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NEEDED EXTENSION IN MINERALOGIC INSTRUCTION*

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One who has been teaching mineralogy for a third of a century may be pardoned for presenting an address which deals with the subject from an educational standpoint, and contains little reference to mineralogy as a science. A teacher sometimes gets the notion that his particular subject is of the utmost importance, if not actually essential, in one's education and he sometimes makes his opinion manifest in our school curricula to the exclusion of subjects which might be more useful to the student in his later life. The proper and best education obtainable for our boys and girls during their elementary school training is the most important proposition we have to consider, and too much stress cannot be laid upon the necessity of a proper choice of subjects; and this choice should include studies best calculated to make the most intelligent and useful citizens. Special attention should be given in our lower grade schools to those subjects which cannot be readily learned from books and yet are a desirable part of one's education.

Mineralogy cannot be considered a subject either essential or of the utmost importance in one's life, but its desirability and usefulness must be conceded, and as an educational subject it stands unique and distinctive in that it gives to the student an insight into the related sciences, crystallography, chemistry, physics, geology, mining, and technical industries such as no other science does. It properly belongs in the list of subjects taught in the lower grade schools, and while the purport of this address is not to advocate the inclusion of a study of minerals as a necessary part of a school curriculum, my object is to point out to you that the gross ignorance which prevails about such common things as minerals is due largely to the fact of its absence and that no provision has ever been made to give the student even an insight into the science, and he finishes his schooling with his

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grammar or high school training and has never had an opportunity to know of minerals or acquire an interest in them.

Anyone who has a knowledge of minerals realizes how isolated he is with his knowledge, for it is rare to find a person in his district or town with whom he can talk about them. Those who know minerals or are interested enough to collect them are few and scattered. As much ignorance of minerals and crystals appears to exist to-day as it did centuries ago. There has been no action taken to remove this defect in our education and it is time something is done to stop perpetuating mineral ignorance, and begin a better dissemination of mineral knowledge.

The two statements: "I think that mineralogy must be a very interesting subject to study"; and, "I wish I knew something about minerals" have been made to me so often that I have taken them as the theme of this address to you. To many laymen minerals and wealth are synonymous, and they naturally think the subject is a very interesting one to study. As a science, however, those who delve just slightly into the subject may hold diversified opinions regarding its interest and only the mineralogist and advanced worker in the science can realize the absorbing interest, delight and profit obtained from a study of well crystallized specimens, since there are so many phases of the science one can follow, especially in the chemical and physical sides, and with the x-ray spectrograph and other instruments for crystallographic study.

But this address is not concerned with what mineralogy can offer the student nor with its development and growth as a science. It is the ignorance of the public regarding minerals, and the often expressed desire to know something about them, to which I wish to call your attention.

In olden times when it was impossible to know what the minerals were, complete ignorance of them was natural and unavoidable. Many of them became endowed with mystic, talismanic, healing, and protective powers, as a result of the prevailing superstition of the age. Today we can know with what we are dealing, and while few educated persons believe in the supernatural powers of stones, their belief is founded upon their general intelligence rather than upon a knowledge of the properties of the stone or mineral.

When we think of what minerals mean to us—that all life is dependent on them, that we live on a solid frame-work of them,

that we use them in our industries and in our daily vocations, that we even possess them and prize them as gems; it seems a most remarkable and unbelievable situation that so little is known and apparently so little interest is taken in our minerals. We have been content to accept as a matter of course the beautiful and useful minerals which nature has abundantly provided for our prosperity, without giving much thought to their kind or formation, or proper appreciation of them as inorganic bodies. The farmer may be interested in this globe to the depth of a few feet, and the miner, geologist and mineralogist may delve deeper, but the rest of mankind is interested only in the life and movement taking place on the surface of the earth.

There is a seeming apathy exhibited towards learning about the minerals, but this indifference is in fact non-existant. Ignorance of any subject will promote an apathy towards that subject and always work against a real active interest in disseminating a knowledge of it. I venture to say that the desire to know about minerals is almost as universal as is the wish to possess them as gems. This widespread desire often culminates in taking advantage of any opportunity which may come in later life to obtain instruction in mineral determination. As an illustration the Extension Division of the University of California offered a course in determinative mineralogy, and enrollments came from sixteen of our states, besides from Mexico, Alaska, and Hawaii, and inquiries from South America. Five of these enrollments were from New York state, and one from Massachusetts. They were of all ages from seventeen to sixty-five, and represented almost as many occupations as enrollments. Culture and advancement were the usual reasons cited for taking the course.

