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BLOWPIPE VADEMECUM

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THE BLOWPIPE VADE MECUM.

THE

BLOWPIPE CHARACTERS OF MINERALS:

DEDUCED FROM THE ORIGINAL OBSERVATIONS OF

AQUILLA SMITH, M.D., M.R.I.A.,

VICE-PRESIDENT OF THE KING AND QUEEN'S COLLEGE OF PHYSICIANS.

ALPHABETICALLY ARRANGED AND EDITED

BY

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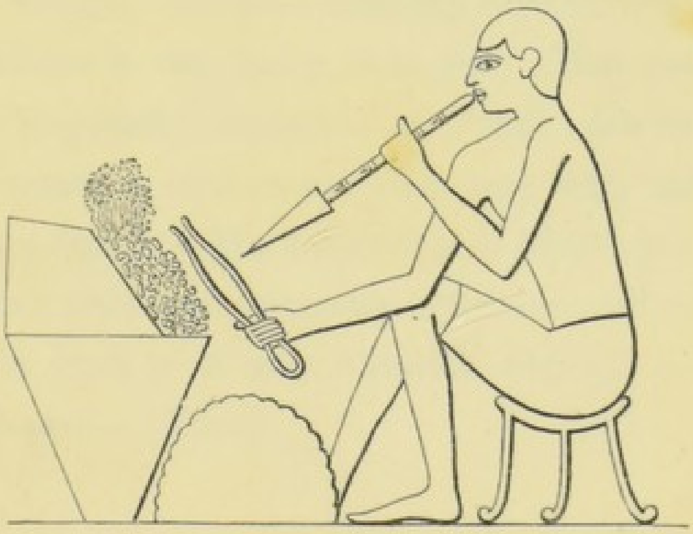

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PREFACE.

THE following Tract contains—A Sketch of the History and Use of the Blowpipe; such characters of minerals as can be ascertained by the use of a penknife and blowpipe; and a new blowpipe arrangement of Irish Minerals.

We have adopted the alphabetical arrangement, as being the most useful to travellers and others using this work as a Mineralogical Vade Mecum, and have carefully verified DR. SMITH's original observations in very many instances. The name of the same mineral is frequently repeated, as it has been found that the blowpipe characters of these minerals vary with the locality in which they are found. The Collection of Minerals on which these observations were made was very extensive, and we believe that the present work is a most valuable addition to British Blowpipe Literature.—[EDS.]

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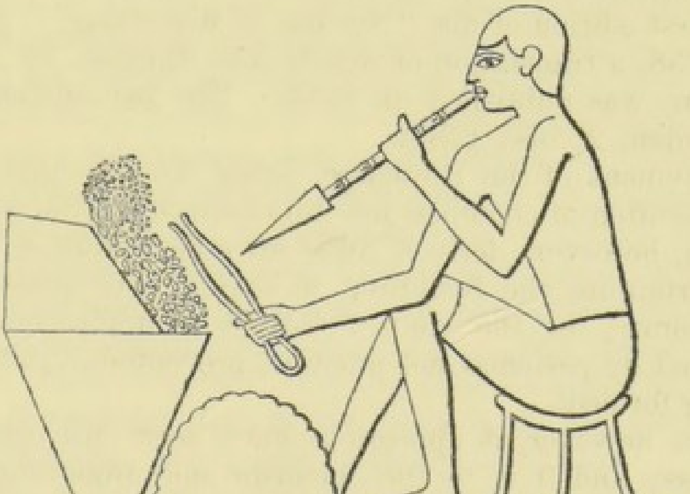
INTRODUCTION.

HISTORY AND USE OF THE BLOWPIPE.

THE Blowpipe is an instrument by means of which the flame of a lamp or candle may be concentrated, so as to communicate a very intense heat to small bodies placed within the flame. Although this instrument was employed in the arts by the ancient Egyptians about 1500 years before our era, and in more modern times has been used for various purposes, particularly by goldsmiths and jewellers in the soldering of metals on a small scale, whence it derives its name in the German language, "Löthrohr," from "Löthen" to solder, and "rohr" a tube or pipe, it is scarcely more than a century since the idea of applying it to mineralogical purposes was conceived.

The accompanying woodcut is taken from Rosellini, and represents an Egyptian silversmith using the Blowpipe. It was found in a Theban tomb, in conjunction with representations of workers of gold.



The following description of this remarkable figure is given by Rosellini:—

"L'artefice sta seduto dinnanzi ad un fornello posto in una vasa di terra, nel quale, mentre soffia con un tubo di canna armato in cima di metallo per difesa dal fuoco, sembra prendere o aggiustar colle môlle la materia che fonde, o che arroventa. A' suoi pede è figurato un mucchio che par d' argilla, della quale usano i fondatori de' metalli, o per forme, o per altre bisogne dell' arte loro."—*Rosellini. I Monumenti dell' Egitto e della Nubia. Parte seconda. Monumenti Civili.*—Tom. ii., p. 292; Tavola lii., fig. 4.

Bergmann informs us that, about the year 1738, Andrew Swab, a Swedish metallurgist, and Counsellor of the College of Mines, was the first to employ this simple and elegant instrument for the purpose of assaying metallic minerals. He, however, left no work on the subject, and it is unknown to what extent his researches with this instrument were carried. The subject does not appear to have received any particular attention from any one until Cronstedt, a Swedish nobleman, in 1758, proposed his system of mineralogy, in which the arrangement is dependent on the chemical composition of the minerals. In order to recommend the general adoption of his system, it became to him a matter of great importance to possess some ready and simple means of determining the constituents of mineral bodies, as it was evident that the slow and laborious operations of chemical analysis could not be generally employed by mineralogists. He found the object of his pursuit in the Blowpipe; and by the employment of fluxes in the experiments performed with this instrument, he may be considered as the founder of a new mode of investigation in chemical science. He used the Blowpipe to distinguish mineral substances from one another, by the means of fusible reagents, whose actions should produce such modifications on the objects to which they were applied as might afford some conclusions respecting their composition, and serve as a basis for the classification he adopted. He carried the use of the Blowpipe to a degree of perfection that could only have resulted from the most persevering industry. The results obtained by him are to be found in the first edition of his "System of Mineralogy," published in Sweden, in 1758, a translation of which into English, by his pupil, G. von Engeström, was published in 1765. The last edition is that by J. H. de Magellan, 2 vols., 1788.

The employment of the Blowpipe, being thus brought into notice, excited the attention of chemists and mineralogists to the use of the instrument, who, however, derived little advantage from it, except as a means of ascertaining the fusibility of bodies, and occasionally their solubility in borax; for the want of skill in its application, which can only be acquired by patience and practice, prevented a just estimate of its value being formed.

In Sweden, however, it appears to have been cultivated with the greatest success; and it is to the chemists and mineralogists of that country that we are indebted for the greater portion of the information we possess on this subject, particularly to Bergmann, Gahn, and above all to Berzelius.

Bergmann extended the use of the Blowpipe by a series of original researches, in which he investigated the properties of most of the then known species of minerals, and applied it to the field of inorganic chemistry, in discovering very minute portions of metallic matter in analytic researches; and published the result of his observations at Vienna, in 1779, in a treatise under the following title: "De Tubo Ferruminatorio, ejusdemque usu in explorandis Corporibus, præsertim Mineralibus;" a translation of which into English will be found in the 2nd vol. of Bergmann's Physical and Chemical Essays, by Dr. Edmund Cullen, Lond., 1788.

The close and continued application which Bergmann bestowed on his studies had such an effect on his health, as to oblige him to continue his philosophical pursuits with the help of an assistant. He accordingly employed Assessor Gahn, who performed, under his directions, a series of operations on all the minerals then known, by which he was taught in what manner each individual conducted itself before the Blowpipe. The experience thus acquired enabled Gahn to employ the instrument in every kind of chemical and mineralogical inquiry; and he attained such a degree of skill in its use, that he could detect the presence of substances in a body by its means, which had escaped the most careful analysis, conducted by the ablest chemists of those times. Gahn was indefatigable in his observations and experiments with the Blowpipe, without which he never travelled; and though he was led to contrive several improvements in its application, which were imagined and executed with such sagacity and precision that his results were entitled to the greatest confidence,—he appears never to have thought of publishing an account of his labours, which no doubt would have been of great importance.

As an instance of his power of detecting the presence of metallic bodies, we are told by Berzelius that he had often seen him extract from the ashes of a quarter of a sheet of paper distinct particles of metallic copper, and that too before the knowledge of the occurrence of this metal in vegetables was known, and therefore before he could have been led from this circumstance to suspect its presence in paper.

Although we cannot but feel regret at having received no work from a man so eminently qualified to instruct on this subject as Gahn, still we must consider it fortunate, that, under such circumstances, the knowledge and experience of so long and laborious a life has not altogether been lost. . Fortunately for science, accident, as it were, made Berzelius the medium through which this information was to be communicated to the world, and it must be universally felt and acknowledged that he has most ably fulfilled the task assigned to him. The zeal and assiduity of Gahn in this study, together with the circumstances to which we are indebted for the preservation of his labours, are told in an interesting manner by Berzelius, in his treatise on the Blowpipe.

Such, then, is the origin of Berzelius' treatise, a work which has been acknowledged as the highest authority on this subject by almost every writer on mineralogy, for the last 20 years. An English translation of the French edition, by M. Fresnel, was published by Mr. Children in 1822.

We have now given as full an account of the rise and progress of the Blowpipe, in its application to mineralogy, as the nature of the subject will admit; and before we conclude this part of our subject, we feel called on to show that the use of this valuable little instrument was not as much neglected in England as we might be led to suppose from an assertion made by Berzelius, at the close of his history of the Blowpipe:—"In all the rest of Europe only one naturalist, but he a very distinguished one, has applied himself to the study of the Blowpipe and its uses, and submitted a large number of mineral substances to its test: this was H. de Saussure." Some years previous to the publication of Berzelius' work, Mr. Arthur Aikin, the author of a Manual of Mineralogy, the second edition of which was published in London in 1815, had arranged all mineral substances according to their habitudes before the Blowpipe, yet it must be admitted that it was applied by him in a limited manner; for in many instances he only states the degree of fusibility of the mineral, and occasionally its colour after fusion, rarely noticing the minute details which are so useful, as in many instances offering most satisfactory characteristics, particularly when the aggregate of the characters are taken into consideration. And although Dr. Wollaston has never communicated his knowledge on this subject to the world, it is well known that he was eminently distinguished for his dexterity in managing this useful little instrument; and in later times Mr. Children and the late Dr. Turner made many important discoveries respecting the use of re-agents with the Blowpipe.

I.—Description of the Blowpipe.

Blowpipes are of two kinds, *simple* and *compound*. A simple Blowpipe consists merely of a conical tube, generally made of metal, through which air is blown from the mouth of the operator. A compound Blowpipe consists of a tube through which common air or gas of some kind is blown by some secondary apparatus, to which the tube is attached.

As our object is to simplify, as much as possible, the application of the Blowpipe to the purposes of the practical mineralogist, we shall only describe the one we have found to answer best, and for the descriptions of the various kinds, both simple and compound, refer to the work of Berzelius, or the useful little manual "on the Use of the Blowpipe," published by Mr. Griffin of Glasgow.

The instrument we have always used is that invented by Dr. Wollaston; it is made of copper, and consists of three pieces, two of which, when united, form the tube, about seven inches in length, the widest extremity of which constitutes the mouth-piece, and is plated, to prevent the disagreeable taste which copper would produce in the mouth of the operator. The third part, or nozzle, which when fitted on the smaller end of the tube forms a right angle with it, is sometimes constructed so as to form an oblique angle with the tube, which, in our opinion, is not as convenient as the former. The nozzle is also sometimes made of platina. We have, however, used one of brass for some years, and it is as good now as when first it was made.

This instrument is very light, so that the operator can, when occasion requires, hold it steadily between his teeth while blowing, and enjoy the use of both his hands for a time, and for portability it far exceeds all others; for when the instrument is not in use, the nozzle fits into the open extremity of the second piece, and the latter within the mouth-piece; in this form its length is reduced to less than four inches, and it occupies no more room than a pocket pencil-case. One inconvenience attends the use of this instrument, that is, the condensation of the vapour of the breath in the interior of the tube; and contrivances have been made to obviate this, by attaching a hollow chamber to some part of the tube to collect the condensed vapour. In our opinion, this trifling objection, which can at all times be readily removed by inverting the tube or blowing forcibly through it, is not at all compensated for by the addition of the chamber, which adds considerably to the weight of the instrument.

II.—The Combustible or Flame.

A great diversity of opinion exists respecting the material which should be used to produce the flame for the Blowpipe: wax, oil, and tallow have been recommended; we have always preferred a candle made of pure wax, about an inch in diameter, with the wick rather thick in proportion to the size of the candle; it is far more cleanly than tallow or oil, burns with a clear flame, does not emit any disagreeable odour, and affords a heat sufficiently intense. The candle should never be more than about six inches in length; and we have found advantage in using a supporter made of tin plate, to the socket of which is attached a stem about three inches long, which is made to slide in a tube of the same length, attached to the foot of the supporter. By means of the sliding socket, the flame of the candle can always be kept at nearly the same elevation from the table, at a height most convenient to the operator.

III.—Method of Blowing.

The operation of keeping up a continued and steady stream of air through the Blowpipe, simple as it seems, is difficult at first; the whole artifice, however, consists in this, that while the operator breathes through his nostrils, he must blow the air contained in his mouth by the mere compression of the cheeks; to accomplish which, the first thing to be done is to acquire the habit of breathing easily, and without fatigue, through the nostrils alone, while the mouth is filled and the cheeks inflated with air; when this is acquired, the Blowpipe may be put into the mouth, and the confined air expelled through the tube by means of the muscles of the cheek. As soon as the air is nearly exhausted, the expiration from the lungs, instead of being made entirely through the nostrils, is to be partly forced into the cavity of the mouth: all subsequent supplies of air are to be introduced in the same manner as the first. Thus, with a little practice, the power may be obtained of keeping up a continued blast for as many minutes as may be necessary for any ordinary operation.*

IV.—Of the Blast and Flame.

Having accomplished the first object of keeping up a steady blast, the next requisite is to produce a good heat: this is best attained by keeping the wick of the candle of a moderate length, and avoiding all drafts or currents of air, which would render the flame unsteady. The point of the Blowpipe should be held just above the wick; and as soon as the blast is directed on the flame it will be observed to assume a conical form, and to consist of two parts, an outer and inner, the latter of a light blue colour, converging to a point at the distance of about an inch from the nozzle; the former of a yellowish colour, and converging less perfectly. The most intense heat will be just at the point of the inner flame.

To attain the maximum degree of heat, we must neither blow too strongly nor too gently; and we should bear in mind that our pyrognostic operations are not confined to obtaining the highest possible temperature; other phenomena must be produced, which require a less intense heat. A very important point in pyrognostic assays is the power of producing at will the phenomena of oxidation and reduction, both of which are easily effected, although diametrically the reverse of one another.

1. *Oxidation.*—Oxidation goes on most actively at an incipient red heat; and the further we recede from the flame, the better the oxidation is effected, provided we can keep up a sufficient heat. The opening in the nozzle of the Blowpipe, we are told, should be larger for this operation than in other cases: however, we have always succeeded with the ordinary nozzle we use for all purposes; and which in this case answers very well, by holding it a little further from the flame.

2. *Reduction.*—Reduction or de-oxidation is best effected in the brilliant part of the flame, immediately beyond the point of the inner blue flame, and it requires more expertness in the operator than the very simple process of oxidation. A very good mode of acquiring the art of making a good reducing flame is to fuse a small portion of tin on a piece of charcoal, so that its surface may always retain its metallic brilliancy: tin has so great a tendency to oxidation, that the moment the flame begins to become an oxidating one, it is converted into an oxide of tin, which covers the metal with an infusible crust.

V.—Of the Support.

The assay, or substance to be examined by the Blowpipe, must necessarily rest on a solid body, or be fixed in a steady position by some

* It is generally supposed that it is a matter of some difficulty to use the Blowpipe—that it requires great pulmonary exertion, and may on this account be injurious to the health. Such, however, is not the case, as the experience of half an hour will convince any person, under the direction of a skilful teacher.

means; and the material or instrument by which this is effected, is called the Support, of which there are two kinds, the combustible and incombustible.

1. *Combustible Supports.* The combustible support generally used is charcoal, and that prepared from the light woods in general answers best; and as it is not always easy to obtain charcoal which possesses all the qualities, which it should possess, we shall detail the manner of preparing such as we have found to answer very well.

Take pieces of white pine-wood of a fine grain and free from knots, about six inches in length, and an inch or more square; place them in a large common crucible, and cover them with fine sand; then place the crucible in the centre of a strong fire, and leave it there until the wood is perfectly charred, which will take place in about an hour. The crucible should then be removed from the fire, and allowed to cool slowly; and when cold, the charcoal will be ready for use. When well prepared, it should be perfectly black, very light, possess some lustre, and be easily broken across the grain; that which splits, scintillates, smokes, or emits flame when heated, is not of good quality.

Mr. Children recommends alder wood, as possessing all the necessary qualities to make good charcoal.

Charcoal is chiefly used in the examination of the metallic ores when our object is to reduce them, because it attracts the oxygen from the oxide, and thereby accelerates reduction to the metallic form. The intensity of the heat may be greatly increased by making a cavity for the assay in the charcoal, and covering it with another piece of charcoal, which by reverberating the heat converts it into a reverberating furnace of great intensity.

Gahn* directs that a small hole should be made in the charcoal, and into this hole the substance to be examined must be put. The assay should be placed on the side of the charcoal, and not the end; otherwise, the substance to be fused spreads about, and a round bead will not be formed. But Berzelius, in the following passage, gives us directions quite contrary (p. 31):—"In order to fix the flux to a point on the surface of the support, one of the ends perpendicular to the layers of the wood is to be chosen for its receptacle; *if placed on the section parallel to the layers, it would spread over the surface.*" We have occasionally used both methods, but prefer placing the assay on the side of the charcoal; however, a little experience will be the best guide for the experimenter.

2. *Incombustible Supports.—Platinum Wire.* The only incombustible substance used as a support which it is necessary to notice is platina, which, from the difficulty of fusing it even in a very high temperature, its malleability, and property of conducting heat very slowly, render it preferable to any other material.

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* *Vide* Thompson's "Annals of Philosophy," vol. xi., p. 40, on the Blowpipe, from a treatise on the Blowpipe by Assessor Gahn, of Fahlun, by Dr. Ure, as Mr. Griffin informs us.

Platinum Forceps.—One of the greatest advantages of this instrument is, that it enables us to fix the object of experiment in a steady position; and by this means a very minute fragment, which it would be impossible to keep fixed on charcoal, can be examined with great advantage.

The chief advantage of this instrument is that it enables the operator to submit a mere fragment of a mineral to a high and uniform temperature, which could not be effected on charcoal, as the assay would be blown away the moment the jet fron the pipe would be directed on it. Hence we have found several minerals which on charcoal were apparently infusible, yet when placed in the forceps, and submitted to a well-directed flame, fuse without difficulty on the edge; and besides it enables us to observe the effect of the assay on the flame, in producing certain colours which are very characteristic of some minerals, as Carbonate of Strontia and Lepidolite, which tinge the flame red; Cyprine and Boracite, which impart a green colour.

The forceps may be used with advantage in the examination of all the earthy and many of the metallic minerals, particularly such as are refractory on charcoal. We should, however, be careful not to employ it as a support for those metallic oxides and compounds which are reducible *per se* before the Blowpipe, and readily form an alloy with platina.

The forceps are used for holding a small portion of a mineral, when we wish to try its fusibility. The most convenient form of this instrument consists of two thin plates of steel, each having a piece of flattened platina about the sixteenth of an inch wide riveted on its extremity. The platina points should possess as little bulk as possible, in order that little heat may be abstracted. These plates are fastened in the middle to a small piece of iron or brass, somewhat of wedge-shape, so that the platina extremities are held in close apposition by the spring of the steel plates, while the other extremities are separated about a quarter of an inch, and may be used as an ordinary spring forceps. The platina extremities are opened by pressing the fore-finger and thumb against two small buttons, the shank of each of which is fixed in one plate, and passes through the other.

VI.—**Additional Instruments.**

Under this head we arrange all those instruments which are used for various purposes, subservient to the examination of minerals.

1. *The Common Steel Cutting Pliers*—Is very useful for detaching small portions from a specimen, without the risk of injuring it by the concussion which would be caused by a hammer.

2. *A small Jeweller's Hammer*—Is also useful for detaching fragments for examination from specimens, and for ascertaining the malleability of the globules obtained from metallic minerals.

3. *A small Anvil*—Is used for crushing pieces of minerals, which are to be wrapped in paper, in order to prevent the dispersion of the fragments, and also for trying the malleability of metals. We have pre-

ferred a small smoothing-iron, the face of which has become *black* by oxidation, the advantage of which will be pointed out hereafter.

