THE METEORITES (CHONDRITE)
AND
THEIR ORGANISMS.

DEPICTED AND DESCRIBED
BY
DR. OTTO HAHN.

32 PLATES WITH 142 ILLUSTRATIONS.
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English translation note:

While choosing terms I attempt to take Hahn's perspective and consider the extent to which his ideas were deemed controversial and even still are today. I prefer updating the terms to reflect the modern nomenclature. Also, I don't have any German language skills. I only wanted a good read and I don't consider this a professional translation by any means. When I saw that Hahn's book was never published in English, and since I really like reading historical material I thought I could have fun and translate it myself to get the gist of what he was saying about meteorites. This is only public in the (hopeful) case that an altruistic person(s) with native skills would help with the result that the end effort may have free copy license for all to enjoy. This is an excellent work with incredible microphotographs at high magnifications (consider the collodion process was invented in 1851, the gelatin dry plate in 1871, this book published in 1880). You can tell the author went through a lot of hard work to bring it all together, as he emphasizes.

1:

It was not the inconsequential attacks on my "Primordial Cell" that made me tire in my efforts to establish certain new geological facts: it was the observation of the untenability of the previous view in the most undisputedly important part of the geological science, in the part through which it is related to the cosmos — that is, the doctrine of the so-called plutonic rocks.

If, in the first part of my "Primordial Cell" I had tolerated the doctrine, and with resignation accepted that the core of the Earth - and also that knowledge pertaining to the real genesis of our Earth will always be hidden from us - then, at the end of this book, there is now an alternative: the meteorite is that which reveals a distant passage, which no researcher has yet dared.

With this guide I now continue.

I did it, accompanied on the one hand by the sharply pronounced sarcasm of the specialists, and on the other hand cheered up by the earlier results and the now daily support and counsel from the few friends whom I have succeeded in convincing.

The results yielded from a strenuous effort of almost super human endeavor over this previous year are laid down in the following pages.

It is a life-world in a rock which fell to Earth and brought us news of the smallest beings from the most distant places - a life-world which a mortal eye could scarcely hope to behold: a world of beings showing us the creative power that made our Earth out of a nebula, and has worked everywhere and evenly in the universe.

Admittedly, the meteorites, namely the chondrites, for these are the ones which are preferentially subject to my investigations, have no life of higher construction; instead, all are lower life forms - the same ones which prevail in the Silurian strata - sponges, corals, and crinoids - it is with these species that similar characteristics are found.

The chondrites that I have studied are olivine enstatite rock. They have undergone alterations since the time of their formation as the remains of life forms, and up until they landed, but not considerably. They have been permeated with a silicate solution, in similar manner to the Jura deposits with a solution of lime. Probably, while it was part of its parent body, it went through planetary cycles, and just as new ones have followed each other down to the lower strata of our Earth, under the influence of which the former have undergone a certain, though not so considerable transformation as one usually assumes.

Only the surface of the meteorites have changed considerably, and indeed only at the last moment of their planetary existence, and mostly due to the influence of frictional heat created in this case by the Earth's atmosphere. But the original meteorite itself essentially remains. So we now see that before us is a piece of a planet as it was in the process of becoming, and thus the history of our Earth's body is now open to us, provided that we are correct that the meteorites in their formation was homogeneous in their chemical composition with the same world matter which formed the Earth and vice versa. At the same time, by sending me the "Meteorite of Ovifak" (I owe it to the kindness of Professor Dr. von Nordenskjöld) I was offered the opportunity to bring this rock into the investigation.

I consider it earthly - consider it the deepest layer our Earth, to the olivine layer, which belongs under the granite. I call the original layer the Olivine Formation. Since the rock is very similar to a meteorite, it was natural to declare it the same. The reasons why I do not consider it to be meteoritic but true to the Earth's core are laid down in this book.

So we have gained two solid points, from which a lever can be set.

The chondrites, an olivine-feldspar (enstatite) rock, consists of a life-world, they are not a layer of sedimentary rock, not a conglomerate, but a thick mat of life, a tissue whose meshes were all once living beings, and life of the lowest kind, the beginnings of a creation.

However, I could not make a systematic enumeration of this life-world which is preserved in the meteorites: I just wanted to prove that it is - there it is. I therefore only depicted the organic beings which I could content myself with determining undoubtedly, on the one hand, the genera which coincides with terrestrial forms, and on the other, separating out the specifically meteoritic forms, while leaving both for future investigation.

