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## I. *On the Existence of Nickel-iron with Widmannstätten's Figures in the Basalt of North Greenland.*


By K. J. V. Steenstrup, C.M.S.


(Translated from Meddelelser fra Grönland. Heft 4. 1888.)

AMONG the minerals found in meteorites, there is none which has attracted the general notice to such a degree as the metallic nickel-iron, especially from the fact that it has hitherto never been seen for certain in any telluric rocks. Nay, so much stress was laid upon this latter circumstance, that such iron was thought never to occur here on earth without having been carried to us from the outer universe, and ever since Chladni's report on the iron-mass of Pallas, every loose block of iron lying on the surface of the ground, nay, even deeply imbedded in it, has generally been declared to be a meteorite, if it only contained a certain percentage of nickel and, which was not always the case, manifested some crystalline texture, called after the discoverer "Widmannstätten's figures." An instance of the value accorded to this percentage of nickel in iron as affording a proof of meteoric origin we

have in the iron brought by Sir John Ross from Sowallick (Savilik). For that famous investigator of the polar regions received from the Esquimaux in Melville Bay some knives consisting of a piece of bone, somewhat like a paper knife, in the edge of which a range of small round iron discs were laid into a furrow. The natives said that they found the material of these on a mountain where two large stones were lying, of which one could not be worked with their tools, whereas they could cut the other to pieces, and that from this latter they took out the small round iron balls and beat them flat. This iron contained nickel, and from that time it has been generally stated that the Esquimaux in Melville Bay made use of meteoric iron.

Professor Nordenskiöld, therefore, after searching in vain for such iron at Fortune Bay, on Disco Island, in North Greenland, where the Rudolph iron is thought to have been found, and being led by the natives to Blaafjeld, Uifak,* did not hesitate to declare the iron masses lying there to be meteorites, when convinced that they contained nickel, and showed Widmannstätten's figures, although he found that iron of the same kind was firmly incorporated in the rock on which the blocks were lying.† He very earnestly denied that this discovery might be interpreted as if the iron were of a telluric origin ‡ and accounted for the relation between the firm and the loose iron by the supposition that the fall of the meteor had taken place when the basalt was forming, which is thought to have occurred in the Miocene period.

Dr. Nauckhoff who, in his capacity of geologist, accompanied the expedition sent out by the Swedish Government in 1871 to Greenland in order to bring home the loose iron-masses, did not venture to pronounce any opinion on their origin, particularly because nickel-iron had not yet been seen in any telluric rock.§ By the manner in which he explained the results of some of his analyses, he contributed however to render the question more complicated, as he believed to have found in the basalt, besides the metallic iron, Troilite and dumpling-shaped portions of Eucrite,

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* In the literature this place is called Ovifak, but ought without doubt to be written Uifak, as we must suppose it to be connected with "uiariak, I, you, shall go outside" (see the Greenland dictionary of Kleinschmidt). With Uivfak, a fern, it has nothing in common.

† Kgl. Sv. Vetensk. Akad. Förh., 1870, p. 1067.

‡ In for instance Quart. Journ. of the Geol. Soc. of London, Vol. XXVIII. page 44; and Post-och Inrikes-Tidningar, 1871, Nos. 255 and 260, and 1872, Nos. 110 and 111.

§ Bihang. t. Kgl. Sv. Vet. Akad. Handl., Vol. I. No. 6, p. 35.

respectively a mineral and a kind of rock especially characteristic of meteorites.

These views were approved of by Nordenskiöld, who now adopted the notion that the meteoric fall had consisted of Eucrite, with balls and grains of metallic iron.*

This view was generally approved of, for instance by Wöhler, Daubrée, and Tschermak;† because it was also to them decisive that metallic nickel-iron had never yet been found in any telluric rock.

On the news of this remarkable discovery Professor Johnstrup, who immediately saw its great importance, obtained, through the instrumentality of our Ministry, the permission of the Swedish Government for a Dane to accompany the above-mentioned expedition in 1871, and by an order of the 4th May of the same year the Ministry for Ecclesiastical Affairs and Public Instruction intrusted me with the performance of this task. Professor Johnstrup, indeed, thought it necessary to examine the facts at the spot itself, before the loose iron blocks were removed, for he considered that these belonged to the rock upon which they were lying, and that, consequently, they were not meteorites. I also came to the conclusion that the manner in which the iron was lying in the basalt allowed but of one explanation, viz. that it belonged to the latter in the same way as every other mineral belongs to the rock in which it has been formed; and that the loose iron-blocks were boulder stones.‡ If this explanation had been applied to any other mineral, nobody, of course, could have had the slightest objection to it, and the question would only have been in what manner the substance had been formed. Now, on the contrary, the fact that the iron-blocks had a shape and a structure corresponding to those of meteorites was regarded as a "proof" that they must have a meteoric origin.