4. *A Pocket Knife*—With well-tempered blades, is an indispensable instrument for trying the hardness of minerals, which is estimated by the resistance they oppose to it. It may also be applied for the purpose of mixing a pulverized mineral in the palm of the hand with water or the fluxes.

5. *A Small Triangular File*—Is requisite to test the degree of hardness of such minerals as resist the knife, and also for the purpose of cutting glass tubes, &c.

6. *A Small Agate Mortar and Pestle*—For the purpose of pulverizing the harder minerals, and separating minute metallic globules from the charcoal on which they have hardened; and a piece of pumice-stone should be at hand, to remove the traces left on the surface of the mortar by the trituration of metallic substances.

7. *A Pocket Microscope*—Containing three glasses of different powers, which may be combined if necessary, is perhaps the most convenient.

VII.—Of the Size of the Assay, and its Preparation for Examination by the Blowpipe.

1. *Size of the Assay.*—The fragment of the substance submitted to the Blowpipe for examination is termed the *Assay*, and it is a matter of the greatest importance in pyrognostic experiments that some definite size for the assay should be agreed on by experimenters. Mr. Mawe tells us that "the piece of mineral to be examined should not in general be larger than a *peppercorn*." Dr. Ure (Chemical Dict., art. Blowpipe) says that "it should not exceed the size of half a peppercorn." Bergmann, however, with whom the specification of this bulk originated, observes "that we must often operate on smaller portions." Von Engeström recommends a piece about the size of a cube one-eighth of an inch on the side. Now, it may be safely asserted, that no correct or extended set of experiments on minerals with the common Blowpipe could be made on pieces nearly so large; and that no person using the Blowpipe for the first time, could make any impression on a piece of that size, unless he happened to meet with a very fusible substance. It is probable that many persons (and I have known instances myself), have failed in their attempt to use the Blowpipe, by using an assay of too large a size; for nothing can be more evident, than that if the assay be large, a part of it must necessarily be out of the force of the flame, which is very small, and must therefore tend to cool the part immersed in the flame; the consequence of which is, that the heat is carried off, and the operator will be tired before the assay is in the least affected, unless it be very fusible indeed.

Mr. Aikin, who published his Manual of Mineralogy in 1813, was the first who perceived the necessity of operating on pieces of very small bulk; and recommends that the size of the assay "*should scarcely exceed the bulk of a pin's head*," which is perhaps as good a type of the size as could be given.

Berzelius says, "As to the size of the morsel operated on, it is large enough, if we can distinctly see the effects produced on it; and we are more likely to fail in our object by using too large, rather than too small a piece;" and adds, that "a piece of the size of a large grain of mustard-seed is almost always sufficient," and that "the only instance in which it may be convenient to operate on portions larger than a mustard-seed is when we wish to extract metals, because in that case we obtain a larger portion of the metal sought for, which may consequently be examined and distinguished with greater ease."

In the first experiment the assay should never exceed the size assigned by Aikin; for unless we attend particularly to this, we can never arrive at uniform results, or institute comparisons which would be of any value. There are many minerals which, if used the size of a peppercorn, which has been recommended by most authors, would be altogether infusible by the means we adopt, yet a small fragment of the same substance will be fused without any difficulty. When we have ascertained that a mineral is easily fused, it is often desirable to operate on a larger piece in metallic minerals. If we find a fragment infusible in the first attempt, we should select another with a thin edge, and submit it to the most intense heat we can produce; and in this way we sometimes succeed in fusing the thin edge of an assay which, under other circumstances, might be pronounced infusible: in such cases we should always examine the edge of the assay with the microscope. Minerals sometimes occur in very minute grains or pulverulent (as Iserine) which cannot be held in the forceps; and if they cannot be retained on charcoal, the only mode of proceeding then is to reduce them to powder, and form it into a paste with a little water in the palm of the hand, and then place it on charcoal, when in some cases it will form a cake, which may then be held in the forceps, if necessary.

2. *Preparatory Examination.*—When we are about to enter on the examination of a mineral substance, we do not begin immediately with the Blowpipe: a few very simple preliminary experiments are first to be made, by which the succeeding steps of the examination may be directed.

As it is a matter of some importance to save trouble, and, above all, time, we shall state the manner in which we have been in the habit of proceeding. Our first care should be to select a homogeneous particle, which will be a matter of no difficulty, if the mineral be crystallized; and should it be amorphous, a magnifying glass becomes necessary, to discover any heterogeneous matter, should it exist, for minerals do not always consist of the same substance throughout, although they may appear so to the unassisted eye. Next we ascertain the degree of hardness, by scratching it with a knife; and if it resists this, we resort to the file. We may then try if it be attracted by the magnet, always using a minute fragment for this purpose. The action of muriatic acid should next be resorted to, to ascertain if the mineral effervesces; and it is right to mention, that the effervescence of some of the carbonates will scarcely be visible unless the mineral has been reduced to powder by scratching with a knife, or pulverizing it in an agate mortar, and at the same time we may determine whether it be partly or entirely soluble in the acid. The specific gravity should in every case be taken, if convenient, but in the present stage of our proceeding it is not absolutely necessary.

VIII.—Re-agents used with the Blowpipe.

1. *Borax Flux.**—The borax of commerce sometimes contains impurities: it should be dissolved, and crystallized again, before it is used for experiments with the Blowpipe. It is kept in the state of powder, and is used to effect the solution or fusion of a great number of substances, and on the whole I consider it the most generally useful of all the fluxes.

I have found the following the most convenient mode of using this flux:—A piece of fine platina-wire, about the thickness of strong sewing silk—it should be fine, provided it be thick enough not to bend with the blast; if too thick, it absorbs too much heat—and about three inches in length, is fixed by one end in a piece of glass-rod, which is easily accomplished by fusing the end of the glass, and inserting the end of the wire, which must also be heated; the other extremity of the wire is bent into a hook, about the one-eighth of an inch in diameter. Having moistened the hook with the tongue, it is to be dipped into the powdered borax; the portion which adheres is to be heated with the Blowpipe; at first it swells up, owing to the water of crystallization which it contains, and afterwards fuses into a transparent globule, which adheres to the curved wire; it should then be allowed to cool, to ascertain if it is perfectly colourless; for should it be otherwise, some impurity is present. The globule should never be more than about the eighth of an inch in diameter; for if it is made too large, its weight while in a state of fusion will overcome its attraction to the wire, and cause it to fall off.

Having the assay prepared of a small size, and placed on the anvil, the next step is to fuse the borax again, and, while it is hot, apply it to the assay, which will adhere to it. At this moment, if the assay contain any water or volatile matter, it will be deposited on the cold iron, and if the quantity of water in the mineral is considerable, the vapour will be condensed in a number of very minute drops; in other cases, the surface of the iron will be only dull for a moment, if no water exists in the specimen. The surface of the anvil should be blackened by oxidation, to exhibit clearly this very delicate test of the presence of water, which, as far as we know, has not been practised by any one else; it is far more convenient than the use of the glass matrass recommended by Berzelius and others, and no time is lost in applying it.

The action of this flux furnishes us with many important characters. The assay may emit a few bubbles of different sizes at first, which in

* The term *flux* is applied to those substances which, when added to mineral bodies, assist their fusion upon exposure to the action of fire; and when we have observed the effect of the heat on the mineral alone, it is then necessary to examine what further change takes place when it is subjected to other trials with the fluxes.

most instances is owing to the portion of water which remains; or it may effervesce briskly, with intumescence, as carbonate of lime; some of the earthy minerals emit a stream of uniform minute bubbles for an instant; while a few, as Scapolite, emit them in a continued shower until the assay is entirely dissolved. Some minerals become transparent, others become opaque, while a few change colour. Solution or fusion of the assay takes place quickly or slowly, wholly or partially, quietly or with effervescence.

But the most important of the characters afforded by this flux is the colour imparted to the glass, by which the presence of several metals is indicated. Chrome gives a rich green—iron, a dark olive-green colour with the glass: if the proportion of iron be very small, the colour is evident only while the glass is warm, a circumstance which, independent of the difference between the green caused by chrome and iron, is of some value in distinguishing them; for chrome becomes more clear when cold. Cobalt affords a very deep blue. We should also observe if the colour be different with the oxidating flame, from what it is with the reducing. Lastly, we observe if the colour increase or diminish by cooling; and if, at the same time, the glass preserve or lose its transparency.

Flaming.—Certain bodies have the property of forming a clear glass with borax, which preserves its transparency after cooling, but when slightly heated by the exterior flame of the candle, becomes opaque, and turns milk-white (Phosphate of Lime), or is coloured, particularly if the flame has been directed on the glass in an unequal and intermitting manner, as Glucina, Titanium. One condition, however, is necessary—that to a certain point the glass must be saturated with the assay; and the presence of silica also prevents the phenomenon, except when a very large proportion of the assay is dissolved in the borax. This property has been termed *flaming* by Berzelius.

2. *Salt of Phosphorus Flux*, or, as it is commonly called, microcosmic salt, is a double salt, or a compound of phosphate of soda and ammonia. It should be pure, which is known by the glass which it forms remaining transparent when cold.

One inconvenience attends the use of this flux; it intumesces to a great degree when heated. I have been in the habit of fusing the salt, allowing it to cool, and then reduced it to coarse powder: in this state it intumesces much less, owing to the ammonia driven off; and a biphosphate of soda remains, which is deliquescent, but if kept in wide-mouthed bottles closely stoppered, little inconvenience results from this. It is more particularly applicable to the examination of the metallic oxides, whose characteristic colours it developes much better than borax. It is also useful in detecting silica in earthy compounds, which it sets free, in the form of a gelatinous mass, in the globule.

3. *Saltpetre, or Nitrate of Potash*—Should be kept in the state of crystal: it is used as an oxidating agent, and is a very delicate test of the presence of manganese, when it exists in a proportion too minute to colour the glass of borax without it. The following is the method I adopt:—Having fused a small portion of the assay with borax on

platina-wire, the globule while warm is to be brought in contact with a small piece of nitre, which decrepitates at first, but a sufficient quantity adheres. It is again submitted to the flame, and heated till intumescence takes place; and before the intumescence ceases it must be withdrawn, and allowed to cool, when an amethyst colour will appear, of more or less intensity according to the proportion of the manganese, and this colour may be destroyed in the reducing flame. By this means I have detected the presence of manganese in minerals which escaped the attention of skilful chemists, as in Cyprine, and in a variety of white Aragonite from Devonshire.

4. *Nitrate of Cobalt.*—Nitrate of cobalt, dissolved in distilled water, is employed to detect the presence of alumina and magnesia. The solution should be rather concentrated, and entirely free from alkali.

Alumina test.—The best mode in general of applying this test for alumina is to roast the assay in the outer flame until it becomes white, which in many instances renders it more absorbent; it is then moistened with a drop of the solution, and heated *strongly*, but *not fused:* after being heated for some time, the assay becomes blue, more or less pure, if it contain alumina. Wavellite exhibits this effect in a very striking manner. The blue colour of alumina is permanent in fusion, but it thereby loses its distinguishing character; for minerals which contain lime or alkali, without alumina, also become *blue* by fusion with oxide of cobalt, *but not till they have been fused.* The presence of a metallic oxide in the assay entirely destroys the action of this test, and hence its use is very limited, owing to the frequency with which iron is met with in earthy minerals. Silica does not prevent the appearance of the blue colour.

For the application of this test to the harder minerals, a different process is required. The stone is to be ground with a little water in an agate mortar till reduced to a state of pulp, a drop of which is to be laid on charcoal, which will absorb the water, whilst the fine powder will remain on the surface. To this we add a drop of the solution of cobalt, and heat it to the brightest incandescence, at which moment the characteristic action is developed, and becomes evident when the assay is cold. If we perceive the mass to detach itself from the charcoal in the form of a scale, we may take it up carefully with the platina forceps, and expose it more easily to the degree of heat required.

Magnesia test.—The process for detecting magnesia is similar to that already described, but in this case we must endeavour to fuse the assay; for the magnesia compound acquires a pale rose-red tint, which is generally stronger after fusion; its use, however, for this purpose is very limited, as there are few compounds of magnesia which do not contain either alumina or iron. The sub-hydrate is the best substance for exhibiting the action of the test.

IX.—**Cupellation.**

The process termed cupellation is only resorted to for the purpose of ascertaining the presence of gold or silver when alloyed with other metals, and is effected in the following manner:—A piece of bone which has been exposed to the heat of a fire until all the animal matter has been consumed, which is known by the bone becoming white, is reduced to a very fine powder, a small quantity of which is to be taken on the point of a knife, moistened with the tongue, and kneaded in the left hand into a thick paste; a little soda may be added to give it cohesion, but it is not necessary. A hole is then made in a piece of charcoal, and filled with the paste, and its surface smoothed or slightly indented in the centre. It is then to be gently heated by the Blowpipe till it is perfectly dry. It is now ready for the assay, which must be previously fused with lead,* and then placed in the middle of the little cupel, and the whole heated by the exterior flame, for the purpose of oxidating the lead, which is absorbed together with the other impurities by the cupel. When the operation is finished, the precious metals are left on the surface; but the proportion of it being generally very small, owing to the size of the entire mass of the alloy often not exceeding a large shot, it is very generally necessary to have recourse to the magnifying glass to be certain of the presence or absence of the fine metal. When the grains are very minute, the colour of the metals will become evident by rubbing them in an agate mortar; and if any doubt exists, the application of a drop of nitric acid will speedily show the difference by its action on the silver, while it produces no effect on gold.

* When we wish to know if silver exists in an ore of lead, it is unnecessary to add any metallic lead to the assay.

THE

BLOWPIPE CHARACTERS OF MINERALS.

Acmite, bacillary (Th.* 479).—Rundemyr, Norway. Hardness nearly = 6·0; streak whitish. In the forceps fuses readily and quietly into a brilliant black globule. No water. With borax fuses very slowly, and tinges glass with iron.

Actinolite (*Vide* **Hornblende**).—Glen Elg, Scotland. In the forceps fuses rather slowly into a dark green globule. No water. With borax emits a few bubbles, and fuses rather readily into a glass, coloured by iron while warm.

Actinolite, asbestiform.—Haytor, Devonshire. Fuses into a black globule, feebly magnetic. With borax slowly soluble.

Actinolite, glassy (Th. 196; Al.† 145).—Asbestos Strahlstein of Werner. Zillerthal, Tyrol. Hardness = 5·3. Streak white. In the forceps becomes whitish, and fuses quietly but slowly on the edge into a greyish bead, and a small fragment forms a globule with difficulty; in the inner flame it effervesces and intumesces much. No water. With borax it fuses rather slowly into a glass, coloured by iron while warm.

Æschynite.—Miask, Siberia. Hardness = about 5·5; yields with difficulty to the knife; streak pale yellow; translucent in the fragments; does not scratch glass. In the forceps intumesces suddenly, and becomes yellow; it then fuses into a dull iron-black globule, not magnetic. Contains a little water. With borax dissolves into a clear glass, slightly coloured by iron while warm. No manganese with nitre.

Note.—Could not detect titanium by fusing it with bisulphate of soda and adding tin.

Albin, crystallized (*Vide* **Apophyllite**). (Th. 352; Al. 130).—Aussig, Bohemia. Yields easily to the knife. In the forceps fuses on the surface slowly, with slight effervescence scarcely perceptible, into a rough blebby enamel, but does not form a bead. Contains much water. With borax effervesces at first, and fuses rather slowly into a colourless glass, which does not become opaque by flaming even when saturated; with acetate of cobalt becomes blue.

Allagite (*Vide* **Rhodonite**).—Schelenholz, in the Hartz. Hardness = 5·5; streak white. In the forceps fuses readily on the edge, with some effervescence, into a greyish blebby glass. No water. With borax emits some bubbles; dissolves slowly, and in the outer flame indicates manganese.

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* Outlines of Mineralogy, Geology, and Mineral Analysis. By Thomas Thomson, M. D. 2 vols. 8vo. London, 1836. The references are to vol. i.

† Manual of Mineralogy. By Robert Allan. 1 vol. 8vo. Edinburgh, 1834.

[**Allanite**.—In forceps fuses readily into a black bead; with borax dissolves readily into a transparent bead coloured with iron; with salt of phosphorus fuses into a transparent bead coloured with iron; on adding nitre, the bead becomes semi-opaque when cold, pearl-grey colour.—Ed.]

Allochroite (*Vide* **Garnet**). (Th. 147; Al. 201).—Virums Iron Works, near Drammen, Norway. Resists the knife. In the forceps fuses readily into a brilliant black globule, not magnetic. No water. With borax emits a few bubbles; and fuses rather slowly into a glass, coloured by iron.

Allophane (Th. 243; Al. 73).—Moldawa, Banat. Of pale bluish-green colour. Yields easily to the knife; streak white. In the forceps becomes white; colours the flame behind the assay green for a long time; and, in a good blast, fuses on the edge into a white enamel. With cobalt it becomes blue. Contains much water. With borax effervesces a little at first; and dissolves rather readily into a clear glass of a pale blue colour when cold. Does not gelatinize in nitric acid. Mr. Allan says, "in acid it gelatinizes."

Alumina, Hydrated (*Vide* **Diaspore; Gibbsite**). (Th. 221; Al. 307).—Richmond in Massachusetts, N. America. Yields easily to the knife. In the forceps is infusible; becomes very white. Contains much water. Infusible with borax; with cobalt a beautiful blue. Extremely rare.

Amphibole, Foliated (*Vide* **Hornblende**). (Th. 198; Al. 145).—Arendal, Norway. Hardness = 4·5. Streak greenish. In the forceps fuses readily into a shining black globule, not magnetic, with scarcely any effervescence. No water. In borax emits a few bubbles; colours the glass with iron; and dissolves rather slowly. No manganese.

Amphodelite (*Vide* **Anorthite**).—(Th. 269).—Lojo, Finland. Hardness about = 4·5; streak white. In the forceps it whitens and effervesces a little; some parts of it fuse more readily, and with more effervescence than others, into a white blebby bead, rendered transparent in a stronger heat. No water. With borax emits a few bubbles at first, and fuses slowly into a colourless glass. No manganese.

Analcime (Th. 337; Al. 115).—Downhill, Londonderry. Hardness about = 5·5; scarcely yields to the knife. In the forceps when gently heated it becomes white and opaque, and fuses rather slowly into a colourless globule, slightly vesicular. [Very fusible; glassy bead; flame indicates much soda.—Ed.] Contains water. With borax dissolves rather slowly into a colourless glass. Does not gelatinize with nitric acid. It becomes so transparent when strongly heated with the borax, that it appears to dissolve quicker than it really does.

Anatase (*Vide* **Brookite; Rutile**). (Ph.* 253).—Dauphiné. Hardness = 5·3; streak white. In the forceps it is infusible. With borax it dissolves slowly; when a very small proportion is dissolved, the glass is transparent and colourless when warm, on cooling it becomes reddish amethyst colour by transmitted light, and muddy reddish by re-

* An Elementary Introduction to Mineralogy. By William Phillips. Fourth Edition, by Robert Allan. 1 vol. 8vo. London, 1837.

flected light; in the reducing flame it becomes opaque, and the reflected colour is darker when cold, and the transmitted colour has a bluer shade. It cannot be rendered colourless in the inner flame, like Brookite; a little nitre discharges the colour. With salt of phosphorus it dissolves with great difficulty; the glass is yellow while warm, pale amethyst colour when cold.

Anatase.—Wheal Virtuous Lady, Tavistock, Devonshire. Hardness = 5·0 –5·5; streak white. In the forceps infusible. With borax fuses rather readily, and appears as if coloured by iron in the oxidating flame; in the reducing flame it becomes brown; its transparency may be restored in the outer flame, and it becomes opaque by flaming.

Andalusite, massive (*Vide* **Chiastolite**). (Th. 231; Al. 164).—Lugduff mountain, near Luganure, County Wicklow. Resists the file; hardness about 7·5. In the forceps it is infusible, but becomes white; with nitrate of cobalt it becomes blue; and with borax it is nearly infusible.

Anorthite (*Vide* **Amphodelite**). (Th. 296; Al. 138).—Vesuvius. Brittle; resists the knife. In the forceps fuses on the edge into a very transparent glass; a small thin fragment may be fused into a globule. No water. With borax it fuses slowly into a colourless glass.

Anthophyllite (*Vide* **Hornblende**). (Th. 206; Al. 107).—Hardness about = 5·5; streak white. Fuses with some difficulty on the edge. No water. With borax fuses very slowly into a glass, coloured with iron.

Anthophyllite, lamellar (Th. 206; Al. 107).—Ujordlersoak, Baffin's Bay. Hardness = 5·5. Streak white. In the forceps fuses on the edge, with some intumescence and effervescence, into a greenish glaze; a small fragment forms a bead. No water. With borax emits a few bubbles, and fuses slowly into a glass coloured slightly by iron.