It is to be expected that my enumeration will be, through further research, and with the help of richer material than I have available, will be multiplied and supplemented. In particular, sudivisions had to be avoided: every newly found being would overturn any divisions and thus make the effort arduous, and any work in vain.

This was the reason why I only made large divisions and these only to the extent that this contributed to the understanding of the forms. I repeat, the work in this direction should not be considered exhaustive and complete.

In other ways I have also made an indulgence, such as in the demarcation of the main divisions themselves.

Anyone who even superficially surveys the forms will soon find that they provide the actual history of development. All the transitions from the sponge to the coral, from the coral to the crinoid are present, so that it becomes really doubtful if one should make a new species to give to these transitions.

In such beginnings, mistakes are inevitable, so it is only a small demand to ask to forgive them. Nor did I want to delay the publication of the work too long, and therefore have it just as it is now available.

2:

Section 1

Previous Views On the Meteorite

History and Overview

Last year, when I wrote down in my diary certain new observations about the composition of the rocks of our Earth and finally also of the meteorities, the importance of the latter to geology was not fully clear to me.

It was only when I was forced by the attacks of opponents to take the investigation again into my hands, that I clearly realized the importance that a careful study of meteorites could be to the history of our Earth. Lastly, I came to the conclusion that, in the present state of geology, the meteorities - and only the meteorites, give the point from which the history of the Earth could at least be explored with almost certainty.

If, in the "Primordial Cell", I thought I had reached the limit of research with granite, I soon learned better. I contemplated that by virtue of its specific gravity, our Earth's core must also consist of at least solid iron, further considering the very probable order in the meteorites, which goes from pure iron to the feldspar rocks of our earth. I further believed that a conclusion from our Earth on the meteorites could be ventured, the conclusion that in the other planets and in those, or the one whose debris we have in the hundred thousand of orbiting meteorites before us, a sequence of stratification from heavy to light, a stratigraphy which we probably pass through in the series from pure iron through the half iron (Pallasite, Hainwood) to the chondrites and eucrites, then to the coal meteorites (Cold Bokkeveld) in front of us.

Once this probability had been gained, it was obvious that the meteorites should be subjected to a thorough examination of their morphological characteristics. This was also highly necessary, because so far almost nothing had happened in this direction: one can convince oneself of this by comparing my illustrations with the roughly twenty meager images, which taken together form the material of the science today. The academic writings of Berlin, Vienna, and Munich have only a few panels each, the drawings are small, and it immediately shows, are taken from the least suitable meteorites for this direction of investigation and, moreover, probably not from the best part, the interior.

So if, I thought, my earlier assertion that the Knyahinya Meteorite consisted entirely of life, was not confirmed by my new investigations, then science would have still been served if I were to show the true form of this meteorite. Fortunately, however, I was spared this retreat: on the contrary the result of the new research was far beyond expectations — a new world emerged.

But, of course - our science is doubtful - it rightly demands more stringent evidence than I offered in my "Primordial Cell"; a book written more at the stage of, I would say, intuition. Today I present that evidence.

As one examines the panels of this work, it immediately becomes certain that these are not mineral forms, but organic forms, that we have before us the images of life, images of life of the lowest order, a creation which, in greater part, finds some of its closest relatives on Earth - with regard to the corals and crinoids, this is determined with absolute certainty; however, the sponges only have a little such similarity with the forms of the terrestrial genera of the Earth.

Thus, the origin was established with regard to the parts. However, in my study of 20 chondrites (and 360 thin sections of them), the assertion made in my "Primordial Cell" confirmed that the rock of the chondrites is not a type of sedimentary rock as on our Earth, in which fossils are embedded, that it is not a conglomerate formation; rather, its whole mass is entirely formed of organic beings, like our coral rocks. So not plant, as I assumed earlier, but Pflanzenthiere! The whole stone a life: — I think science will forgive me the first mistake.

Needless to say, the meteoric iron was now subject to another test. Here it remained at my first observation.

However, time and circumstances, especially the lack of available materials prevented me from concluding the investigation prior to this publication. But if I repeat today the first assertion that the meteoritic iron is nothing but a mat of plants, then I may now regard myself as more legitimate than at the time when

I wrote the “Primordial Cell” in asserting the prior statement. I have to add that I also found life forms in iron. The researchers who avoided the forms of chondrites that I depict may have overlooked the fact that the so-called Widmanstätten's figures are, for the most part, plant cells and not crystals.