I, however, immediately saw that their shape could be of no moment, and that chemical analysis could not decide the question; for we had, indeed, to deal here with a new telluric mineral, and however much the structure might resemble that of meteoric iron, this circumstance would have no weight; for no one has ventured to maintain that such iron could not be of telluric origin, and this would certainly be the only just foun-

* Post-och Inrikes Tidningar, 1872, No. 111.

† Wöhler, Göttinger gelehrte Anzeigen, 1872. Daubrée, Comptes rendus, LXXIV., LXXV. and LXXXIV. Tschermak, Mineralog. Mittheil., 1874.

‡ Vidensk. Meddelelser fra den Naturh. Forening i Kbhvn, 1875, p. 295, and Min. Magazine, Vol. I. p. 143.

dation for such a "proof." However, as long as the assertion that any "nickeliferous metallic iron, not being an artificial product, must be meteoric iron" remained unshaken, it was impossible to advance the other view, and my efforts were therefore directed to finding such iron at other places in the basalt, and under such circumstances, as would admit of no doubt as to its telluric origin.

When therefore next year Professor Johnstrup obtained a grant for me to return to Greenland in order to follow up this question further, I examined the basalt at as many places as possible, after first visiting Blaafjeld. At first it seemed that I should not succeed. I nowhere found metallic iron in the basalt, and only at one place, at Asuk in Wajgat, did the boulder-stones give signs of it, but I found no iron in them. When coming home, I saw this question before me quite as insoluble as in the preceding year. Then I began the microscopic examination, and in the preparation No. 17 I had the good luck to discover small grains of metallic iron in a basalt of a peculiar aspect from Asuk in Wajgat, of which I, unfortunately, had in a hurry taken but one sample, without much noticing the mode of occurrence. I then examined more than 200 basalt preparations from more than 40 different places in North Greenland; but in no other, the basalt from Blaafjeld of course excepted, could I discover metallic iron, though several of them precipitated copper. The Professor, Dr. Jörgensen, had the kindness to examine the iron-grains from Asuk, and found that they contained traces of nickel and cobalt. Consequently, the aim was nearly reached, for here metallic iron was for the first time discovered in the basalt, the single grains being visible to the naked eye, and containing those elements which were thought to be peculiarly characteristic of meteoric iron. I had also the satisfaction to find that with respect to this discovery, Rammelsberg declared it to be most probable that the iron masses of Nordenskiöld must be considered of telluric origin,* and he adds that the presence of nickel alone will hereafter not be sufficient to stamp a loose iron block as a meteorite.†

One of the few who from the beginning objected to considering the iron masses of Nordenskiöld to be meteorites, Professor Lawrence Smith, in North America, has lately performed a very careful analysis of the rocks and minerals concerned;‡ and after showing the erroneous interpretation of Nauckhoff with respect to the Troilite and Eucrite, which are simply

* Zeitsch. d. deutsch. geolog. Gesellschaft, XXVIII. p. 225.

† Abh. der Akad. d. Wissenschaften zu Berlin, 1879.

‡ Annales de Chimie et de Physique, XVI. 1879.

magnetic pyrites and dolerite, he proves in how many ways Nordenskiöld's iron differs from meteoric iron, its sole claim to be so considered only consisting in its containing nickel; for, he adds: "Il ne faut pas perdre de vue que l'on ne possède pas, jusqu'ici, de fer natif terrestre authentique en masses auxquelles nous puissions comparer les blocs groënlandais; . . . . mais, si nous admettons que le fer d'Asuk est d'origine terrestre (et je ne vois pas comment la chose peut être douteuse après la description du gisement donnée par M. Steenstrup), la présence du nickel et du cobalt perd une grande partie de sa signification, car nous avons vu que ce fer en renferme."* Daubrée, too, who, as above said, was at first much inclined to consider the iron masses of Nordenskiöld as meteorites, has, after the publication of this treatise, abandoned his former view.†