Antimony, nickeliferous sulphuret of.—Gozenbach, Siegen. Hardness = 5·0. Powder dark iron-grey. On charcoal it emits some white fumes, with slight pungent odour, and fuses readily into a black bead, not magnetic; it is brittle, and breaks with metallic lustre. This bead, fused with borax, colours it deep blue in the outer flame, and alloys with the platina wire, in the inner flame the blue colour is changed into a brownish amethyst shade.

Antimony, red (Ph. 347; Th. 87).—Hungary. Yields very easily to the knife, streak dark red. Heated on charcoal it fuses speedily into a black vitreous mass; emits fumes of sulphurous acid; is entirely volatilized; and deposits a white sublimate on the charcoal. Hydrosulphuret of ammonia added to the sublimate converts it into an orange-yellow colour.

Antimony, sulphuret of (Ph. 345, Th. 86).—Felsobanya, Hungary. Yields very easily to the knife. Streak dark grey. On charcoal fuses very readily into a black vitreous mass, emits fumes of sulphurous acid, and then deposits a white sublimate on the charcoal, and is entirely volatilized.

Antimony, sulphuret of, compact variegated.—Golderonach, near Bayreuth, Franconia. Decrepitates violently when heated; but when reduced to powder and moistened, it affords same pyrognostic character as the last.

Antimony, white (Ph. 348; Th. 83).—Very rare. Yields very easily to the knife. Heated on charcoal, it decrepitates a little; fuses speedily into a fluid globule; volatizes without odour, and deposits white sublimate. On the charcoal a drop of hydrosulphuret of ammonia added to the white sublimate converts it to an orange-yellow colour after a few minutes.

Apatite (*Vide* **Asparagus Stone, Lime, Phosphate of**). (Th. 124; Al. 27).—Ehrenfriedersdorf, Saxony. In the forceps fuses with some difficulty on the edge. No water. With borax fuses very slowly into a colourless glass, which becomes opaque by flaming, when only a small quantity of the assay is dissolved.

[**Apatite.**—Dalkey. In the forceps infusible, glows brilliantly. With borax, dissolves slowly; bead clear in reducing flame, becomes opaque in the ordinary flame, and coloured by manganese.—Ed.]

Apophyllite (*Vide* **Albin**). (Th. 352; Al. 129).—Karartut, Disko Island, Greenland. Hardness about = 5·0. In the forceps, at a low heat, it becomes white, exfoliates, intumesces much, and fuses readily with effervescence into a blebby globule, colourless. Contains much water. With borax it effervesces at first, and fuses readily into a colourless glass, which, when saturated, I could not render opaque by flaming. Berzelius says it becomes opaque by flaming. With acetate of cobalt it melts into a blue glass; reduced to powder, it gelatinizes with nitric acid.

Arendalite (*Vide* **Epidote**). (Th. 364; Al. 150).—Arendal, Norway. Resists the knife. In the forceps intumesces and effervesces, and fuses into a scoria, which, in a strong heat, is converted into a shining black globule, not magnetic. Contains no water. With borax fuses readily into a glass coloured by iron.

Arragonite.—Kanniok, Greenland. Effervesces briskly with muriatic acid. In forceps does not fall to powder; infusible. No water. With borax dissolves speedily.

Arragonite, fibrous.—Cornwall. With nitrate of potash gives indication of manganese. Contains 1·03 per cent. of manganese.

Arragonite, macled (Th. 117; Al. 30).—Molina, Arragon, Spain. Effervesces briskly with muriatic acid. In the forceps it becomes white, falls to powder immediately on being heated, and is infusible. Contains no water. With borax it fuses speedily with much effervescence into a colourless glass, which becomes opaque by flaming if a larger portion be added.

Arsenic, native (Ph. 280; Th. 79).—Idria, Carniola. Its fresh fracture presents a tin-white appearance, but it very soon tarnishes on exposure to the air. Hardness about = 3·5. Streak metallic. Heated on charcoal, it emits copious greyish fumes of strong arsenical odour, and is entirely volatilized.

Arsenic, red sulphuret of (*Vide* **Realgar**). (Ph. 281; Th. 81).—Transylvania. Soft, brittle. Streak orange-yellow. On charcoal it burns with a bluish flame; emits copious sulphureous fumes, and a slight odour of arsenic.

Arsenic, yellow sulphuret of (*Vide* **Orpiment**). (Ph. 283; Th. 82).—Transylvania. Very soft. Powder bright yellow. On charcoal it burns with a bluish flame, emits fumes of sulphurous acid, and is entirely volatilized.

Arsenical Iron (Ph. 213).—Faithleg, Waterford. Hardness = 6. On charcoal it emits copious arsenical fumes, and fuses readily into a magnetic bead.

Arsenical Iron (Ph. 213).—Haytor Mine, Devonshire. Yields with some difficulty to the knife. Hardness = 5·5. Heated on charcoal, it emits copious arsenical fumes, and melts into a shining porous gray globule, attracted by the magnet.

Arsenical Iron.—Johanngeorgenstadt, Saxony. Hardness about = 5·5; streak shining; powder greyish-black. On charcoal it very soon emits fumes of arsenic, and becomes magnetic; it forms a bead with difficulty, even in the forceps.

Arsenical Iron, massive.—Hardness = 5·5; streak greyish-black. On charcoal it emits arsenical fumes readily and copiously, and fuses into a dark grey irregular scoria, which is magnetic; and when transferred to the forceps, forms a bead with difficulty. Does the difficulty of forming a bead by fusion depend on its containing less sulphur than other specimens?

[**Asbestus** (*Vide* **Hornblende**).—In the forceps fuses readily into a yellow-coloured opaque bead, with a narrow neck. No water. With borax dissolves readily into a colourless transparent bead. With microcosmic salt dissolves slowly, and leaves no siliceous skeleton.—Ed.]

Asparagus Stone (*Vide* **Apatite**).

Augite, black (*Vide* **Pyroxene**). (Th. 190; Al. 143).—Arendal, Norway. Hardness nearly = 5·0; streak greenish. In the forceps fuses rather readily into a black bead. No water. With borax very slowly soluble.

Augite, black.—Ersby Pargas, Finland Hardness near = 5·0; streak white. In the forceps in the inner flame fuses on the surface into a dark green glass, and forms a bead very slowly. No water. With borax emits a few bubbles, colours the glass with iron, and is very slowly soluble.

Augite, white (*Vide* **Pyroxene**). (Th. 187).—United States. Hardness = 5·0. In the forceps effervesces and intumesces, and fuses readily into a colourless blebby globule. No water. With borax dissolves partly at first, and leaves a residue very slowly soluble.

[The Augites dissolve in borax somewhat more easily than the Hornblendes; and in the forceps show slight traces of soda.—Ed.]

Axinite (Th. 367; Al. 191).—Dauphiné. Resists the knife. In the forceps it fuses readily, with much intumescence and effervescence, into a dark green shining globule. No water. With borax it breaks up and dissolves readily into a transparent glass, coloured by iron; with nitrate of potash it indicates the presence of manganese.

Barytes, crystallized carbonate of (Th. 101; Al. 47).—Cumberland. Effervesces feebly with nitric acid, unless when scraped, and is entirely soluble in it. In the forceps decrepitates, and fuses readily into a very fluid globule, transparent while hot, white and opaque when cold, and tinges the flame behind the assay pale greenish-yellow. With borax fuses rapidly, with effervescence, into a glass opaque when cold, if saturated with the assay.

Barytes, carbonate of (Th. 101; Al. 47).—Yorkshire. Does not effervesce with acid, unless when scraped. Hardness = 3·0. In the forceps fuses readily, *without decrepitation*, and in other respects its characters are the same as the preceding.

Barytes, sulphate of.—Hardness about = 3·5. In the forceps fuses quietly into an opaque bead, white. No water. With borax fuses quietly, and rather readily, into a colourless glass.

Barytes, sulphate of.—Does not effervesce with acid; decrepitates violently. Tinges the flame behind the assay greenish-yellow, and fuses into a white enamel. No water. With borax dissolves with continued effervescence. The effervescence with borax is probably due to the presence of some carbonate of barytes.

Barytes, sulphate of.—Glenmalure, Co. Wicklow. Does not decrepitate; fuses into a white enamel.

Barytes, sulphate of.—Isle of Sheppey. Decrepitates; colours the flame greenish-yellow; fuses into a white bead. With borax dissolves readily.

Barytes, sulphate of (Th. 103; Al. 48).—From Transylvania. Decrepitates very slightly.

Barytocalcite (of Brooke). (Th. 140; Al. 50).—Cumberland. Hardness = 3·5. Effervesces feebly with nitric acid. Decrepitates in the flame of a candle, and fuses with difficulty into a rough mass of a pale bluish-green colour. With borax effervesces much.

Barytocalcite.—Alston Moor, Cumberland. Effervesces with acid. Tinges the flame pale yellowish-green, and in a strong heat it glazes a little on the surface, and becomes pale bluish-green. With borax effervesces much, and dissolves speedily. See the latter part of Mr. Allan's observations on Barytocalcite.

Berthierite (Ph. 344; Th. 498).—Bräunsdorf, near Freiberg, Saxony. Hardness about = 3·0, or 3·5; streak dark grey. Heated on charcoal, it fuses (but not so speedily as grey antimony), emits sulphurous acid fumes, deposits a white sublimate on the charcoal, and is not entirely volatilized. A dull black globule remains, which is attracted by the magnet; when broken, a fragment of this globule fused with borax indicates iron.

Bismuth Cobalt ore (Ph. 287; Th. 534).—Bieber, Hesse. Hardness = 5·5; streak metallic, powder dark grey. Gently heated on charcoal, it emits small globules; and when the heat is increased, gives off arsenical fumes, and then fuses into a dark bead rather slowly, which is feebly magnetic. A portion of the roasted assay colours borax deep blue.

Bismuth, cupreous sulphuret of (Ph. 278).—Cornwall. Sectile, streak tin-white. The instant it is heated, it emits white globules, sulphurous acid fumes, and, after intense roasting, a bead of pure copper; said to be found only at Wittichen.

Bismuth, native (Ph. 276; Th. 588).—St. Just, Cornwall. Sectile, streak shining. Heated on charcoal, it fuses instantly, and is entirely volatilized, depositing a yellowish sublimate on the charcoal; the colour of the sublimate is much darker while it is warm.

Bismuth, sulphuret of (Ph. 277; Th. 588).—Cornwall. Yields to the nail. Fuses readily; emits sulphurous acid smell, and is only partly volatilized; leaves a bead, which is magnetic.

Bismuth, sulphuret of (Ph. 277; Th. 589).—Lanescot Mine, Cornwall. Yields to the nail, powder dark grey, brittle. Heated on charcoal, it fuses readily into a bead, brilliant while warm, emits slight smell of sulphurous acid; is entirely volatilized, and deposits a sublimate, yellow while warm.

Blende (Ph. 371).—Luganure Mine, county of Wicklow. Hardness = 4·5. In the forceps decrepitates at first, and fuses on the edge. No water. With borax it is slowly soluble.

Bluespar (*Vide* **Lazulite**). (Th. 311).—Krieglach, Upper Styria. Yields with difficulty to the knife; streak white. In the forceps becomes white, and fuses on the edge, in a good heat, into a white enamel. Contains a trace of water. With borax effervesces a little at first, and fuses into a clear glass, slightly coloured by iron; with acetate of cobalt becomes deep blue.

Bole.—Benevenagh, Derry. Sectile, streak unaltered; marks paper faintly; does not adhere to the tongue; does not fall to pieces in water. In the forceps fuses rather readily, with slight effervescence into a dark greenish bead. Contains a good deal of water. With borax fuses rather slowly, and colours the glass with iron while warm.

Bole.—Giant's Causeway. Scratched by the nail, streak shining; marks paper strongly; adheres slightly to the tongue, and falls to pieces in water. In the forceps decrepitates, and in a good heat fuses on the edge into a black glass, not magnetic. Contains a good deal of water. With borax dissolves slowly; no manganese. Is Dr. Thompson's plinthite a variety of bole?

Bonsdorffite (*Vide* **Fahlunite**). (Th. 278 and 323).—Bodenmais, Bavaria. Translucent; yields to the knife. Hardness about = 3·5; streak white. In the forceps fuses on the edge into a greyish glass. Contains some water. With borax fuses rather slowly into a transparent glass.

Boracite (Th. 161; Al. 194).—Lüneburg, Hanover. Resists the knife. In the forceps intumesces, effervesces, and colours the *flame green* behind the assay, then fuses into an opaque yellowish-white bead. No water. With borax fuses into a transparent bead, slightly coloured by iron.

Borosilicate of Lime (*Vide* **Datholite**) (Th. 144; Al. 111).—Nodobröe, near Arendal, Norway. Rather hard; yields to the knife. In the forceps becomes white and opaque, and fuses readily, with slight intumescence and effervescence, into a transparent colourless globule, rather fluid, and tinges the flame behind the assay green. *This globule becomes opaque by flaming.* No water. With borax effervesces at first, and dissolves speedily into a colourless glass.

Botryolite (*Vide* **Datholite**). (Th. 144; Al. 111).—Arendal, Norway. Yields rather easily to the knife. In the forceps becomes white; intumesces slightly; tinges the flame green behind the assay, and fuses very readily into a globule perfectly transparent and colourless. No water. With borax dissolves readily into a clear glass.

Bournonite (Ph. 352; Th. 624).—Kapnik, Transylvania. Yields easily to the knife; streak dark grey. On charcoal, if gently heated, it fuses very readily into a dark-coloured globule, brilliant while warm; deposits on the charcoal a white sublimate in small quantity; it then disengages white fumes, which have a weak smell of sulphurous acid. In a stronger heat, it deposits a yellowish coating on the charcoal; and if the dark-coloured bead be roasted for a considerable time, a small globule of pure copper will remain, which is not equal in size to one-fourth of the assay, so that it is volatile in large proportion. This specimen appears to me to contain very little antimony, certainly much less than analysts have generally found.

Breunnerite (Th. 180; Al. 38).—Zillerthal, Tyrol. About as hard as fluor-spar. Does not effervesce with muriatic acid, even when scraped. In the forceps becomes black and magnetic, and is infusible. No water. With borax effervesces, briskly at first, and fuses speedily into a glass coloured by iron.

Brewsterite (Th. 347; Al. 128).—Strontian, Scotland. In the forceps whitens, exfoliates, curls up, and fuses rather slowly into a colourless blebby glass. Contains water. Fuses very speedily with borax.

[**Bronzite** (*Vide* **Pyroxene**).—In the forceps fusible with great difficulty on the edges. Dissolves in borax, like Coccolite, into a bead coloured by iron.—Ed.]

Brookite (*Vide* **Anatase; Rutile**). (Ph. 256).—Resists the knife. Hardness = 7·0. In the forceps infusible. With borax it fuses very slowly; the glass is transparent while hot; when cold, it is brick-red by reflected light, and a reddish amethyst colour by transmitted light, according to the degree of oxidation; a minute proportion produces these effects; in the reducing flame it becomes transparent, and remains so when cold, and may be rendered opaque again by careful management of the flame; nitre destroys the amethyst colour. With salt of phosphorus it becomes opaque, but requires a very intense and prolonged heat to dissolve it; the glass is opaque while hot; then becomes transparent olive-green, then blackish; and when perfectly cold, an amethyst colour by transmitted light.

Bucholzite (*Vide* **Kyanite**). (Th. 234; Al. 204).—Chester, on the Delaware, near Philadelphia. About as hard as quartz. In the forceps infusible in the smallest fragments. Contains no water. Infusible with borax; with nitrate of cobalt it becomes pale blue.

Buntkupfererz (*Vide* **Purple Copper**), (Ph. 310; Th. 662).—Alten Mines, Finmark. Its characters are very similar to purple copper. It bubbles a little while flaming.

Bustamite (*Vide* **Rhodonite**). (Th. 518).—Mexico. Hardness = 6·0; streak white. In the forceps at a low heat it blackens, and fuses slowly into a brilliant black enamel, forming a bead with difficulty. A trace of moisture. With borax dissolves readily, with some effervescence, into a glass of a reddish-purple colour.

The greenish radiated part is of hardness = 6·0. In the forceps fuses readily into a transparent globule of a pale brown colour, and effervesces a little while fusing. A trace of moisture. With borax dissolves rather readily, with effervescence, into a glass of a deep amethyst colour.

Calaite (*Vide* **Turquoise**). (Th. 230; Al. 157).—Abdool Razakee Mine, Persia. Scarcely yields to the knife; streak white. In the forceps becomes brown, and tinges the flame green behind the assay, but it is infusible. Gives out much water. With borax fuses rather readily into a glass coloured by iron.

Calaite.—Oelsnitz, Saxony. Hardness near = 5·0; streak white. In the forceps tinges the flame pale green; becomes white, and infusible. Contains a good deal of water. With borax dissolves not very readily.

Calamine, Botryoidal electric.—Nertschinsky, Siberia. Hardness = 4·5; streak white; effervesces with nitric acid, particularly if scraped. On charcoal it is infusible; in a low heat it cracks and becomes yellow; in a stronger heat, it becomes nearly black, and the charcoal is covered with a powder which is yellow while warm. No water. With borax it emits bubbles, and dissolves readily into a glass, yellow while warm, colourless when cold.

Cerite (Ph. 262; Th. 415).—Bastnäs, in Sweden.

Cerite. Hardness = 5·0; streak white. In the forceps scintillates a little, becomes pale buff-yellow, and is infusible. A trace of moisture. With borax it effervesces at first, and dissolves rather slowly into a glass, of a deep umber colour while warm, then passes into a pale green, and is nearly colourless when cold; the glass becomes milky by flaming, if a large proportion of the assay be used.

Cerine. Colour black, hardness = 5·0; streak greyish. In the forceps fuses rather readily, with slight ebullition, into a black shining glass, not attracted by the magnet. A trace of moisture. With borax it effervesces, and dissolves rather readily into a glass, reddish while hot; greenish, as if coloured by iron, when cold. It becomes opalescent by flaming when nearly saturated.

Chabasite (Th. 333; Al. 118).—Yields rather easily to the knife; streak white. In the forceps becomes white; intumesces much, and fuses with slight effervescence into a white blebby globule. Contains much water. With borax it dissolves speedily, with slight effervescence, into a colourless glass. Does not gelatinize in nitric acid, even when heated.

Chabasite.—North of Ireland. Yields easily to the knife. In the forceps becomes white; intumesces much; and fuses into a white blebby bead. Contains much water. With borax effervesces a little, and dissolves readily.

Chalilite (*Vide* **Thomsonite**). (Th. 324).—Benevenagh, Derry. Resists the knife. Hardness about = 5·5 ; translucent on the edge. In the forceps fuses quietly, and rather readily, into a transparent, colourless bead, slightly blebby. Contains much water. With borax it fuses rather readily into a glass, slightly coloured by iron while warm, and leaves a small skeleton, which dissolves slowly.

Chalcolite (Ph. 270).—Wheal Bassett, near Gwennap, Cornwall. Hardness = 2·5–3·0 ; streak pale green. In the forceps becomes pale green, and fuses readily, with some ebullition and intumescence, into a black semi-vitreous globule; colours the flame pale green. Contains much water. With borax it dissolves readily into a glass, green by transmitted light, reddish by reflected light.

Chiastolite (*Vide* **Andalusite**). (Al. 160).—Hof Bayreuth, Germany. Sectile. In the forceps, at a low heat, it becomes dark grey, and in a stronger heat it becomes white, and fuses on the edge into a white blebby glass; with acetate of cobalt, fuses into a blue frit. Contains a good deal of water. With borax it dissolves slowly into a colourless glass.

Childrenite (Al. 39).—Tavistock, Devonshire. Hardness about = 4 ; powder white. In the forceps the crystals separate, become black, and fuse into a black globule, attracted strongly by the magnet. Contains water. With borax dissolves rather readily.

Chlorite.—Glandore, Co. Cork. Sectile; streak greenish. In the forceps partly falls to pieces, and fuses into a dull black globule, feebly magnetic. Trace of moisture. With borax effervesces at first, and fuses speedily into a glass, deeply coloured by iron.

Chlorite, crystallized.—Marazion, Cornwall. Sectile. In the forceps the laminæ diverge a little ; it fuses quietly into a dull black magnetic bead. Some water. With borax it effervesces at first, and fuses speedily into a glass, coloured deeply by iron.

Chloropal.—Unghwar, Hungary. Yields to the nail. In the forceps it blackens, becomes magnetic, and is infusible. Contains a little water. With borax dissolves readily. No manganese.

Chondrodite (Th. 183 ; Al. 193).—Sussex County, New Jersey, North America. Hardness about = 4·5; streak white. Infusible. No water. With borax dissolves rather slowly into a glass coloured by iron while warm.

Chromate of Iron (Ph. 275 ; Th. 482).—Shetland. Hardness = 5: streak pale brown. Infusible; does not become magnetic. With borax dissolves very slowly, and colours the glass green; the intensity of the colour increases as the glass cools.

