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SCIENCE BULLETIN

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IOWA STATE TEACHERS COLLEGE

Editor-in-Chief: R. W. Getchell. Advisory Board: Dr. L. Begeman, Head, Department of Physical Science; Dr. E. J. Cable, Head, Department of Natural Science.

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ANNIVERSARIES OF SCIENCE

General

To know biography is to have a knowledge of history. By a study of the biography of our scientists we may secure a very satisfactory knowledge of the development of most scientific discoveries. The life and works of many of the noted scientists present a story of adventure and achievement which to the young may become a great inspiration.

The brief references in our textbooks to notable discoveries seldom arouse very much enthusiasm nor do they relate them to the science as a living and developing subject. Too frequently the pupil assumes that discovery arises through some stroke of genius, and that scientific ideas spring full-grown and completely formulated from the mind of their discoverer.

Much interest and enthusiasm in a subject or a discovery is aroused when the pupil begins to look up the records and sees the many contributing causes that led to its development. For example, Archimedes is given the credit for discovering the rules for determining density, but the student commits them to memory without in any wise knowing the circumstances which contributed to their discovery. To Archimedes it was a thrilling affair. When the student studies his life, these rules become a vital factor in his interest in density. During the investigation of the subject, many other very fundamental facts concerning physics are secured, showing its important relationship to other subjects. Our text books seldom arrange for such biographical studies, thus making it difficult to know how or when to present them.

We keep alive the achievements of our national heroes by celebrating their birthdays, or we arouse patriotism by celebrating the anniversary of some historic event. Why not in our science subjects commemorate the birthdays of some of our noted scientists and arrange a program for a class period? At this time various members of the class may present short biographies and discuss various subjects which the scientist has been vitally instrumental in developing. Or we may take the anniversary of some remarkable discovery and have papers prepared concerning the people and the events leading up to it. An example of this would be the discovery of oxygen by Joseph Priestly. Much more interest in oxygen and its discovery might be so secured. At the same time, the student would secure a better understanding of the early conditions of scientific study both as to lack of equipment and information, and to erroneous ideas which had to be overcome.

In the field of biological science there is no one who has stimulated the idea of careful, systematic study more than Charles Darwin. Although his conclusions have aroused bitter controversy, they have evoked much careful research and have given to the world a fund of information. Papers on his travels and work would be very profitable.

Asa Gray did a great work in organizing a systematic study of plant life. A careful survey of his life and work would inspire a love for plants that is much needed today.

It may be difficult to classify Louis Pasteur definitely with either biological or chemical science but this very fact makes his investigations all the more rich in topics for study. His early ambition lead him into chemistry, in which he made some notable discoveries. These prepared him for his biological and medical contributions, resulting later in the great Pasteur Institute in France.

It would not be difficult to prepare a program on the life and works of Sir Isaac Newton. His mathematical achievements and investigations in the field of physics offer many possibilities for papers.

Among others that would make an interesting program would be Galileo, John Dalton, Louis Agassiz, and Blaise Pascol.

Should the reader care to follow out the ideas suggested above, the following brief bibliography will be of service. (1) For reference work for all of them we would recommend the standard encyclopedias, such as "Britannica" and "The New International." (2) Archimedes (about 287-212 B.C.) "Library of Historic Characters," Vol. 6, by A. R. Spafford and others; "History of Science" by H. S. Williams. (3) Joseph Priestly (1733-1804) "A History of the Sciences, Chemistry," Vol. 1, by Edward Thorpe; "History of Chemistry" by F. P. Venable. (4) Charles Darwin (1809-1882) "Library of Historic Characters," Vol. 10, by A. R. Spafford and others; "Charles Darwin and Other English Thinkers" by S. P. Cadman; "The Evolution of Charles Darwin" by George Amos Dorsey; "Biographies of Eminent Persons," Vol. 3; "Darwin" by Gamaliel Bradford. (5) Asa Gray (1810-1888) "Leading American Men of Science," by D. S. Jordan. (6) Louis Pasteur (1822-1895) "Library of Historic Characters," Vol. 10, by A. B. Spafford and others; "Life of Pasteur" by Rene Vallery-Radot; "Pasteur and His Works" by L. Descour. (7) Sir Isaac Newton (1642-1727) "Library of Historic Characters," Vol. 10, by A. R. Spafford and others; "Book of Days, Sir Issac Newton and the Apple," Vol. 2, by R. Chambers; "Dictionary of National Biography," Vol. 14; "A History of Science," Vol. 2, by H. S. Williams. (8) Galileo (1564-1642) "Radiant Suns" by Agnes Gilbern; "Beacon Lights of History," Vol. 3, by J. Lord; "Encyclopedia of Universal History," Vol. 2, by J. C. Ridpath.