At the invitation of Nordenskiöld, Dr. Törnebohm made a microscopic examination of the rocks Dr. Nauckhoff had brought home from Blaafjeld,‡ and like Lawrence Smith, he rejected the Troilite and the Eucrite. On the other hand, partly on the basis of the analyses of Nauckhoff, he mentioned a new kind of rock, Anorthitfels, consisting of Anorthite with Graphite and the red-violet mineral which, according to Nauckhoff, is spinel, according to Lawrence Smith, corundum. As to the iron, he only ventures to speak about the iron-grains which are only large enough for a microscopic examination. In his opinion, they appear, together with magnetic pyrites and the mineral that resembles hisingerite, as later interstitial minerals in a large grained basalt, which, on the other hand, together with "Anorthitfels," is found in a breccia-like manner imbedded in the basalt. The small iron grains, he thinks, originate from the circumstance that the basalt, by its eruption, has melted a bituminous rock, containing lime and clayey soil, which by that means has become Anorthitfels, and the bitumen of which has then later on reduced some iron-solution. These iron-grains are consequently of a telluric origin, and though he does not attempt to prove any difference between the iron in these small grains and that in the large masses, he dares not pronounce any judgment about the origin of the latter. Yet he adds: "In dem Laboratorium der Natur dürfte indessen der Unterschied zwischen der Hervorbringung einer Kugel von der Grösse einer Erbse oder einer solchen von zwei oder drei Kubicmeter Inhalt wohl nicht als besonders wesentlich angesehen zu werden brauchen."§

* Annales de Chimie et de Physique, XVI., 1879, p. 491.

† Comptes rendus, LXXXVII., 1878, Séance du 9 Décembre.

‡ Bihang. t. Kgl. Sv. Vet. Akad. Handlingar, Bd. V. No. 10.

§ Bihang. t. Kgl. Sv. Vet. Akad. Handlingar, Vol. V. No. 10, p. 17.

As a matter of course I very much wished once more to be able to examine the ferriferous basalt at Asuk, and when the Board for the Geological Examination of Greenland in 1878 gave me the charge of investigating North Greenland, my wish was gratified, though it was only in the summer of 1880 that I arrived at this remote place.

In the autumn of 1879, however, I had made a discovery in connection with this matter, for in an old Greenland grave at Ekaluit, at Ikerasak in Umanaks-Fjord, I found 9 *pieces of basalt containing round balls and irregular pieces of metallic iron.* These pieces were lying together with knives, similar to those brought home by Ross, as well as with the usual stone tools, for which latter the raw materials were found in pieces of rock-crystal, chalcedony and Lydian-stone, whereas the 9 pieces of basalt with the iron balls were evidently the materials for the bone knives. This iron is soft and keeps well in the air, from which reason it is fit for use in the manner described by Ross. The rock in which the iron appears is a typical, large-grained felspar-basalt, and this discovery has a double significance, firstly, because it is the first time we have seen the material out of which *the Esquimaux made artificial knives* before they got iron from the Europeans, and secondly, because it showed *that they have used telluric iron for that purpose,* so that the supposition that they used meteoric iron* falls to the ground, for that only depended upon the belief that all metallic nickel-iron had a meteoric origin. It is, therefore, a matter of course that the blocks, from which the material of Ross's knives has been taken, must from this moment, at least until they have been subjected to a more searching examination,† be considered as being more probably telluric than meteoric iron. Futhermore, this discovery also throws a light on Rink's iron from Fiskernæs,‡ and, perhaps, on that brought by Giesecké from Arveprindsens Eiland,§ being, like the former, malleable,

* Ross, Voyage of Discovery . . . . of North-West Passage, London, 1819, p. 98, and LXXXIX. The Edinburgh Phil. Journal, Vol. I., 1819, p. 154. Silliman, American Journal of Science, Vol. 42, 1866, p 249. Compte rendu du Congrès international d'Anthropologie et d'Archéologie préhistoriques, Bruxelles, 1872, 6me. Session, p. 242.

† Christian VIII. caused in the years of 1840-50 two expeditions to be equipped for the purpose of looking for these iron masses, one on dog sledges, and one in boats; but no result was obtained, the former only going a few miles from Upernivik, and the latter not even setting out.