Chromiferous Iron Ore (Ph. 275).—Croagh Hay, Croaghpatrick mountain, Mayo. Streak pale brown. In the forceps infusible. A trace of moisture. With borax it dissolves slowly; the glass is coloured bottle-green while warm, and when cold it becomes rich grass-green. It is attracted freely by the magnet.

Chrysocolla (Ph. 322; Th. 619).—Ogancos, Chili. Translucent on the edge. Yields easily to the knife; streak nearly white. Does not effervesce with cold muriatic acid; partly soluble in warm muriatic acid, leaving a white residuum. In the forceps it blackens, and the flame behind the assay is coloured green; in a stronger heat it becomes a reddish-brown, and cracks on the surface, but does not fuse. Contains a good deal of water. With borax it fuses readily, with effervescence, into a glass, green while warm, blue when cold.

Cinnabar (Th. 634).—Idria, in Carniola. Hardness = 2·0; streak red. On charcoal it burns with a blue flame, emits the smell of sulphur, and is entirely volatilized.

Cinnabar, hepatic.—Idria, in Carniola. Hardness = 2·0; streak brown. On charcoal it emits slight smell of sulphur, and is volatilized, with the exception of a carbonaceous residue.

Cinnamon stone (*vide* **Garnet**). (Th. 265; Al. 201).—Colombo, Ceylon. Hardness about equal to quartz. In the forceps fuses rather easily into a translucent green bead, not magnetic. With borax it effervesces a little at first, and fuses rather slowly into a clear glass, faintly coloured by iron while warm.

Cobalt Bloom (Ph. 289; Th. 535).—Schneeberg, Saxony. Hardness = 2·5; streak nearly white. On charcoal, when first heated, it becomes blue, then fuses readily, with some arsenical odour, into a black bead, which in a stronger heat spreads on the charcoal, and forms a scoria, which is infusible. Contains much water. A minute portion of the scoria, fused with borax, colours it deep blue. In the open tube gives off water, but no sublimate.

Cobalt Glance (Ph. 284; Th. 537).—Modum, Norway. Hardness = 5·5; streak grey. Heated on charcoal, it decrepitates feebly; at first it disengages a weak smell of sulphurous acid, then fumes of arsenic, and requires an intense heat to fuse it into a dark globule, which is feebly attracted by the magnet; a very minute fragment of the fused assay, dissolved in borax on platina wire, communicates to it a deep purple colour.

Cobalt, Goose-dung (Ph. 306).—Allement, Dauphiné, France. Soft. On charcoal it becomes black; gives off slight arsenical fumes, and fuses slowly into a dark-coloured bead, very feebly magnetic; a fragment of the bead colours borax deep blue. Contains much water. Thompson, at page 535, mentions yellow and brown cobalt ochres. This is the "Gänseköthig-erz," of the Germans.

Cobalt, massive grey (Ph. 286; Th. 533).—Bieber, Hesse. Hardness 5·5; streak shining; powder nearly black. On charcoal emits copious arsenical fumes, and leaves a small black globule, magnetic. A minute fragment colours borax deep blue.

Cobalt, massive tin white (Ph. 286; Th. 533).—Schladming, Styria. Hardness = 5·5; streak shining; powder grey. Emits copious arsenical fumes on charcoal, and fuses readily into a black globule, feebly magnetic. A minute fragment of the roasted globule colours borax deep blue.

Cobalt, Slickensides, sulphuret of.—Hardness = 5·0; powder-black. On charcoal it decrepitates violently. Does not contain any water. Reduced to fine powder, and moistened, it may be fused rather readily, on charcoal, into a black globule, very feebly magnetic. Before fusing it emits fumes of sulphurous acid and weak arsenical fumes. A minute fragment of the bead colours borax deep blue.

Cobalt, tin-white (P. 286; Th. 533).—Bieber, Hesse. Hardness = 5·0; streak shining; powder grey. On charcoal speedily emits fumes of arsenic, and fuses readily into an iron-grey globule, not magnetic. A minute portion of the fused globule colours borax a deep blue.

Cobalt, tin white (Ph. 286; Th. 533).—Wittichen, Baden. Emits copious arsenical fumes, and fuses into a globule which is magnetic; in other respects same as last.

Coccolite (*Vide* **Pyroxene**). (Th. 190; Al. 143).—Arendal, Norway. Yields with some difficulty to the knife. In the forceps fuses on the edge, with effervescence, into a greenish translucent glass. No water. With borax it is very slowly soluble. A minute fragment forms a bead.

Colophonite (*Vide* **Garnet**). (Th. 147; Al. 200).—Arendal, in Norway. Resists the knife. In the forceps fuses readily, with much intumescence and effervescence, into a shining dark-brown globule, not magnetic. No water. With borax breaks up, and fuses readily, with slight effervescence, into a glass, deeply coloured by iron. Contains some manganese.

Columbite (*Vide* **Tantalite**). (Ph. 272; Th. 484).—Resists the knife. Decrepitates in the flame of candle in a strong heat; glazes on the edge. Some moisture. With borax emits a few bubbles; breaks up into minute greenish fragments, and dissolves slowly into a glass, coloured by iron, which, if saturated, becomes greyish-opaque by flaming. No manganese or tungsten.

Copper, acicular muriate of (Ph. 325).—Bemolinos, Chili. Streak greenish-white. On charcoal it decrepitates; powdered and moistened, it colours the flame green and blue, and is reduced readily to metallic grains. Contains much water.

Copper, antimonial grey.—Crinnis Mine, Cornwall. Yields easily to the knife; brittle. On charcoal it decrepitates violently, but when reduced to a fine powder, and moistened, it fuses readily, with some ebullition and scintillation, into a dark scoriaceous bead, attracted feebly by the magnet. While fusing it emits sulphurous acid fumes, and deposits a white powder, which becomes orange when moistened with hydro-sulphuret of ammonia. It is scarcely reducible *per se* on charcoal, but with carbonate of soda it soon yields a malleable globule.

Copper, black oxide of (Th. 318; Ph. 598).—Knockmahon Mines, Waterford. Yields to the nail; soils. On charcoal emits some sulphurous fumes, and fuses readily, with some ebullition, into a dark grey globule, not magnetic, and when well roasted it yields a bead of copper. It contains some water.

Copper, blue carbonate of (Ph. 319; Th. 618).—Chessy, near Lyons, France. Yields easily to the knife; hardness about = 4; streak pale blue. It effervesces with muriatic acid, particularly when scraped. On charcoal it blackens, then fuses rather readily, with some ebullition, into a dark-grey bead, which consists of red oxide of copper, as is evident by powdering it; and, when well roasted, a globule of pure copper is obtained. It contains some water. It is not so readily reduced as the red oxide.

Copper, fibrous green carbonate of (Ph. 320; Th. 602).—Knockmahon Mines, Waterford. Yields easily to the knife; streak pale green. Effervesces with muriatic acid. On charcoal it blackens, and fuses quietly into a bead, which affords metallic copper much sooner than the blue carbonate. It contains a good deal of water.

Copper Glance (Ph. 308; Th. 599).—Botallack mine, Cornwall. Sectile. On charcoal fuses readily, with some ebullition and scintillation, into a dark grey bead, not attracted by the magnet. While fusing it emits slight smell of sulphurous acid; and when well roasted, a globule of metallic copper will be found on breaking the assay.

Copper, massive Vitreous Sulphuret of (*Vide* **Copper Glance**), (Ph. 388; Th. 599).—Knockmahon Mines, Co. Waterford. Sectile; powder black. On charcoal fuses readily, with some ebullition and scintillation, into a dark grey globule, feebly attracted by the magnet. Gives off slight sulphurous smell; and when roasted, a globule of copper will be found on breaking the assay.

Copper, oblique prismatic arseniate of (Ph. 331).—Cornwall. Streak bluish-green. On charcoal it melts very speedily into a fluid mass; emits smell of arsenic, and gives a bead of copper when well roasted. It contains water.

Copper, octohedral arseniate of (Ph. 329).—Ting Tang, Cornwall. Yields easily to the knife; streak nearly white. On charcoal, at a low heat, it becomes green, then black, and fuses into a black scoria; disengages a slight smell of arsenic; and when well roasted, it yields grains of copper. Contains much water.

Copper ore, grey.—Gross Kogel, Tyrol. Brittle; yields easily to the knife; colour of cut surface bright lead grey. On charcoal it decrepitates violently, but when reduced to a fine powder and moistened, it fuses readily, with some ebullition and scintillation, into a dark scoriaceous bead, attracted feebly by the magnet. While fusing, it emits sulphurous acid fumes, and deposits a white powder, which becomes orange when moistened with hydro-sulphuret of ammonia. It is scarcely reducible *per se*, or charcoal, but with carbonate of soda it soon yields a malleable globule. In the open tube it decrepitates, emits acid fumes, and deposits a white powder, which becomes orange with hydro-sulphuret of ammonia.

Copper, phosphate of (Ph. 327).—Liebethen, Hungary. Yields easily to the knife; streak greenish. On charcoal it fuses readily, with ebullition, into a dark shining bead, which, when well roasted, emits a flash of light; when congealing, it then yields a bead of copper. Contains a little water.

Copper, plush-like Arseniate of (Ph. 332).—Cornwall. On charcoal it speedily fuses, with ebullition, into a fluid mass; emits copious fumes of arsenic, and is very soon reduced into a metallic bead. Contains a trace of water.

Copper, purple (*vide* **Buntkupfererz**). (Ph. 310; Th. 622).—Moldawa, Banat. Brittle, sectile; colour of cut surface, pale copper-red. On charcoal it fuses readily, without ebullition, into a dark grey globule, attracted by the magnet. While fusing, it emits a sulphurous smell; and when well roasted, a globule of copper.

[**Copper pyrites.**—Roasted on charcoal, forms a globule readily, which, when dissolved in borax, adding nitre, proves the presence of abundant iron, by the green colour of the bead when warm; and of copper, by its intense blue when cold.—Ed.]

Copper, red oxide of (Ph. 316; Th. 598).—Cornwall. Hardness about = 4; streak red. On charcoal it fuses readily, and is speedily reduced. In the forceps it colours the flame green, and is reduced.

Copper, rhomboidal arseniate of (Ph. 330).—Cornwall. On charcoal it decrepitates, and is reduced to very minute scales; but if very slowly heated, it fuses into a dark scoria. Emits some arsenical odour; and when well roasted, it yields grains of copper. No water.

Copper, right prismatic arseniate of (Ph. 332).—Cornwall. Streak nearly white. On charcoal emits smell of arsenic; fuses readily into a fluid mass, and is very soon reduced into a metallic globule. No water.

Cork, mountain (*Vide* **Hornblende**). (Th. 208; Al. 147).—In a low heat it becomes orange-red, and fuses readily, with very slight effervescence, into a shining black bead. Contains some water. With borax fuses readily into a clear glass, coloured by iron. No manganese.

Corundum (*Vide* **Emery**) (Th. 211; Al. 167).—East Indies. Scratches steel readily. In the forceps it is quite infusible. Almost infusible with borax. Heated with solution of nitrate of cobalt, it becomes blue.

Corundum, crystallized.—Mozzo, in Piedmont. Scratches topaz. In the forceps it becomes white, and is infusible. With nitrate of cobalt it becomes blue. Contains a trace of water, and is almost infusible with borax.

Crucilite (Th. 435).—Clonmel, Co. Tipperary. It is soft. In the forceps fuses on the edge into a grey glaze, and becomes highly magnetic. It contains a good deal of water. The crucilite is decomposed arsenical iron.

Cryolite (Th. 251; Al. 22).—Ivakœet, Arkuts Fiord, South Greenland. Yields easily to the knife; nearly as hard as calc spar. Does not fuse in the flame of a candle; on charcoal fuses readily into a very fluid colourless globule, which becomes white and opaque when cold; and if kept for a short time in the reducing flame, it is converted into a white infusible scoria. With nitrate of cobalt the scoria becomes blue. Contains no water. With borax it fuses speedily into a colourless bead, which becomes opaque on cooling, if it be saturated; and at a certain point of saturation, if cooled slowly, small rectangular crystals may be observed. A little of the powder with sulphuric acid, heated on a piece of platina foil, corrodes a piece of glass placed over it.

Cyprine (*Vide* **Idocrase**) (Th. 262; Al. 198).—Souland, Tellemarkin, Norway. Very brittle; yields to the knife; streak white. In the forceps it fuses readily, with intumescence and effervescence, into a muddy-green bead, red at its base, and colours the flame behind the assay a rich yellowish-green. No water. With borax it breaks up, and fuses speedily into a clear glass, coloured by iron while warm. A fragment fused with borax, and touched with nitrate of potash, indicates the presence of manganese. Berzelius and Thompson have omitted to notice the very characteristic colour given to the flame behind the assay. Although Berzelius has not mentioned it, he probably observed it, and was on that account induced to name it "Cuperiferous Idocrase." Dr. Thompson could not detect copper, and I also failed to detect it by re-agents with the blowpipe.

Datholite (*Vide* **Botryolite; Borosilicate of Lime**).

Diallage (Th. 173.)—The Lizard, Cornwall. Hardness about = 3; streak white. In the forceps fuses on the edge slowly. Contains water With borax fuses slowly [with effervescence—Ed.] into a glass coloured by iron.

Diaspore (*Vide* **Alumina, hydrated**).—In the forceps decrepitates slightly; blackens at first, and in a strong heat becomes white like enamel, but is infusible. With acetate of cobalt becomes blue. Gives off some water in the matrass. With borax effervesces a little at first, becomes white, tinges it faintly with iron while warm, and fuses very slowly. Entirely, but very slowly, soluble with bisulphate of soda.

Dichroite (*Vide* **Iolite**). (Th. 277; Al. 177).—Eric Matts, Sweden. Resists the knife. In the forceps fuses on the edge into a greyish blebby glass. No water. With borax emits some bubbles, and fuses rather slowly into a colourless glass.

Dipyre (Th. 271; Al. 139).—Mauléon, Pyrenees. Hardness about = 4·0. In the forceps it fuses with effervescence, and some intumescence, into a blebby greyish globule. Contains a little water. With borax fuses, with continued effervescence, into a glass slightly coloured by iron.

Dolomite.—From Mountrath, Queen's County. Scarcely as hard as calc spar. Effervesces briskly with nitric acid. In the forceps fuses on the edge into a greyish blebby translucent glass. No water. With borax effervesces briskly, and dissolves speedily. Contains a little iron. Heated with nitric acid, it leaves a large insoluble residue.

Edelite (*Vide* **Prehnite**) (Th. 317).—Tyrol. This mineral consists of two distinct substances—the dark red, or central portion, and the pale red fibrous portion.

The dark red central portion yields to the knife with difficulty; streak white. Hardness about = 5·5. Does not effervesce with muriatic acid. In the forceps it becomes white, and fuses, or rather only glazes, on the edges. With nitrate of cobalt it becomes blue. Contains much water. With borax it dissolves very slowly into a colourless glass.

The pale red fibrous portion yields very easily to the knife; streak white. Effervesces briskly with muriatic acid. Contains some water. In the forceps glazes on the edge, and becomes alkaline. With borax it effervesces much, and fuses very quickly into a transparent glass, feebly coloured by iron. It dissolves in large quantity, and cannot be made opaque by flaming.

Edenite.—North America. Yields to the knife. Hardness about = 5·5. In the forceps intumesces and effervesces much, and fuses rather readily into a very pale bluish globule, slightly blebby and transparent. No water. With borax fuses rather slowly into a transparent glass slightly tinged with iron.

Egeran (*Vide* **Idocrase**) (Th. 259).—Eger, near Haslau, Bohemia. Its characters correspond with Norway Idocrase, except that it does not contain manganese.

Elæolite (*Vide* **Nepheline**). (Th. 363; Al. 142).—Stavern, Norway. Hardness about = 6·0; streak white. In the forceps soon fuses on the edge into a blebby colourless glass, but forms a bead slowly. No water. With borax it dissolves very slowly; reduced to powder, and moistened with nitric acid, it gelatinizes speedily.

Emery (*Vide* **Corundum**). (Th. 211; Al. 167).—East Indies. Its characters are the same as Corundum.

Emery—Ochsenkopf, near Schneeberg in Saxony. Scratches quartz readily. Magnetic. In the forceps, in a good blast, it fuses into a black magnetic slag. With borax the iron dissolves, leaving a large residue.

Emmonite (*Vide* **Strontian, carbonate of**).—Massachussets. Hardness = 3·0. Effervesces with nitric acid, and otherwise corresponds with the characters of carbonate of strontian. Thompson's Records of Science, June, 1836, p. 414.

Epidote (*Vide* **Arendalite**; **Zoisite**). (Th. 364; Al. 150).—From Bourge D'Oisans, Dauphiné. Resists the knife. In the forceps intumesces, and fuses readily into a brown scoria, which, in a good heat, melts into a brilliant black bead; not magnetic. No water. With borax it breaks up, and fuses rather readily into a clear glass coloured by iron.

Epidote.—Knockmahon Cliffs, County Waterford. In the forceps it fuses, with intumescence and effervescence, readily into a dark scoria, which, in stronger heat, is converted into a shining black enamel. No water. With borax fuses into a glass coloured by iron while warm.

Epidote, manganesian (Th. 366; Al. 151).—From Aosta, Piedmont. Hardness about = 5·5. Scratched by a knife, streak reddish pink. In the forceps it intumesces much, effervesces, and fuses readily into a brilliant dark purple bead. No water. With borax it effervesces, and dissolves speedily into a glass of a deep violet colour.

Epistilbite (Al. 127).—Faroe. Hardness about = 4·0. In the forceps it intumesces and curls up a little, and fuses readily into a white blebby globule, rendered perfectly transparent in a long-continued heat. Contains much water. With borax fuses readily into a colourless glass; gelatinizes slightly in cold nitric acid.

Erinite (Th. 341).—Antrim. Yields to the nail; streak white; feels soapy. In the forceps becomes white, and fuses with slight effervescence into a white blebby glass, rendered more transparent in a strong heat. Contains much water. With borax it effervesces a little at first, and fuses rather slowly into a colourless glass; with nitrate of cobalt it fuses into a blue glass; with bi-phosphate of soda it dissolves slowly into a colourless glass, which becomes opaline when cold, and leaves a transparent skeleton of silica. Mr. Allen had given the name of Erinite to an Arseniate of copper, said to be from the county Limerick, previous to the publication of Dr. Thompson's Mineralogy.—Allan, p. 83.

Essonite (*Vide* **Garnet**). (Th. 265; Al. 201).—County Donegal. About as hard as quartz. In the forceps fuses quietly and rather readily into a transparent greenish globule, slightly blebby. No water. With borax dissolves slowly into a glass coloured by iron.

Fahlunite, massive (*Vide* **Bonsdorffite**). (Th. 284; Al. 101).—Eric Matts, Sweden. Yields easily to the knife; almost sectile; streak white. In the forceps becomes white, and fuses on the edge (intumesces and curls up a little) and surface into a white blebby glass. Contains some water. With borax fuses very slowly into a colourless glass.

Fluate of Lime, octohedral.—In the forceps decrepitates violently; reduced to powder, and moistened, it fuses readily into a white bead, which turns turmeric paper brown. Contains some water. With borax fuses rather readily into a clear glass, which becomes opaque by flaming, if a sufficient quantity of the assay be used; heated on platina foil with sulphuric acid, it corrodes glass placed over it. Some specimens, in the forceps, phosphoresce, and emit a *purple* light for an instant, decrepitating slightly.

Franklinite (Ph. 219).—New Jersey, North America. Yields to the knife. Powder reddish-brown. A minute fragment is taken up by the magnet. In the forceps it fuses on the edge with some difficulty, and is rendered more attractable by the magnet. No water. With borax it dissolves slowly, the glass is coloured by iron; by adding a little nitre, the purple colour of manganese becomes evident in the outer flame. I believe Franklinite contains much less of manganese than its analyses indicate.

Fuchsite.—Tyrol. In the forceps, fusible on the edge with great difficulty. With borax dissolves very readily, with effervescence, leaving a permanent green colour in the bead (chrome). In microcosmic salt dissolves with equal facility, leaving a skeleton; and the bead is coloured green when hot, colourless when cold (iron).—Ed.]

Fuller's Earth (Th. 246; Al. 307).—Nutfield, Surrey. Adheres to the tongue. Yields to the nail, and receives a polish from it; immersed in water, it falls into a pulpy mass. In the forceps it becomes brown, intumesces slightly, effervesces, and fuses readily on the edges into a greenish enamel, and forms a greyish blebby bead with difficulty. Contains water. With borax dissolves rather slowly into a transparent glass coloured by iron while warm.

Gabronite (Th. 289).—Stavern, Norway. Translucent on the edge. Yields to the knife: hardness about = 5·5; streak white. In the forceps, when gently heated, it becomes white and opaque, and a thin fragment fuses into a white blebby globule, which becomes transparent, if intensely heated. Contains little water. With borax it effervesces a little at first, and fuses very slowly into a colourless glass.