The investigations up till now, in the whole field, with the exception of [Karl Wilhelm von] Gümbel's work in the Munich Academy, are of litte use, both regarding their accuracy of observation and even more as regards the interpretations based upon those observations, on unproven hypotheses and weak assumptions - not suitable for scientific findings as such. And due to this the field was still wide open to me, although my only regret is that I cannot make a draft in time regarding the iron.

I now come to the conclusions for geography. If the chondrites, an olivine and enstatite rock, are really what I assure: that is, only pieces of sponge-coral-crinoid rock, then a fact of immeasurable consequence has been discovered for the science of our Earth.

A feldspar mineral is purely a water production, it is petrifying matter of millions of organisms! Thus, all hypotheses about the metamorphic and plutonic rocks of our Earth fall, and with them the theory of the fire-liquid Earth interior – at least no conclusion can be drawn from the rocks any more.

I have to justify this now. The comparison of rocks from Earth with the meteorites shows that the chondrite, at least according to its chemical nature, has its closest relatives on the Earth.

The olivine rock of our Earth is, as a Lherzolite, a bedrock layer as we see with basalt breaking through the granite; I arrive at these results which [Gabriel Auguste] Daubrée has shown.

The deeper granite is definitely younger than the olivine. But if the olivine of the meteorites, by virtue of its composition, is a water-rock, it will probably be the granite of our Earth; if the olivine of the meteorites is the remains of life, the then same will be the case with the olivine of the Earth: it could probably be concluded that this rock of our Earth is also composed in its original deposits of the same life as that of the chondrites. And for the same reason the granite, as younger rock, will probably have a similar origin. If we have to see in our Swabian basalt only leaching from the ogiinal olivine, then the bedrock of Lherzolite is found under the granite. And even if this rock appears as a deposit of liquid without distinguishable forms, then the iron of Ovifak has such; but this is much connected with the basalt, so intimately, and not only mechanically, that both must be regarded as one rock. So this is the original olivine bedrock. But with this, the scientific reason is removed from the assumption of the origin of the Earth by way of fire.

If the surface of the planets or of the planets consists of layers of olivine from life, then the same layers of our Earth were probably not formed by fire, at least there is not the slightest reason for this supposition, on the contrary, it should be assumed that the same layer of the Earth was a water formation. Here I encounter the Kant-Laplace theory.

I imagine that the planetary materials (including water, which is usually overlooked) during the first mass formation were not, as [Immanuel] Kant and [Pierre-Simon] Laplace say, a glowing haze, but rather a vapor and mass cold as space. Here, however, one has overlooked a great logical error in the above mentioned theory.

The attraction of mass should form the mass! The effect should be the cause simultaneously! The mass is to be formed by mass attraction, that is, by the fact that it was already there! It is to be regretted that this error of thought has not been discovered earlier. The mass, when it is present, can increase by attraction, but not by it: it is as if someone should be his own father!

So another force had to form the mass; but this could only be either the crystallization force or the organic formative force. The former does not suffice to explain the formation of the planets, and no crystals are found: consequently only the second force remains - the organic one. Here I recall my observations of the structure of the meteorite and so today, for me at least, it is clear that the first beginnings of our Earth, like the rest of the planet, has an organic cause.

If the sentence also appears a bit deafening, one need only resort to the familiar.

First, the mass of building materials available at the beginning of planetary formation is completely sufficient to explain the formation of the planetary mass in an organic way.

Secondly, the experience of today shows how in a short time the lowest plants and animals multiply their number, including their mass, in a way that is conditioned only by the mass of building materials, while their organization itself makes it possible to expand into infinity as long as building materials are present.

What seems to contradict this explanation is only the geothermal heat and the associated appearance of the volcanoes still active today. With regard to these two facts, one has long been led back to a different explanation, that of the liquid-fire Earth interior. The water has a dissolving effect on feldspar. In this dissolving process, heat is released. The volcanoes follow the sea because the water helps form the gases, which ignited from above, melt the forthcoming rock.

How could a fiery Earth core ultimately survive without oxygen! And does not the very existence of combustible gases (for these are the causes of volcanic phenomena), in particular that of sulphur gases, indicate the presence of oragnic substances in the Earth's interior? There really is no need for new evidence here, but only the abandonment of certain ideas, which have taken possession of the imagination excited by some obvious phenomena.