‡ Rink got this iron, among other minerals, from a Greenlander. It resembles very much the iron from Ekaluit, and is the same piece which Forchhammer mentions to have received from Motzfeldt. (Lütken Almeenf. Naturskildringer, I. p. 220, Note.)

§ Of this iron we know nothing but what is written in Giesecké's MS. Catalogue: "Ein zerfressenes Stück (gediegen Eisen?) gefunden in einem Torflager auf Arveprindsens Eiland."

and keeping well in the air. That the iron from Fiskernæs has been found so far from the trap-territory is easily explained in the same way as the pieces of bell-metal which are found along the coast through all North Greenland, that the Esquimaux, on their frequent voyages, have carried it with them, and it may perhaps, like the iron from Ekaluit, at some time or other have come from a grave.

Finally, the iron found at Ekaluit is also of importance from the reason that it affords testimony of the old graves of the Esquimaux being used for the storing of telluric iron. Yet it cannot be of frequent occurrence there, as it would else scarcely have escaped the eyes of the many persons who have sought for antiquities in the graves, however easily it may be disregarded; for even I myself, who am so accustomed to look for metallic iron, have only found it in this one grave, though I have examined several hundreds.

Everybody who knows the manner in which the Esquimaux form the names of localities, must see in Ross's name Sowallick (Savilik) an intimation with respect to seeking places where metallic iron is to be found. Thus Kleinschmidt, in his Greenlandish Dictionary, has already mentioned names which allude to it, and, after the discovery at Ekaluit, I do not doubt of success in that direction. I have had myself only an opportunity to make investigations at one of these places, say at Saviorkat, at the post of Niakornak in Umanaks-Fjord; but the time was so very short, and the weather so unfavourable, a thick fog with showers prevailing during all my stay there, that my search was performed just as if I were blindfolded, therefore the negative result I obtained is of no importance whatever. Although a search in such places might be interesting and, without doubt, also accompanied by success, it is still, after my later discoveries, of less importance, for in the summer of 1880, without this clue, I succeeded in discovering nickel-iron in solid basalt at several places on the coast of Disco. The first of these was Asuk.

As above mentioned, I brought from thence in 1872 the piece of basalt that was found later to contain metallic iron, but without noticing the existence of it, as I had no idea of its importance, and I therefore found it a little difficult to discover the place again. However, I was convinced that if I could discover the place where I then had pitched my tent, I should certainly also find the basalt. I had therefore secured the same coxswain of the woman-boat (*oomiak*) who then accompanied me, for, confiding in the faculty of the Greenlanders to find out localities, I was sure he would be able to recognise the site of my tent. Unfortunately, however, he could not find it again, and therefore brought me to a place six miles too far to the east; on that account I lost some days in looking for the right place, and having at

last found it, I could scarcely, for want of provisions, remain there for 24 hours. The place is, however, easy to be recognised, being where "Asukhouse" has stood; nay, this house has even been built of the ferriferous basalt, just as the tent walls near Ivigtut were formerly built of cryolite. Fig. 1 shows the stratification here. At the base

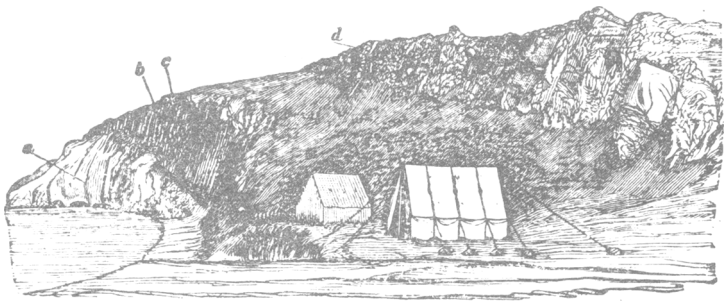


FIG. 1. (R. Hammer.)