[**Gadolinite**.—Sweden. In the forceps glows intensely, and turns whitish-grey, fusing on the edge with slight intumescence. Contains water. With borax dissolves readily, giving a transparent bead coloured with iron. With microcosmic salt dissolves very slowly, and gives a transparent bead.—Ed.]

[**Gadolinite**.—County Donegal. In the forceps fuses readily into a black bead, with intumescence and ebullition. Contains water. With borax dissolves readily, with effervescence at first, into a bead coloured by iron when hot, colourless when cold; with nitre added, behaves as before, but the bead is greyish when cold. In microcosmic salt, dissolves, leaving a siliceous skeleton; bead coloured by iron while hot, of pearl-grey colour when cold, and somewhat opaque when nitre is added.—Ed.]

Garnet.—Vesuvius. In the forceps it fuses, with slight effervescence, into a dark green glass. Contains no water. With borax it effervesces a little at first, and small fragments fuse very slowly into a colourless glass, indicating a little iron while warm.

Garnet (*Vide* **Allochroite, Colophonite, Cinnamon Stone, Essonite**).—Resists the knife; hardness nearly = 7·0. In the forceps it fuses readily into a very brilliant black magnetic globule; in the inner flame it intumesces a little. No water. With borax fuses slowly into a glass deeply coloured by iron.

Garnet.—Resists the knife; hardness about = 7·5. In the forceps in a low heat becomes opaque, but regains its transparency on cooling; fuses quietly into a brilliant black globule, not magnetic. With borax fuses slowly into a glass coloured by iron.

Garnet, Pyrope or **Bohemian** (Th. 268; Al. 200).—It is not affected by the file. In the forceps, in a low heat, it becomes opaque, and regains its colour and transparency when cold; in the inner flame it effervesces, and fuses on the surface into a dark green glass, and scarcely forms a bead. Contains no water. With borax it fuses very slowly into a clear glass, indicating iron while warm, but becomes a bright chrome green when cold. [Fuses on the edge with difficulty. With borax fuses with difficulty into a bead coloured permanently green, indicating the presence of chrome.—Ed.]

Garnet, yellow manganesian.—Franklin Furnace, Sussex, New Jersey. Resists the knife. In the forceps fuses readily into a shining black globule. No water. With borax dissolves slowly into a glass coloured by iron; when nitre is added, and again heated, the glass becomes deep purple.

Gehlenite (Th. 281; Al. 161).—From Mount Monzoni in the Valley of Fassa, in the Tyrol. Scarcely yields to the knife; streak white. In the forceps fuses rather slowly on the edge, with some ebullition, into a muddy green glass, a very small fragment fuses into a bead. Contains a little water. With borax fuses slowly into a colourless glass, indicating a little iron while warm; with biphosphate of soda fuses slowly into a clear glass, which becomes opaline when cold, and leaves a skeleton of silica undissolved. This specimen does not gelatinize when reduced to powder, and moistened with nitric acid. Thompson asserts it does.

Gibbsite (*Vide* **Alumina, hydrated**).

Gieseckite (Th. 382; Al. 100).—Akulliarasiarksuk, Greenland. Yields readily to the knife; streak white. In the forceps whitens; and in a good blast fuses on the edge into a white enamel. With borax it effervesces a little at first, and fuses very slowly into a colourless glass, indicating iron while it is warm. Rare.

Gilbertite (Th. 235).—Cornwall. Yields easily to the knife; sectile. In the forceps fuses slowly on the edge into a white enamel. Trace of water. With borax emits a few bubbles, and fuses slowly into a colourless glass; with acetate of cobalt, a deep blue.

Gmelinite (*Vide* **Hydrolite**). (Th. 340; Al. 119).—Island Magee, county Antrim. Yields rather easily to the knife; hardness 4·5; streak white. In the forceps partly falls to powder, then fuses quietly but slowly into a white blebby glass, semi-transparent when intensely heated. Contains much water. With borax fuses readily, leaving a skeleton which dissolves slowly; does not gelatinize with nitric acid.

Grenatite (Th. 279; Al. 202).—Manetsok, North Greenland. Scarcely yields to the knife. In the forceps it is infusible, but in a thin fragment blackens, and glazes a little in a good blast. Not magnetic after roasting. With borax effervesces a little, and is scarcely soluble.

[**Grenatite.**—Fuses with extreme difficulty, on the edge, turning black; and with borax, dissolves very slowly, with slight effervescence at first.—Ed.]

Halloysite (Th. 239; Al. 73).—Angleur, near Liege, France. Adheres to the tongue. Yields to the nail, and receives a polish from it; brittle. In the forceps it becomes first brown, then white; and is almost infusible; a thin edge glazes in a good blast. Contains much water. With borax it is nearly insoluble. Heated with nitrate of cobalt, it becomes blue on the edge.

Harmotome.—Strontian, Argyleshire. Yields rather easily to the knife. In the forceps, when roasted, it becomes white and opaque, and very brittle, and fuses quietly into an opaline globule. Contains much water. With borax it breaks up, and dissolves very slowly into a colourless glass.

Harmotome (Th. 349; Al. 116).—Luganure, county Wicklow. It requires a stronger heat to fuse it than the specimens from other localities; characters similar in other respects.

Harmotome (Th. 349; Al. 116).—North of Ireland. Hardness about = 4·0. In the forceps becomes white and opaque, and fuses quietly into a milky globule, slightly blebby, and not rendered more transparent in a strong heat. Contains much water. With borax dissolves very slowly into a colourless glass.

Harmotome (Th. 349; Al. 116).—St. Andreasberg, Hartz Mountains. Yields to the knife with some difficulty. In the forceps becomes white, and fuses rather slowly into a white bead, rather opaque, and not blebby. Contains much water. With borax dissolves very slowly into a clear glass.

[Many specimens of Harmotome, in the forceps, decrepitate and become opaque, afterwards glow brilliantly, and then fuse, indicating soda by the flame.—Ed.]

Haüyne.—Vesuvius. Does not yield to the knife. In the forceps, in a good blast, fuses on the edge, with very slight effervescence, into a colourless blebby glass. With borax effervesces and fuses in large quantity, into a colourless glass.

Helvine (Th. 522.)—Saxony. Hardness = 6·0; streak white. In the forceps fuses with effervescence into an opaque yellow globule. With borax indicates manganese in the oxidating flame. No water.

Hematite, fibrous brown (*Vide* **Iron, hydrous oxide of**). (Ph. 221).—Glandore, County Cork. Hardness = 5; streak bright yellowish-brown. In the forceps blackens and becomes magnetic, and fuses on the edge. Contains water.

Hematite, fibrous red (Ph. 218).—Restormal Mine, Lostwithiel, Cornwall. Not attracted by the magnet. Yields with some difficulty to the knife. Hardness = 5·5; streak dark red. In forceps decrepitates at first, and fuses into a grey magnetic scoria. It contains some water.

Heulandite (Th. 346; Al. 126).—Osteröe, Faröe Isles. Hardness about = 3·5. In the forceps becomes white; intumesces much; curls up; fuses into a white blebby bead. Contains much water. With borax it fuses rapidly into a colourless glass. The white rough grains are infusible alone, and very slowly soluble with borax. Reduced to a fine powder, it does not gelatinize when moistened with nitric acid.

Hisingerite.—Bodenmais, Bavaria. Yields to the knife; streak brownish. In the forceps it fuses on the edge, and becomes magnetic. Contains much water. With borax fuses speedily into a glass coloured by iron. No trace of manganese.

Hornblende (*Vide* **Actinolite; Amphibole; Anthophyllite; Asbestus; Mountain Cork; Smaragdite; Tremolite**).—Norway. Yields to the knife. In the forceps fuses readily, and with scarcely any effervescence, into a black globule [or black scoriaceous mass—Ed.] No water. With borax emits a few bubbles, and dissolves slowly.

Hornblende, ferruginous (Th. 198; Al. 145).—Hardness = 4·5; streak greenish. In the forceps intumesces and effervesces a good deal, and fuses very speedily into a black globule, feebly magnetic. No water. With borax dissolves speedily into a glass deeply coloured by iron. No manganese.

Hydrolite (*Vide* **Gmelinite**). (Th. 340; Al. 119).—North of Ireland. Hardness about = 4·0. In the forceps becomes white, and falls to powder; if very slowly heated, it fuses into a blebby white globule. Contains much water. With borax effervesces a little at first, and fuses readily into a colourless glass, leaving a small residue, which is more slowly soluble.

Hypersthene (*Vide* **Pyroxene**). (Th. 201; Al. 106).—Hardness about = 4·5. Superficial streak brown, deep streak greenish-grey. In the forceps a small portion fuses into a dark green bead; a large piece fuses only on the edge. Contains a trace of water. With borax fuses rather readily into a clear glass, coloured by iron. No manganese. It is rarely found crystallized.

Hypersthene.—Hardness about = 5·0; streak white. In the forceps in the inner flame fuses on the edge, with some ebullition, into a dark glaze. No water. With borax fuses very slowly into a glass coloured by iron.

Idocrase (*Vide* **Egeran; Cyprine**). (Th. 259; Al. 198).—Yields to the knife; streak white. Hardness about = 5·5. In the forceps it fuses readily, with intumescence and effervescence, into a brilliant dark-coloured globule, which in the outer flame becomes nearly transparent; and its opacity is restored in the reducing flame. With borax it effervesces a little, and fuses speedily into a glass coloured by iron.

Idocrase.—Norway. Resists the knife. In the forceps intumesces and effervesces much, and fuses readily into a dark, olive-coloured brilliant globule; not rendered more transparent by flaming. No water. With borax it breaks up, and fuses speedily into a clear glass, coloured by iron, which gives a trace of manganese on the addition of nitrate of potash.

Iolite (*Vide* **Dichroite; Pyrargyllite**).

Iron, arseniate of.—Cornwall. Yields very readily to the knife; streak nearly white. On charcoal it fuses readily, with intumescence, into a dark globule, attracted by the magnet; it emits some smell of arsenic. Contains water. Dissolves readily with borax.

Iron, carbonate of (*Vide* **Sphærosiderite**).—Cornwall. Yields easily to the knife; streak white. Does not effervesce with cold acids. In the forceps, by a gentle heat, it assumes a shining black colour, and becomes magnetic; in the inner flame it fuses on the edge. No water. With borax it emits bubbles at first, and dissolves readily into a glass deeply coloured by iron.

Iron, crystallized Oligiste (Th. 434.)—Isle of Elba. Yields with some difficulty to the knife. Hardness = 5·5; streak red. Feebly attracted by the magnet. In the forceps fuses with difficulty on the edge, [throwing out brilliant scintillations, if the experimenter understand the use of his blowpipe—Ed.], and becomes strongly magnetic. With borax it dissolves slowly into an olive-yellow glass.

Iron Earth, blue, (**subsesquiphosphate of Iron**).—Cornwall. Yields to the nail; streak blue. It fuses readily into a metallic-looking globule; magnetic when well roasted. Contains much water. With borax it fuses speedily into a glass coloured by iron.

Iron, hydrous oxide of (*Vide* **Hematite, brown**). (Th. 320).—Restormal Mine, near Lostwithiel, Cornwall. Not magnetic. Brittle; hardness = 5·0; streak yellowish-brown. In the forceps fuses on the edge without difficulty, and in a strong heat scintillates; it becomes strongly magnetic. Contains water.

Iron, magnetic oxide, fasciculated columnar.—Bohemia, or Franconia. Before roasting, and in a good heat, fuses into a black magnetic scoria. Contains water. It is very remarkable for its magnetic property.

Iron, massive phosphate of.—North America. Streak bluish. In the forceps it decrepitates; but if slowly heated, it fuses readily into a black globule. This appears to be the Mullicite of Thomson, p. 452.

Iron Ore, bog (Ph. 222).—North of Ireland. Hardness about = 3·5. Powder yellowish-brown. In the forceps blackens, fuses readily on the edge, and becomes magnetic. Contains much water.

Iron Ore, lamellar specular.—Arinahincha, county Cork. Not magnetic. Yields to the knife. Powder dark red; very thin laminæ transmit a blue-red light, when viewed with a lens. In the forceps it fuses on the edge, and becomes magnetic.

Iron, oxydulated, (**magnetic Oxide**).—Haytor Mine, Dartmoor, Devonshire. Brittle; hardness = 5·5; powder black. Attracted by the magnet, but does not attract iron filings. In the forceps, in a strong heat, it fuses on the edge, into a steel-grey mass, but a small fragment forms a bead with great difficulty. With borax fuses rather readily into a glass deeply coloured by iron.

Iron, phosphate of (**Vivianite**), (Th. 455).—Dobschau, Hungary. Yields very easily to the knife; hardness = 1·5; streak blue. In the forceps it fuses very readily into a greenish-black globule, with a metallic lustre, which becomes magnetic when well roasted. Contains much water. With borax it fuses speedily into a glass coloured by iron. It contains no manganese.

Iron Pyrites, magnetic (Ph. 213).—Hardness about = 4·5. Powder greyish-black. On charcoal it emits the smell of sulphurous acid, and fuses readily into a globule, brilliant while hot, greyish-black and rough when cold. It is attracted by the magnet, both before and after roasting.

Iron, radiated carbonate of.—Kannioak, Greenland. Hardness = 4; streak white. Does not effervesce with cold muriatic acid; dissolves with effervescence in warm acid. In the forceps it blackens, and becomes magnetic; in a strong heat it fuses on the edge into a black glaze. Contains water. With borax effervesces, and dissolves readily into a glass coloured by iron. No trace of manganese. This mineral is generally supposed to be brown wavellite, and is sold in London at a very high price.

Iron, titaniferous (Ph. 216).—Auvergne. Translucent on the edge. Hardness=5·0–5·5; streak greyish. Infusible. With borax slowly soluble into a glass coloured by iron; with salt of phosphorus, dissolves slowly into a glass coloured by iron while warm; reddish amethyst colour when cold.

Iron, Tungstate of (Wolfram). (Ph. 236).—Zinnwald, Bohemia. Hardness = 4·5; streak reddish-brown. In the forceps it fuses rather readily into a black scoriaceous bead not attracted by the magnet. No water. With borax, dissolves readily, in the outer flame, into a glass, reddish-purple when cold; in the inner flame it is greenish while warm, and nearly colourless when cold.

Isopyre (Th. 377; Al. 190).—From Huel Bassett, Cornwall. Not so hard as quartz; powder greenish-white; thin fragments are translucent, with an olive colour. In the forceps it is infusible, but loses its colour and becomes greyish-white. Contains a good deal of water. With borax dissolves very slowly into a glass, coloured by iron while warm; with biphosphate of soda partially fuses, and becomes slightly opaline when cold, if saturated.

[**Jelletite.**—Saas Thal, Switzerland. Hardness = 7; sp. gr. = 3·741. In the forceps turns black, and fuses, with difficulty, on the edge. No water. With borax, fuses into a bead coloured with much iron. With microcosmic salt dissolves slowly, leaving no skeleton. This is a variety of Garnet.—Ed.]

Johannite (sulphate of Uranium). (Ph. 271).—Joachimsthal, Bohemia. Sectile; powder very pale green. In the forceps, at a low heat, it becomes orange-coloured; is reduced in size (probably owing to the vaporization of the water), and is infusible. Contains much water. With borax it effervesces, and dissolves readily into a glass of a yellow colour, not discharged on adding nitre. Dissolves readily in nitric acid, with effervescence; at least, the yellow pulverulent coating behaves thus with nitric acid. Extremely rare.

Karpholite (Th. 325; Al. 161).—Schlackenwald, Bohemia. Hardness about = 5·0; streak white. In the forceps becomes white, and fuses rather readily, with ebullition, into a yellowish bead. Trace of moisture. With borax, in outer flame, fuses rather readily, with slight effervescence at first, into an amethyst-coloured glass.

Karpholite (Th. 325; Al. 161).—Schlackenwald, Bohemia. Hardness about = 4; streak white. In the forceps the fibres diverge, and fume with slight intumescence and effervescence into a pale brown scoria, which, in a good heat, forms a bead of the same colour. No water. With borax dissolves readily into a glass, coloured by manganese in the outer flame; in the inner flame it becomes colourless.

Killinite (Th. 330; Al. 102).—Killiney Quarry, near Dublin. Yields easily to the knife; streak white. In the forceps, at a low heat, it blackens, then intumesces a little, and fuses on the surface into a rough white enamel; a minute splinter fuses into a shining white globule. Contains some water. With borax effervesces at first, indicates some iron, and fuses very slowly into a colourless glass.

[In the forceps intumesces, and melts into a glassy bead, more readily than Spodumene; flame indicates slight trace of Lithia; and, in melting, the assay glows brilliantly.—Ed.]

Kirwanite (Th. 378).—Mourne Mountains, county of Down. Yields easily to the knife; streak nearly white. Effervesces with muriatic acid, very briskly if reduced to powder. In the forceps it intumesces, and effervesces a little at first, and fuses readily into a shining black globule, very feebly magnetic. Contains a little water. With borax it effervesces a little at first, and fuses rather quickly into a glass deeply coloured by iron. No trace of manganese.

Kyanite (*Vide* **Bucholzite; Rhætizite**).

Kyanite (Th. 241; Al. 108).—St. Gothard. Yields easily to the knife on the broad plane of the prism, while the edge of the crystal resists the file; streak white. In the forceps it is infusible; and when intensely heated, it loses its colour, and becomes white. Contains no water. With borax it is almost infusible. With nitrate of cobalt it becomes blue.

Kyanite (Th. 241; Al. 108).—Shetland Isles. Hardness about = 4·0. In the forceps infusible. No water. With borax scarcely soluble.

Labradorite (Th. 297; Al. 139).—Gweebarra River, Donegal. In the forceps fuses on the edge into a clear glass; in a good heat a small fragment forms a bead. With borax it is very slowly soluble. No water.

Laumonite (Th. 332; Al. 120).—Maggia, St. Gothard. Hardness about = 4·0. In the forceps, at a low heat, it blackens for an instant, then fuses quietly but slowly into a rough blebby colourless glass, and scarcely forms a bead. Contains a good deal of water. With borax it is very slowly soluble. Does not gelatinize in nitric acid.

Lazulite (*Vide* **Bluespar**). (Th. 310; Al. 157).—Vorau, Styria. Yields to the knife; streak pale blue. In the forceps loses its colour, and fuses on the edge into a white enamel. With borax fuses into a glass coloured by iron.

Lead, arseniate of (Ph. 364).—Johanngeorgenstadt, Saxony. Hardness = 3·5; streak white. On charcoal it decrepitates a little; fuses readily; emits the smell of arsenic, and nothing remains but globules of metallic lead.

Lead, arsenio-phosphate of (Ph. 362).—Cumberland. Hardness = 3·5; streak white. On charcoal it fuses quietly, with some ebullition, into a globule, which on cooling becomes white, and crystallizes into polygonal facets, emits a faint smell of arsenic, and yields some globules of lead.

Lead, arsenio-phosphate of.—West Fell, Cumberland. Of a wax-yellow colour. Hardness = 3·0; streak yellow. On charcoal decrepitates; but if slowly heated, it melts, and emits a faint smell of arsenic; metallic globules of lead are formed, and enveloped in a glassy residue, which forms a globule with difficulty; it crystallizes on cooling. Rare. The dark-coloured crystalline globule, when fused with borax, forms a colourless glass, which becomes green when cold: this is, probably, owing to a minute portion of chrome.

Lead, fasciculated brown arseniate of.—Cornwall. Hardness = 3·5; streak white. On charcoal it fuses readily, and emits faint odour of arsenic, and nothing remains on the charcoal but grains of lead.

Lead, chromate of (Ph. 368; Th. 560).—Beresoff Mine, Siberia. Hardness = 2·5; streak and powder orange-yellow. On charcoal it decrepitates violently; reduced to powder, and moistened, it becomes black, and fuses readily into a black fluid mass; deposits minute globules of lead round the assay, and leaves a black scoria, infusible, and not magnetic. With borax fuses into a deep green glass, opaque unless a very minute portion of the assay be used.

Lead, molybdate of, crystallized (Th. 562).—Bleiberg, Carinthia. Hardness = 3·0; streak white. Decrepitates violently on charcoal; it fuses, when reduced to powder and moistened, into a yellow mass, and globules of lead are formed. With salt of phosphorus a small portion of assay fuses readily into a glass of a fine green colour.

Lead, muriate of (Ph. 360; Th. 557).—Churchill, in the Mendip Hills, Somersetshire. Hardness = 2·5; streak white. On charcoal it decrepitates; reduced to powder and moistened, it is speedily reduced to metallic lead on charcoal, and exhales white fumes; heated with biphosphate of soda, and peroxide of copper, the flame assumes a fine blue colour for an instant. Extremely rare.

Lead, phosphate of (Ph. 362).—Luganure, county Wicklow. Hardness = 3·5; streak white. On charcoal fuses readily, with slight ebullition, into a globule, yellow while warm, pearly white and crystallized when cold; with carbonate of soda it yields globules of lead.