This goes to show that the lack of knowledge of minerals which so glaringly exists today is the result of circumstances which the individual could in no way change during his scholastic period. It is to the interest of all lovers of crystallography and mineralogy to do all they can to promote a wider knowledge of those subjects so that an elementary knowledge of them will not be for the specialist. The more interest manifested in any science, the more workers will there be in it, and it follows that more discoveries and greater advancement will result. We have a campaign of mineral education before us and our problem is how to conduct it.

Practically all instruction in mineralogy in this country, even of the most elementary kind, such as might be given in Nature work, has been relegated to colleges and other institutions of like grade. My long experience as a teacher has shown me that no valid reason exists for this delayed instruction, and it is the cause to a great extent of the present widespread ignorance of minerals. By this system of making elementary mineralogy a college course, ninety-eight percent of our boys and girls can never obtain instruction in the minerals, since statistics show that not more than two per cent of our population enter college. High school attendance is increasing and the percentage of students to population is much higher in some states than in others, yet the number who finish their high school course is small compared with the number who terminate their schooling at the end of the grammar grades.

Conceding that two per cent of our population might obtain instruction in the science in college, we know that only a small fraction of those who enter college would have the time or inclination to study mineralogy, so the few of us who have learned what a crystal is, are specialists. It is quite evident that if we wish to bring about a better and wider knowledge of minerals, instruction must begin in the lower grade schools, and not be relegated to the college as at present. A few excellent specimens of minerals to show beauty of form and color might well serve as object lessons to children to teach them observation and give them an insight in what nature can produce. It should be made possible for the high school student to obtain instruction in a knowledge of the more common and useful minerals, and such a course should be listed in their curricula as an elective or alternative course. Mineralogy teaches more than a knowledge of minerals. It gives the student a start and insight into those closely related sciences, mathematics, chemistry, physics, geology, and geography, and this fact should be weighed in making up the study list for the high school pupil. I am not asserting that crystallography or mineralogy are essential to know, or that they should be required subjects in any school or college, but I certainly believe they should be made possible studies for more than two per cent of our population. Furthermore, mineralogy is a fundamental subject to a knowledge of the earth sciences.

For most of us, training in mineralogy has begun and ended with the single elementary college course. This has been most

unfortunate for a dissemination of the science, and has had the effect of limiting the number who become mineralogists, and the amount of research work accomplished.

The physicist with his superior electrical and instrumental knowledge has devised instruments for important x-ray investigation of crystal structure and mineral composition, and has substantiated the "space-lattice" theory of internal molecular, or atomic, structure of crystals, and has been enabled to make important additions to our knowledge of crystal symmetry. We must look to our crystallographers and mineralogists to carry on in this work since it manifestly comes within their province; but there must be more of them to keep pace with our modern methods of investigation.

Since instruction in the two sciences, crystallography and mineralogy begins and ends with such a small quota of our population, it is essential for the growth and welfare of these sciences which our Society represents that instruction in them must be extended and naturally the best time in one's life to arouse interest in any subject is during one's school days, and extension of our elementary courses in mineralogy can take place only in our secondary and high schools. It is perhaps in the minds of some of you that chemistry is prerequisite for mineralogy. This is a great error and probably has had much to do with relegating the first courses in mineral study to college grade. Some of the ablest mineralogists began their preliminary training back in their early school days and gained much of their knowledge of chemical symbols and chemical reactions from a study of the minerals they collected.

I think most of you will agree with me that mineralogical instruction can be undertaken in the public schools with benefit to the student, and such instruction would go a long ways towards increasing a knowledge of minerals. Our problem to solve is to find a method by which such instruction can be introduced into these lower grade schools. Crystallography and mineralogy differ from many sciences in that little progress can be made in the study of either science from textbooks alone. One requires models to illustrate the forms and the other good representative collections of minerals for comparison and for determination, and no instruction can be offered where these are not available. The collections in our public museums attract the visitor more by the beauty of

the specimen than by names and properties of the minerals; but for the student of the subject and for the person who may have forgotten a large part of what he once knew of minerals, such collections are of great value and interest. Unfortunately these public collections are too few in number and usually only to be found in our larger cities and therefore are not available to many of the pupils in our schools. The great majority of the youth of this land neither hear anything of minerals during their school life nor do they ever see a collection of them. It seems imperative that we should give some attention to the accomplishment of a wider knowledge of minerals than exists today, and three factors are involved to bring this about: namely, mineral collections, teachers and books.