at the surface of the water, to the left, are to be seen the coal formations, *a*, in a slope about 20 feet high. Above these is a peculiar mass, *b*, resembling tuff, and consisting of a mixture kneaded together of basalt-tuff and a partly hardened and modified clay-slate containing sand. On this rests a stratum of basalt, about 50 or 60 feet thick, *c*, shaped in magnificent columns, among the finest I ever saw in Greenland, and thereupon follows at last the *ferriferous basalt*, *d* (the bed seen above the tents), with a thickness of about 50 feet. The whole slope is about 120 feet high, and the strata dip about 10 degrees in the direction of the coast towards north-west. The limits towards the columnar-basalt below can easily be seen, as they are very sharp,* but I did not succeed in discovering the upper boundary; the reason of this, however, was certainly only want of time. *This peculiar layer of basalt is filled from top to bottom with iron-grains* of all sizes, from the fraction of a millimeter to a length of 18 mm. with a breadth of 14 mm., which is the greatest I have found. Yet the larger balls do not consist entirely of iron, for they seem to be an aggregate of smaller grains grown together, a section through them reminding one of the structure shown by the Mesosiderites. When polished this iron shows beautiful Widmannstätten figures, which fact, consequently, proves the truth of my supposition set forth in my former paper, that if we succeeded in finding larger blocks of telluric iron, we should also find

* But only seen with the naked eye; for in microscopic preparations, exhibiting both varieties, one sees how the fluctuating structure by which the ferriferous basalt is in so high a degree distinguished, passes into the granular structure of the columnar-basalt and effaces the limit.

these figures in it. In the same paper I directed attention to the occurrence of graphite together with the iron, and this time I found here in the basalt a considerable amount of this mineral as well as of the graphitiferous felspar (the "Anorthitfels" of Törnebohm) found at Blaafjeld. Also in the basalt from Ekaluit there was graphite together with the pure iron.

The next place where I found a solid ferriferous basalt is *a neck of land on the northern side of the mouth of Mellemfjord, on the western side of Disco*. Already at Napasuligsuak, in the north of Nordfjord, I had found boulder-stones of the basalt, but neither there nor in this whole fjord did I find it *in situ*. The neck of land at Mellemfjord we called "Jernpynten," because it, having a breadth of about the quarter of a Danish mile, proved to consist almost entirely of this rock. Yet this is only true with respect to the extremity of it; for some hundred feet inside we find an ordinary large-grained basalt (Doleritporphyr), and only at a distance of about 4,000 feet we again discovered the upper part of this layer on the slope of the rock in a height of about 540 feet. The lower boundary I could not determine, on account of downfallen masses and of vegetation. This description, however, only refers to the southern side of the neck of land; on the northern side, the large-grained basalt is found quite out to the extremity, but immediately within there the ferriferous basalt stands firmly in a slope about sixty feet high, and also forms a couple of rocks lying a little northward to the isthmus. Seen from the southern side of Mellemfjord the layers in the rocks dip here about eight degrees towards west, which fact also corresponds with the circumstance that after the interruption the ferriferous basalt is only met with at a height of about 550 feet, and that the angle from there to the isthmus was measured to be eight degrees. How great the thickness of the layer is I cannot tell, but I estimate it at about 100 feet. When we walk higher up the slope of the rock that for a part is overgrown, we again meet with it in a height of 950 feet. The angle from here to the isthmus is 9½ degrees. Above, there lies a red amygdaloid, and higher upwards I could not find the layer either *in situ* or in loose pieces.

The ferriferous basalt here resembles generally that from Asuk, as well in hand-pieces as in microscopic preparations, yet at several spots it approaches the appearance of a small-grained basalt. The manner in which the iron appears is quite analogous to that at Asuk; and here too graphite and graphitiferous felspar are to be seen, partly in sharp-edged pieces, partly in concretion-like excretions.

About one and a half Danish miles further up the Mellemfjord, I found near some remnants of a house, in the steep bed of a river, a considerable number of large, sharp-edged blocks of the ferriferous basalt. The stratum to which they belonged I could not find or reach, the bed of the river being yet full of snow and ice; but their being *in situ* is not to be doubted, for the pieces looked as fresh as if they had lately fallen down.

Furthermore, ferriferous basalt is found *in situ* in *a ravine on the northern side of the inner part of Mellemfjord*, in a height of 800 feet. Here the iron was to be seen partly secreted in the basalt-mass itself, partly filling the cavities of pores in connection with magnetic pyrites. Here too are seen both sharp-edged pieces and concrétion-like secretions of graphite and graphitiferous felspar. The basalt is partly as small-grained as at Asuk, partly large-grained, and then is not to be distinguished from the common dolerite. The iron shows on being polished and etched beautiful Widmannstätten figures, and contains, according to an analysis which Professor Dr. J. M. Jörgensen has been kind enough to perform, 2·69 per cent. of nickel. It is soft and malleable, so that it can easily be hammered into plates thin as paper, and shows, like the iron at the above-mentioned places, plane cleavages (after the octahedron ?) with a strong tin-white lustre that remains unchanged for months.