O. B. READ

MOLECULAR FORCES

Physics

(Continued from April issue)

The three states of matter denoted as solids, liquids and gases are different phenomena of matter arising from a change in the intensity of molecular attractions.

By the application of heat iron can be made to change from a solid to a liquid and finally into a gaseous state. In changing from a solid to a liquid, the molecules of a substance are forced by heat from a fixed vibratory condition into a mobile vibratory state. Hence it is evident that in the liquid state the molecular attractions are much less intense than in the solid state. Then, as the liquid state gives place to the gaseous state, the molecular attractions must become exceedingly small, as evidenced by the high speeds of the molecules of gases.

The three most prominent phenomena arising from molecular attractions and discussed in elementary physics are those of surface tension, capillarity and crystallization. These phenomena are exceedingly interesting and play a very important role in the processes of nature and in the inventions of man.

In discussing surface tension the instructor should emphasize particularly its practical side. The term itself is quite abstract to the beginning pupil and hence its discussion should be placed on a commonplace basis. The phenomenon is most strikingly illustrated in the free surface of a liquid, as the free surface of water in a tumbler. The impression should not be created, however, that water has a monopoly on this property. It pertains to all kinds of fluids.

How surface tension arises out of the molecular attraction in the surface layer of a liquid is quite clearly presented in most high school texts and need not be discussed here. The important task for the instructor is to bring the pupil to see that there is a tension—a contractile force—acting in the surface film of a liquid as of water in a tumbler. He should first be shown by experimental demonstration that the surface of a liquid is in quite a different physical condition from its interior. A heavy cambric needle, when carefully placed in a horizontal position upon the surface of water, will float, even though its density is seven or eight times that of water. A Gillette razor blade can be floated in the same way. A glass tumbler can be filled with water above its brim. In this case the upper surface of the water will take a convex form, the surface film acting as a cover to keep the water from running over. In nature we can observe water beetles scampering around upon the surface of water in sloughs, ponds and running streams without breaking through. All such phenomena convince us that there must be a virtual film at the surface of water strong enough to support these objects. This is actually the case. In the home the dishes used for pouring liquids are equipped with spouts. The spout is for the purpose of breaking the film at the surface of the pouring liquid so that it will flow out smoothly and steadily.

In the next place, point out that there is a stress in this surface film responsible for its existence, and resulting from the unbalanced molecular attractions. This fact is illustrated by placing two matches close together upon the surface of water in a dish and then dropping some alcohol between them by means of a pipette or a glass tube. As a result, the matches are pulled apart with a suddenness that is quite striking. Dropping fresh water between the two matches so placed causes no such effect. It is clear that the alcohol must weaken the surface tension between the matches so that the tension of the water film acting on their outer sides can pull them apart. It might also be said that the alcohol cuts the film between the matches while the water does not. The effect in this experiment is not unlike that of a stretched rubber band when cut in the middle, the free ends flying violently in opposite directions.

Having introduced the idea of tension, it should be driven home by means of a number of homely illustrations. A very beautiful one is obtained by scraping a number of very small particles from some camphor gum upon the surface of clean water. The little particles will scamper around over the surface in a whirling or zig-zag fashion, like a swarm of water beetles. The camphor particles weaken the surface tension in their successive positions, thus permitting the unbalanced tensions in the water films surrounding them to pull them around in quick irregular movements.

As a second illustration we may dip a fine haired, fluffy paint brush into paint and lift it out perpendicularly, when it will be noticed that the brush is drawn to a point by the film force. Again, when one wets his hair, it is surface tension that draws the hair into pointed, compact strands. If oil is dropped upon the surface of water, it is surface tension which instantly spreads it in all directions. This last phenomenon has often been used in a practical way by seamen. A few years ago a steamer took fire off the coast of Ireland and it was not possible to take off the passengers and crew because of the rough sea. A wireless message was sent to London for a Standard Oil tanker. Upon its arrival the oil steamer sprayed the surface of the sea with oil, thus quieting the waves and permitting the use of life boats. The oil here formed a covering over the water so that the wind could not get a "bite" on it, and the waves subsided by virtue of their own friction or viscosity.

