IV.—*On Mineral growth, at ordinary temperatures, and under ordinary conditions.*

By T. A. Readwin, F.G.S., M.R.I.A.

(Read at the first meeting of the Liverpool Branch of the Mineralogical Society, May 5th, 1877.)

"PLANTS live, and grow; Animals live, grow, and move; Minerals, neither live, grow, nor move."

For so long a time, has this been an article of almost universal belief, that any nonconformity therewith, is looked upon with more or less of grave suspicion.

In what follows, it is proposed to show that there is a rather more natural order in which the aphorism may appropriately run; namely:—

Minerals *grow*, Plants live and grow, Animals live, grow, and move at will. "The three kingdoms of nature," as they are not at all inconveniently called, exist in close relationship; so very close, indeed, that some naturalists think they are not really apart from each other.

Of this Trinity in Creation, inorganic matter certainly takes precedence. All fixed vegetal-life draws its food therefrom; and all moving animal-life feeds partly on it, and partly upon organic matter which has grown therefrom. Minerals appear to have been dismissed by negation from participation in that natural state of being, which is commonly known as "*growth.*" Chemists, however, not unfrequently use the expression, when speaking of certain changes which take place in metallurgical operations; but, as far as I know, the term has not yet been applied to spontaneous changes of recent origin, in minerals in their ordinary *natural* condition.

To apply the term "growth" to the imperceptible aggregation of particles of mineral matter, possibly may be considered an impropriety of speech. However, at all hazards, for want of a

better, it will be used in this paper, as not only directly expressive, but, *generally* appropriate in the description of certain recent "goings on," in my collection, upon auriferous and other minerals, chiefly of my own finding, during the last quarter of a century.

These changes, or *growths* have, of late, been so numerous and extraordinary, that they have been, and are, to me, a continual source of agitating pleasure and admiration. A something which one cannot see, exists and works mysteriously in the sensible development of these metallic changes, and thought perpetually stretches out the enquiry—whereunto will they grow? They still *go on*; and the consideration proposed for lilies is also irresistible here, as to "How they grow?" This is altogether, far above and beyond my comprehension. I can only refer the change-origin to an ever-living creator; and reiterate the ejaculations of the grandest of old naturalists:—"Lo! these are parts of his ways."* "The secrets of wisdom."†

A—CHEMICAL INORGANIC CHANGES.

Touching time-periods involved in inorganic changes, chemists in their laboratory operations are constantly observing extraordinary changes by crystallization and otherwise, and, some of them, of exceedingly *rapid* development.

"Metallic-vegetation" is a fanciful expression which was in familiar use in ages past. "Arbor Saturni," "Arbor Dianæ," "Arbor Jovis," are most interesting reminders of youthful recreation. Their very recollection is positively refreshing. In these artifical productions very beautiful arborescent and other shapes, are almost seen to grow. Curious laminæ seem to shoot out from nothing, in creative appearances of vegetation. To account for these charming phenomena, they are said to result from *voltaic action* being set up between the liquids, and the respective metals introduced.

It will not be denied that some of *these* growths are very rapidly developed. Again, reservoirs of water have been known to crystallize thickly into ice during a single night, to the sudden joy of ardent skaters. Who has not actually seen fine needle-like ice shoot half across a window-pane, and unite with *measureable* rapidity. Icicles, though slower, "grow downwards."

* Job, xxvi, 14.
† Job, xi, 6.

It is not unreasonable to suppose the pre-existence of the elements, Silicium, Calcium, Aluminium, &c., to that of their oxides, &c.

Natural decomposition and re-creation take place continually under man's unaided eye; and he is easily helped by a microscope to the wondrous sight of many others, which touch the fringes of the "Infinitely little." The decomposition of pyritous-matter and the new formation of copperas, is a familiar example of recreative growth in aggregation of particles. And yet, strangely enough, there exists an astonishing amount of popular infidelity as to the truth of comparatively recent metal-growths; just as if it was a prime duty to believe that all minerals had their changes at once and for ever, at a period long anterior to the human family!

I may observe here, that some years ago, with a lighted candle stuck by a bit of clay to a hat borrowed for the occasion, cautiously following second of a party of five, I went into the deep adit of a Silver-Lead mine in Devonshire, which had been closely built up at its entrance not more than half a century previously. At less than a hundred yards inside the level, from the roof-timbering hung many long strings of what, in plain-speaking might be called *lead-vegetation*, which upon touching, went immediately into fine powder. Metal-growth I have since thought not altogether an inappropriate expression to apply to those beautiful metal aggregations. The exact age of those growths cannot be known; but they must have been produced within 50 years of the time when I saw them. This interesting fact pointed out to me that some importance attached to the formation of minerals and metals, in their relation to time. Possibly, the growth went on as rapidly as the Arbor Saturni, just referred to.

I will also refer to a curious and interesting vegetable-growth which I found in 1871, in a copper mine at Holyford, county Limerick, in a level 150 yards deep from the surface. There was a lot of it, and some portions had grown from the top to the bottom of the level. A miner who was with me had assisted in driving the level a few years prior to this. The growth, therefore, must have been very rapid. It resembles somewhat the "Moss-Copper," to be described presently, and it is just as impatient of confinement in a box. I am not, of course, saying that this apparently dead vegetation is growing now. I found also some small "copper growths" in the place; but it did not occur to me, till lately, that metallic

copper might, by deposition from water, at some time or other take the place of this form of vegetal growth, and go on in aggregation until soluble silica filled up intervening spaces, in the formation of what is called a "quartz-vein mineralized with copper."

Moss-Copper, Moss-Gold, and Moss-Silver.

These expressions have been in use for some time touching "growths" noticeable after certain metallurgical operations.

*De la Beche** a long time ago wrote about Moss-Copper:—"It is a well known fact that metallic copper occurs diffused through certain kinds of copper regulus, in the form of minute angular particles, which do not show the least trace of having undergone fusion; all the edges of these particles are sharp, and not in the least rounded, and, where cavities occur, the metallic copper may be seen protruding into them, in the form of minute points, and hair-like threads and filaments."

Dr. Percy † wrote—"In Copper Works this term (Moss-Copper) is commonly used to designate those accumulations of filamentous or moss-like copper which are found in cavities in pigs of certain kinds of Regulus. Mr. Edward informs me that, in melting copper from Cornish ores, Moss-copper seldom appears; but more of it is produced when these ores are melted in admixture with a little Irish Ore (copper pyrites, mixed with *much iron pyrites*); it occurs most abundantly when foreign ores are much used. It is chiefly observed, and in the finest state, in *Pimple-metal*, when all the cavities are filled with it; and it is found protruding from the *bottom of the pigs* into the sand underneath; sometimes, a little of it, strong and wiry to the touch, appears on the upper surface of the pigs. According to Mr. Edward, it may be seen in the little prills or shots of metal in the ore-slag; and the surfaces of the pigs of metal from the *calcined metal* furnaces are covered with a coating of it, generally of a dark colour, and as thick as the nap, or pile, on velvet. In specimens in my collection the filaments of copper vary in size from the finest thread to fibres 3-16ths of an inch in diameter, and from one of three specimens obtained from a *fine-metal* furnace-bottom, I have taken separate filaments, perfectly continuous, and exceeding five inches in length. Under the microscope, the filaments present numerous minute

* Geological Observer.

