

manner of an arch-file bill holder. The vertical stems on the front of the files hold the individual level-sheets in position so that they register perfectly with each other, and the swinging hooks at the top permit the removal of any sheet for additions or corrections. To keep the sheets from curling, a heavy past-board cover should be fitted over the top, and instead of perforating it for the front uprights, it will be found better to cut longitudinal slots to take both front and back uprights, so that the cover can be readily lifted off whenever the sheets are to be used.

"Where a district of considerable area has to be covered and a large number of section-hooks are required, they are most conveniently kept in a horizontal position in a case provided with runners, the same as drawers, and, in order to economise space, special arches 1.5 in. lower than the regular pattern can be readily obtained from the factory.

"After the individual sheet-maps are traced, the next step is to transfer them by means of carbon paper into pocket note-books. Any size may be adopted for this work; but in practice it is found that a large book, say 8 by 10 in., permitting comparisons over a considerable area, is most convenient. In some cases, where the geology is reasonably simple, a convenient plan is to take very light-coloured blue-prints of the individual level-sheets directly into the mine. These can be folded into a convenient size for carrying in the pocket, and, unless the geology is extraordinarily complicated, will answer every purpose. In taking the geology of different levels the greatest care must be taken to record the facts as they occur in the ground, without bias or favour for or against any previously adopted theory. In old workings the openings must be examined with the greatest care, in order to determine exactly the boundaries of the ore-body and the strike and dip of the spurs and intersecting veins, as well as of all faults, slips, water-courses, etc.

"After the geological records have been thus brought up to date, the geology of new workings is very much more easily determined. In fact, it will usually be found that the foreman, shift-bosses, and even the common miners will take such an interest in the work that every change of rock or ore-values, and every slip or fault, will be pointed out to the geologist by the men, instead of his having to hunt for them, as he had to do in the older workings.

"It has always been found that, when the work is recorded in exact accordance with observed facts, the theories will take care of themselves, and little or no difficulty will be experienced in interpreting the facts when vertical sections are made from the horizontal sheets. These are to be platted directly from the horizontal level-sheets, and, if the work has been carefully and correctly done, the result will be a set of vertical geological sections of the greatest value, not only in checking up the work on the horizontal sections, but also in furnishing the best possible basis for measuring the rate of development and ore-extraction, as well as determining at any time the amount and value of ore in sight.

"Both horizontal and vertical sections may be used

for the recording of samples, the better plan being to encumber the map only with the number of the sample; the description of the ore, the width sampled, etc., together with the assays, being entered in a separate note-book.

"The entire system will be readily understood upon a study of the accompanying illustrations,\* which, as engraved, differ from the originals in three respects: (1) They have been reduced in scale; (2) They are bound in place, so that the several sheets are not removable as they would be in practice; and (3) The colours which are most convenient and effective in practice are here replaced with conventional *brochure* in black.

"I would here say, that, in my judgment, every company operating large mines would find it advantageous to employ, as a separate official, a competent mining geologist, whose duty it should be to follow continuously all workings and surveys, and note with precision those indications which hard-worked superintendents, firemen and surveyors, however intelligent, might easily overlook or fail to record. The proper man for this most important work is a man who has nothing else to do, and who will do this one thing with industry, enthusiasm and technical knowledge.

"Description and Discussion of Illustrated Drawings.—These drawings represent an imaginary mine, presenting the ordinary conditions of practice.

"Fig 1 shows an ordinary mine-map, sometimes known as a composite map. This is useful only for showing the relations of the workings to each other and the boundary-lines of the property. It does not form a record of the ore-bodies encountered, or the disturbances to which they may have been subjected, nor has it any great value as a guide in further developments. In practice, this map would be tinted with a different colour for each level. In the engraving, these colours are omitted, since the different tints, as well as the county road on the surface, can be easily distinguished without such aid. It is evident upon an inspection of the map that, since the levels at successively increasing depths (40 ft. vertically apart) are situated correspondingly further to the east, while they have a general north-and-south direction the ore-deposit strikes N.-S., and dips E. But this is all that the map can tell us concerning it.

"Figs. 2, 3, 4, 5, 6 and 7 are the individual level-sheet geological maps. Each of these level-sheets is traced directly from the ordinary survey-map, after which the geology as exposed in the openings and determined by careful examination is platted on the map, care being taken to note the strike and dip of all faults, spurs, and intersecting veins. Tracing-cloth is always used for these maps both for speed and convenience in tracing from the working survey-map, and for the further reason that when the level-sheets are in the holder at least three sets of levels can always be seen through the transparent cloth, thereby af-

\*These can not conveniently be reproduced here, but will be obtainable later upon application to the secretary of the American Institute of Mining Engineers, 99, John Street, New York, N.Y., U.S.A.