These are the conclusions from the study of the meteorites for our Earth's formation. But the facts which astronomy can derive from it are no more significant.

The 20 meteorite (chondrite) thin sections that I have studied, some of falls which are more than a century apart, show the same forms, much as a fossil-shells occurs everywhere in the same formation; [Karl Wilhelm von] Gümbel, if he did not correctly interpret the forms of the chondrites, has excellently expressed this.

So these chondrites are probably from one and the same world body, a planet. Or, has evolution been so much the same on different planets?

This planet carries water life, so life has arisen in water and lives by water; the planet has not passed through fire, because the traces of fire do not show in these rocks. The meteorite, having been shattered, only receives a 1 mm thick enamel fushion crust in its short path through our atmosphere, as a result frictional heat.

The life of the chondrite is almost entirely a microscopic one, it ranges from 0.20 to a maximum of 3 mm in diameter, often it takes a magnification of 1000 to clearly see the delicate structures, while at such magnifcation our [terrestrial] fossils dissolve into a shapeless surface.

Thus, through the observations first laid down in my "Primordial Cell", a path was wide open for me to cover the distances our science must cross.

But it really didn't take a titanium force to overthrow the old building. It had already been much worn, only ignored: it requires only one striking proof and the work will have been done. Traditions, based on insufficient observations, dissolve into what they are, allowing science to once again proceed freely on its course.

The following is a brief presentation on the previous views regarding the origin and nature of the meteorites.

Only the morphological work on individual meteorites, from the time when the microscope began to be used in geology, should be enumerated. What the microscope has so far provided for the interpretation of the meteorites is, apart from the enlarged olivine crystals in [Nikolai Ivanovich] Koksharov's "Minerals of Russia VI", is contained in the following writings:

1. [Gustav] Tschermak [von Seysenegg]: the fragmentary structure of the Orvinio and Chantonnay meteorites, presented at the meeting of the Royal Academy of Sciences (Vienna) on November 12, 1874. (XXth volume of the proceedings of the Royal Academy of Sciences, I. Section, November issue 1874. With 2 plates.)

2. [Alexander] Makowsky and [Gustav] Tschermak [von Seysenegg]: Report on the fall of a meteorite near Zischitz in Moravia. With 5 plates and 2 woodcuts, presented at the meeting of the mathematical and natural science class (the Royal Academy of Sciences in Vienna) on November 21, 1878. XXIX. Volume of memoranda of the mentioned class.

3. [Johann Gottfried] Galle and [Arnold Constantin Peter Franz] von Lasaulx, submitted by [Christian Friedrich Martin] Websky: Report on the Meteorite Fall at Gnadenfrei on May 17, 1879. Session of July 31, 1879. Monthly reports of the Royal Prussian Academy of Berlin.

The previous descriptions are limited to examinations with the naked eye and the magnifying glass, as well as chemical analysis.

They all agree that the chondrites consist of a matrix of spheres of enstatite (bronzite), olivine and iron, nickel and chromium iron.

[Karl Wilhelm von] Gümbel: On the stone meteorites found in Bavaria; Meeting reports of the mathematical-physical class of the Munich Royal Academy of Sciences 1878. Issue 1, p. 14 et seq. In the description of the meteorites of Eichstädt and Schöneberg, he mentioned “Maschenstructur” (p. 27. 46). However, he also speaks of "descendants of larger broken chondrules" (p. 28). The important section of his observations is on page 58, which follows here:

"If one examines the results of the investigation of this, albeit limited, group of stone meteorites, then the perception that comes to the fore is that, in spite of some difference in the nature of their conglomeration, they are nevertheless governed by completely identical structural relations. All are undoubtedly debris, composed of small and larger mineral grains, from the well known roundish chondrules: which are usually completely preserved, but often appear broken as pieces, to the globs of metallic meteoritic substances, sulfur iron, and chromium iron. All these fragments are glued together, not cemented by an intermediate substance or by a binder, as there are no amorphous, glassy or lava admixtures at all. Only the fusion crust and black constrictions, which often appear on clefts and are similar to the crust, consist of amorphous glass, which, however, originated after falling within our atmosphere. In this melted crust, the heavier meltable and larger mineral grains are usually still embedded unmelted. The mineral splinters do not bear any traces of rounding or unrolling, they are sharp-edged and pointed. As for the chondrules, their surface is not smooth, as it would have been if they were the product of a roll, rather it is always uneven, mulberry-like, and warty or multifaceted with a projection of crystalline surfaces. Many of them are elongated, with a distinct rejuvenation or sharpening in one direction, as is the case with hailstones. Often you encounter pieces, which apparently have to be regarded as parts of shattered chondrules. As an exception are twin-like connected beads, more commonly those in which meteoritic iron beads have grown. In numerous thin sections they are composed differently. Most often there is an excentric, radiating fibrous structure which spreads from a point far from the center after tapering or slightly tattered lines spread like rays towards the outside. Since cuts made at various angles always reveal columnar or needle-shaped arrangement, never leaves or lamellas in the substance forming these tufts, it seems to be columnar fibers from which such chondrules are built up. With certain cuts, according to this assuption, in the cross-sections of the fibers which are perpendicular to the length direction, only irregularly angular, minute fields are observed, as if the whole was composed of small polyhedral granules. Sometimes they appear as if there were several systems radiating in different directions in a sphere, or as if the point of radiation were changed during its formation, so that a constant and seemingly confused elongated structure emerges. Towards the outside, against which the junction point of the radiating bundle is shifted unilaterally, the fiber structure normally becomes indistinct or replaced by a more granular aggregate formation. In none of the numerous ground-up chondrules could I observe that the tufts ran so directly to the edge, as if the point of emission was outside the sphere, provided that only the same was completely preserved and not a mere shattered piece. The delicate tranversely dividing fibers usually do not run along the entire length of the tuft, but rather they gradually sharpen, branch or end to allow others to take their place, so that in the cross sections, a manifold, mesh-like or netted drawing is created. These fibrils consist, as has often been described above, of a mostly lighter core and a darker envelope, which is more of less dissolved by acids, while the latter resists. Highly curious are the bowl-shaped constructions, which seem to be meteoritic iron, and generally only spread over a smaller part of the globules. The same unilateral striations, visible on the average as cresent bowed streaks, also appear inside the chondrules and provide strong evidence contrary to the chondrules being forming by an unrolling of some material, the entire arrangement of the tufted structure speaks to a resolution against their origin by unrolling. However, not all chrondules are the eccentric fibrous type; many, especially the smaller ones, have a fine-grained composition, as if they are composed of a mass of aggregated dust. Here too, the one-sided formation of the spheres is sometimes noticable by an intensely greater compression of the dust parts."

And further, p. 61:

"The most common type of stony meteorites is predominately that of the so-called chondrites, the composition and structure of which coincide so much that we may not see that the common origin and initial cohesion of these chondrites - if not all meteorites - could be of doubt.

The fact that they enter our atmosphere as highly irregularly shaped pieces — apart from the shattering within the pieces into several fragments, which is common, but can not be assumed in all cases, especially if, by direct observation, the falling of only one piece is confirmed, it can be further concluded that they already make their orbits in the heavenly space as demolished pieces of a single larger celestial body and in their absent-mindedness occasionally fall to Earth when they enter into the area of attraction of the Earth. The lack of original lava like amorphous constituents in connection with the external irregular form is like to exclude from the geo- or cosmological points of view the assumption that these meteorites are ejections of lunar volcanoes, as is often claimed."

Gümbel, having placed the meteorites as related to the olivine rocks of our Earth, summarizes his view on the origin (p. 64) in the sentence: "Therefore, the meteorites appear to be a kind of first process of encasing the celestial bodies, but since they contain metallic iron - to have been produced in the absence of oxygen and water."

So ingenous, he continues (p. 68), "these hypotheses are Daubree's and Tschermak's (origins from shattered volcanic rock), so I can not agree with their view on the formation of the globules (chondrites) on the basis of my latest research. Contrary to Tschermak's assumption, I sought to prove that the internal structure of the chondrules is not out of context with their sphereical shape, and that these globules can not be regarded as pieces of a mineral crystal or solid rock. Even the unsmooth, unpolished surface speaks, which, if formed by abrasion or unrolling, should be mirror-smooth with similar hardness of the material, while it appears rough, bumpy, often facially striated, against the theory of friction, so there is no reason at all by which to understand why the other mineral fragments and are rounded like grains of sand, and why, in particular, the meteorite, the iron, and the very hard chromium iron, as I have been convinced in the meteorite of L'Aigle, are always not rounded, with often extremly finely sliced forms. How is it conceivable that, as if often observed, there would be a concentric accumulation of meteoritic iron within the globules? Also, the excentric fibrous structures of most globules in their one-sided radiating does not appear to be random in relation to the surface, but rather to similar to the nature of the structure of hailstones. This inner structure is closely related to the act of its formation, which can only be explained as a growth of mineral forming substances with simultaneous rotation in gaseous vapors, which provided the material for further support, whereby more material began in the direction of movement."