† Percy's Metallurgy, Vol. 1., p. 349.

parallel and longitudinal lines, or grooves, as though they consisted of bundles of extremely delicate fibres. The mode in which these fibres are produced is an interesting subject of inquiry. Each fibre seems to have been pushed, as it were, through a draw-plate, and at a temperature when the metal was soft, but certainly not exceeding that of well melted copper; or otherwise, the fibres immediately after their protrusion, would have been remelted into globules."

Prof. Liversidge,* of Sydney, N.S.W., writes:—"I placed some lumps of native copper disulphide (Redruthite), (Copper-Glance of *Maskelyne*, and Chalcocite of *Dana*), in a hard-glass bulb tube, heated, and passed current of Hydrogen gas. After the experiment, the whole surface of the mineral was found to be thickly covered with a nap of acicular filaments of copper. *No traces of fusion* were exhibited."

Mr. W. H. Hutchings,‡ of Birkenhead, wrote:—"Perhaps the most interesting and curious fact recorded by Prof. Liversidge, is the very low temperature at which the "Moss" is formed. I took a ¼lb of regulus (containing 65·9 per cent Copper) and fused it under borax in a clay crucible, pouring the molten mass into an iron mould. After cooling (by using a thin mould and standing on a hot plate) the regulus was found to contain a large amount of disseminated copper, the fractured surface showing numerous veins, and little nests of needles, in small cavities in the regulus, even to the naked eye; while a lens, or microscope showed the entire surface dotted with particles of copper. When a small portion of the regulus was fused as above, and cooled very rapidly, very little copper was visible under the microscope. When a large button of regulus (¼lb as above) had cooled in the mould for some time, so that it had been quite solidified for some minutes, it was laid on an anvil, and broken in two by a blow with a hammer. It was still too hot to hold in the hand; but had cooled far below redness, even in the centre. At the moment of fracture, the surfaces exposed, were perfectly clean, and lustrous, looked at quickly with a lens, they showed only the little veins and nests and imbedded particles of the disseminated copper; but *in the course of a minute or two* they were seen to become slowly covered with a growth of minute copper filaments, which increased, till in some places it

* Chemical News, Feb. 16, 1877.

‡ *Ibid.* March 23, 1877.

resembled a coarse velvet. After three or four minutes, one of the halves was again broken in two, and again the fresh and lustrous surface of regulus exposed, which contrasted strongly with the surface already covered with "Moss." The piece was now just cool enough to be held in the hand. In the course of a few minutes this also showed moss-copper on the surface, though not nearly so much as the first fracture, and only in patches, which formed very slowly. In all cases the growth is most extensive on the hotter parts of the surface—those nearest the centre, and if large buttons of regulus are broken while still much hotter than above-mentioned, a far thicker covering is rapidly obtained. Of course there is no question here of this "moss-copper" being formed at a temperature sufficient to soften copper. . . . Seen under the microscope, these filaments (which, in these experiments are exceedingly minute) exactly resemble the larger ones described by Dr. Percy, being deeply grooved and striated. Many of them are broad and flat, like blades of grass, as described by Prof. Liversidge in the cases of Moss-silver, and many seem to show plainly that they were formed by the *union of several finer threads*, as they look when magnified, exactly like coiled wire-rope."*

MOSS-GOLD.

Prof. Liversidge gives the result of an experiment of his, "to ascertain, if possible, whether the gold which was known to be present in a certain specimen of mispickel existed in the crystallized state, or was merely disseminated through the mineral in amorphous particles." Two specimens were experimented on, both of which contained visible gold; one of them rich in gold. The mispickel was taken to contain the following proportions:—

Iron	34·4	(or $FeAs_2FeS_2$)
Sulphur	19·6	
Arsenic	46·0	
	100·0	

"The first specimen was roasted in a muffle in order to expel the sulphur and arsenic." * * *

* May 6. I received from Mr. Hutchings this morning, a kindly note on Moss-Copper, and Moss-Silver, resulting from experiments at *a low degree of heat*. The object, however, which I have at heart, is a proof that metallic-growth also takes place at ordinary temperatures, and, probably, under ordinary conditions.

"On taking the specimen out of the muffle. after the whole of the arsenic and sulphur had been driven off, I found that the surface was studded with small, irregular, more or less rounded excrescences of gold, having the appearance and colour of sulphur. On closer examination, and especially with the aid of a microscope, the surface of these mushroom-like growths were seen to be covered with minute capillary wires and branching forms which, in some cases, appeared to be made up of minute irregularly formed crystals. This is more noticeable in the second specimen. Some of the cavities in the gold are seen to be lined with the most beautiful spiculæ of gold, and some of the rounded bosses are composed solely of such spiculæ, interlaced into a ball-like form. Many of these capillary wires are curled into most symmetrical and beautiful spirals; one about $\frac{1}{4}$ to $\frac{1}{3}$ inch in length, and of about $\frac{1}{100}$ inch in diameter, is coiled with the utmost regularity, the pitch of the screw being maintained uniformly throughout its entire length. In some cases the mushroom-like growths are seen to be supported on but a very slender stem, while others have apparently become recumbent from their weight, and have grown along the surface. It is by no means an uncommon thing to find natural gold in the form of capillary threads, which are often interlaced and twisted into beautiful and fantastic shapes; also as thin flakes and scales, having a more or less fibrous surface, and at times, in scales so exceedingly thin that they are not thicker than ordinary gold-leaf. I should mention, however, that I have never seen or heard of any native gold presenting exactly the same kind of appearance as the before-described artificially-formed specimens."

MOSS-SILVER.

Prof. Liversidge's experiments with silver-sulphide, treated in a similar manner to the gold-mispickel experiment, resulted in "beautiful little growths of metallic silver dotted over its surface, and particularly near the upper edges; the lower portion of the mass, to a height of about $\frac{1}{4}$ of an inch, only presenting one or two points of silver, at the right-hand end. The projecting filaments had a most brilliant silver-white color and lustre. In certain instances, the crystals could *almost be seen to lengthen;* a perceptible increase in length in more than one instance was observed within the space of one or two minutes. . . . The extruded wires and filaments appear to be *rooted in the sulphide,* as if they pushed

their way out from within, and they usually project out at nearly right-angles to the apparently unchanged dark lead-colored silver-sulphide, just as Dr. Percy describes the formation of silver-filaments from the same compound under the reducing agency of a current of Hydrogen gas."