Lead, phosphate of.—From Drigeth, West Fell, Cumberland. Soluble in warm nitric acid, without effervescence. Character same as last.

Lead, green phosphate of.—Luganure, county Wicklow. On charcoal it decrepitates; but if slowly heated, it fuses with some ebullition into a globule, which crystallizes in large facets when cold; but if the fusion is prolonged, it retains its globular form even when cold.

Lead, brown phosphate of.—Przibram, Bohemia. Hardness = 3·5; streak white. On charcoal fuses readily and quietly into a globule, which crystallizes in broad facets when cold; at the moment it crystallizes, a gleam of light is emitted by the globule; it does not contain arsenic; with carbonate of soda it gives globules of lead.

Lead, brown phosphate of.—Huelgoet, Lower Brittany. Hardness = 3·0; streak white. On charcoal minute particles fly off with slight decrepitation; fuses readily into a bead, which is white and crystallized on its surface when cold. No water. With borax effervesces a little, and dissolves rapidly into a glass, transparent and yellow while warm, colourless when cold. Becomes opaque by flaming. With carbonate of soda it is speedily reduced.

Lead, sulphato-carbonate of (Ph. 358; Th. 567).—Lead Hills, Cumberland. Hardness = 2·5. Does not effervesce in acid; it is partly dissolved. On charcoal does not decrepitate, and fuses readily into a brown mass, and yields globules of lead.

Lead, sulphate of (Ph. 365; Th. 559).—Paris Mine, Isle of Anglesea. Hardness = 3·0. On charcoal, in the outer flame, fuses quietly and readily into a globule, which is white when cold, and in the reducing flame it speedily yields globules of lead.

Lead, sulphate of.—Luganure Mine, county Wicklow. It decrepitates strongly when heated; in other respects it is similar to the last. Extremely rare in this locality.

Lead, sulphuret of.—Hero Shaft, Luganure, county Wicklow. Yields easily to the knife. On charcoal it fuses quietly, and becomes very fluid; in the reducing flame it yields grains of lead, and deposits a yellow powder on the charcoal; does not emit smell of sulphur while fusing.

Lead, Tungstate of (Ph. 370).—Zinnwald, Bohemia. Hardness = 3·0; streak white. On charcoal it fuses readily into a dark-coloured globule. No water. With borax dissolves readily into a glass, which becomes opaque and white when cold, if a large portion of the assay be used.

Lead, vanadiate of (Ph. 370; Th. 573).—Wanlock Head, Lead Hills, Cumberland. The crystals are aggregated in small globules. Hardness = 3·0; streak white. On charcoal it fuses readily, with ebullition, and is partly reduced to metallic globules, and a black scoriaceous mass remains. No water. With borax it dissolves readily, and on cooling becomes opaque; and blue (by reflected light only), if the proportion of the assay be large; but if a small portion be used, the bead is emerald green.

Lead, vanadiate of, compact mammillated.—Wanlock Head, Lead Hills, Cumberland. Hardness = 3·5–4·0. Its pyrognostic characters are the same as the last.

Lehuntite (Th. 338).—Glenarm, county Antrim. Yields to the knife; hardness about = 4·0. In the forceps fuses quietly into a blebby colourless bead. Contains water. With borax it fuses rather slowly into a colourless glass. Gelatinizes feebly in nitric acid.

Lepidokrokite.—Pfortzheim, Baden. Yields easily to the knife; streak yellowish-brown. In the forceps fuses into a grey metallic-looking magnetic globule. With borax it fuses speedily into a glass deeply coloured by iron. Contains water. Nitre does not indicate manganese.

Lepidolite (Th. 361; Al. 93).—Rozena, Moravia. Yields easily to the knife; streak white. In the forceps fuses very readily, with intumescence and effervescence, into a white vesicular globule, which becomes transparent and colourless, if heated intensely for a short time. With borax, it fuses speedily with effervescence, and in large quantity, into a colourless glass. [The borax bead, held in the oxydating flame, acquires an amethystine colour, indicating the presence of manganese—Ed.] I could not detect boracic acid by the blowpipe with Dr. Turner's flux of bisulphate of potash, and fluate of lime. While fusing, it tinges the flame behind the assay carmine-red, particularly if the jet be passed near the assay and does not envelope it; if the assay be fused with powdered fluor spar, the red colour is readily perceived. Heated with sulphuric acid on platina foil, and a piece of glass placed over it, it gives a trace of fluoric acid.

Leucite (Th. 286; Al. 112).—Yields to the knife. In the forceps emits a brilliant light, and in good blast fuses on the edge into a clear glass. With borax dissolves very slowly into a clear glass.

Levyne (Th. 335; Al. 118).—Benevenagh, county Derry. Yields to the knife. In the forceps becomes white, intumesces much, and fuses into a white blebby globule. Contains much water. With borax dissolves speedily into a transparent glass, with slight effervescence. Does not gelatinize with nitric acid.

Lievrite (Th. 148; Al. 230).—Rio la Marina, Island of Elba. Hardness about = 5·5; powder blackish-green. Not magnetic before roasting. In the forceps it becomes magnetic when gently heated, and fuses readily, with slight effervescence, into a black magnetic bead. With borax effervesces for an instant and fuses rather slowly into a transparent glass deeply coloured by iron. Does not contain manganese.

Lime, bisesquihydrous arseniate of, (**Pharmacolite**) (Th. 135; Al. 21).—Princess Sophia Mine, near Wittichen, Baden. On charcoal it gives out a faint arsenical odour. In the forceps it fuses readily, with some effervescence and intumescence, into a bluish globule, opaque. Contains much water. With borax fuses readily into a pale cobalt-blue glass.

Lime, phosphate of (*Vide* **Apatite**).—Arendal. Hardness about = 4·5; streak white. In the forceps fuses slowly on the edge into a white glaze. No water. With borax it dissolves very slowly, and becomes opaque by flaming; it is entirely soluble in biphosphate of soda.

Lime, Tungstate of (Ph. 182).—Bohemia. Hardness = 4·0; streak white. In the forceps it becomes white, then grey, and fuses on the edge, with difficulty, into a dark grey glaze. No water. With borax dissolves, rather readily in the inner flame, into a glass bluish-grey when cold, and it becomes white by flaming.

Lime, Tungstate of, amorphous.—Schoenfield, Bohemia. Hardness = 4·0. Decrepitates a little; acts with fluxes like the preceding, except that it does not become grey in the reducing flame.

Lithomarge (Th. 374).—Adheres to the tongue. Yields to the nail, and receives a polish from it. In the forceps whitens, and is infusible. Contains much water. Nearly infusible with borax. With cobalt becomes blue.

Magnesia, carbonate of (Th. 157; Al. 39).—Down Hill, Derry. Hardness nearly = 5·0. With muriatic acid it effervesces briskly. In the forceps is infusible. No water. With borax it effervesces much, and dissolves readily and in large quantity into a glass, which becomes opaque by flaming, if it be saturated.

Magnesia, carbonate of (Th. 157; Al. 39).—Hoboken, New Jersey. Hardness = 4·5. Does not effervesce, unless reduced to powder. Infusible. No water. With borax effervesces briskly, and dissolves rapidly.

Magnesia, hydrate of (Th. 156; Al. 95).—Swinaness-Unst, one of the Shetland Isles. Soft, yields to the nail. Is entirely soluble in nitric acid, without effervescence. In the forceps it becomes white and opaque, but retains its pearly lustre, and is infusible. When roasted, it tinges turmeric paper brown. With acetate of cobalt becomes pale pink. Contains water. With borax fuses readily into a clear glass, which, if saturated, is opaque when cold.

Magnesia, hydro-carbonate of (Th. 159).—Hoboken, New Jersey. Structure fibrous, radiated, soft. Effervesces briskly with muriatic acid. In the forceps the fibres diverge and curl up much, but it is infusible. Contains a good deal of water. With borax dissolves readily, with slight effervescence.

Manganese, bisilicate of (Th. 516).—Ural Mountains, Siberia. Hardness = 5·7; streak white. In the forceps it fuses readily, with slight effervescence, on the edge, into a brown glass, and forms a bead with difficulty. No water. With borax it emits some bubbles, and fuses slowly into a glass of an amethyst colour in the oxydating flame.

Manganese, black oxide of.—Harz. Hardness = 4·0; powder black. Contains a good deal of water. Decrepitates a little when heated, and is infusible.

Manganese, lenticular carbonate of.—Schneeberg, Saxony. Hardness = 3·5. When scraped, it effervesces briskly with acid. In the forceps it decrepitates violently; reduced to powder, and moistened, it blackens, and is infusible. No water. With borax it effervesces briskly, and dissolves readily into a glass of a deep reddish colour.

Manganese, hydrated oxide of.—Glandore, county Cork. Hardness = 5·5–6·0. Powder brownish-black. In the forceps glazes on the edge, and is feebly attracted by the magnet. Contains a large portion of water.

Manganese, mamillated oxide of.—Restormal Mine, Lostwithiel, Cornwall. Hardness = 4·0. Powder black. Infusible. Contains some water.

Manganese, phosphate of, and Iron (Th. 472).—Near Limoges, France. Hardness = 5·0; streak greyish-white. In the forceps it decrepitates; but if gradually heated, it fuses readily, with slight intumescence, into a black bead, attracted by the magnet. A trace of water. With borax it dissolves readily. In the outer flame it indicates manganese, and in the reducing flame iron.

Manganese, sesquisilicate of (Th. 514). Franklin, New Jersey, North America. Colour nearly black. Hardness = 5·5; streak dark red. In the forceps glazes on the edge, but does not fuse; it is attracted by the magnet after roasting. No water. Dissolves in borax; and it is difficult to exhibit the colour of the manganese in the outer flame.

Manganese, slaty oxide of.—Roury, county Cork. Hardness = 4·0. Powder black. Fuses on the edge into a black glass. Contains some water.

Manganese, sulphuret of.—Nagyag, Transylvania. Colour dark brown. Hardness = 4·0; streak greenish. Effervesces with muriatic acid, and gives out a smell of sulphuretted hydrogen. On charcoal it fuses quietly, but slowly, into a black scoriaceous bead, not attracted by the magnet. No water. With borax it is very slowly soluble, and the amethyst colour does not appear until the assay is entirely dissolved.

The grey portion.—Hardness = 2·5; streak grey. In the forceps it becomes black, and glazes on the edge, but does not fuse. Effervesces with muriatic acid, and emits a smell of sulphuretted hydrogen. With borax it dissolves very slowly, and the moment the assay is entirely dissolved, the amethyst colour is developed.

There appear to be two distinct combinations of sulphur and manganese in this specimen. Compare the analyses of Vauquelin, and Arfvedson in Allan's Manual of Mineralogy, page 279.

Manganite, crystallized (Th. 502).—From Lahn, on the Rhine. Hardness = 3·5. Powder greyish-black; infusible. Contains a little water. With borax gives an amethyst coloured glass.

Manganite, prismatic.—Hardness = 4·0; powder brown. Decrepitates; infusible. Contains some water.

Marmatite (sulphuret of Zinc and Iron) (Th. 548). Hardness = 4·5; streak pale yellowish-brown. In the forceps it does not decrepitate; it is more fusible than the common brown blende; it scarcely forms a bead, which is feebly attracted by the magnet. No water. With borax dissolves slowly into a glass, transparent while hot; muddy, opaque, and dark-coloured when cold.

Meionite (Th. 271; Al. 139).—Monte Somma, Vesuvius. Effervesces with muriatic acid. In the forceps intumesces and effervesces to a great degree, and fuses slowly into a blebby colourless glass. With borax fuses rather slowly, with *continued* effervescence. This specimen does not gelatinize with nitric acid. The effervescence is caused by a superficial coating of carbonate of lime on the crystals. The transparent part of the crystals does not effervesce. Yields with difficulty to the knife.

Mellilite (Th. 207; All. 207).—Capo de Bove, near Rome. Yields to the knife; hardness about = 4·5; streak white. In the forceps fuses readily into a transparent green glass bead. No water. With borax it dissolves slowly into a glass coloured by iron.

Menilite.—Menilmontant, near Paris. Hardness about = 7·0. In the forceps infusible, but becomes white and opaque. Contains water. With borax fuses slowly into a colourless glass.

Mesole.—Yields easily to the knife; scratched by fluor spar. In the forceps fuses readily, with some intumescence and effervescence, into a bead, transparent while hot, but white and opaque when cold. Contains much water. With borax effervesces a little at first, and fuses slowly into a glass, colourless and transparent; with nitrate of cobalt, it fuses into a blue glass. Reduced to powder, and moistened with nitric acid, it gelatinizes slightly. It is very tough.

Mesole (Al. 128).—Faroe Isles. Hardness about = 3·5. Its pyrognostic characters correspond exactly with those of Mesolite.

Mesole (Al. 128.)—Portrush, North of Ireland. Hardness about = 4·0. In the forceps becomes white; exfoliates a little; intumesces and fuses rather slowly into a white blebby bead. Contains much water. With borax it dissolves readily. When reduced to powder, and moistened with nitric acid, it gelatinizes.

Mesolite (Th. 317; Al. 122).—Yields with some difficulty to the knife. In the forceps it becomes opaque, exfoliates, intumesces, and fuses into a white blebby globule, which becomes more transparent in a stronger heat. Contains much water. With borax it effervesces a little at first, and then fuses readily into a transparent colourless glass, leaving a skeleton which is more slowly soluble. When powdered, it gelatinizes with nitric acid. This is the Skolezite of Mr. Allan.

[**Mica, Margarodite.**—Three-rock Mountain, county Dublin. Fusible on the edge with great difficulty. Contains water. With borax dissolves readily. Leaves a skeleton of silica in microcosmic salt, in which, however, it easily dissolves.—Ed.]

Molybdena, sulphuret of (Th. 88).—Cumberland. Yields to the nail. In the forceps it is infusible, and does not undergo any change with borax.

Mussite (*Vide* **Pyroxene**). (Th. 187; Al. 144).—Mussa, Piedmont. Hardness = 5·0. In the forceps, in the outer flame, fuses quietly into a clear glass; in the inner flame intumesces and effervesces. A piece the size of a pin's head fuses only on the edge. With borax fuses very slowly. Contains no water.

Nacrite (Th. 244).—Fair Mountain, Glendalough, county Wicklow. Yields easily to the knife; streak white. In the forceps fuses on the edge with difficulty, into a white enamel. Gives a trace of water. With borax it effervesces at first, and fuses slowly into a transparent glass, coloured by iron while warm. With biphosphate of soda partly fuses into a glass, which is slightly opaline when cold, if saturated, and leaves a large residue of silex.

Napoleonite (Th. 291). Corsica. Yields with difficulty to the knife; powder white. In the forceps becomes white, and fuses on the edge into a blebby glass. Does not contain water. Almost insoluble with borax.

Natrolite (Th. 315; Al. 121)—North of Ireland. Yields to the knife; hardness about = 5. In the forceps, at a low heat, it becomes opaque, and fuses readily and quietly into a clear colourless globule; in a stronger heat it blisters on the surface. Contains water. With borax it fuses rather readily into a colourless glass. Reduced to powder, and moistened with nitric acid, it gelatinizes.

Natrolite, crystallized (Th. 315; Al. 121).—Hohentwiel, Suabia. Yields to the knife; hardness about = 5·0. The crystals fuse readily into a transparent colourless globule. The brown fibrous portion, when gently heated in the forceps, becomes red, and fuses readily into a blebby colourless bead, which becomes transparent in a good blast. Contains water. With borax fuses slowly into a colourless glass. Gelatinizes with nitric acid.

Needle Ore of Bismuth (Ph. 278; Th. 596).—Beresoff, Siberia. Yields readily to the knife; powder lead-grey. On charcoal fuses readily; emits some sulphurous fumes; is partly volatilized; deposits minute globules of lead around the assay; and after intense roasting a globule of pure copper remains. Extremely rare.

Nemalite (Th. 166; Al. 314).—From Hoboken, New Jersey. Does not effervesce in nitric acid, and is not entirely soluble in it. Infusible, but becomes pale brown. Contains water. Dissolves readily in borax into a glass slightly coloured by iron.

Nepheline, primitive (*Vide* **Elæolite**). (Th. 256; Al. 132). Vesuvius. Fuses into a colourless and transparent bead slowly in the forceps. Very slowly soluble in borax.

Nickel, copper-coloured.—Hardness = 5·5; brittle. On charcoal it soon gives arsenical fumes, and fuses rather slowly into a black bead, which is not magnetic. With borax the globule dissolves readily, and forms a blue glass. It alloys with the platina.

Nickel Ochre (Th. 528, and 524).—Cornwall. When heated on charcoal, becomes yellow; and, after long continued roasting, it fuses into a black scoria, which soon forms a globule, highly magnetic.

Nickel, sulphuret of (Th. 524).—Merthyr Tydvil, South Wales. On charcoal it fuses readily into a black globule, strongly attracted by the magnet. The fused globule dissolves readily in borax, and gives an amethyst-coloured glass; in a stronger heat the glass is violet-blue by transmitted light, and olive-green by reflected light.

Nuttalite (*Vide* **Scapolite**). (Th. 382; Al. 142).—Boston, Massachussets, North America. Yields to the knife with difficulty; streak white. In the forceps intumesces and effervesces much, and fuses slowly into a blebby colourless glass. Trace of moisture. With borax fuses rather quickly, with prolonged effervescence, into a transparent glass, faintly coloured by iron.

Obsidian (Th. 393; Al. 188).—Tokay, Hungary. Translucent on the edge. Resists the knife; hardness about = 6·5; powder greyish-white. In the forceps it becomes colourless, and fuses with difficulty on the edge into a slightly blebby, transparent, and colourless glass. Contains no water. With borax dissolves very slowly into a transparent colourless glass.

Olivine (Th. 163; Al. 192).—Otaheite. Resists the knife. In the forceps infusible. No water. With borax soon indicates iron, but fuses very slowly.

[**Olivine**.—Vesuvius. In the forceps fuses readily, with effervescence, into a black scoria. No water. With borax dissolves easily into a transparent bead, coloured by much iron. With microcosmic salt, dissolves readily, with continued effervescence, leaving a siliceous skeleton.—Ed.]

Orpiment (*Vide* **Arsenic, yellow sulphuret of**).

Paranthine (*Vide* **Scapolite**). (Th. 271; Al. 139).—Hardness = 4·5–5·0. In the forceps effervesces and intumesces, and fuses readily into a colourless blebby globule. No water. With borax dissolves readily, with prolonged effervescence, into a clear glass, slightly coloured by iron while warm.

Pearl spar.—Killiney Quarry, Dublin. Scratches calc spar. Effervesces feebly with nitric acid. In the forceps decrepitates slightly, becomes black, and fuses on the edge into a black glaze, not magnetic. No water. With borax effervesces much, and dissolves readily. Contains iron.

Pearl Spar.—Knockmahon, county Waterford. Scratches calc spar. Effervesces with muriatic acid when scraped. In the forceps decrepitates violently; infusible; effervesces strongly with borax.

Pearlstone (Th. 390; Al. 188).—Bochnitz, Hungary. Hardness = 5·0; brittle. In the forceps intumesces much, suddenly, and fuses very slowly into a rough, blebby, colourless glass. No water, or only a trace. With borax emits a few bubbles, and fuses rather readily into a clear glass.

Phillipsite (Th. 351: Al. 117).—Island Magee, North of Ireland. In the forceps becomes white and opaque, falls partly to pieces, and fuses rather slowly into a transparent rough bead. Contains much water. With borax it becomes transparent, and fuses slowly into a colourless glass.

Pimelite.—From Silesia. Hardness = 2·0; streak white. In the forceps decrepitates at first, blackens, and fuses on the edge into a grey glass; it does not form a bead. Contains much water. With borax, in the outer flame, it dissolves slowly, and the glass is of a pale amethyst colour when cooling, but is nearly colourless when cold.

Pitchstone (Th. 392).—Johanngeorgenstadt, Saxony. Yields to the knife; streak white; hardness about = 5·5. In the forceps becomes white, and fuses on the edge into a blebby colourless glass. Contains a good deal of water. With borax it effervesces a little at first, and fuses rather slowly into a colourless glass.

Pitchstone (Th. 392).—Saxony. Resists the knife; hardness about = 6·5. In the forceps fuses readily into a brilliant dark green globule. No water. With borax it effervesces a little at first, and fuses slowly into a clear glass coloured by iron.

Pitchstone, slaty (Th. 392).—Newry. Yields with difficulty to the knife; streak white. In the forceps becomes white, and fuses on the edge into a blebby colourless glass. Contains some water. With borax fuses slowly, with slight effervescence, into a colourless glass.

Plasma.—Hard as quartz. Translucent on the edge. In the forceps becomes white, but is infusible. Contains a good deal of water. With borax, a small fragment dissolves slowly; with carbonate of soda effervesces briskly, and dissolves speedily.