Gümbel goes on to say that the material constituting the chondrites was formed by a disturbed crystallization and fragmentation resulting from an explosive processes within a space filled with steam and hydrogen gases supplying the minerals. He cloes p. 72 with a discussion of the Kaba meteorite:

"Perhaps, however, it is still possible to prove the presence of organic beings on extraterrestrial bodies." I hope this is successful. From his illustrations one can see that the investigation was based on bad material. After all, more thin sections would have to be made, and the magnification is far from enough. What I refer to is the following description of my tables.

What I value so highly in Gümbel's report is the scrupulous prejudice-free, let's say impartial observations. I have allowed myself to quote the work of Gümbel literally because it is indeed difficult for me to summarize such representations and to separate fact from interpretation.

Proper observations and incorrect explanations are so closely intertwined that it is impossible to do both. I thought when I read Gümbel's paper (after completing my own investigations and manuscript) that I was coming to step on my conclusions at every moment. But as the surge of the surf seizes and throws back the man who wants to win the land every time he thinks he has taken the land, so also here: the old dogma always pulls the honored researcher from the saving cliff into the sea and into the bottomless whirlpool of traditions.

Daubree's commendable work "Experimental Geology" was obtained only in translation and also after completion of my work. No one will find that it refuted my conclusions. Daubree himself depicted Knyahinya. M. pressed, melted, dissolved, calculated, only not — seen.

The Meteorites and their Mineralogical Properties

1.

The literature on meteorites is very extensive. However, it is so well known in terms of the type and number of chemical compositions, that I do not need to dwell on this part of it, in particular the earlier works.

2.

The meteorites are divided into iron and stone, but there is still a class between the two: "half-iron", i.e. a combination of solid iron and stone - the pallasites. While the irons show many similarities, both in their chemical composition and in the form of their structure, the pallasites are very different (depending on the predominance of iron). But there are other differences among them. Hainholz [mesosiderite], for example, has a blue mineral (enstatite) in addition to iron and olivine, and in this a great richness of life forms. The stones are divided into chondrite, stannerite [Stannern meteorite - eucrite], luotolaxer [Luotolax meteorite - howardite], bokkefelder [Cold Bokkeveld meteorite - carbonaceous], bishopville [Bishopville meteorite - aubrite], (Quenstedt, Klar and Wahr p.280 follow).

I prefer to study the chondrites, and where I speak of meteorites, I am refering to this class of stone meteorites, which is also the most abundant.

I have examined:

Tabor, Böhmen - July 3, 1753
Siena, Toskana - June 16, 1794
L'Aigle, Normandy - April 26, 1803
Weston, Connecticut - December 14, 1807
Tipperary, Ireland - November 23, 1810
Blansko, Brünn - November 25, 1833
Château-Renard, Loiret - July 12, 1841
Linn County [Marion], Iowa - February 25, 1847
Cabarras County [Monroe], North Carolina - October 31, 1849
Mezö-Madaras [Romania] - September 4, 1852
Borkut, Ungarn - October 13, 1852
Bremervörde, Hanover - May 13, 1855
Parnallee, Ostindien - February 28, 1857
Heredia, Costa Rica - April 1, 1857
New Concord, Ohio - May 1, 1860
Knyahinya, Ungarn. - June 9, 1866
Pultusk, Warschau - January 30, 1868
Olvinio - August 31, 1872
Simbirsk

All rocks are thoroughly certified. Above all, I have the kindness of my revered teacher, Professor Dr. [Friedrich August] von Quenstedts, with whom he thankfully commemorate the excellent Tübingen University Collection (which, as is well known, for the most part by [Karl Ludwig] Baron von Reichenbach in Vienna).

3.

From Knyahinya I own 360 thin sections, of L'Aigle 6, of Pultusk 6, of the remaining 1 - 3 each. I will name all stones after their place of fall. When making the thin sections, I made the cuts in two directions. After several attempts on Knyahinya, it turned out that it breaks in certain directions.

This was deduced from the inclusions, which, once their position had been found, regularly resulted in certain forms, to which those forms corresponded in sections made perpendicular to this position.

