

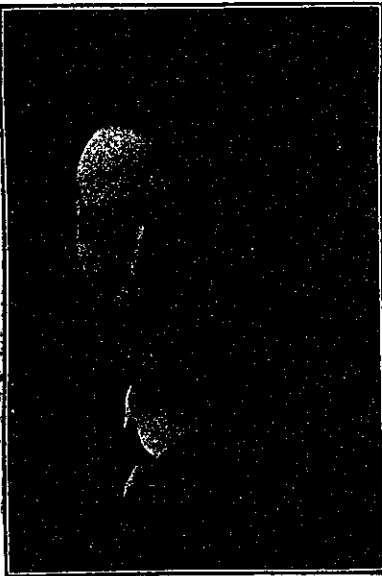
MINERALOGY; PETROLOGY

By PROF. C. H. WARREN.

No man can fairly consider himself a broadly educated one who is not to some extent familiar with the structural character and history of the earth's crust, upon which he lives and from which comes in the end so large a portion of the material things of everyday life. The visible units of the earth's crust are the definite chemical compounds known as minerals, or perhaps in a larger sense, the various individual mineral aggregates, the rocks. A somewhat general knowledge of these units, such, for example, as may be obtained in a course in general geology, is usually sufficient for most men, and the same is true regarding the earth's structure and history. Certain groups of professional men, however, more particularly mining engineers, chemists, and chemical engineers, have occasion to deal more or less constantly with minerals or rocks, or both, as physical and chemical objects, and to such, a more thorough knowledge of these objects and of the methods of studying them is important.

The general object of the course in mineralogy and petrology at the Institute is to supply the needs of these groups of students. In mineralogy the specific aims are, to furnish the student with an opportunity to become familiar with the more important mineral species, their uses and relative importance, and to some extent, their modes of occurrence, to obtain a general view of the range of chemical composition among minerals, and particularly to become skilled in the practical methods of studying them.

In a general way the actual work of the course consists, first, of a preliminary laboratory study, accompanied by some lecture work, of the important minerals and of methods of examining and determining them, and secondly of a large amount of practice in such work. The preliminary work naturally includes a small amount of crystallography. The



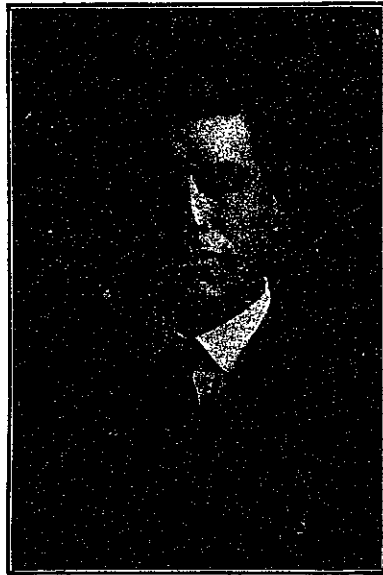
PROF. C. H. WARREN.

crystalline state is the normal one, under ordinary conditions, for most solid matter, whether made in the laboratory or occurring naturally, and a correct appreciation of the leading characteristics of crystalline matter is important and can be used easily and to great advantage in studying substances in general.

The methods used in the examination and determination of minerals aim toward making the greatest possible use of such physical properties, cleavage and hardness for example, as can be successfully studied without elaborate appara-

tus and the combining of the facts thus obtained with the information gained from simple tests made with the aid of the blowpipe or by short and easily performed qualitative, chemical reactions made in the wet way. This combination of physical and chemical properties renders identification vastly quicker and generally more certain than reliance on either one alone.

For use in the preliminary work several large and carefully selected reference and study collections are available for study, while in the later determinative work an extensive collection of "Unknowns" accumulated from mineral deposits the world over is used.



PROF. E. E. BUGBEE.

Petrology, which is, broadly speaking, the science of rocks, is covered by two courses. The first of these is designed to present the principles upon which the science is based and to furnish the opportunity to become familiar with the leading rock types, their distribution and modes of occurrence, and with practical methods of identifying such of these rocks as can be successfully identified in the field or mine. The work is therefore essentially a laboratory course accompanied by lectures or recitations and assigned reading. While the use of the polarizing microscope for the study of thin rock sections is not a part of this course, its great value as a means of study is shown and microscopic sections are used to illustrate principles and features not readily apparent or not apparent at all without their use. The petrology is required of all mining engineering students and is open to others who can and desire to take it.

The second course is a more advanced one, known as petrography, to which the first is a necessary preparation. This is naturally a course for those who wish to become more proficient in the application of geology to mining or those who intend to follow geology as a profession.

Petrography is the systematic study and classification of rocks and involves to a very considerable extent the use of the polarizing microscope. A large part of the work of this course consists, therefore, of learning methods of microscopic study and of putting them into practice. For identifying the constituent minerals of a rock with the microscope, finely crushed material may be studied, or very thin rock-slices. The latter are more commonly used, since they have the great advantage of having all of the mineral grains of the same thickness, and therefore comparable for certain optical properties which vary with thickness. They also show exactly what the actual relationship of one mineral to another is. These sections are made by simply grinding down a small slice of rock until it has a uniform thickness of about 0.03 mm. The area is usually from 1.5 to 2.0 sq. cm. The section is mounted on a glass slide with Canada balsam, and is covered with a

cover-glass. Although one can learn to grind these sections one's self with a little practice, they are usually prepared by men who make it their business to cut sections. The cost is but a trifle (30 to 40 cents). These sections are quite transparent and permit not only the structure of the rock to be clearly seen under the microscope, but also make it possible to identify the individual mineral constituents by means of their optical properties.