When one blows bubbles in water they immediately burst because the tension in the films is so intense. When, however, soapy water is used, the bubbles remain for a time because the soap weakens its surface tension. Lubricating oil is of good quality if its surface tension quickly spreads it over a bearing.

In nature, raindrops are molded by surface tension. As the small masses of water fall from a cloud the film which surrounds them contracts and forces them into spherical form. Electricity strengthens surface tension and after a lightning stroke we frequently observe a shower of very large drops. During a high wind, ponds are often covered with fine sticks, straw and leaves. It is surface tension which later gathers these in clusters around stumps, logs and the shore, thus gradually clearing the water surface. The stronger the surface tension the larger the drops it can mold into spherical

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SCIENCE BULLETIN

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EDITORIAL

Nothing will more largely contribute to the teacher's peace of mind or to the pupils' efficiency than proper foresight for the fall. A two or three day incarceration in your empty and silent laboratory and classroom some time between the closing and reopening of school should represent a good investment. During this voluntary exile, put to yourself a few questions and motorize the answers.

What equipment must be purchased to replace or supplement the present stock? Late orders to supply houses arrive at their busy season and may mean delayed shipments. Is there an alphabetical list prepared of the stock of equipment, and the quantities? This means applying business science to laboratory science. Is any of the equipment rusted or tarnished? Paint, sand paper, steel wool and polishing powders will solve the problem. Do the stock room, the bottles or the specimens need rearranging or relabelling? A little planning, a few labels and colorless shellac can work wonders.

Do some of the library books need rebinding or the files of bulletins and pamphlets extended? Reports and supplementary references from pupils can be valuable in direct proportion to the size of your library. Why not add to your displays through the courtesy of various manufacturers? Lists of houses which furnish educational displays are available. Have you planned a series of outside activities, such as science club, visits to local industries, field trips, public displays of class work, county fair exhibits and the like? These activities tend to be conspicuous by their absence but they are fully worth while.

We must close this list or the reader may decide that his task is not one of three days but of three months. Yet it pays big dividends. Don't speculate about it; invest in it.

Science Bulletin closes its first volume with this issue. We have sought ever to keep in mind the science teacher in service and to offer to these teachers only such subject matter and methods as would fill a need in the classroom, laboratory or field. That we have in some measure succeeded is indicated by the many kind and appreciative comments which have reached us. The generous co-operation of our contributors has made possible the well-filled pages and prompt publication.

Plans are going forward for the nine issues of the second volume. The present editor will spend next year at a university in chemical research, but the new staff will "carry on," and with greater efficiency. They will welcome from the readers any suggestions which will make Science Bulletin more helpful to the teacher in service. "If we have served, we have succeeded." We wish you a pleasant vacation.

TEACHERS' COURSES

Special courses for teachers of science are offered at this college. A three hour course in teaching biological sciences offers training in subject matter and methods as applied to the classroom, laboratory, and field. A physics teachers' course will be offered this summer, open to those who are actually teaching physics or who have had two years of college physics. This course deals directly with the problems of the high school classroom and laboratory.

MOLECULAR FORCES

(Continued from page 51)

form. If fresh water and soapy water are dropped from the end of a tube, the fresh water drops will be much the larger. This also shows the greater intensity of the surface tension of fresh water. Ten drops of different liquids, for instance, do not represent the same bulk since each liquid has a different surface tension.

The drop-forming power of surface tension has been utilized in the manufacturing arts. Melted lead is poured through a fine sieve mounted high in a tower and the little liquid masses quickly assume a spherical shape before reaching the cooling bath of water below.

L. BEGEMAN

HAS COMMERCIAL GEOGRAPHY BEEN LEFT ON YOUR DOORSTEP

Geography

If one of the chief aims of a teacher is to induce her pupils to know and love a subject which she herself knows and loves, then commercial geography in many an Iowa high school is in a sorry plight. In cases too numerous to cite, the home economics teacher, the mathematics teacher, the physics teacher, the english teacher, — in fact anyone who is so unfortunate as to have one period of the day unfilled by his or her own special subject,—is likely to have that foundling child, commercial geography, left on the doorstep.

