

THE END.