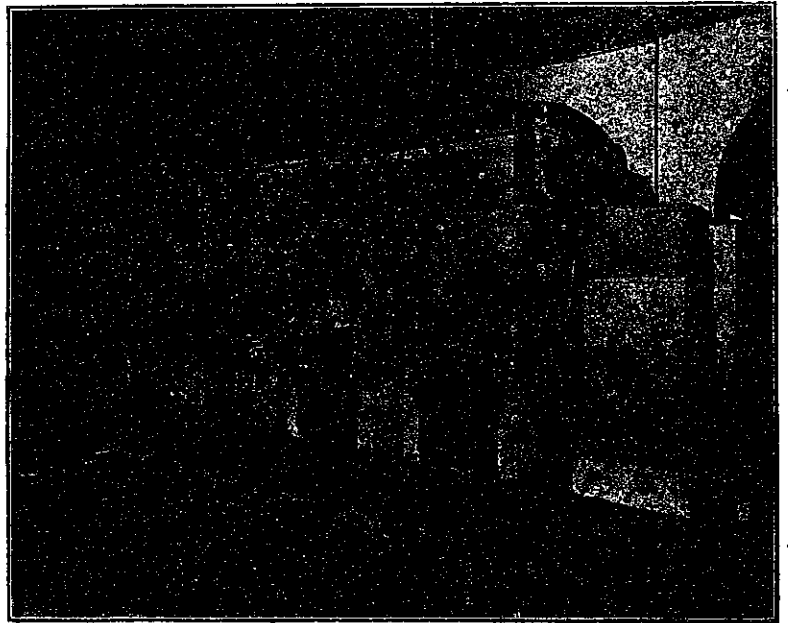
These are just as characteristic for each species as are their chemical reactions or macroscopic characters and can be determined with great precision even on exceedingly minute grains. The determination by this means must not be thought to be always easy, for the exercise of much patience, skill and thought are often necessary for the making of a single determination. Practice, however, makes the recognition of the more common minerals a comparatively easy matter. The identification of a rock by means of a thin-section can be done quickly and easily in most cases. In petrographic work, where the chemical as well as the mineral composition is desired, this may often be computed approximately from measurements made

microscopically upon the individual minerals if their composition is known, although for very accurate work, chemical analyses must be resorted to.

The polarizing microscope is also a valuable tool to the chemist in his study of laboratory salts, to the metallurgist, and sometimes to the mill manager.

Besides large collections of rock specimens, the Institute also has hundreds of thin-sections available for study, and these collections are being constantly added to. There are twelve microscopes for regular petrographic work, also a large microscope fitted with many useful accessories particularly adapted for research work.

Aside from the direct and obvious value of mineralogic and petrologic knowledge to the chemist or chemical engineer, the mining engineer, and geologist, the work in these subjects has an indirect value which, although not always recognized, is to the writer's mind quite if not really more important than the mere knowledge they impart, and this is the training of the powers of observation and deduction which must be exercised constantly throughout such work if any measure of success is to be attained.



MUFFLE FURNACES.

FIRE ASSAYING

By PROF. EDWARD E. BUGBEE.

Fire assaying is a particular branch of analytical chemistry by which the quantity of metals in ores, furnace products, bullion, etc., is determined by the aid of heat and dry reagents. The object in each case being to separate the metal sought from the other components of the ore, weighing it in the metallic state. The determinations most commonly made are of gold, silver and lead, with occasionally tin, mercury and platinum. Assaying is principally confined to mining and metallurgical operations where it is desired to obtain accurate results in the shortest possible time. Fire assaying is not only by far the most rapid method for the determination of gold and silver in ores, but with proper precautions it is also the most accurate method for these determinations. The fire assay for lead is not as accurate as some of the wet methods, but on many ores it is quite satisfactory, and as the fire determination may be done with the expenditure of perhaps one-tenth the time and labor required for the wet method, it is in general use where speed is more important than extreme accuracy.

The course in fire assaying as given at the Institute is designed not merely to give a theoretical and practical knowledge of the subject itself, but also to serve as an introduction to the study

of metallurgy which follows it. The aim of the department is to teach the student the reasons for the various steps taken, as well as the limitations of the processes. Fire assaying is just emerging from the "rule of thumb" stage and the student of today should benefit thereby. In addition to the third-year course in assaying further practice is obtained in the fourth year course, termed metallurgical laboratory, required of all Course III students. Here the men make various metallurgical tests, each step of which is followed by assays and the student is shown how to check his work as the surveyor checks himself by closing a survey.

Assaying is to the mining engineering course what surveying is to the civil engineering course. It is a fundamental subject so far as the course is concerned and one to which practically every mining engineering graduate at one time or another in his career will have occasion to refer. For many men it will be the opening through which they enter the profession, others will use it from time to time as emergency may require, while still others will employ their theoretical knowledge to insure the engagement of competent men to do the work for them.

Attention is called to the Geological Survey Examination to be held on Feb. 16th and 17th. See Prof. Jaggars' article for particulars.

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