RELATION OF GEOLOGY TO MINING

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The delivery of the presidential address to the Institution of Mining and Metallurgy affords an opportunity which is in some respects unique. For, not only is the choice of subject unfettered, but the occasion is privileged in so far as it is exempt from discussion; and the calling of a temporary halt in the consideration of topics of more immediate interest provides an interval for taking stock in some one of the numerous provinces of our many-sided profession, for reviewing its recent progress, appreciating its present position, and forecasting its future development.

This being conceded, the incoming president will naturally choose his subject from the department with which his work has been more particularly connected. Since in my career as a mining engineer a knowledge of geology has stood me in good stead, I cannot do better than choose as the subject of my address the Relation of Geology to Mining.

Geology was founded to a large extent on the observations of the miner.—The primary geological conceptions, such as outcrop, strike, dip, hanging wall and foot wall, together with a wealth of mineralogical and petrological detail, were furnished by the work of the early metal miner; while the close study of the bedding relations of the coal seams which their profitable extraction demanded, formed the basis of modern stratigraphy. The earlier geologists acknowledged their debt to mining. But to-day the positions are reversed; mining is in debt to geology. Thus, by the application of geological principles, valuable seams and lodes, even when disturbed by igneous intrusions or dislocated by faulting, are traced far beyond their first known outcrops, and facts bearing on their downward extension are scientifically interpreted; while detailed geological surveys of mining districts are of the greatest service to prospectors, and sometimes lead to entirely new discoveries. To-day, on the great iron and copper mines of the United States, not only are geologists retained to study the deposits, but the exploratory work is often committed to their care. By means of a system of routine work, successfully organized on some of these mines, veins and ore shoots are correlated from level to level; raises, crosscuts and pump stations are located in the positions most suitable to geological conditions; and ore bodies lost in faulted country are recovered, the fault-displacement being determined quantitatively and allowed for in subsequent development work on lower levels.

Specific instances of the successful application of geological knowledge to mining work can, of course, be given in abundance; but a few must suffice for the present purpose.

In this country the proving of the underground extension of the coal fields beneath the younger rocks surrounding them is of paramount importance to its industrial welfare. One of the first pieces of work in this direction resulted from the admirable mapping of the Midland coal field by Beete Jukes, a distinguished member of the Geological Survey of England and Wales. The entire correctness of his theories was demonstrated by Henry Johnson in a deep sinking at Sandwell Park when the first definite proof was furnished of the prolongation of the South Staffordshire coal field to the east under the fringe of overlying red rocks.

Similarly the discovery of a buried coal field in the south-east of England was the direct result of a piece of pure scientific deduction. Godwin-Austen argued that the tectonic folds in the Palaeozoic floor, by which the existence of coal basins are determined, would be traceable even when covered by a great thickness of newer rocks, because a line of disturbance, whether of faulting or folding, when once established, tends to be the locus of subsequent movement and thus to set its mark on the newer strata. The correctness of this tectonic principle was demonstrated by the successful borings carried out in the neighborhood of Dover, first by Sir Edward Watkin and later by the Burr companies under the scientific advice of Prof. W. Boyd Dawkins and other geologists. These borings showed that deeply-buried under Mesozoic and Tertiary strata is a coal field, situated on the line connecting the seams worked in Northern France and Belgium with those of South Wales and Bristol; and it appears not improbable that other coal areas might be found, if the underground geology of this line of country were systematically explored. A satisfactory feature of the discovery of buried coal fields in England is the large addition thereby made to our coal resources, as to which previous estimates had been rather pessimistic.

Another striking instance of the successful application of geology to mining is furnished by the tracing eastward and southward of the sub-outcrop or apex of the Rand banket formation under a cover of up to 1,200 ft. of later unconformable beds. The investigations that led to this result were based on a geological survey of the country between Boksburg, the Springs and Heidelberg, the first results of which made it probable to me that the Van Ryn conglomerate, which disappears near the Springs beneath the Karroo coal measures, and the Nigel conglomerate, emerging therefrom near Heidelberg, were geologically identical, although separated by a large area in which dolomite and coal measures from the surface. As my work progressed, the supposition that the two outcrops with their opposed dips were respectively the northern and southern lips of a large but shallow synclinal basin became almost a certainty, and deep borings made in the intervening country confirmed in the end the correctness of the theory in the most satisfactory manner.

The successful outcome of these investigations added to the Witwatersrand gold field an enormous area of mining ground in which the banket is not too deep for exploitation, should its average gold-content prove high enough to enable it to be profitably extracted—a consummation, of course, devoutly to be wished, but only demonstrable by shaft-sinking and development, since the assay results of bore-hole cores are no guide to average values. The deepest bore-hole of the series under my immediate supervision, namely, that put down on the boundary of the farms Grootvlei and Daggafontein, was practically on the axis of the syncline, and cut the "main reef" at a depth of 5,540 ft. (or corrected for deviation, 4,880 ft.). It passed through 1,140 ft. of dolomite before entering the Witwatersrand formation, but gave a most instructive section of the latter, intersecting the Kimberley, Bird, Modderfontein and Van Ryn or Main Reef series of conglomerates as well as their associated quartzites,

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