*De La Beche** wrote:—"Artificial sulphuret of silver was found to be readily decomposed by steam, and more easily so at a moderate heat. At a temperature under the melting-point of zinc, this was soon effected, and the silver effloresced in such forms as to induce M. Gustav Bischoff to regard the moss-like and filamentous occurrence of native silver in veins as very probably the result of the decomposition of sulphurets."

Dr. Percy wrote:—"Filaments of silver, which, examined under the microscope, appear to possess *identically the same structure* as Moss-Copper, may be formed by heating finely divided sulphide of silver in a current of Hydrogen at a temperature sufficient to agglutinate the sulphide, but below the actual melting point of silver. This beautiful experiment may be made in a glass tube, through which a current of the gas is passed. Long delicate fibres of silver may be seen protruding from minute rounded masses of the sulphide; and as they are produced while the masses are in a soft state, and lying free in the tube, the idea that they result from the application of external pressure, in a similar manner to maccaroni, can hardly be entertained. *There seems to be a force in operation at the base of each filament, which causes the particles of silver at the moment of liberation successively to arrange themselves in one continuous fibre, or series of fibres; or, in other words, each filament grows, as it were, from a root imbedded in sulphide of silver.*"

I have received this morning from Mr. Hutchings a beautiful specimen of silver-growth from argentite at a red heat, by the action of steam. Of it he writes:—"You will see the argentite has only fused at the bottom, where in contact with crucible. When quite fresh, it was a most beautiful specimen; but it is tarnished now."

I have cited the authorities above, at some length, because they form a fitting introduction to the facts I have now to describe; the only difference being that mine are *natural* facts, produced at

* Geological Observer, p. 768.

ordinary temperatures, and, as far as I know, under ordinary circumstances, and the others are all produced by artificial means, at comparatively high temperatures. I cannot, however, refrain from remarking here, that if these respected authors think it appropriate to apply the term "growth" to their artificial creations, surely it will not be considered inappropriate, if I apply the same expression exactly, to the *natural* facts which I am about to introduce.

B—SPONTANEOUS METAL-GROWTH.

An opinion prevails that all crystallized minerals must have had a very slow, and somewhat remote origin and development. A single glance at this large bunch of interlaced white quartz-crystals (marked A*), and this large mass of Amethyst crystals (marked B), ought to dissipate any such opinion, instantly. I incline more to the idea that, at times, and in certain natural conditions, mineral crystallization, if not instantaneous, is comparatively rapid. I believe the same of the crystallization and sundry kinds of growth of *metals*.

I think there are ample proofs before us. I propose to proceed in the following order :—

1. As to Metal-growth of unknown, and possibly remote date, including Copper, Silver, and Gold-growths.
2. As to Metal-growths, of approximately known, and of recent date, including Iron, Copper, Silver, and Gold-growths.
3. As to recent Metal-growths, the result of experiments.

1—*Spontaneous metal-growth of unknown date.*

COPPER-GROWTH OF UNKNOWN DATE.

Specimen marked 100^{n}. is a common fern-like form of copper-growth upon limestone. 100^{h}. is a beautiful vegetal-looking bunch-growth.

SILVER-GROWTH OF UNKNOWN DATE.

No. 3. The silver in this specimen, is highly auriferous. Here is an agreeable union of the "Royal Metals," forming, probably, what is called küstelite. Some portions of the associated quartz bear impressions of silver that have been broken off.

* The specimens referred to were exhibited by the author in illustration of his paper.

32ª. is a sinuous wire-shaped silver-growth, springing from calcite, in association with silver sulphide (argentite). This specimen, now three inches long, was accidentally broken in half by me, 4 years ago. I have seen growths of this kind a foot long.

No. 4. is an oak-tree-like silver-growth associated with copper and calcite. There can be no hesitancy in treating this large beautiful specimen as a growth.

GOLD-GROWTH OF UNKNOWN DATE.

71ª A most interesting example of Silver-Gold-growth (known as *electrum)* upon Siberian sandstone. (Bought 1863.) Here we have gold in exceedingly fantastic shapes, blisterings, featherings, interlacings, &c., &c. This valuable specimen may be taken as a type of many recent Electrum-growths, to be shown presently. Probably this Electrum was originally brightly shining, and tarnished afterwards, like some of the Merioneth specimens before us.

70. exhibits beautiful and peculiar gold-growths in sheets, upon chalcedonic-quartz. The large growth broke off of itself, in 1874. Most interesting under microscope.

842. Australian Gold-growth (43 grains,) almost pure, carefully detatched from matrix. Bought in 1864.

Specimen 28, probably forming after the fashion of 842.

14 and 869. Native gold apparently pure, grown in slightly wrinkled plate-like shapes, from decomposing mispickel; exceedingly beautiful. The iron sulphate has been very recently produced.

69 is an exquisite fern-like gold-growth, probably pseudomorphous.

2—*Spontaneous metal-growth of recent origin.*

Here are upwards of 1000 Gold specimens, varying in weight from a few grains to half a cwt. and more, and in or upon them the gold occurs in something like 100 different modes and associations. Most of these were discovered by myself and have never been out of my possession. More than 500 of these stones exhibit metal-growths that have come under my own observation. I select about 100 of them for illustration, which will, I think, amply suffice to prove my case of recent metal-growth, beyond all further doubt.

IRON-GROWTH OF RECENT DATE.

No 840. Upon this specimen of magnetite are many serrated protrusions. Most of those at the edges emanated in less than a week, prior to 8th of February, 1876. On April 6th, this year,

I noticed that two of the growths would sway to and fro under the influence of a magnet, just as if hinged. These remained depressed for a few moments after removal of the magnet, when one of them suddenly returned to its original position, as if elastic. The experiment was repeated once too often, and it broke off. Numerous smaller growths have appeared since February, 1876.

COPPER-GROWTHS OF RECENT DATE.

No. 100[b]. is a lovely mass of isometric cuprite crystals, showing beautiful coral-like copper-growth, some of which have occurred since I had the specimen from Redruth a few years ago. One crystal is projected outward 1-16th of an inch, upon which are also other copper protrusions.

No. 100[c]. A cherty quartz-fragment, from Lake Superior, very rusty-looking. From a fissure in this specimen, native copper, apparently pure, has recently (within 2 or three years) protruded along the whole length of it, rather more than an inch.

This interesting exudation, under microscope, exhibits more or less perfect octahedral crystallization. These exude longitudinally as a rule, but above the centre of the line of movements there is a vertical accumulation 1-8th of an inch. At this point it took a sharp bend, grew outwards a little, and then downwards about 1-10th of an inch. Sometime within the last 3 months, it has sent out a filament, or antenna-like feeler, and has become united to the vertical portion, forming a metallic loop. Another crystal-form has shot from the side of the vertical column, and there is a fresh indication of movement at its apex. The loop, probably, will be filled up eventually.

843, 843[a]. Two specimens of Cuprite, from Redruth, showing copper growths, whilst in my possession.