The reason for this proceeding is as obvious as its results. Iowa is a state with hundreds of small high schools. In many of these the only geography work given is one term of commercial, unless there happens to be a term of normal training geography. Except where there is a regular commercial teacher, it is not likely that there will be on the staff any person who has had a course in commercial geography and few who have had any course in geography since the seventh grade.

The superintendent is put to it to find some one to take the work. He must have teachers with special preparation for the subjects in which there are several classes. Among these teachers he must find some one who does not raise too violent objections to assuming the burden of commercial geography. For the teacher thus selected, it means much extra work and the very uncomfortable feeling that she is fumbling around in a subject whose principles, objectives and subject matter are foreign to her. After several years of such teaching this feeling may wear off and she may become very much attached to the subject, but the process is rather painful to the teacher and not without tribulation to the pupils.

This brief article is addressed to those who find themselves struggling in this new field. Let us first consider the chief aim of commercial geography. Geography is the science of relationships; it is concerned with the way in which man fits himself into his natural environment. Commercial geography is but one branch of this science and it must follow in some highly specialized way the general trend of all geography. Its special aim is to study the relationships of commercial activities to natural environment.

If the class is studying the production of certain commodities it is not enough that they should know the great producing areas. The pupils must be able to recognize the environmental factors which make these areas able to produce. For example, they find that the great wheat producing belt of North America extends from Texas to central Saskatchewan. This information becomes geographic only when they clearly understand that the factors of semi-aridity, of large areas of gently rolling surface and of fertile soils have made possible this production. The commercial geography of the situation involves also the transportation problems which the inland location of the wheat belt impose, its relation to the milling centers and to the markets of the eastern United States and of Europe. With the reasons for our own wheat production in mind the pupil is ready to understand our relations to world markets, the competition of such sparsely populated countries as Canada and Argentina, and the prospects of our own declining export as population increases.

Even this one example demonstrates clearly the need of up-to-date statistics in the teaching of commercial geography. Producing areas are constantly changing, but there is abundant evidence that not all teachers are changing their statistics in response to these changes. There are those in Iowa schools who in this year of grace are still teaching that Europe depends upon the United States for most of its wheat and corn, and that the world's supply of rubber comes from Brazil. One may have to use an old text, as text editions cannot change very frequently, but it is generally possible to bring statistics up to date by the use of some government publication, such as the Yearbook of the Department of Agriculture or the Yearbook of Foreign and Domestic Commerce.

Even if the text book which is used by the class is old, it is possible for the teacher to supply herself with the more recently published ones. Among these are: Industrial Geography by Whitbeck, American Book Co., Commerce and Industry by J. Russell Smith, Holt and Co. 1925, Commercial Geography for High Schools by C. C. Colby and C. Foster, now on the press, Ginn and Co.

With several texts as a guide in the selection of subject matter, a liberal use of outline maps and graph paper, and the burning of much midnight oil, even those who have had the subject unexpectedly thrust upon them may do a piece of work of which they will have no cause to feel ashamed.

ALISON E. AITCHISON

NEW-TYPE TESTS IN AGRICULTURE

Agriculture

Modern methods of testing a pupil's knowledge have been applied successfully in the teaching of agriculture. The writer submits a few sample question sets as illustrative material.

I—Single-word answer.

Unit: Babcock Test for Butterfat in Milk. Answer each question with one word. Arrange the questions in a column and place answers in right hand margin.

1. How much milk is used? 2. How much acid is used? 3. What kind of acid is used? 4. What is the specific gravity of this acid? 5. When was this test developed? 6. Who developed this test? 7. In what University was he a teacher? 8. Give the name of the instrument which is used in measuring the amount of milk used? 9. What is used to preserve the sample of milk? 10. What does this test measure?

II—True-False.

Unit: Characteristics of Legumes. Arrange in a column, with a parenthesis preceding each statement. In parentheses, put a (+) if true and a (—) if false. Impose a penalty for guessing.

