THE AMERICAN MINERALOGIST

JOURNAL OF THE MINERALOGICAL SOCIETY OF AMERICA

VOL. 7 DECEMBER, 1922 No. 12

MINERALOGY FOR STUDENTS OF DENTISTRY

EDWARD H. KRAUS, *University of Michigan*

INTRODUCTION

For many years some knowledge of crystallography and mineralogy has been considered of basic value in the training of geologists, mining and civil engineers, foresters, chemists, pharmacists, and ceramists for their pursuits, of necessity, take them into the field, or involve the use of minerals as raw materials. Many of them also find the use of crystal-optical methods of great value in their analytical and general determinative work. Furthermore, physicists have recently begun to take a lively interest in these subjects, because of the startling results achieved by the application of X-rays to the study of crystal structure.

Although the beginning courses in mineralogy in our larger universities are generally attended by students of greatly diversified interests, the announcement last year that at the University of Michigan all first year students in the College of Dental Surgery would be required to take a course in this subject was entirely unexpected and surprising to dental educators and teachers of mineralogy. It has, therefore, been thought highly desirable that a brief description of this instruction, including the objects to be attained, should be given.

OBJECT OF THE COURSE

The instruction in dentistry at this university covers a period of five years, divided into one year of pre-dental studies in the College of Literature, Science, and the Arts, or any recognized institution of collegiate standing, and four years of instruction in the College of Dental Surgery. The pre-dental studies include (a) as required subjects, English, zoology, botany, and general and qualitative chemistry, and (b) as electives, foreign languages, mathematics, history, geology, and technical drawing. The fall semester of the first year in the Dental College is also devoted to

fundamental subjects, preparatory to dentistry, and includes physics, organic chemistry, drawing, and mineralogy. The technical instruction begins in the second semester when histology, embryology, and anatomy are begun.

Since the successful dentist must, among other things, be an expert observer, have good power of visualization, and possess manipulative skill to a marked degree, it is obvious that these qualities should be developed as early as possible in his course. It is also of great advantage to the student to learn early, preferably before he has begun the highly technical instruction, that he has at least average ability along the three lines indicated.

This special course in mineralogy attempts first, to develop ability of keen observation and of accurate visualization, and second, to determine whether or not the student possesses mechanical or manipulative ability or sense, and third, to impart a comparatively large amount of valuable general and technical information.

(1) Observation and visualization. The recognition of crystal forms occurring on wooden models and natural crystals has long been considered an unexcelled training in keen observation and accurate visualization. This is also true of practice in the determination of unlabeled mineral specimens based upon the recognition of their general physical properties.

(2) Manipulative skill. The handling of a precision instrument, such as the mineralogical microscope, requires not only the exercise of great care, but also reveals to a marked extent whether or not a student has or can develop mechanical skill or sense.

(3) General and technical information. It is to be taken for granted that the dentist should be intelligently informed concerning the raw materials which enter into the manufacture of his instruments and materials. This more general information is imparted by describing the important minerals which act as such raw materials. It is obvious that a discussion of the manufacture and structure, especially microscopical, of those dental materials involving the use of minerals or mineral products, such as plaster of Paris, and dental porcelains, cements, powders, and pastes will give the student extremely valuable information of a highly technical character.

Conduct of the Course

The course consists of two lectures and a two hour laboratory period a week for one semester, embracing sixteen weeks of class-

room work, exclusive of examinations. After a general introductory lecture the following subjects are discussed: crystal forms, physical and chemical properties of minerals, descriptive mineralogy, elementary treatment of optical methods, and the manufacture and general properties, both macro-and microscopical, of plaster of Paris, and dental porcelains, cements, and pastes. In the laboratory the student is given training in (a) the recognition of crystal forms, (b) the determination of minerals, (c) the use of the mineralogical microscope, and (d) the study and determination of various dental products. Since the laboratory work is very closely supervised, one assistant being available for every six or seven students, rapid progress is assured.

Content of the Course

The ground covered in the various subjects discussed in the lectures and studied in the laboratory will be described briefly.

(1) Crystal forms. Aside from imparting an elementary knowledge of crystallization and crystal forms and preparing the way for the rapid recognition of the common minerals, the chief objects to be attained are, as indicated above, the development of keen observation and accurate visualization. About three lectures and four laboratory periods are devoted to this phase of the work. Only the most common and important forms are considered. A special collection of forty-five wooden models has been assembled for this purpose. The laboratory possesses a sufficient number of these collections so that every student in each section is provided with one.