SILVER-GROWTH OF RECENT DATE.

848. Silver sulphide (Kongsberg argentite) upon white calcite crystals. The argentite has recently thrown out, and is continually throwing out, a great number of the most exquisite silver-growths. The growth-activity of this specimen is very remarkable, and began not more than two years ago. The growth since February, 1876, has been very brisk. The grown off portions, so to speak, have themselves increased in bulk very much since January last, and now equal in bulk the argentite from which they had their origin. The growth will probably go on, until the argentite altogether disappears.

849. Mexican argentite upon crystalline white quartz. Probably 848 and this specimen were at one time united. I have an indistinct recollection of their parting in my cabinet 3 or 4 years ago. Here are exquisite silver-growths, exactly of the same character as 848, only apparently with less disposition to curl off. There is one very bright recent-growth, since February, 1876.

172[b]. Mexican argentite upon quartz, showing miniature silver-growths, very recent, being beautifully bright,

605. Chilian argentite upon crystalline quartz, showing twisted Silver-growths. Changed considerably since February, 1876.

16[c]. Mass of transparent quartz crystals (Mexican) partly covered with argentite, out of which since 1863, many closely-matted, curly-wig-like Silver-growths have appeared. Some of them resemble ravelled garden-matting. When the growths fall off, they lose their bright white color and lustre, become dirty-grey, and almost dusty. Some of the growths are the products of this year (now 28th April, 1877). A fine long red filament has also appeared, crossing and twisting upon the top of the Silver-growths. The scrolling-growths at the bottom of the tray have all fallen off since December last.

846. Mexican argentite, upon unusually glistening crystallized quartz, shows numberless short, curly, coupling, Silver-growths, resulting since 1863. One vigorous recent growth, on the opposite side of the specimen, has appeared apparently independent of the silver sulphide.

18. Mexican argentite with a mass of glistening white quartz crystals, shows silver-growths since 1867. Some of them have grown during this year. See a bunch of interlaced and twining silver-threads, and others, somewhat like vine-tendrils. The growths at the bottom of the tray have all fallen off this year.

847. Mexican argentite covering white crystallized quartz, shows numerous curly silver-growths in cavities of the specimen. Nearly all since 1863. Some of them much more recent.

844. Mexican argentite curiously mixed up with a mass of quartz crystals, shows silver-growths of date since 1863. Some very delicate growths of more recent date.

117. Mass of Hartz polybasite has exhibited since 1866 several scroll silver-growths, particularly a short flat one upon a red gossany portion of the specimen, ¼ inch long.

845. Nevada silver ore, showing silver-growth since Feb., 1876.

3—Recent Metal Growth, &c.—The result of Experiments.

TITANIUM.

Bottle No. 80 contains Isometric Titanium Crystals, taken from a Low Moor Iron-furnace, after working incessantly for 50 years. Had about 1864. Many of the forms have since been modified, and a few obliterated.

COPPER.

No. 1. "Moss-copper" taken from a much larger quantity had sometime before 1869. Said to have been swept off copper-ingots, after a 13th fusion at Swansea. (?)

It consists of filaments of various lengths and thicknesses, all more or less gracefully curled, and occasionally very intricately intertwined. The prevailing colors are red, bronze, grey, yellow, violet, and scarlet, in many shades; all brilliant; and some of them extremely so.

Some of this Copper-growth, for cabinet convenience, was closely pressed down into a paper-tray, about 12 months ago; but, soon after reading Prof. Liversidge's interesting notes on "Moss-gold and Silver," in *Chemical News*, of February 16th, I was induced to inspect my own minerals of similar character, and to my astonishment, found that my "Moss-copper" had spontaneously risen in some places above the edges of the paper-tray, into which I had pressed it. Some of the filamental protrusions, which I incline to call "growths," were over an inch in length. I have since transferred them to a glass-topped box, affording scope for methodic observation. At present, all I have observed are sundry snake-like enfoldings which most likely are altogether mechanical.

No. 2. Glass-topped box contains a pinch of Moss-copper taken from No. 1, about the middle of February last. Note.—There is a grey copper-filament, 2 inches long, bent at about half its length, at a right angle. On the appearance of Mr. Hutchings' note on Moss-copper in *Chemical News*, 23rd March, again examined; found that the grey filament had grown fully half an inch and had reached to the top of the box, as now. There is also a very slender red filament with the same propensity, only in a less noticeable degree. Another growth $^{7}/_{10}$ in. long, appears to prefer a horizontal mode of proceeding. (29th March.)

April 19. The grey filament appears to have fallen as if by increased weight. The horizontal filament has twisted out of its

original shape; the red filament has grown considerably. (1st May, 1877. The grey filament has risen half-way up the side of the box. The red filament has reached the top of the box and has bent over, as if trying to escape through whatever space there is betwixt the annular portion of the box lid and that of the box. Eased the lid with a needle. There have also been movements in portions of the material at the bottom of the box. The horizontal-moving filament above mentioned cannot be now recognized. (1st May.)

GOLD.

81. Specimen of Merioneth auriferous quartz, experimented on by me in 1856, shows hundreds of globules of gold. The changes since then are the collapsing of a few of the globules—the expansion of one globule; the very palpable flattening of two others, the apparent breaking-up and regular crystallization of another, and the general alteration of the surfaces of the globules. (27th April.)

92. Merioneth auriferous quartz with bismuthine, experimented on by me in 1856. At that time there appeared hundreds of gold-globules, some of them $^1/_{16}$ inch in diameter, others invisible except by microscopic aid. All smooth and bright. Surface changes have been general; but not very recent. (27th April.)

96. Merioneth auriferous quartz, experimented on by me in 1856, producing hundreds of gold globules on its-surface. This specimen originally had upon it much auriferous iron sulphide (pyrites). Globules then to the eye appeared smooth. The surface alterations, although not recent, are very interesting. (27th April.

217. Merioneth quartz (experimented on, 1864,) exhibits more than 100 gold-globules, some of them with a very bright surface. A globule in a cavity in process of alteration. The cylindrical growth with a globule at top was not observed until 6th of April last. It certainly was not there in February, 1876. Interesting.

100^p. and 100^v. Quartz containing tetradymite. (Exp. July, 1875 at a low heat.) Gold-globules chiefly bright at that time. Interesting changes in formation since.

86. Quartz calcined by the late Mr Clement, F.G.S., in 1846. Given to me in 1863. Since then gold sensibly changed in form.

100^t. Button of electrum "Double-gold of the Jewellers" containing 20% Ag. extracted from Merioneth quartz by amalgamation in 1864. The Hg. was charged with sodium amalgam. At first

was quite a bright yellow; then became enclosed in a dirty-white coating which has recently partly peeled off, and revealed microscopic growth-like alterations.