Collections are essential. Steps should be taken to install mineral sets in our public schools, and especially in the high schools of our smaller cities and towns, where no public collections occur. Specimens of the more common minerals should be displayed sufficiently attractive to obtain the interest of the pupil. I think this a matter for the Society to look into and perhaps adopt some plan for a wider distribution of collections as the first step towards a wider interest in, and knowledge of, the minerals.

One of my friends who is a private collector and also a member of this society has arranged and installed a collection of the common minerals in the high school of his town, and there may be others of you who can do likewise. Well installed and labeled specimens showing fine crystallizations would stimulate a respect for the value of them and this would go a long way towards stopping the willful waste and destruction of good material so prevalent today by those ignorant of anything except the metallic contents. Minerals are learned better by constantly seeing them and there is no better place to have them installed than in the lower grade school where our boys and girls can at least have the opportunity to develop an interest in them. A more universal distribution of mineral collections will tend to overcome the great drawback which mineralogy suffers, namely, lack of specimens. Museum collections are necessary and are of great value to win the interest of the general public, but their educational value would be little compared to what it would be if the same material was part of our school equipment. Arouse the interest of the student in the

minerals before he visits the large collections, if value is to be obtained from such a visit. Too much stress can not be put upon this matter of providing the best examples of mineral specimens for our boys and girls to frequently see and thus become familiar with.

Minerals for identification should also be part of the equipment of the high school and all beginner's courses should be wholly practical requiring no book study. Lectures and textbook work can be relegated to the college.

Instruction in the subject requires capable teachers. Owing to the fact that nothing relating in any way to mineralogy is taught in our schools, there has never been a demand for teachers of the subject, consequently, our graduates of teachers' colleges have not included mineralogy in their curriculum. The few who elect mineralogy in their college course have no idea of ever teaching it and few of them ever do. Every high school should have a teacher capable of giving instruction in mineralogy in a beginner's course, but since there is at present little demand for such teachers it would be difficult to get Boards of Education to call for them; consequently a demand must first be created and this will necessarily result in a supply. If a widespread movement to install collections of minerals in our high schools is undertaken a demand for teachers of the subject will naturally follow.

The collection needs to be obtained before the teacher as the easier solution of how to get mineral instruction into our lower grades. Calling a man to teach mineralogy and letting him build up a collection is a policy for the college rather than for the high school. An abundance of good mineral specimens and the boy's and girl's desire to know about them will bring about a new order of things which will work a wonderful improvement in the knowledge and conception of minerals as the years go on.

We are dependent on books for most of our education. Teachers may direct our minds in the earlier years of our lives, but after schooling is over we must resort to books. Many sciences are readily understandable from a book study, but unfortunately for crystallography and mineralogy an actual contact with the specimen is necessary for identification purposes, and that is the usual first step in learning minerals. There are perhaps many persons who have a good general knowledge of the properties and uses of minerals and at the same time have practically no sight knowledge

of them. Such knowledge has been obtained wholly from books and mineral publications, and is of course a useful knowledge, but the ability to recognize the minerals should come first in mineral instruction. Our present types of books and publications are not designed for the general reader. The books on mineralogy are all of the stereotyped textbook style, dry and uninteresting to a layman and few students find them of much use let alone the general reader. There are interesting phases of crystallography and of mineralogy which could be written about in a readable manner, but the proper author has not appeared. It has been said that mineralogy cannot be popularized since it is such an exact science of facts, which are definite characteristics of the mineral and books descriptive of the minerals of necessity must be largely an enumeration of these facts and therefore dry and uninteresting. This statement seems to be borne out by the fact that in the list of one hundred books on scientific subjects written in a popular way so as to be available for the general reader, recommended by a committee appointed to prepare such a list, not one title on the subject of mineralogy is included. Ruskin may have gone to extremes to make the subject of crystallography understandable when he wrote his "Ethics of the Dust," and while his style of presenting the subject does not commend itself to the crystallographer, his book is, nevertheless readable, and has been read by many more persons than has any textbook on the subject. We need to cultivate a new style of writing for our textbooks both in mineralogy and crystallography, a style that presents the facts and theories in an interesting as well as in an instructive manner. Until this is done we cannot hope to see any of our books on the shelf of the home library, nor can we expect to see our sciences obtain or retain an equal place with other sciences, in the minds of the general public.

SUGGESTIONS CONCERNING THE USE OF SPECIES NAMES IN THE GARNET, AMPHIBOLE, PYROXENE, AND TOURMALINE GROUPS (ABSTRACT)

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For some years the writer has met with considerable difficulty in mineralogy classes because writers of many textbooks consider garnets, amphiboles, pyroxenes, and tourmalines as single mineral