Pleonaste (**Black Spinel**). (Th. 213; Al. 165).—Amity, New York, North America. Scratches quartz; brittle. Infusible alone. No water. With borax fuses with great difficulty.

Polymignite (Ph. 261).—Friedrichsvärn, Norway. Hardness = 5·5; streak pale brown. In the forceps infusible. With borax effervesces, and fuses rather easily into a glass coloured by iron.

Prehnite (*Vide* **Edelite**). (Th. 274; Al. 110).—Resists the knife; hardness about = 6·0. In the forceps whitens; the fibres diverge; it intumesces and effervesces much, and fuses readily into a pale green transparent globule, slightly blebby. No trace of water. With borax effervesces much at first, and fuses readily into a transparent glass coloured by iron while warm. Does not gelatinize with nitric acid.

Prehnite (Th. 274; Al. 110).—Scotland. Resists the knife. In the forceps it becomes white; intumesces and effervesces much, and fuses into a colourless blebby globule. No water. With borax it fuses, with effervescence, very quickly into a colourless glass, and dissolves in very large quantity. [In microcosmic salt, dissolves more slowly than in borax, with effervescence, into a colourless bead, leaving a siliceous skeleton.—Ed.]

Psilomelane.—Glenmalure Mine, county Wicklow. Hardness = 6·0. Decrepitates when heated; infusible.

Psilomelane, botryoidal (Th. 508).—Siegen, on the Rhine. Hardness = 6·0; powder nearly black. Infusible; not attracted by the magnet after roasting. Contains a little water.

Pycnite (*Vide* **Topaz**). (Th. 254; Al. 174).—Altenberg, in Saxony. Brittle; scratches quartz feebly. In the forceps it decrepitates a little, becomes white and opaque, and is infusible. Contains no water. With borax it fuses slowly into a colourless glass.

Pyrargyllite (*Vide* **Iolite**). (Th. 238; Al. 318).—Helsingfors, in Finland. Hardness about = 3·25; yields easily to the knife; streak white. Small fragments are translucent on the edge. In the forceps cracks a little, becomes white; in a good blast it glazes on the edge. Heated with nitrate of cobalt, it becomes pale blue. Contains a considerable portion of water. With borax dissolves very slowly into a transparent glass, feebly coloured by iron while warm. Very rare.

Pyrites, cockscomb (Ph. 212).—Derbyshire. Yields with difficulty to the knife; hardness about = 6; streak greyish-black. On charcoal it blackens; emits pungent fumes, and fuses readily into a globule, rough and magnetic when cold.

Pyrolusite, acicular.—Schurde, Thuringia. Hardness = 2·5; powder greyish-black. Infusible. A trace of water.

Pyrolusite, radiated.—Soft; soils paper like Plumbago; powder nearly black. Infusible. Does not contain water. With borax it dissolves readily, and tinges it of a deep amethyst colour.

Pyrolusite, compact mamillated.—Hardness = 2·5; powder black. Infusible. No water. With borax as before.

Pyrope (*Vide* **Garnet**).

Pyrophysalite (*Vide* **Topaz**). (Th. 253; Al. 174).—Finbo, near Fahlun, Sweden. Yields to the knife; streak white. In the forceps becomes white; and, in a good heat, fuses or rather glazes on the edge. Contains a little water. With borax effervesces a little at first and fuses very slowly; with acetate of cobalt, becomes blue.

Pyroxene (*Vide* **Augite; Bronzite; Coccolite; Hypersthene; Mussite; Sahlite**).—Fuses readily on the surface with very slight effervescence; but forms a bead with difficulty. With borax soon indicates iron, and dissolves very slowly. The black grains from the under side fuse readily, with effervescence and intumescence, and thereby prove that the other portion has been partially fused.

Realgar (*Vide* **Arsenic, red sulphuret of**).

Rhætizite (*Vide* **Kyanite**). (Th. 241; Al. 108).—Tyrol. Yields easily to the knife. In the forceps becomes white; is infusible; and, with nitrate of cobalt, becomes blue. Almost insoluble with borax. No water.

Rhodonite (*Vide* **Allagite; Bustamite**).

Rhomb Spar.—Cornwall. Scratches calc spar. Effervesces feebly with nitric acid when scraped; decrepitates violently; when heated slowly, it blackens; is infusible, and does not become magnetic. With borax it effervesces briskly, and dissolves readily.

Rutile (*Vide* **Anatase; Brookite; Titanium, golden-haired**). (Ph. 254).—Killin, Argyleshire. Hardness = 5·5; streak nearly white; brittle. In the forceps infusible; with borax it dissolves very slowly into a glass of a pale amethyst colour when cold; with a larger proportion of the assay it is almost black and opaque by reflected light, and dark amethyst colour by transmitted light; in the outer flame the colour is discharged; not made opaque by flaming. With salt of phosphorus it dissolves with the greatest difficulty, requiring a very prolonged and intense heat; the glass is yellow while warm, amethyst colour when cold;—the colour is not discharged by the outer flame.

Rutile (Ph. 254).—Brocca Mountain, Luganure Mines, county Wicklow. Hardness 5·0–5·5; streak yellowish-white. A thin fragment is translucent on the edge; transmits a red colour. In the forceps it is infusible; in an intense heat glazes a little on its surface. No water. With borax very slowly soluble; the glass is colourless while warm; pale amethyst colour while cold; not made opaque by flaming; in the outer flame the colour is discharged, and it remains colourless on cooling.

Sahlite (*Vide* **Pyroxene**). (Th. 187; Al. 143).—Tiree Island, Scotland. Hardness = 5·0; streak white. In the forceps, in the outer flame, it fuses on the edge into a green glass, slightly blebby; in a strong heat it boils a good deal, and a small fragment forms a clear green bead with difficulty. Does not contain any water. With borax emits a few bubbles; colours the glass faintly with iron; and is very slowly soluble.

Sapphirine (Th. 218; Al. 207).—Greenland. Scratches quartz feebly. In the forceps it is not altered in any respect; and a fragment is infusible in borax.

Saussurite (Th. 391).—Geneva. Very hard; almost resists the file. In the forceps it intumesces and effervesces a little, and fuses rather readily into a glass slightly blebby. No water. With borax effervesces a little, and fuses rather speedily into a glass coloured by iron.

Scapolite (*Vide* **Nuttalite; Paranthine; Wernerite**). (Th. 271; Al. 139).—Hardness about = 5·5. In the forceps intumesces and effervesces much, and fuses readily into a colourless blebby glass. With borax fuses readily, with continued effervescence, into a clear glass.

Scapolite (Th. 271; Al. 139).—Probably from Arendal. Resists the knife. In the forceps becomes white and opaque; it intumesces and effervesces, and fuses readily into a blebby translucent globule; [soda flame—Ed.] Trace of moisture. With borax it fuses readily, with *continued* effervescence, until the assay is entirely dissolved into a colourless transparent glass; with nitrate of cobalt gives a blue glass. [With microcosmic salt dissolves readily, with continued effervescence, leaving a skeleton.—Ed.]

[**Scapolite, red.**—County Donegal. Fuses, with some difficulty, into a white opaque glass; no soda. With borax, dissolves very slowly, without any effervescence; no iron.—Ed.]

Schwarz-erz (Ph. 313).—Nagyag, Transylvania. Brittle. On charcoal fuses quietly and readily into a dark globule; and, after long roasting, yields a grain of pale-coloured copper; when heated on charcoal it deposits a white powder, which is pale yellow while warm. (Is this Zinc?)

Selenite (Th. 119; Al. 19).—Near Bonmahon, county of Waterford. Yields to the nail. In the forceps becomes white, and fuses readily into a white enamel. Contains much water. A small piece, with nearly an equal portion of powdered fluor spar, on charcoal fuses into a bead, transparent while warm, opaque when cold.

Selenite, lenticular (Th. 119; Al. 19).—Near Paris. In the forceps exfoliates, becomes white, and fuses rather slowly into a white enamel. Contains much water. With borax fuses readily into a clear glass.

[**Serpentine.**—County Galway. In the forceps fuses on the edge, with great difficulty. Contains water (8, p. c.). With borax, fuses slowly into a transparent bead coloured by iron. With microcosmic salt, dissolves slowly, with effervescence, leaving a skeleton.—Ed.]

Silver, arsenical antimonial.—Hardness = 3·0; streak dark grey; fresh fracture steel grey, and fine grained. On charcoal emits copious white fumes, with some smell of arsenic at first, and leaves a bead on the charcoal, which, after long roasting, becomes malleable.

Silver, malleable sulphuret of (Th. 641).—Sombrerete, Mexico. Sectile; cut surface shining. On charcoal it fuses very readily, and leaves a large bead of silver.

Silver Ore, dark red (Th. 648).—Abendroth Mine, Andreasberg, in the Hartz. Yields easily to the knife; streak dark red. On charcoal it decrepitates violently; but when powdered, and moistened, it is speedily reduced.

Silver Ore, dark red, massive,—Hardness about = 3·0; streak dark red; brittle. On charcoal decrepitates, and fuses very readily into a black shining globule, which is soon reduced to a globule of pure silver; it deposits a yellowish powder at some distance from the assay.

Smaragdite (*Vide* **Hornblende**).—Hardness near 6·0; scarcely yields to the knife; powder white. In the forceps fuses, with very slight effervescence, into a green slightly blebby bead, which becomes pale blue in a strong heat. No water. With borax dissolves very slowly into a glass slightly coloured by iron.

Sodalite (Th. 257; Al. 113; Ph. 127, Jameson,* vol. ii. p. 52).—Kangardluarsuk Fiord, West Greenland. Hardness nearly equal to Felspar; yields to the knife; streak white. In the forceps fuses with effervescence into a colourless blebby glass on the edge, which, in a prolonged blast, is converted into a white infusible scoria, probably owing to the escape of the soda. Contains a little water. With borax it fuses quickly at first, and leaves a porous skeleton, which dissolves slowly into a colourless glass. Reduced to powder, and moistened with nitric acid, it gelatinizes; dissolved in warm dilute nitric acid, it gives a white curdy precipitate with nitrate of silver, which blackens after exposure to light. While fusing, it makes a slight crepitating noise, very like carbonate of soda when fused on platina wire. I could not detect the muriatic acid with microcosmic salt and oxide of copper, as recommended by Berzelius.

Sodalite (Th. 257).—Vesuvius. Colourless, and nearly transparent. It is brittle. Contains no water; and agrees with the Greenland variety in its pyrognostic and chemical characters. In the forceps effervesces little, and fuses readily into a colourless globule, slightly blebby. See Annales de Chimie et Physique, tome xxix. p. 17.

Sodalite (Th. 257; Al. 113).—Vesuvius. Of a pale green colour. In the forceps, in the outer flame, it is not affected much; in the inner flame it effervesces and intumesces much, and fuses into a transparent colourless glass, slightly blebby. No water. With borax fuses very slowly into a colourless glass. Reduced to powder, and moistened with nitric acid, does not gelatinize.

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* "A System of Mineralogy," &c., &c. By Robert Jameson. Third edition, 8vo, 3 vols. Edinburgh: 1820.

Sordawalite (Th. 380; Al. 321).—Sordawala, Finland. Brittle; resists the knife. Perfectly opaque. In the forceps intumesces a good deal, and fuses, with slight effervescence, rather readily into a brilliant black bead, not magnetic. Contains some water. With borax emits a few bubbles, and fuses readily into a glass coloured by iron. No manganese.

Sphærosiderite (*Vide* **Carbonate of Iron**). (Al. 42).—Hanau, Germany. Translucent and greenish. Hardness = 4·5; streak white. Does not effervesce with cold muriatic acid; with warm acid it effervesces briskly, and is entirely soluble in it. In the forceps, when gently heated, it blackens and becomes magnetic; in the reducing flame it fuses on the edge into a shining greyish-black magnetic scoria. With borax it effervesces briskly at first, and fuses speedily into a glass deeply coloured by iron; a minute portion fused with borax, so as to tinge it faintly with the iron, and touched with a crystal of nitre, indicates, by the purple colour, the presence of a little manganese; the colour produced by the manganese may be discharged by the reducing flame

Sphærulite (Th. 395; Al. 207).—Schemnitz, Hungary. Hardness = 5·0; brittle; resists the knife. In a very strong heat it becomes transparent, and fuses with difficulty on the edge into a blebby colourless glass. Trace of moisture. With borax it is scarcely soluble.

Sphene (Ph. 258).—Sartut, in Greenland. Hardness = 5·3; streak white. In the forceps, in the outer flame, loses its brown colour, becomes yellow and translucent. In the inner flame it fuses readily on the edge, with some ebullition and slight scintillation, into a dark-coloured scoria; it does not form a bead unless the assay be very minute. No water. With borax it fuses slowly into a glass, yellow while warm, colourless when cold.

Sphene (Ph. 250).—Andernach, on the Rhine. Hardness = 5·2; streak white. In the forceps fuses rather readily on the edge into a dark-coloured glass; the colour of the unfused portion is not altered. No water. With borax it dissolves slowly into a glass, yellow while warm; in the inner flame it is yellow while warm, and brownish when cold.

Spinellane (Th. 257; Al. 114).—Jaher, near Laach on the Rhine. Hardness = 5·5; streak white. In the forceps effervesces slightly, and fuses rather slowly into a colourless blebby glass. No water. With borax fuses rather readily, with prolonged effervescence, into a colourless glass. Reduced to powder, and moistened with nitric acid, it soon gelatinizes.

Spodumene (Th. 302; Al. 109).—Killiney, county Dublin. Resists the knife; hardness about = 6·0. In the forceps, when gently heated, it becomes white and very brittle; [and glows brilliantly—Ed.;] curls up and fuses, with very slight intumescence, into a number of small globules, which require a good blast to unite them in a clear blebby bead. Contains no water. With borax fuses readily at first, leaving a transparent skeleton, which dissolves slowly. At the moment it fuses, it tinges the flame behind the assay carmine-red (proof of lithia), particularly if the point of the inner flame be let play over the edge of the assay; it is not so readily observed if the assay be entirely enveloped in the flame.

Spodumene (Th. 302; Al. 109).—Dalkey Quarry, near Dublin. Resists the knife. In the forceps intumesces, and fuses, with slight effervescence, into numerous small globules, which unite in a strong heat, and form a blebby globule. No water. With borax dissolves rather slowly.

Steatite (Th. 329; Al. 97).—Rathlin Island, Antrim. Yields easily to the nail; cuts like wax. In the forceps becomes white, and in a strong heat fuses on the edge into a white blebby enamel; a very small fragment forms a bead. Contains much water. With borax slowly soluble, [with effervescence.—Ed.].

Steatite (Th. 329; Al. 97).—Gue Grace, Lizard Point, Cornwall. Sectile; does not yield to the nail. In the forceps it fuses rather readily on the edge, with some effervescence, into a white enamel, and a small fragment forms a bead with difficulty. Contains a little water. Dissolves slowly with borax.

[The Steatite of Gue Grace occurs as a Sahlband between the Serpentine porphyry and the Granite veins that penetrate it; it derives its magnesia from the Serpentine, and its alumina from the Granite; the Steatite commonly found in Granite veins, at Luganure and Ballycorus, in the Wicklow and Dublin mountains, contains no magnesia, and is not so soft or fusible as that found in Basalt at Rathlin Island, and it contains less water.—Ed.]

Stilbite, red (Th. 344; Al. 125).—Scotland. Yields easily to the knife. In the forceps becomes white; exfoliates, curls up, and fuses into a white blebby globule. Contains much water. With borax it effervesces, and dissolves very rapidly into a colourless glass. [Dissolves readily in microcosmic salt, leaving a skeleton.—Ed.] Does not gelatinize with nitric acid.

Stilbite.—Benevenagh, county Derry. Its characters are the same as last.

Strontian, brown carbonate of (Th. 108; Al. 46).—Strontian, Argyleshire. Its pyrognostic characters same as those of the Carbonate.

Strontian, carbonate of (*Vide* **Emmonite**). (Th. 107; Al. 46.)—Golden Bridge, near Dublin. Yields easily to the knife. Effervesces briskly with muriatic acid, and is entirely soluble in it. In the forceps throws out a white cauliflower-like excrescence, tinges the flame behind the assay deep carmine-red, and is infusible. No water. With borax it effervesces much, and fuses very speedily, and in large quantity, into a glass, which is opaque when cold, if saturated.

Strontian, green carbonate of (Th. 107; Al. 46.).—Strontian, Argyleshire. Its pyrognostic characters same as those of the Carbonate.

Strontian, sulphate of (Th. 109; Al. 49).—Bristol. Hardness about = 3·0. In the forceps a large piece decrepitates; a small fragment fuses easily into a white enamel; and when well roasted, it tinges the flame behind the assay carmine-red; but not so strong as the carbonate of Strontian. No water. With borax fuses readily, and in large quantity, into a glass which becomes opaque when cold, if saturated.

Sulphate of Lime, compact hydrous.—Hardness less than calcareous spar. In the forceps fuses readily into a white opaque globule, which boils a little if intensely heated. Contains much water. With borax dissolves very readily into a clear glass, which becomes opaque when cold, if a sufficient quantity of the assay be used.

Table Spar (*Vide* **Wollastonite**). (Th. 129; Al. 152).—Cziklowa, in the Banat, Temeswar. Does not effervesce with muriatic acid. Yields to the knife. In the forceps fuses, with slight effervescence in the inner flame, into an opaline globule. Contains a little water. With borax fuses slowly into a colourless glass. Dr. Thompson gives the name of Wollastonite to a different mineral (*Qu.* Stellite).

Table Spar (Th. 129; Al. 152).—Hardness about = 3·5. Does not effervesce with nitric acid. In the forceps decrepitates slightly, and fuses readily into a white enamel; in a strong heat it effervesces a little. No water. With borax dissolves readily into a transparent colourless glass.

Table Spar (Th. 129).—Does not effervesce with acid. Hardness about = 4·0. In the forceps it fuses on the edge into a semi-transparent glass, and forms a bead with some difficulty in a prolonged blast. With borax effervesces a little at first, and fuses rather slowly into a colourless glass.

Talc (Th. 357; Al. 90).—St. Stephen's, Cornwall. Yields easily to the knife. In the forceps fuses readily, with some intumescence and effervescence, into a brownish black scoriaceous bead, feebly magnetic. With borax fuses readily, with effervescence, into a glass coloured deeply by iron.

Talc, indurated (Al. 91).—Shetland. Hardness about = 4·0; streak white. Sectile in a low degree. In the forceps fuses, with great difficulty, on its thinnest edges. Trace of moisture. With borax emits a few bubbles, tinges it with iron, and dissolves very slowly. [With microcosmic salt, intumesces and dissolves, leaving a siliceous skeleton.—Ed.]

Talc, Venetian (Th. 186).—Tyrol. Flexible, sectile. Yields to the nail. In the forceps exfoliates and fuses on the edge into a white enamel. No water. With borax effervesces much, dissolves speedily, and in large quantity, into a clear glass not rendered opaque by flaming. Not soluble in hot nitric acid.

Tantalite (*Vide* **Columbite**). (Ph. 272; Th. 484).—Connecticut, North America. Hardness about = 5·25; streak pale reddish-brown. In a good heat it fuses on the edge into an iron-grey glaze; not attracted by the magnet. No water. With borax fuses very slowly into a glass slightly coloured by iron; if saturated, the bead becomes greyish by flaming, and nearly opaque; with borax and nitre gives a trace of manganese. With salt of phosphorus dissolves slowly into a glass coloured by iron while warm; does not become red when cold; therefore does not contain Tungsten.

Tennantite (Th. 630).—Huel Damsel Mine, St. Day, Cornwall. Brittle; yields easily to the knife; powder dark-grey. On charcoal does not decrepitate; when first heated, it burns with a pale blue flame round the assay; fuses readily; emits sulphurous acid fumes and an arsenical smell for a short time. The fused scoria is attracted by the magnet. When well roasted, a grain of copper will be found on breaking the assay.

Thomsonite (*Vide* **Chalilite**). (Th. 314; Al. 124).—Kilpatrick, near Glasgow. Yields to the knife; hardness about = 5·0. In the forceps it becomes white, exfoliates, intumesces, and fuses readily into a white bead, which, if intensely heated, effervesces a little, and becomes nearly transparent and colourless. Contains water. With borax effervesces a little at first, and fuses readily into a colourless glass. Gelatinizes readily with nitric acid. Thompson says, "it does not melt."

Thomsonite (Th. 314; Al. 124).—From the neighbourhood of Glasgow. Scarcely yields to the knife; hardness about = 5·0–5·2. In the forceps becomes white, intumesces, and fuses, with slight effervescence, into a blebby, semi-transparent, colourless bead. Contains much water. With borax effervesces a little at first, and fuses speedily into a colourless glass, leaving a small skeleton which dissolves slowly. Gelatinizes readily with nitric acid.

Tin, cupreous sulphuret of (Th. 586).—St. Agnes, Cornwall. Hardness = 3·0; streak blackish. On charcoal emits slight sulphurous smell, and fuses very readily into a magnetic bead. Yields copper after long roasting.