100ⁿ. Bottle containing Au., Bi., Te., &c., compounds in loose particles, (175 gr.) obtained by me July, 1875, from 16 oz. Clogau quartz. Heat in this experiment was low, owing to bad coke. No Hg. used. Very marked alterations in shapes. 100ᵛ. Part of last experiment; gold-globules considerably changed.

9. Button of gold (80 Au., 20 Ag.,) 11 grs. extracted by me in 1854 from 37 ozs. Merioneth quartz, having no gold visible under microscope. Surface at first smooth and bright, neither now.

7. Portion of 56 ozs. pale yellow electrum, extracted by me in 1867, has commenced foliating on one side, and not on the other.

7ᵃ. Pure or "Red-gold" parted from a portion of the same bar as 7. No alteration in these pieces, either at surface or edges.

276. Portion of a large quantity of electrum, extracted by me in 1864; this specimen once had precisely the appearance of 7, on its *altered* side. Both sides are now changed; one side is grooved in comparatively smooth parallel lines, along its whole length; the other side displays curious plant-like growths. A sharp edge of the specimen has a serrated appearance and is bending over to the concave side. (Noticed on the 1st inst.) I am not aware that this metallurgical fact has been before observed; it is of intense interest to me, as I am enabled to take it as a type-growth, with which to compare electrum-growths in certain other specimens.

276ᵃ. Pure gold parted from a portion of the same bar of electrum, from which 276 was taken, and at the same time. No alteration observable in these broken pieces, any more than in 7ᵃ, clearly showing that pure gold (within 10 years) does not always alter in surface appearance, while the silver-gold (electrum) from which it was parted, is apt to do so, during the *same* lapse of time.

10ˢ. "Red gold" precipitated for me (1864) by Dr. Reynolds, from Merioneth gold. Lustre in part reappearing, and microscopic changes taking place.

8. Bright 22-carat gold (as per Johnson and Co., 13th May, 1864.) Sample of 3 ozs. of which this albert chain was made. Gold extracted by me from Merioneth quartz; color became a dull, dark red *at edges* when broken.

13ᵃ. Gold-filings (22-carat fine, like No. 8.) obtained in the

manufacture of watch chain by Wotherston and Brogden, in 1864. Microscopic changes taking place.

11. Piece of gold containing 18 p.c. Ag. extracted by me in 1864. Microscopic foliating surface-changes appearing.

12. "Sponge-gold." Part produce of Hg distillation, after trituration in it of Merioneth quartz in 1864, contains Au, Ag, and Hg. Microscopic changes observable.

RECENT GOLD-GROWTH IN ROCK SPECIMENS.

78. Hungarian Sandstone, bought in 1864, of Dr. Krantz, shows filamental and foliating electrum-growths. These have numerically increased since 1870. Some of them, in course of their new state of formation, appear to have pushed all obstacles out of their way; others, ant-like, seem to have carried bits of the matrix away bodily. The Au. and Ag. in this specimen are approximately equal. In some respects the behaviour of these electrum-growths correspond with several of my recent silver-growths from argentite.

583. Lower Silurian Greenstone (?) with calciferous-quartz patches (Clogau, Merioneth, July, 1875) shows a string of gold 1½ in. long, out of which is a gold-growth resulting since that date. The specimen is probably unique, as this locality, to my knowledge, has as yet produced no electrum. Te and Bi combined in variable proportions with S, are more common here than Ag.

43. Merioneth quartz fragment, in (apparently) interjected chlorite-slate, partly decomposed, shows electrum-protrusions, also specks of erubescite and tetradymite, found by me in 1864.

592. Merioneth slate-rock, found by me in 1865, adhering to crystallized quartz, shows copper pyrites and electrum-growths.

181. Iron-quartz conglomerate with gossan, (Merioneth, 1866) shows 11 recent electrum-growths, apparently less inclined to branching than most of the others from the same locality.

RECENT GOLD-GROWTH IN NON-METALLIC MINERALS.

Barytes.—109. Pink Merioneth barytes, between Lower Silurian schist, (found 1852). In the Barytes are 26 recent gold-growths, and a few specks of copper pyrites. At the junction of barytes and schist are patches of argentiferous galena, in which appear numerous gold-growths. A few, also in the galena itself. Gold is apparent in 3 places on surface of the schist, on one side of the specimen. A patch of barytes, in the centre, has about a dozen progressing flaky gold-growths, which may ultimately unite. From

the dark colour of the gold, I infer that it contains very little Ag. A sulphide, at the sharpest corner of specimen, is bismuthine.

Here are 300 specimens of Welsh quartz showing electrum-growth.

UPON QUARTZ-CRYSTALS.

13*a*. Broken pure white quartz-crystals attached to a mass of mispickel-crystals. (Merioneth, 1864). From a margin of the two minerals has sprung up a column of electrum, $^2/_{10}$ in. high. It had reached this height several years ago, and I kept it carefully in a glass-topped box. When examined minutely in Jan. 1876, it was, perhaps, as large as it is now. But, since then, another growth has arisen about $^1/_{16}$ in. high. Noticed this about a fortnight ago.

556. Mass of white quartz-crystals (Merioneth, 1868). Large crystals in all directions on one side, showing very interesting gold-growth (near the number ticket). Gold spongoid under microscope. On the reverse side, which is less crystallized, are several electrum-growths; all unobserved up to Feb., 1876. Unassociated with sulphides. (Now April, 1877.)

532. Branch of yellow ochrey-coated quartz-crystals (1865), shows electrum-growth. 52. Bunch of interlacing milky, quartz-crystals, some of them iron-stained (1865), shows 15 beautiful electrum-growths, several of them upon the clear crystals, unassociated with any other mineral. In intervening spaces are more growths. Noticed first, 1874. Found progressing, Jan., 1875. Again, Jan., 1876. Near the bottom of the largest space, a straight growth has since developed. A large bushy growth is also springing from the very bottom.

545. Milk-white quartz-crystals, slightly iron-stained, (1864). Have upon them yellow and red gossan, the results of decomposed iron pyrites. The semi-foliated electrum growth, $\frac{1}{2}$ in. long, upon this specimen, is extremely interesting, as showing that its present shape and bulk could not have been contained *within the original sulphide*. The original pyrites-crystal fitted into the quartz-crystal exactly. Which was therefore the oldest? possibly, the sulphide contained all the gold from which this recent growth sprung. How long it lay dormant will never be known, nor perhaps, *why* this Royal movement took place so recently. Possibly, neither the quartz nor the pyrites are of very remote origin.

565. A complicated mass of white quartz-crystals covered with a yellow gossany dust, and a portion of it iron-stained (1866), shows electrum-growth, unassociated (apparently) with other metallic substances.

IN CRYSTALLIZED QUARTZ.

583. Curiously crystallized milk-white quartz, a portion of which has a yellow gossany coating, showing recent electrum-growths in cavities (1868); one, a beautiful Bishop's-mitre-like growth, first observed under a lens near the end of 1875. Had visibly increased, Feb. 1876. Has grown fully one-half since. This growth is at the edge of a long chalcedony-like cavity, entirely unassociated with any sulphide.