If the forms were placed on this stone, the same position in the remaining stones would have been obtained, provided, of course, that the material had been available. For some, the same happened by chance, while not in others, but for the reasons stated above further determination in this direction.

Also, I deliberately made the thin sections in three different thicknesses: heavy translucent, in order to see the whole inclusions as complete as possible; very thin, in order to clarify the structural conditions; and for the majority, in such a way that both were still visible.

I would like to make a comment here, which will be confirmed by anyone who has dealt with thin sections of fossiliferous material.

Only in rare cases of total transparency, that are entirely cut thin, is the structure visible. Anyone who looks at a thin section, if cut in this manner, with the microscope will be delighted at the beautiful shapes and lines. In the joy of this, one will want to make things even better and expects with continued grinding a perfect picture. But when one puts the thin section under the microscope after this second time - there is nothing left but an almost structureless surface, with hardly hinted, even blurred shapes, from which you previously perceived with the magnifying glass can no longer be seen, not even with the microscope. However, this phenomenon is related to the type of metamorphosis of the rock and the forms within it. The matter is well known and therefore does not require further explaination. I only mentioned the matter so that those who want to make these observations will not be surprised and will improve their own mode of observation.

4.

The fact that the chondrites consist for the most part of bronzite enstatite (augite) and olivine, as well as being magnetic throughout, is an accepted fact in the science. Quenstedt, Handbook of Mineralogy p. 722.

In particular, however, the inclusions which I claim are coral have been addressed as enstatite. This was believed to be able to explain the such structures. Others went further and explained the inclusions as a type of glass: (Tschermak).

So, before getting to the justification of my view, the microscopic appearance of main mineral, the enstatite, must be clearly identified.

Allow me to give a breif outline of what [Karl Heinrich Ferdinand] Rosenbusch says in his book: Microscopic Physiography of Petrographically Important Minerals, Stuttgart 1873, p. 252, about enstatite (and bronzite): "As is known, since the optical investigations of [Alfred] Des Cloizeaux, the enstatite, bronzite and hypersthene have been treated as rhombic crystallizing separated from the pyroxene and compiled into their own group. In addition to the cleavage after the prism of 87°, the same shows further divisions after the vertical pinacoid, the relative perfection of which the data of the various researchers do not exactly match. Chemically, these three minerals form an uninterrupted series, at the beginning of which stands the almost iron free enstatite, and at the end of which stands the very iron rich hypersthene. Additionally, enstatite and bronzite are so similar in all physical properties that it is difficult to separate them into two species. Hypersthene, on the other hand, shows a different optical orientation and therefore forms its own species. It is interesting to note that Tschermak's arrangement of the negative angles of the optical axes and the iron content of the three minerals mentioned makes it clear that the angle of the optical axes decreases steadily as the [iron oxide] FeO content increases. The microstructure of all the minerals of the enstatite group is generally so similar that, in the special case, a safe decision can only be made by chemical and precise optical analysis.

Enstatite and bronzite are not found in the rocks as crystals, but almost only in irregularly limited crystalline grains, which usually show a very dense striation, which is more straightforward in the case of enstatite, more gently winding and wave-like. But this difference is not a pervasive one. The same striation is also shown by the monoclinic diopside and rhombic bastite, which can not easily be separated from bronzite by other, later to be discussed, visual phenomena. If the cut meets the enstatite or bronzite at a strong incline to the main cleavage surface, then the surface will not be equally fine-grained, but rather like a rough stairway. Transverse surfaces and fractures are not uncommon.

Both are relatively poor in extraneous deposits; yes they are missing for example in the enstatite from the pseudophite of the Aloysthals in Mähren and in some enstatites or bronzites of the lherzolites and olivines. The former is traversed only by frequent veins of the pseudophite, from which fine-grained decomposition products penetrate into the enstatite in a vertical direction. Other occurrences and even other individuals of the same hand specimen often contain mass inclusions of green or brown lamallae, splints, and grains (depending on the position of the grinding plane) which, without exception, are invariably parallel to the most perfect cleavage direction. This suggests the idea that various indications on the relative perfection of the pinacoid (inf P inf) cleavage compared with the prismatic one may be due to the more or less mass presence of these interpositions, which undoubtedly also determine the Schiller metalloid on the brachypinakoid. Then, however, the ease of separation in this direction would be more a separation than true fissility.