1. Legumes are high in proteins. 2. Legumes are high in nitrogen. 3. Legumes grow best in sour soils. 4. Legumes rank below timothy as a hay for dairy cows. 5. Legumes grown on rich soil are higher in feeding value than those grown on poor soils. 6. Legumes secure their nitrogen from the soil. 7. Legumes secure their phosphorus from the air. 8. Legumes are hard to harvest. 9. Legumes do not make a good hay for horses. 10. Rhizobium leguminosarum live on the roots of legumes.

III—Multiple Choice.

Unit: Breeds of Swine. Underline the word or words which make the correct statement.

1. Poland-China came from (China, Poland, New York, Kentucky, Ohio.) 2. The (Tamworth, Chester white, Berkshire, Poland-China, Duroc-Jersey) is the best mother. 3. The average size of a litter of the Duroc-Jersey is (4-6-7-8-9-10-11-12). 4. The lard type is the most popular in (England, Denmark, Germany, United States of America) 5. The (Yorkshire, Duroc-Jersey, Berkshire, Tamworth, Hampshire, Poland-China, Chester white) belong to the bacon type.

IV—Enumeration.

Unit: Seed Corn. Arrange the answers in columns and designate them as "a," "b," etc.

1. Name 4 leading varieties of corn. 2. List 4 characteristics of an ear of corn, which have no bearing on its value for seed corn. 3. Give the 2 main reasons for selecting seed corn from the field. 4. Give 4 requirements of storage bins for seed corn. 5. Give the 3 main reasons for testing seed corn.

V.—Association.

Unit: The Dairy Cow. Opposite each term write a short accurate paragraph which will explain the meaning of the term.

1. Dairy temperament. 2. Constitution. 3. Quality. 4. Texture. 5. Mammary system. 6. Capacity. 7. Conformation. 8. Registry. 9. Advanced Registry. 10. Tuberculine Test.

VI—Matching.

Unit: Breeds of Chickens. Arrange lists "A" and "B" in columns (A and B). Place three sets of parentheses before each term in list "A." From column "B" choose terms which match terms in column "A" and place the corresponding numbers in the parentheses of column "A." More than one term may apply to a single breed.

A. Leghorn. Minorca. Rhode Island Red. Plymouth Rock. Wyandotte. Cochin. Orpington. Langshan.

B. 1. Is the most popular breed in Iowa. 2. Noted for especially high egg production. 3. Noted for large white eggs. 4. Are of a dual type. 5. Are a meat type. 6. Are poor mothers. 7. Were developed in Europe. 8. Are small birds. 9. Are good for producing spring fries. 10. Are good for producing capons.

WINFIELD SCOTT

CAPILLARITY
Physics

One of the best practical illustrations of the effect of surface tension is found in capillarity. For this topic the instructor will do well to base his teaching upon surface tension. It is this force that raises the water in a clean glass capillary tube and that depresses the mercury in such a tube.

The principles of capillarity are usually stated under four heads. It is not necessary to repeat them here. It must be realized, however, that each statement explains a condition under which surface tension acts to produce the phenomenon. When water rises in a fine bore glass tube, the surface tension lifts the column against the force of gravity. In a tube with a larger bore, the column does not rise so high because surface tension is there opposed by a greater weight. Temperature weakens surface tension and hot water will not rise as high as cold water in the same tube. Everything in this phenomenon is dependent upon the intensity of surface tension. In discussing capillarity do not emphasize so much the statements of its principles as the explanation of its phenomena, in terms of surface tension. If this is done the statements of the principles will become clear and significant to the pupil.

Capillarity is abundantly illustrated in our daily environment. One must take a broad gauged view of the subject and see that it applies to fine slits and cracks as well as to fine bored tubes. The ordinary pen is a capillary invention. The slit in the pen acts as a capillary tube to hold the ink back from the point of the pen. When one writes, he presses on the tip of the pen, thus widening the slit and letting the ink down. Good ink must have good surface tension. If it becomes frozen, its surface tension is weakened and it becomes worthless.

Cleaning processes in the home such as washing, mopping, wiping dishes and drying one's face with a towel are accomplished through capillarity. A garment taken out of hot soapy water is much lighter than when lifted out of the rinsing water because the surface tension of the hot, soapy water is very much less than that of the cold rinsing water. Consequently there is much more water held by capillarity in the garment lifted from the cold water.