526. Apparently manganese-stained (July, 1875), has 3 electrum-growths (close together) upon white quartz, result since Feby., 1876. One of them is branching out in two opposite directions.

87*a*. Quartz, (formerly white) (1868), one end gossany; but no other metallic substance on the stone. This specimen, in Jan. 1876, was put into ordinary red-ink, about half its depth, for half an hour, to show how quartz would absorb a colored acid, and so to stain it, that gold-growths, if any, might be afterwards more readily seen and vouched for. The index points to 2 small cavities in which gold-growth is appearing. On the opposite side are 3 small growths, two of which have appeared since the stone was stained.

587. Iron-stained quartz, (1866). Crystals on one side, and iron-rust on the side opposite, with one end free of oxide. There are 32 brightly-shining, pale yellow electrum-growths on the specimen. Only a few are actually in the oxide, the rest are in ever varying branchlets, in cavities, unassociated with other metallic substances. Some of these have shewn progress since Feb , 1876.

501. Greyish white quartz, slightly iron-stained (1864), contains a cavity where iron pyrites was decomposed, from which is thrust straight out a pointed scoop-like and serrated electrum-growth, ¼ in. long, grown chiefly since 1870. No other metallic substance visible. A palpable proof of gold-growth. Nos. 123 and 502 specimens exhibit exactly similar growth.

816. Milk-white quartz (1868) having a considerable portion of its surface coated with a dirty yellow ochre, the quartz curiously arranged. Here appear several electrum-growths in cavities and otherwise. At a jutting-out place, the growth looks as if extend-

ing over the naked quartz. The index points to a cavity in which are two very beautifully bright branching growths. Also, a bit of quartz evidently raised up from the bottom $^1/_{16}$ in., by one pillar of gold, and supported from the side by another pillar-growth of about the same length. Another growth, a little further off, appears projecting from the side in the direction of the upheld bit of quartz. An intensely interesting specimen.

832. Large mass of coarsely-crystallized dirty-white quartz. (Weight, by guess, more than ½ cwt.) When found by me, 1863, it had an area on surface of about 16 square inches, which exhibited, plainly, 20 or 30 scaly, rough-looking specks of gold (electrum). I placed it temporarily in some rock-work in my garden. It has been "knocking-about," often "in the way," almost ever since. In Feb. 1876, at a visit of Mr. Collins, F.G.S., I put it under a water-tap and discovered an increase in the size of the "specks." Having no cabinet-drawer big enough to put the stone in, it was consigned to an "out-of-the-way" place, with a big companion (834) upon the floor in the corner of the room; on April 16 last, recollecting this large stone (832), I submitted it to the dust-removing effect of a water-tap, and to my great delight discovered at least, 50 more electrum-growths, of varying fantastic shapes. Some of them have become more or less tarnished; but, from the tarnished-portions have come out several bright, branched, and foliated shoots of gold. One growth in particular has exuded since April 16. The rapidity of growth in this case is beyond doubt.

834. Coarse crystalline quartz (? manganese-stained), weight by guess, 30lbs or more. This stone was found by a shepherd boy (1862) when not minding his sheep, and given me by the late Capt. G. Williams. At the time it showed, literally, hundreds of specks of gold. (Electrum). This specimen was neglected till Feb., 1876, when I saw for the first time indications of electrum-growth. On April 16 (after I had so served 832), I put it under a water-tap, and, to my surprise, found that one-half, at least, of the formerly existing gold-specks had *fallen* (or grown) off! I discovered, also, that many of those remaining had grown into fantastic shapes similar to those observable on 832, only much smaller. The gold-bespangled surface of this specimen, or rather an area of 14 x 9 inches of it, affords now, a fine open field for future observations as to gold-growth in relation to time.

589. Highly crystallized iron-stained and white quartz, containing bits of slaty rock (1864). Surface partly covered with bunches of dirty-white prismatic quartz-crystals. A gossany cavity contains 12 exquisitely branched electrum-growths, one of them upon a quartz-crystal; another in dirty brown gossan. In a deep recess, behind the two last-named growths, are several very interesting growths of similar fantastic shapes. Nearly all these have developed since 1875. I particularly noticed them in Feb. 1876. Some unmistakably increased between 31st March and 24th April last, particularly the smaller growth on the edge of the stone.

581. Mass of crystalline iron-stained quartz (1868) showing 13 bright recent electrum-growths. Particularly one growth in a cavity.

814. Coarsely crystalline iron-stained quartz, with a cube crystal of argentiferous galena (1865), showing at the edge of a cavity, a peculiar flattened electrum-growth.

815. Crystalline iron stained quartz, having at one corner a bunch of white quartz-crystals (1868). In a yellowish gossan-lined cavity is the most brilliant antler-like electrum-growth I have yet seen. At the edge of this cavity is another larger and more complicated growth; evidently expanding whilst covered with a gossany-coating, but, becoming bright at the apex, as if forcing through the coating.

594. Crystalline white quartz, rather gossany in cavities (1865) shows 14 electrum-growths. Index *a* points to an interesting formation in a cavity. Most of this growth has certainly taken place since 1867. Some of it since 1875. But the small growth $^1/_{16}$ in. long, in the pure pearly-white quartz, pointed at by index *b*, decidedly has appeared since January last.

525. Crystalline white quartz, partly cavernous and slightly gossany (1864), shows 35 recent electrum-growths, unassociated with sulphides, &c. These growths were first noticed by me in 1874 or 1875. Again, in January 1876; again, in January 1877. Some of them have sensibly increased in bulk since the last date. The most beautiful growths are seen in the cavities. A corner of the stone protrudes somewhat nigger-lip fashion. The upper lip is adorned with 7 exquisite bright growths, one of them prominently pendant. The lower lip furnishes 4 similar examples.

Looking down the throat (so to speak) with the aid of a lens, can be seen a kind of uvula-growth.

511. Rugged crystalline quartz (1864) shows 16 electrum-growths, chiefly recent.

592. Coarsely crystalline quartz (1865) shows quite a *crop* of recent electum-growths.

123. Crystalline iron-stained quartz (1865) showing recent electrum growths $^3/_{16}$ in. long. One growth is curiously trilobed.

6. Quartz-fragment with an odd history. It was found buried in Captain K. Roberts's left hand at Cwmhesian mine in Merioneth, after a "scattering blast" in 1846; given to me by him in 1863. It has now, under microscope, the appearance of gold-growth.

6ª. A shawl-pin in which was set, by Hancock, in 1856, a beautiful bit of quartz, containing native electrum, from Dolfrwynog, Merioneth; recent electrum-growth evident.

RECENT GOLD-GROWTHS IN IRREGULARLY-SHAPED QUARTZ.