Once more I found ferriferous basalt *in situ*, viz. on the southern side of Mellemfjord at Ivigsarkut, where it closely resembles common basalt; it has, however, partly a lava-like aspect.

On the rock in the east thereof, the loose stones, on the slope to a great extent overgrown in a height of about 1,350 feet, also consisted nearly exclusively of ferriferous basalt, so that the layer must there also be firm. As on the northern side of the fjord, the strata dipped about six degrees outward, towards north-west.

*Metallic nickel-iron with Widmannstätten figures has now been proved to be also a telluric mineral*, and the presence of nickel together with a certain crystalline structure are consequently not sufficient to give the character of meteorites to loose iron-blocks, so that the view put forth by Professor Johnstrup in 1871,* in opposition to the "meteoric iron" of Nordenskiöld, has been proved to be right.

*The places where metallic iron is found in North Greenland*, the number of which has now been considerably enlarged, are marked on the map† with Fe and (Fe) respectively, when the iron has been found *in situ*

* Communicated in "Videnskabelskab," the 26th Jan. and 9th Feb., 1872.

† Not given with this Paper.

or only in loose blocks. Without entering upon details with respect to the chemical composition, an account of which will be given in the following treatise by Mr. J. Lorenzen, I shall only here observe that *there seem to be two kinds of iron*, one being hard, brittle, and easily weathered, containing a greater quantity of carbon, which we with Forchhammer may call *meteoric cast iron*, to which belongs the iron from Niakornak, Jacobshavn, Fortune Bay, Blaafjeld, and, perhaps, Arveprindsens Eiland (Heir Apparent Island); and another, *meteoric wrought iron*, being soft, malleable into thin plates, for a greater part resisting the influence of the atmosphere, and only containing a small quantity of carbon, to which belongs the iron from Sowallick (Savilik), Fiskernæs, and all that I have found. The latter kind of iron, which resembles real meteoric iron more than the iron from Blaafjeld does, will undoubtedly prove a curious material for comparison in the study of meteorites, and we shall now see if in a chemical way any difference can be detected between meteoric and telluric nickel-iron.

In my former treatise I tried to maintain that the manner in which the iron appeared in the basalt at Blaafjeld* *could only be explained by its being formed in it*, and this notion has also been fully approved of by Lawrence Smith and partly by Törnebohm, as far as those iron-grains which are not larger than are fit for a microscopic examination. The reason why Dr. Törnebohm does not venture to go further, is evidently the same that made Nauckhoff, Tschermak and Daubrée doubt the telluric origin of the iron-masses of Nordenskiöld—I mean the fact that such iron had not been found elsewhere; but this objection now being removed, I do not doubt that he too will give up his reservation. The peculiar breccia-like structure the basalt has at Blaafjeld *there* where it encloses the iron, caused Nauckhoff to suppose that there were lumps and dumpling-like parts of other rocks in a common basalt, but while his description particularly suggested the supposition that these rocks were derived from *outside*, as also Nordenskiöld has understood it, Törnebohm represented the matter as if a dolerite and his "Anorthitfels" were carried up as fragments with the basalt. I, too, immediately saw this breccia-like structure; but as to the Anorthitfels, I considered it to be porphyritically secreted lumps of a graphitiferous felspar, and the large-grained parts (the dolerite of Törnebohm) I thought to be a variety of the common

* According to Dr. Törnebohm, my notion that the iron is here found in a layer and not in one or two dykes has now been acceded to by Professor Nordenskiöld. L. c. p. 4. See also Nordenskiöld: "Studier och Forskningar," p. 210.

basalt, which, on account of peculiar circumstances being at work, has got a somewhat different aspect, and has probably also during the formation been subject to great changes of volume that have produced smaller veins. It is moreover difficult to observe matters at the place, partly on account of the quantity of weathered iron crossing the basalt (so that each fragment is surrounded by a coating of rust), and partly on account of the large loose stones covering the shore and thereby preventing a systematical investigation. At any rate, a breccia-like aspect, as well as concretion-like secretions, are no very rare features in the basalt; but expatiating upon this would here lead me too much astray, the more as I hope later to return to this subject in a statement of my researches on the basalt in North Greenland, generally speaking.

