

PETROGRAPHIC RANGE OF ROAD-BUILDING MATERIALS.

It frequently falls to the lot of a petrographer to classify stone which it is proposed to furnish for a special piece of work, and to give an opinion as to its fitness or its likelihood of meeting the requirements of specifications. In most cases these requirements are very far from being specific, in a petrographic sense, i.e., precise rock names are rarely used, whereas some general term or some phrase descriptive of the quality is common. The commonest term of all is "trap."

A few quotations copied from standard specifications covering regular contracts under various state and municipal departments, and bureaus of highways, are given as representative of this usage by Mr. Chas. P. Berkey, in the School of Mines Quarterly of Columbia University:—

(a) "Only broken stone . . . of a hard and compact texture and of uniform grain will be allowed. . . . Disintegrated and rotten stone . . . will not be accepted."

(b) "The trap rock shall be of satisfactory quality, equal to that used in . . . for macadam roads."

(c) "The mineral aggregate used shall consist of trap rock, newly broken, of uniform quality throughout, free from slaty and flat pieces, soft or disintegrated stone, dirt and other objectionable material."

(d) "The stone . . . must be trap or approved native rock. It must show a fresh, crystalline surface."

(e) "All stone must be . . . the same kind and quality, equally good in every particular as that shown in the Engineer's office."

(f) "Only good, solid stone shall be used. . . . Bidders will name the kind of stone they propose using in said work, also its location."

(g) " . . . shall consist of first quality trap rock. . . . Mineral aggregate shall be clean, crushed trap rock of approved quality."

(h) "Crushed stone shall have a coefficient of wear, according to the Duval test, of not less than 8, and a cementation value of not less than 50."

(i) "The first course shall consist of sound rock . . . Unless otherwise specified, the stone of the second course shall be trap rock. . . . For the third course other material than trap rock screenings may be used if approved by the Engineer."

(j) "Stone for macadam shall consist of approved local stone, trap rock, or a combination of local stone and trap rock . . ."

(k) "The crushed stone shall be trap or other suitable rock, satisfactory to the office in charge."

(l) "The macadam shall be of limestone of approved quality. . . . The stone must be of good and uniform texture."

(m) "All stone for concrete shall be hard limestone, sandstone, trap, furnace slag, quartzite, or granite, acceptable to the Chief Engineer. Broken stone must be quarried from massive ledge, and any stone which shows a tendency to break into flat, thin pieces will be rejected."

(n) "The broken stone shall be trap, granite, or limestone, or such other stone taken from the line of work as shall be satisfactory in the judgment of the Engineer."

Such a summary is probably fairly typical. From it two or three generalizations may be made. For example: (1) The standard, so far as there is a standard, with which all rocks are compared in highway work, is "trap." (2) Trap is usually specified by name wherever there is any reasonable hope of furnishing it for the contract. (3) Wherever substitutes are encouraged they are

either indicated by name, or are described in efficiency terms, or the responsibility is placed directly on the engineer in charge.

It is the general opinion, based on experience, that the "traps" are pre-eminently satisfactory for highway uses. But trap is not a very definite petrographic term. In a very broad way this means that the basic igneous rocks of massive structure, and having a tendency to diabasic or closely interlocked habit of the mineral constituents, are the best road material. The acid igneous rocks are not so successful, especially when there is heavy traffic sufficient to test the toughness of the rock. The metamorphic rocks, as a class, are not regarded with much favor. The clastic or fragmental rocks, as a rule, are not recommended, but limestones are very serviceable where hardness is not a prime essential. In every large class of rocks there are special types which prove to be of acceptable grade, but no large class compares with the basic igneous rocks for general efficiency under the most exacting conditions.

In spite of this apparent reduction to such simple terms in the matter of range of rock types regarded as acceptable, as a matter of fact, a great variety of rocks are actually used and are quite worthy of serious consideration. Many factors enter into the question of choice; it is not always a simple problem. There is little excuse for a community to demand trap in any except the most critical cases, unless there are trap ledges in the vicinity or somewhere near its borders. It may well happen, in many cases, that the increased efficiency is more than counterbalanced by the extra cost over local stone. In the average case, local stones everywhere merit serious consideration, and a little judicious discrimination will usually discover an acceptable one.

It is in this connection that critical knowledge of rock variation will be found useful. Names of rocks alone are not so useful as might at first appear, because all types vary greatly in minor points of texture, structure, chemical and dynamic modification, and consequent efficiency. No amount of mere classification can take the place of careful discrimination of structural variety within the principal types themselves.

It may be useful, however, to consider briefly the range of types coming within observation for such uses, and to indicate their petrographic grouping. Probably no publication on rock for highway uses has given a fuller list of varieties than Bulletin 44 of the Office of Public Roads, United States Department of Agriculture, Washington.

The following list has been compiled from this and other sources, and the terms are classified under the commonly used headings familiar to all students of natural rock materials. In it there is no attempt to indicate relative value for actual use. For reasons suggested in an earlier paragraph it is certain that particular varieties of a type which is usually considered of poor quality may very well prove to be much superior to the more faulty varieties of rock types that are generally regarded as high-grade. The descriptive terms following some of the rock names indicate the varieties that have been used; the terms are inserted just as they occur in the literature, without any attempt to reduce them to uniformity:—

I. Igneous Rocks:

(a) Volcanic fragmental materials:

1. Volcanic ash.
2. Volcanic breccias.
3. Rhyolite tuff.
4. Andesite tuff.
5. Basalt tuff.