(2) Physical properties. These are discussed in three lectures and include luster, color, streak, hardness, specific gravity, magnetism, cleavage, fracture, tenacity, diaphaneity, taste, odor, feel, and structure. On account of the importance of hardness in connection with the proper selection of abrasives and in the manufacture of pastes and powders, this subject is discussed at length.

(3) Chemical properties. Three lectures are also devoted to the more essential chemical properties and methods of formation and occurrence of minerals.

(4) Descriptive mineralogy. A list of forty-four minerals of vital importance as sources of dental apparatus and supplies are considered in eight lectures in which practical applications are always emphasized.

(5) Determinative mineralogy. This work is done in five laboratory periods during which the student learns to identify the

minerals discussed in the lectures. This instruction is unexcelled in the development of observation and reasoning ability.

(6) Optical methods. In six lectures the construction of the mineralogical microscope and the methods of determining the principal characteristics, such as index of refraction, isotropic or anisotropic character, extinction angles, strength and character of double refraction and so forth, of sections and fragments are presented. These lectures are well illustrated not only with numerous models but also with slides and mineral sections and powders which are projected upon the screen by an epidiascope using a mineralogical microscope. In the laboratory the student works through a series of exercises illustrating the above methods and gains sufficient facility so that they can be applied in the study of dental minerals. Two and one-half laboratory periods are given over to this work.

(7) Technical applications. The necessary scientific foundation having been laid, it is now possible to discuss the manufacture and properties of some of the more important dental supplies, especially those of a non-metallic character.

(a) Plaster of Paris. One lecture is devoted to the manufacture of this substance which is of such great importance to the dentist. Its nature, methods of dehydrating gypsum, effects of time and temperature on the process of hydration, impurities, effects of accelerators and retarders, and the cause and nature of "setting" are considered. In the laboratory the constituents of dental plaster are studied under the microscope. The student also observes that "setting" is a crystallization process and notes that the strength of plaster of Paris, after setting, is due to the interlocking of the many minute, slender crystals which have been formed.

(b) Dental porcelain. Two lectures are devoted to the consideration of the manufacture and various properties of teeth and dental porcelain in general. The optical and thermal properties of the raw materials such as quartz, feldspar, and kaolin, are first discussed, and in considerable detail. The various steps in the manufacture of artificial teeth are then described, due reference being made to the reactions involved. Porcelain inlays are also referred to. Moreover, the difference between dental and ordinary porcelain is pointed out. In the laboratory, first, observations of the optical properties of the raw materials are made. Then thin

sections of finished teeth are studied with respect to the structure and constituents of the product and with reference to the changes the raw materials have undergone.

(c) DENTAL CEMENTS. The nature, composition, preparation, and properties of some of the more important cements constantly used by the dentist are discussed, such as zinc oxide and silicate cements. Theories concerning their setting are also advanced. In the laboratory the various reactions taking place in the setting of a zinc oxide cement are followed under the microscope. Observations are also made regarding the optical properties, growth, structure, and arrangement of the resultant crystals. A sample of porcelain cement is also studied.

(d) DENTAL POWDERS AND PASTES. Standard preparations now on the market are considered. The properties of the various constituents and methods for their identification under the microscope are presented. The laboratory practice includes the identification of the constituents of several well-known preparations.

(e) CRYSTALLINE SALTS OF THE SALIVA. The forms and nature of the products, the result of the evaporation of saliva, as revealed by the microscope, are presented. A list of the important substances thus observed is given. In the laboratory the student is given an opportunity to make these observations.

One lecture is devoted to each of the last three subjects. The laboratory work relating to technical applications is done in about three laboratory periods.

SUMMARY

This course is designed to stimulate and develop observation, visualization, and manipulative ability and skill early in the dental curriculum, especially before the highly technical instruction is begun. This is of great advantage so that those who are markedly deficient along these lines may be advised to prepare themselves for other professions. Upon the completion of the course the instructors furnish the administrative officers of the College of Dental Surgery with estimates of each student's ability along the several lines indicated above, which are taken into consideration in evaluating the students' chances of success in the subsequent strictly professional courses. The results obtained thus far indicate that this special course will unquestionably prove of great value in the training of better equipped dentists with broad interests.