In nature capillarity spreads the water throughout the sub-soil bringing it up to the roots of a plant for continuous nourishment. Capillarity also causes water to creep into the cracks of rocks, causing breakage when it freezes. Thus it contributes to erosion and soil formation. The physics instructor should always keep in mind that the more environmental—man-made as well as natural—he can make his discussions, the more they will contribute to the mental awakening of the pupil. There is no subject that lends itself better to such an end than capillarity.

L. BEGEMAN

COLLECTING SPECIMENS AT NIGHT
Biology

Many teachers of biology do not realize how much valuable biological material may be collected after dark. In fact, certain specimens, as grasshoppers, earthworms, and various species of amphibia, are most easily captured then.

The only apparatus needed is a good flash-light, a pair of waders, and containers for the specimens. The frogs and toads may be placed in a gunny sack fitted with a draw string, and earth worms in any can containing damp, green grass — no earth is necessary for them, and they will last for days in this condition. A fruit jar with a perforated lid makes a convenient receptacle for grasshoppers.

Leopard, Green, and Cricket frogs

may be collected around ponds or along streams on any night during the warm weather, but common toads and tree frogs may be found around water only during the spring breeding season. This is usually in May, and as the males of these species sing lustily, it is easy to find them by following the direction of their songs. The tree frogs will often be found sitting on a bit of wood several feet from the bank. They may easily be captured with a net while holding the light directly upon them.

Earthworms may be collected in large numbers from almost all bluegrass lawn, especially where the soil is a rich, sandy loam. It is best to choose a lawn somewhat removed from the street as the glare of street lamps or the flash of automobile headlights tend to keep the worms in their burrows. Choose a warm night following an afternoon shower, or else wet the lawn thoroughly from a hose. The earthworms come out of their burrows shortly after dark, and may be captured as they lie stretched at full length, feeding. Each worm keeps its tail in its burrow and can withdraw into it with amazing rapidity, as the beginner at nocturnal collecting will soon discover. Many an eager grab will net only a handful of grass. When an earthworm is seized, it resists being pulled from the burrow, and unless care is exercised, the animal will break in two. Even when it does not break, the worm may be so injured by a strong pull, that it will soon die. Such injured worms should not be placed in the container with the others, as one dead, decomposing worm will soon cause the death or injury of the rest. Since worms mate at night, copulating pairs may often be captured as they lie stretched between adjacent burrows; they usually separate quickly when seized.

Grasshoppers are most easily collected in the late summer. A weedy fence-row along a corn field, or tall weeds along a country road, are favorable places for the capture of the large yellowish-green, differential locust or grasshopper. These insects roost along the stems of the weeds, and on a cool night may be collected by the hundreds. They furnish excellent food for captive garter-snakes and various fishes; when injected, or preserved whole without injection, they keep indefinitely as laboratory specimens.

If the biology teachers who read this article will make one nocturnal collecting trip, they will probably make another, as it is a fascinating game. ROY L. ABBOTT

CRYSTALLIZATION

Physics

One of the most interesting molecular phenomena in nature is known as crystallization. It is brought about in the arts of man and in nature by three methods. When a chemical salt, such as table salt, is dissolved in water and allowed to stand in a shallow dish until it dries, it will be observed that the solid residue appears as crystals. Those from common table salt will be cubical in form. However, every different salt will yield its own distinctly shaped crystal.

A second method consists of the slow cooling of a mineral substance from a molten condition. When sulphur is melted and allowed to cool slowly, beautiful slender hexagonal crystals are formed. Permanent crystals found in nature such as those of quartz or of diamonds and other precious stones were formed by this process of cooling from a molten condition under suitable conditions.

The third method in which crystals are formed is by sublimation. When a substance in a vapor condition changes slowly into the solid state without passing through the liquid state, it frequently assumes a crystallized form. Frost crystals on a window pane are an illustration of this method of crystal formation. A piece of camphor placed in a bottle with clean walls will sublime and form a layer of tiny crystals on the walls of the bottle. Flowers of sulphur, which are crystalline, are produced by vaporizing sulphur in a closed chamber and allowing the vapor to condense directly to the solid state.

In the arts, crystallization of salts from solution and crystallization by sublimation are both frequently used to purify substances for medicinal and other purposes.

L. BEGEMAN