588. Curiously foliated dirty.white quartz (1868) shows beautiful electrum-growths.

535. Amorphous iron-stained cavernous quartz, holding interjected bits of slaty-rock, and some red iron oxide. (1869.) This remarkably rich stone shows literally hundreds of small points of electrum-growth. The movements were not noticed till sometime in 1875. In February, 1876, I was able to mark progress a little. In the cavities are growths in great variety. (January, 1877). The red index points to a cavity of intense interest. This cavity is lined with dirty-white quartz-crystals, and in it are beautiful electrum-growths, certainly no older than January, 1877; one of which, $^3/_{16}$ inch long, has almost entirely grown since 16th April last. This is my shortest *noted* time of growth.

28. Spongiform iron-quartz, rather gossany (1865) shows numerous recent electrnm-growths.

566. Fantastically crystallised and foliated dirty-looking pearly-white quartz (1868) shows in an indexed cavity, an interesting trefoil-looking electrum-growth, resulting since January, 1875. No. 817, similar to 566, has electrum-growths scarcely 6 months old.

46. Crystallizing cavernous pearly-white quartz without sulphides (1866). In a dirty-looking portion of the surface there are more than 50 recent electrum-growths, which have a propensity for

moving along the surface of the stone. On a kind of floor at the entrance of a cavity (near the number ticket), is a crop of 14 growths, all of which have an upright tendency. Twelve or more growths are seen upon another irregularly crystallised surface. Some of these are foliating. All increased since February, 1876.

196. Cavernous quartz (1865) shows 25 variously shaped bright growths of an age since February, 1876. No. 187. Gaping and jagged quartz (1864) shows 6 beautifully bright electrum-growths.

10. A specimen of engrossing interest. Spongy-looking iron-stained gossany quartz (Merioneth, 1868) shows 6 palpable examples of recent electrum-growth. Index *a* points to growth decidedly since February, 1876; *b*, since Christmas, 1876; *c*, before February 1876; *d*, has grown a little since February, 1876. There were two other beautiful growths like *d*, which unnaturally disappeared whilst on a visit to a photographer. Since then, however, some curious infantile growths have appeared in the crevice to the right of *d*. There are several other growths not indexed. *e*, is a splendid growth $^{3}/_{8}$ inch long, carrying upwards with it, a bit of white quartz. This has grown fully one-half since Februarv, 1876, and I think there has been more recent progress. On a level with the apex of this growth has recently appeared a sympathetic little growth, with a couple of arms reaching towards the other *e*. In the same cavity from which *e* sprung, are other extremely interesting growths. Index *f* shows a brilliant growth in gossan, which considerably enlarged betwixt January, 1876, and April last. This specimen alone is sufficient to set at rest the question whether gold-growth occurs now-a-days under *purely natural conditions*. To the eye there is not a trace of sulphide in the stone.

809. Curiously jagged, spongoid, dirty, chalcedonic quartz, coated nearly all over with yellowish gossan (1865) shows 25 recent electrum-growths. 32^{b}. Mass of irregularly crystallised white quartz, slightly iron-stained, shows 27 beautiful recent growths.

838. Greyish calciferous quartz, with Lower Silurian shale and bismuthine (1856) shows recent gold-growth (not electrum), both on the quartz and on the Shale.

110. Miniature quartz-vein in Lower Silurian shale (1862). quartz contains bismuthine and much gold, part of the gold-growth tarnished, the rest bright. Some of it of recent growth.

RECENT GOLD GROWTH IN METALLIC MINERALS.

37. In Merioneth tetrahedrite, since 1863.

100[a]. In Merioneth covellite, since July, 1875.

129. In Merioneth manganite, since 1868.

98. In limonite (?) since 1869. A projecting portion $^1/_{16}$ inch, has curved over. Growth observable since February, 1876.

97. Black blende (sphalerite of *Dana*) with coarsely crystalline iron-stained (?) quartz (1865). Several beautiful electrum-growths in the Blende, and many hundreds in the quartz. Growth first observed in 1873; again in progression, February, 1876; again, ditto, January, 1877, and up to this date still further progress.

220. Brown blende (1865) show 30 electrum-growths, for the most part occurring near little bits of quartz, which as well as the growths are, probably, also of recent origin!

80[a]. Bismuthine with crystalline white quartz (1862) shows electrum-growths both in the sulphide and the quartz.

56. Tetradymite (1855 or 1856) very rich in gold, shows literally hundreds of electrum-growths, many of which are spreading widely and closely together.

829. Tetradymite (1875) shows beautiful electrum-growths.

35. Amorphous quartz with a string of brilliant crystallised galena intersecting it (1868), shows recent electrum-growths.

502. Crystalline greyish-white quartz containing argentiferous galena and iron pyrites (1864). In a cavity lined with red iron oxide, is a beautiful trefoil-looking electrum growth resulting since February, 1876. At the margin of this cavity is a scoop-like and pointed recent growth $^3/_{16}$ in. long, having a tendency to curve *into* the cavity. It is remarkable that this growth appears to take its rise from a portion of the pyrites that is not at all decomposed. This growth is almost identical with the growths in 123, 501, and 502.

16. Shows electrum-growth in galena (1856).

40. Portion of a miniature quartz-vein (1 inch thick) occurring in Silurian schist (1864). Shows upwards of 50 recent electrum-growths in galena and quartz.

215. Crystalline gossany-quartz containing auriferous galena (1866), shows beautiful electrum-growths $^5/_{16}$ inch, at a corner of the specimen, and in an adjacent cavity. In a crevice, an inch to the left of the last, is a red copper-looking growth; just over the

edge, hereabouts, is literally a crop of infantile growths. Below this again, are gold-growths in galena. In gossan also, and in other smaller cavities of the specimen.

207. Iron-stained crystalline quartz. The upper surface thickly coated with red iron oxide, probably from decomposed pyrites (1864). From the oxide 22 electrum-growths are rising, and some of them of great beauty, observed first 1874; again February, 1876, in progression; again 25th April last, when it appeared that one broad-growth had extended $^1/_{16}$ inch over an edge at the thinnest end of the stone.

22[a]. Marcasite *undecomposed* (1863 or 1864) shows singularly interesting electrum-growths of an age since 1873.

117[a]. Mispickel, *undecomposed*, with amorphous quartz (1864), shows remarkable electrum-growths. One, a double antler-like growth $^5/_{16}$ inch high, and $^3/_{16}$ inch at its widest part. The gold appears as if built up of successive over-lappings. The top branch embracing a bit of quartz, has evidently carried it up in its growth. The other growths are of a different character. One appears as if it had risen lengthwise from filling a cavity beneath, exactly of its own dimensions. The largest branch was less than half its present height when I had it first in 1864. First sensible enlargement observed in 1876, next in January, 1875. The smaller growths have all progressed since then.

42. Amorphous iron-stained quartz associated with decomposing mispickel (Merioneth, July, 1875) from which electrum has since protruded in several places. A spicule of gold shot straight up early in 1876, $^1/_4$ inch long, carrying with it a little bit of quartz and mispickel. Fourteen days was the extreme limit of this growth. It does not appear to have altered since.