Tin, oxide of (Th. 585).—Saxony. Yields with difficulty to the knife; hardness = 6·0; streak white. On charcoal it decrepitates, and in a good reducing flame it yields a malleable globule, brilliant while hot, dull when cold, on account of its rapid oxidation.

Titanium, golden-haired (*Vide* **Rutile**).—Piedmont. Infusible. With borax effervesces briskly at first, and fuses rather slowly into a transparent glass, which is colourless if the assay be small, but, if the proportion of the assay be increased, the glass is yellowish-green while hot, and blackish-brown while cold, by transmitted light; and if saturated, becomes white by flaming. With salt of phosphorus, it effervesces briskly at first; gives a glass, yellow while hot, then greenish, and finally a pale amethyst colour when cold; and leaves a residuum which dissolves very slowly.

Topaz (*Vide* **Pycnite**; **Pyrophysalite**).

Tourmaline, black.—Bovey Tracey, Devonshire. Resists the knife. In the forceps it fuses readily, with intumescence and effervescence, into a dark-coloured slag. No water. With borax it effervesces, breaks up, and fuses quickly into a glass coloured by iron.

Tourmaline, black.—Land's End, Cornwall. Fuses readily, with much intumescence and effervescence, into a black bead. With borax effervesces and fuses readily into a glass coloured by iron. [With salt of phosphorus dissolves readily, leaving a skeleton of silica; bead cherry-red when hot, green on cooling, and colourless when cold.—Ed.]

Tourmaline, green.—Chesterfield, America. Resists the knife. In the forceps it fuses on the edge, with slight intumescence, into a greyish-white rough enamel. No water. With borax it effervesces at first, breaks up, and fuses quickly into a clear glass, coloured by iron while warm; with nitrate of potash, manganese is made apparent.

Tourmaline, green.—Killiney, county Dublin. Characters same as last: not so much manganese.

Tremolite, asbestiform (*Vide* **Hornblende**). (Th. 194; Al. 147).—Camborne, Cornwall. Hardness = 4·5. In the forceps fuses, on the edge, with difficulty into a greenish glass, with scarcely any effer-escence. No water. With borax emits some bubbles, and fuses slowly into a colourless glass.

Tremolite, crystallized (Th. 194; Al. 145).—St. Gothard. Hardness about = 5·0. In the forceps, in the inner flame, fuses on the edge, with some effervescence and intumescence, into a blebby white glass, rendered more transparent in a strong heat; and a small fragment forms a bead with difficulty. No water. With borax emits a few bubbles, and fuses rather readily into a glass slightly coloured by iron.

Triphyline.—Bodenmais, Bavaria. Hardness about = 5; streak white. In the forceps fuses readily into an iron-black globule, feebly attracted by the magnet; in a stronger heat the assay spreads over the points of the forceps; heated with some of Turner's test (bisulphate of potash, four and a half parts; fluor spar, one part), it tinges the flame red. Contains very little water. With borax dissolves speedily into a glass deeply coloured by iron. With nitre it indicates manganese.

Turquoise (*Vide* **Calaite**).

Uranium, oxydulous (Th. 268).—Hardness = 5·5; streak black. Infusible; glazes a little in a strong heat. Contains a good deal of water. With borax it emits some bubbles, and dissolves readily; in the outer flame it is greenish, and contains numerous black flocculi; in the inner flame it becomes clearer and of a darker colour.

Voltzine (*Vide* **Zinc oxysulphuret**). (Th, 540).—Lanescot Mine, Cornwall. Hardness = 5·0–5·5; streak white. Decrepitates violently even when reduced to powder and moistened; it deposits on the charcoal a powder, yellow while warm. Contains no water. With borax it breaks up into minute pieces, and dissolves slowly into a glass, colourless while warm, which exhibits milky streaks when cold; by careful flaming it may be made more opaque; in the inner flame it remains transparent when cold, and cannot be made opaque again without a fresh portion of the assay being added. Rare. This appears to be the mammillated blende of Phillips; see his Mineralogy, Third Edition, page 353.

Wavellite (Th. 308; Al. 24).—Clonmel, Tipperary. Yields to the knife; hardness about = 4·0; streak white. In the forceps it becomes white; the fibres diverge, but are infusible. Gives out a good deal of water. With borax fuses readily into a colourless glass, in large quantity; with nitrate of cobalt, becomes blue.

Wernerite (*Vide* **Scapolite**). (Th. 271; Al. 139).—Arendal, Norway. Hardness about = 5·0. In the forceps fuses readily, with intumescence and effervescence, into a colourless blebby glass. No water. With borax fuses readily, with continued effervescence, into a clear glass.

Withamite (Th. 376; Al. 156).—Glencoe, Argyleshire, Scotland. Nearly as hard as Felspar; streak white. Translucent in thin fragments. In the forceps fuses readily, with intumescence and effervescence, into a dark-coloured slag, which melts with some difficulty, on the edge into a black shining glass. No water. With borax fuses readily into a glass coloured by iron while warm; with nitre it indicates the presence of a little manganese.

Wollastonite (*Vide* **Table Spar**). (Th. 130).—Kilsyth, Scotland. Yields to the knife. In the forceps fuses readily into a transparent colourless globule, which effervesces a little in a strong heat. Trace of water. With borax fuses readily, with slight effervescence at first, into a colourless glass, and dissolves in large quantity.

Zinc, blue silicious oxide of.—Catherinenberg, Siberia. Hardness = 4·5; streak white. Does not effervesce with muriatic acid. In the forceps it tinges the flame a fine bright green; intumesces, and fuses on the edge into a white enamel. Contains a good deal of water. With borax it fuses speedily, with effervescence, and in large quantity, into a clear glass, and does not become opaque on cooling, even when saturated.

Zinc, carbonate of.—Hardness = 4·5; streak white. Effervesces with nitric acid. In the forceps becomes yellow while hot, and deposits a powder on the points of the forceps, yellow while warm, white when cold; glazes on the edge. With borax gives a transparent bead, yellow while hot.

Zinc, carbonate of.—Siberia. Hardness = 4·5; streak white. Effervesces with nitric acid when scraped. In the forceps becomes opaque and yellow while hot. Infusible, but is slowly vaporized. Very fine.

Zinc, oxysulphuret (*Vide* **Voltzine**).

Zinc, pale blue silicate of.—Cumberland. Hardness = 4·5; streak white. In the forceps intumesces a little, tinges the flame greenish, and is infusible; it is pale yellow while warm, and white when cold. Contains a little moisture. With borax it dissolves very slowly. With acetate of cobalt it turns blue.

Zinc, silicious oxide of.—Cziklowa, in the Banat. Specific gravity = 3·36. Hardness = 5·0; streak white. In the forceps small fragments fly off; it becomes opaque, white, and brittle; while hot it is yellow, and tinges the flame pale-green, and fuses on the edge into a white enamel. No water. With borax it effervesces at first, and dissolves rather readily into a transparent glass, which is pale yellow while warm, and does not become opaque by flaming, even when saturated. With salt of phosphorus it fuses into a transparent bead, which becomes opaline on cooling, and a portion remains undissolved. Reduced to powder it gelatinizes in muriatic acid in a few minutes.

Zinc, white carbonate of.—Catherinenberg, Siberia. Hardness about = 4·0. Effervesces briskly with muriatic acid. In the forceps infusible, but becomes yellow while warm. No water. With borax it fuses, with prolonged effervescence, into a transparent glass, which, when saturated, becomes opaque on cooling.

Zoisite (*Vide* **Epidote**) (Th. 270; Al. 150).—From Williamsburg, Massachussets, North America. Hardness nearly equal to quartz. In the forceps fuses readily, with intumescence, into a pale green scoria, which glazes on its surface in a very strong heat. No water. With borax fuses readily, with effervescence, into a transparent bead, coloured by iron while warm.

Zoisite (Th. 270; Al. 150).—From Saxony. Resists the knife; hardness about = 7·0. In the forceps it intumesces, effervesces, and fuses readily into a pale green scoria. No water. With borax it dissolves speedily, with effervescence, into a transparent glass, coloured by iron while warm.

Zoisite (Th. 270; Al. 150).—From Strabane, county Tyrone. Resists the knife. In the forceps fuses into a dark green slag. No water. With borax it breaks up, and fuses readily into a clear glass coloured by iron while warm.

Zoisite.—Pfitch, Tyrol. Resists the knife; hardness = 7·0. In the forceps intumesces, effervesces, and fuses readily into a pale green scoria. No water. With borax it dissolves speedily at first, and leaves a residue more slowly soluble; the glass is coloured by iron.

APPENDIX:

CONTAINING

A NEW PYROGNOSTIC ARRANGEMENT OF THE SIMPLE MINERALS HITHERTO FOUND IN IRELAND.

Class I.—FUSIBLE.

Order I.—Combustible.

Div. I.—Combustible *with* flame.

Div. II.—Combustible *without* flame.

Order II.—Incombustible.

Div. I.—Fuse into a slag or bead.*

- A. *With* exfoliation, intumescence, or effervescence.†
  - *a.* Bead colourless or white.
    1. Anhydrous.
    2. Hydrous.
  - *b.* Bead-coloured.
    1. Form a slag or scoria.
    2. Form a perfect bead or globule.
- B. *Without* exfoliation, intumescence, or effervescence.
  - *a.* Bead colourless or white.
    1. Anhydrous.
    2. Hydrous.
  - *b.* Bead coloured.
    1. Not metallic nor magnetic.
    2. Metallic or magnetic.

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* The assay should be the size of a common pin's head.

† Decrepitation is not a permanent character, even in specimens of the same species, e. g. fluor spar and sulphate of barytes.

Div. II.—Fuse on the edge, but do not form a bead.

a. Fused portion colourless or white.

1. Anhydrous.
2. Hydrous.

b. Fused portion coloured or black.

1. Not magnetic.
2. Magnetic.

Class II.—INFUSIBLE.

Order I.—Effervesce with Acids or with Borax.

Order II.—Do not effervesce with Acids or with Borax.

Div. I.—Hardness under 6, or yield to the knife.

Div. II.—Hardness above 6, resist the knife.

Appendix.

Minerals not arranged.

CLASS I.

Order I.

I. Division.—*Combustible* with *flame*.

1. Sulphur. Pale yellow colour, burns with a blue flame, and suffocating odour.

2. Amber. Yellow, becomes electric by friction with a piece of silk or woollen cloth, and attracts light bodies.

3. Bituminous Wood. Brownish black, burns with a weak flame.

4. Bituminous Coal. Black, burns with a bright flame and much smoke.

II. Division.—*Combustible* without *flame*.

5. Gray Antimony. Heavy, melts first, and emits strong sulphurous odour.

6. Anthracite. Light, colour black, burns slowly.

7. Graphite. Grayish black, soils paper, burns *very slowly*.

Order II.—Incombustible.

I. Division.—*Fuse into a slag or bead.*

A. *With* exfoliation, intumescence, or effervescence.

a. Bead colourless or white.

1. Anhydrous.

8. Prehnite. Pale yellowish green, fuses readily with borax.

9. Scapolite. With borax it fuses with effervescence until the assay is entirely dissolved.

10. Spodumene. Contains lithia, and tinges the flame carmine red, when its proper flux or test is used.

11. Pearlstone. Occurs in globular concretions, and fuses with some difficulty.

2. Hydrous.

12. Selenite. Exfoliates or curls up; yields to the nail.

13. Stilbite. Ditto, ditto.

14. Heulandite. Ditto, ditto, high pearly lustre.

15. Apophyllite. Ditto, ditto, square prisms, or some with four-sided pyramids.

16. Thompsonite. Ditto, ditto, in long radiating prisms.

17. Skolezite. Ditto, ditto, ditto.

18. Chabasie or Levyne. Intumesces much, does *not* gelatinize in warm nitric acid.

19. Laumonite. Gelatinizes, in nitric acid.

20. Mesole. Ditto, ditto, in globules of a radiated structure.

21. Chalilite. Ditto, ditto, amorphous, colour reddish or yellow.

22. Killinite. Found only in granite at Killiney, county of Dublin.

Note.—Nos. 13 to 21, inclusive, are found only in trap rocks, and chiefly in the north of Ireland.

b. Bead coloured.

1. Form a slag or scoria.

23. Epidote or Zoisite. Baikalite.

24. Dark-green Tourmaline.

2. Form a smooth bead.

25. Idocrase. Hardness = 6·0.

26. Talc. Soft, in thin laminæ, not elastic.

27. Mountain Cork. Amorphous, yields to the nail.

ORDER II.

I. Division.—*Fuse into a slag or bead.*

B. *Without* exfoliation, intumescence, or effervescence.

a. Bead colourless or white.

1. Anhydrous.

28. Fluate of Lime. Purple colour, corrodes glass when heated with sulphuric acid, crystals cubic.
29. Sulphate of Barytes. Heavy.
30. Sulphate of Strontia.
31. Phosphate of Lead. Forms a polygonal bead, and yields lead when fused with carbonate of soda.

2. Hydrous.

32. Gypsum or Vulpenite. Soft.
33. Erinite. Soft.
34. Hydrolite.
35. Philipsite.
36. Harmotome. In quadrangular prisms, forming macles.
37. Natrolite or Lehuntite. Fuses slowly with borax.
38. Mesotype.
39. Antrimolite.
40. Harringtonite.
41. Analcime.

NOTE.—Nos. 32 to 41, inclusive, are found in the trap districts, chiefly in the north of Ireland. Harmotome occurs on granite in the county of Wicklow.

b. Bead coloured.

1. Not metallic nor magnetic.

42. Essonite. Amorphous, bead translucent, greenish.
43. Garnet. Crystallized, bead black.
44. Chlorite. Green, soft, granular, amorphous.
45. Kirwanite.
46. Actinolite.
47. Hornblende.
48. Augite.
49. Lievrite.
50. Pitchstone.

2. Metallic or magnetic.

51. Gold.
52. Copper. A malleable bead.
53. Red Oxide of Copper, Tile Ore. Ditto.
54. Black Oxide of Copper. Ditto.
55. Green Carbonate. Effervesces with acid.
56. Blue Carbonate. Ditto.
57. Brittle Silver Ore.

58. Galena.
59. Carbonate of Lead. Effervesces with acid.

The Nos. 51 to 59 yield a malleable bead.

60. Vitreous Copper.
61. Purple Copper.
62. Fahl Ore.
63. Copper Pyrites.
64. Sulphuret of Nickel. In delicate acicular crystals.
65. Grey Cobalt. Colours borax deep amethyst colour.
66. Red Cobalt. Ditto.
67. Wolfram.

Order II.

II. Division.—*Fuse on the edge, but do not form a bead.*

a. Fused portion colourless or white.

1. Anhydrous.

68. Asbestus. Fibrous.
69. Amianthus. Ditto.
70. Tremolite. Ditto.
71. Pinite. Six-sided prisms, hardness = 2·5.
72. Apatite. Ditto, hardness = 5·0.
73. Sahlite.
74. Felspar. Hardness = 6·0.
75. Adularia. Ditto.
76. Albite. Ditto.
77. Moonstone. Ditto.
78. Labradorite. Ditto.
79. Iolite.
80. Indicolite. Dark blue, in long prisms.
81. Beryl. In six-sided prisms.

2. Hydrous.

82. Plinthite.
83. Steatite.
84. Serpentine.
85. Schillerspar.
86. Chiastolite.

b. Fused portion, coloured or black.

1. Not magnetic before or after roasting.

87. Mica. Soft in elastic laminæ.
88. Red Manganese. Colours borax deep purple.
89. Calamine. Effervesces with borax.
90. Blende. In a strong heat its edges round off, but do not fuse; it is yellow while warm.
91. Sphene.

2. Magnetic before or after roasting.

92. Carbonate of Iron. Effervesces with borax.
93. Red Hematite. Streak red.

94. Brown Hematite. Streak yellowish brown.
95. Specular Iron, Micaceous. Streak red, transmits a red colour.
96. Magnetic Iron-stone. Magnetic before roasting.
Magnetic Iron-sand. Ditto.
97. Oxydulous Iron. Ditto.
98. Arsenical Iron. Emits smell of arsenic.
99. Iron Pyrites. Emits smell of sulphur.
100. Clay Iron-stone.
101. Meadow Iron Ore.
102. Nigrine.
103. Phosphate of Iron.

Class II.—INFUSIBLE.

Order I.—Effervesce with Acids or with Borax.

104. Calcareous Spar.
Schiefer Spar.
Rock Milk.
Chalk.
Swinestone.
Dolomite.
105. Arragonite. Contains Strontia.
106. Pearl Spar.
107. Carbonate of Magnesia.
108. Carbonate of Strontia. Colours the flame carmine red.
109. Carbonate of Zinc.

Order II.—Do not effervesce with Acids or Borax.

Div. I.—*Hardness under* 6·0, *or yield to the knife.*

110. Nacrite,	,,	= 2·25.	In small scales.
111. Lithomarge,	,,	2·5.	Amorphous.
112. Rhodalite,	,,	2·0.	
113. Wavellite,	,,	3·5.	In radiated globules.
114. Earthy manganese,	,,	1·0.	Colours borax deep purple.
115. Compact.			Ditto.
116. Grey.			Ditto.

Div. II.—*Hardness above* 6·0, *or resist the knife.*

117. Tinstone.
118. Chrome iron. Colours borax green of rich colour.
119. Rutile.
120. Grenatite.
121. Andalusite.
122. Quartz, rock-crystal, &c.
123. Olivine.
124. Topaz.
125. Corundum.

List of Minerals mentioned in the Catalogue of Giesecké, etc.; but not included in the foregoing arrangement.

No. in Giesecké's Catalogue,	76.	Porcelain clay.
,,	77.	Pipe do.
,,	78.	Slate do.
,,	79.	Clay-stone.
,,	80.	Tripoli.
,,	81.	Alumstone.
,,	82.	Bituminous slate.
,,	83.	Drawing slate.
,,	84.	Whet slate.
,,	85.	Clay slate.
,,	86.	Alum slate.
,,	89.	Potstone.
,,	99.	Wacke.
,,	100.	Iron clay.
,,	101.	Green earth.
,,	103.	Bole.
,,	104.	Cimolite.
,,	107.	Nephrite.
,,	158.	Slaggy mineral pitch.
,,	159.	Bog tallow.
,,	222.	Orthite.

General laws of the effect of heat, fluxes, etc., on the earthy minerals. Deduced from experiments by A. Smith.

1st Class.—Compounds of *Silex*, *Alumina*, Iron, Water, &c.

In the forceps most of them are infusible, those containing a large portion of iron glaze or fuse on the edge, in proportion to the quantity of iron they contain; with borax, they are almost insoluble. The anhydrous species are hard: those which contain water in chemical combination are rather soft. They all become blue when heated with solution of nitrate of cobalt, except such as contain iron.

2nd Class.—Compounds of *Silex, Alumina, Alkalies*, Iron, Water, &c.

In the forceps they all fuse quietly (?) on the edge: some form a bead. With borax, most of them dissolve slowly; a few more readily. The anhydrous species are harder than the hydrous: some of the latter gelatinize in nitric acid.

3rd Class.—Compounds of *Silex, Alumina, Lime*, Iron, Water, &c.

In the forceps all fuse, most of them with intumescence, and form a bead readily. With borax, all dissolve; many speedily, some slowly. Hardness of the anhydrous species generally from 6 to 7; of the hydrous, from 3 to 5.

4th Class.—Compounds of *Silex, Alumina, Magnesia*, Iron, Water, &c.

In the forceps all fuse on the edge; some form a bead. With borax, all dissolve; some speedily, some slowly.

5th Class.—Compounds of *Lime* and *Acids*.

The carbonates are infusible; the others are fusible. With borax, all dissolve; some speedily, the carbonates with effervescence.

6th Class.—Compounds of *Silex, Magnesia*, Iron, Water, &c.

Infusible, or fuse slowly on the edge. With borax, dissolve very slowly.

7th Class.—Compounds of *Silex, Magnesia*, and *Lime*.

All fusible; some readily, some on the edge. All soluble in borax; some readily, some slowly.

8th Class.—Compounds of *Baryta, Strontia*, and *Acids*.

THE END.

[illegible] OF [illegible]

4th Class.—[illegible] *Manganese, Iron, Nickel,* [illegible]

In the [illegible] *on the* [illegible] *a* [illegible] *all* [illegible], *some* [illegible], *some* [illegible].

5th Class.—*Compounds of* [illegible]

The [illegible] *the* [illegible] *With borax,* [illegible] *some* [illegible], *the* [illegible]

6th Class.—*Compounds of Silver, Magnesia, Iron, Water, &c.*

[illegible] *or fuse slowly on the edge. With borax, dissolve very slowly.*

7th Class.—*Compounds of* [illegible], *Magnesia, and Lime.*

All [illegible]; *some readily, some on the edge.* [illegible] *in borax;* [illegible] *some slowly.*

8th Class.—*Compounds of* [illegible], *Alumina, and Acid.*