When we proceed to examine the relations in which the iron appears at the other places, though they are easier to be overlooked there, because the blocks of iron are smaller, yet, as at Blaafjeld, we also everywhere meet graphite and magnetic pyrites together with the iron, the graphite being found partly in the basalt as small lumps, partly penetrating a triclinic felspar in connection with the same small red-violet grains as at Blaafjeld. This felspar appears either as single porphyritically secreted crystals or as concretion-like secretions.

In my first treatise I directed the attention to the fact that the ferriferous basalt at Asuk had a peculiar aspect; but it was, however, not my meaning that it should not be considered a basaltic rock, even if it be not a typical basalt. This view has been confirmed by my later discoveries; for however peculiar it may look in general, yet it shows in Mellemfjord *such complete transitions to common basalt* that it is evidently but a variety which we might characterise as *iron-basalt*. The iron appears here in three ways:—(1) partly as small, drop-like particles equally distributed throughout the whole mass, as it is in a typical way at Asuk; (2) partly as sharp-edged grains grown together, with a tin-white lustre at "Jernpynten," and partly in Mellemfjord; and (3) finally, filling out pores in connection with magnetic pyrites, as in the inner part of Mellemfjord.

Not only is the graphite a steady companion of the iron, but this mineral is also to be found at several places in the basalt where the iron is not visible, at least not to naked eyes, partly as small round balls; thus, in a dyke of basalt at Kook Angnertunek, on the southern side of Upernivik's Island in Umanaksfjord (Fig. 2, p. 13), and in a dyke of basalt at Nuk in Waigat, and partly quite penetrating the basalt, so that we are entitled to speak of a *graphite-basalt*. Such a rock, graphite-basalt, appears in a great bed in the steep inaccessible rocky wall above Nuk,

in Waigat (and there it also contains microscopic iron-grains); furthermore, at Nungerut, near the coal mine of Ritenbenk; and, judging from the boulder-stones at Asuk, also perhaps at the north-western extremity of Disco; and, finally, it is found *in situ* at Nordfjord.

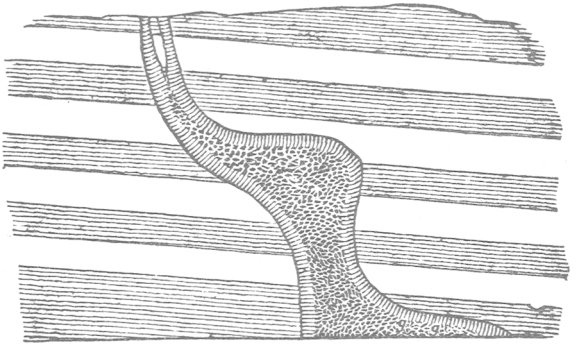

FIG. 2.—Dyke of basalt breaking through the coal-containing formation (slate, the striped compartments and sandstone) at Kook Angnertunek. Towards the side the basalt is separated in columns, and at *g* it contains round lumps of graphite as large as peas.

Here it is to be mentioned, too, that the basalt on the northern side of the large Bay of Kasigisat, between Nord- and Mellemfjord, contains large concretion-like lumps of graphitiferous felspar, much resembling rounded fragments, and, perhaps, also being so.

However there may be a difference between the manner in which the iron appears at Blaafjeld, and that in which the one or the several ferriferous basalt layers appear along the northern and western coast of Disco, wherefore, perhaps, we may be inclined to make the following inference:—

Of course the iron in the basalt layers is telluric, but the large iron-masses at Blaafjeld, which appear only in a much limited region, are, as to their aspect and size, so essentially different therefrom, that we cannot think them formed in the same manner, and so they may, perhaps, be meteoric; however that may be, I must, in the first place, be permitted to refer to the *mass of magnetic pyrites in the dyke of basalt* at Igdlokunguak,* which is quite as large and shows that masses of a similar size can be formed in the basalt, or can, at any rate, be carried up with it; and, in the second place, I must refer to the fact that nickel-iron with Widmannstätten figures now *has been proved to be a telluric mineral*, the want of evidence of this fact, according to Lawrence Smith, being the only ground for considering the iron-masses of Nordenskiöld to be meteorites; for in all other respects real iron meteors were, indeed, very dissimilar from them.

* Vidensk. Meddelelser fra den naturh. Forening i Kbhvn, 1875, p. 304.