48. Crystalline dirty-looking quartz (1868) shows a foliating electrum-growth from *decomposing* Mispickel.

7[e]. Amorphous iron-stained quartz (1864) outside nearly covered with nests of decomposing pyrites, shows interesting electrum-growths not very recent; on the opposite side is crystallised galena and copper pyrites, and gold-growths, some of which have already tarnished. 105 and 44 show smaller growths since January last. In 194, a decomposing mispickel, a bright yellow electrum-growth $^1/_8$ in. long. has appeared since February, 1876. 823 shows 3 growths in decomposing pyrites, since Feb., 1876.

49. Amorphous white quartz half-covered with auriferous and argentiferous mispickel (1868). (Much copperas in course of rapid crystallization.) Several tarnished copper-like electrum-growths, which a year ago were bright-yellow. Near one of the corners are two very bright growths, which could certainly not have pre-existed in their present shapes in any iron-sulphide that may have surrounded them. About an inch from this spot are, what have all the appearances of pure *silver-growths;* features altogether new to me. I scrutinized this specimen closely about a month ago, and did not observe them. It is barely possible that I overlooked them at the time; but the exhibits are too palpable to suppose such an accident. See also 574.

PSEUDOMORPHOUS CRYSTALS OF GOLD.

20. Crystallized and slightly iron-stained quartz enclosing Merioneth blende (1868) shows electrum-growths near a cavity in the quartz. This cavity contains what may be called a gold-crystal (pseudomorphous after quartz), also other quartz prisms. The largest of the electrum-growths was not one-third its present length in May, 1874, and it has grown fully ⅓rd since February, 1876. An exceedingly interesting specimen.

818. Coarsely crystalled iron-stained quartz (1868), shows a number of electrum-growths of an age not anterior to Feb. 1876. The most remarkable feature of this stone is that of the appearance on it, since Feb. 1876, of a brilliant twin gold-crystal. The quartz-crystals near it are enveloped in a brown coating, probably the twin has recently come to light through the peeling off of a similar coating.

202. Coarsely crystalline quartz (1866) shows several recent electrum-growths, one of which overlaps a bit of projecting quartz and clasps it firmly. First noticed in 1875. The red index points to a twin crystal of gold of an age since that date, a portion of which tends to elongation out from a cavity.

840. Highly crystalline and partly cavernous white quartz (1868), containing in cavities peculiarly interesting fantastical shaped, broad and branching electrum-growths, some of them very recent. In one cavity is a gold-crystal pseudomorphous after quartz. First noticed in 1875. Has become *denser* since Feb., 1876. 1876.

236. Cherty quartz-rock, partly coated with chalcedony. (Transylvania, 1864). Shows numerous gold-crystals, with

octahedral and dodecahedral faces. Most of the crystals have upon them what appear to be parasitic black crystals. Possibly the black coating upon them will eventually peel off, and reveal angular *enlargements* of the crystals. Perhaps *crystal-twinning* may occasionally take place in some such fashion. Did all these beautiful crystals originate in this way? The specimen is unique and of great interest for watching transformations,

841. Highly crystallized dirty-white quartz containing patches of blende, and interjected silurian schist. (1863. The original label bearing this date is on the specimen). The under side of the stone is associated with quartzose ferruginous schist, holding cube and twin crystals of iron-pyrites. This unique quartz specimen shows electrum-growths of a date not anterior to February, 1876. It shows also what appears to be a *prismatic gold crystal*, with lateral striations. In 1870 I read a short notice of this identical crystal at the Liverpool meeting of the British Association*. It is there said "the author exhibited a quartz-crystal, which he picked from a large heap of quartz, near Bala Lake, in 1863. At the time, he said it was quite transparent, though slightly tinged with golden-yellow; yet under the microscope, the color entirely disappeared. The crystal was put away in his cabinet with other gold-associations of interest, and lay there unnoticed until last year. It had then become more opaque, and consequently, of more interest to him. It has now all the appearance of a solid crystal of gold, and for which it has frequently been taken. The color is pale, but he had observed that all the gold formed in that locality is light-colored, owing to the presence of a large quantity of silver, sometimes as much as 20 per cent. He exhibited, also, several ounces of water-worn gold some pieces weighing from 20 to 30 grains each, recently found in the Cain, a tributary of the Mawddach, north of Dolgelly, and also a very rich specimen broken from a quartz-lode at the Gwynfyndd mine, adjoining the Cain and Mawddach rivers. He said he brought before the section as mineralogical facts:—viz.—That of the change of the crystal; that the gold where the crystal was found is of 14-carat fine only; that from the quartz

* "Notes on a Merionethshire gold quartz crystal, and some stream gold found in the river Mawddach, by T. A. Readwin, F.G.S. (See notes and abstracts of sections, p. 84.

lode at Gwynlynydd is 18-carat fine; and that the water-worn gold from the Cain and Mawddach, is 23-carat fine—giving them as facts open to a good deal of interesting speculation."

At the reading of this short paper, it was suggested by a mineralogist present that the crystal was electro-gilt! a sagacious remark I may be permitted to record, alongside another made by a a late eminent official at the bank of England some years before, to the effect that "getting the gold into the quartz was an ingenious contrivance betwixt a dentist and a watchmaker."

I cannot say, positively, that this very crystal has undergone any remarkable change since 1870, except that its lustre is greater, and it is, perhaps, more distinctly striated. I put this fact before crystallographers for what it is worth, thinking it fairly open to consideration as *progressing pseudomorphism*.

Modern Gold-growth had not been noticed in 1863, if it had in 1870, and it is singular that most of the specimens upon which these beautiful illustrations of electrum-growth appear, were found by me near the very spot whence the pseudomorph last mentioned came, which I take to be a fact of some significance in the consideration of possible *absorption* by the crystal of gold existing in the specimen in some condition, other than metallic.

July 23, 1877. Since reading the above paper in May last, I have observed in specimens 1, 2, 13a, 16a, 217, 276, 832, 834, 535, and particularly in 10, 848 and 849, decided progress in Metal-growth.

I have, also, visited the British Museum, and the museums of Copenhagen, Stockholm, Christiania, and Kongsberg, in search of corroborative evidences of *recent* metal-growth.

Of electrum-growth, the British Museum afforded me the very scantiest of proof. Christiania and Stockholm gave me more encouragement; but Copenhagen supplied abundant proofs.

At all of these celebrated places, more or less ancient silver-growths abound; at Copenhagen and Stockholm, in specimens of wonderous beauty.

Kongsberg and Christiania have had to yield to the sovereign will at times, and give their best specimens to the other two museums.

Argentine-growths are not at all scarce at the British Museum and elsewhere. I brought home a few charming specimens of Kongsberg recent silver-growth from argentite, in which I have detected some most interesting changes since they have come into my possession.

T. A. R.