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Read by Title, January 22, 1906.

During a visit in the spring of 1905 to places along the coast of Chili, from the southern border of Peru southward to Valparaiso, with inland excursions, the writer had the pleasure of examining a number of interesting meteorites. Three of these being new to science, he takes the present occasion to put them upon record with a preliminary description. We first notice the siderite

ILIMAES.

This most interesting pallasite is in the mineral collection of the Lyceo, at the small city of Copiapo, Chili. We first saw it there in 1889; a huge, dirty mass on the floor under a table. My efforts to obtain a specimen piece by exchange, were met by the remark that it would require a year of correspondence with the authorities at Santiago. In late years there has been a change in the administration of the Lyceum. It now possesses, as an important adjunct, a School of Mines (Escuela de Minas), of which the able director is Señor Casimiro Domeyko, son of the well-known Ignacio Domeyko, geologist and naturalist, celebrated in the scientific annals of Chili during the middle half of the last century. The meteorite is now mounted on a stand, and adorns a central part of the fine Museum. Its label records that it came from Imalaes (sic) 12 leagues southwest from Taltal, Department of Taltal, Province of Atacama. Its weight is given as 95 kilograms. It measured about 16 x 10 x 8 inches, and appeared to be an entire boloid, with the exception of a few cor-

ners which had been cut from one side by Professor Domeyko in the effort to obtain a polished surface.

The main portion of the exterior was covered by a thick coating of melted matter, or crust, which was broken by several areas, of several square inches each, where masses of almost clear olivine, held but slightly together by the iron network, lay grouped usually at a little lower level than the general surface. Through the kind favor of Professor Domeyko, aided by a satisfactory exchange, we were allowed to take the mass to the Railroad Machine Shops at the port of Caldera, 40 miles away, and there in several days of heavy work, cut off a piece weighing 16.7 kilograms, or about 37 pounds. Plate 23 shows the two masses after the cutting. The form of the entire original boloid is thus evident. On the upper piece (the one now in the possession of the writer) the deep melting and flowing of the crust is very apparent. The whole surface is not only changed in texture and blackened, but it appears as if rubbed down under heavy pressure. The thickness of this crust is from 0.3 to 0.5 mm., being thicker above the stony than above the iron part of the mass. It is, in the main, tightly adherent, but in a few places it may be flaked off. The section (Plate 24, fig. 1) shows it as a molten slag, or mixture of metal and stone, with the metal more settled in its lower, inner surface. At some places in its thin mass there are fine points of bright metal, doubtless pure nickel iron. The upper surface is of a dull black color, matt, and in places having a certain bloom appearance. Quite exceptional among all the pallasites with which the writer is acquainted, although approximated by Marjalahti, is the thickness and firm investment of this outer crust. Within, the constituents and structure of the mass are not less interesting. It is a combination of nickel iron and of silicates, with the usual pallasite grouping, the iron making cells which are filled by the latter. A polished surface shows a broad, stout network of bright iron surrounding cells which are polygonal in form, with walls more angular than curved, enclosing polyhedral crystals of stony matter, partly broken and the fragments sometimes partly separated by blades of the iron. In this feature Ilimaes belongs to the Rokicky Group of Brezina, taking its place with Brahin (Rokicky), Admire, and Eagle Station. In this it

differs from pallasites of the Imilac and the Krasnojarsk group, where the cells have almost uniformly rounded walls, conformed to the rounded, instead of angular olivine crystals. The olivine in Ilimaes is a bright, clear yellow and greenish yellow color, in crystals which vary from small grains to pieces from 5 to 10, and even 15 mm. across. Sometimes these are bunched together in areas from 3 to 5 cm. in either diameter, with no intervening iron. In Plate 20 one of the patches of olivine is visible on the surface at left hand of the upper mass; and two of them show in the lower mass.

Plate 24 presents a slice of Imilac below a slice of Ilimaes, showing well the different cell-structure of the two pallasites.

By careful separation of the olivine from the iron particles in 200 grams of the matter, as it fell from the machine in the cutting, we found the former to be 70 grams and the latter 130 grams; a ratio of 54 per cent. of the olivine to the iron. In volume there are 10 parts of olivine to 8 per cent. of iron, assuming specific gravity of the mass as 7.7 and that of the olivine as 3.4. In the Ilimaes the coarse structure of the olivine crystals makes great contrast with the almost flour-like grain of much of either member of the Imilac group, Imilac or Marjalahti. In the latter of these, in all the peripheral portion of the mass, it is so uniformly fine that it has the semblance of having been crowded into the cells as a powder. Borgström ventures the surmise that the crystaline olivine has been brought to this mealy state by the sudden shock received by the heavy mass as this meteorite struck the rock on which it fell. We are pleased to interrupt our brief description of Ilimaes by giving in full a letter, at this moment received from Dr. Aristid Brezina, of Vienna, to whom we, some weeks ago, had sent a small slice of the iron. Dr. Brezina writes:

"The section weighing 127 grams of a pallasite labeled Ilimaes which you sent me is at hand. It shows the following microscopic and macroscopic particularities.

"The olivines of brown color measure usually from 3 to 17 mm. in length and 2 to 13 mm. in breadth; rarely they appear as small particles of 0.5 to 2 mm. in diameter. They show in general polyhedral edges; very rarely they have rounded edges, which occurs in the smallest individuals only. Schreibersite occurs abundantly, and in three forms (respective ages) *a*, individuals of 1-4 mm. following immediately after the olivine; *b*, small veins between the grains of wrapping kamacite, and *c*, microscopic grains and crystals in kamacite near

its boundaries against taenite, apparently as products of cohesion of this latter. Wrapping kamacite is rather broad, from 0.5 to 4 mm. in thickness. Taenite is 0.05 to 0.2 mm. thick; its borders to kamacite are often corroded and replaced by chains of small schreibersites. The plessite fields show in general a confused mixture, rarely crystalline deliquifying. The olivine fills 58% of the cut face, nickel iron 38.7%, schreibersite 2.5%. The volumes calculated with the cubes of the square roots of these numbers and the specific gravities 3.4, 7.8, 7.2 respectively give the percentage of weight of olivine 41.5, nickel iron 50.8, schreibersite 7.7. The position of this pallasite in the system is intermediate between the Imilac group and the Rokicky group.

"Imilac and Marjalahti both show polyhedral olivine, but differ from Ilimaes by their double boundaries of taenite and by their crushed olivines, while in the new pallasite the olivines seem wholly or nearly entire. Rokicky and Admire have polyhedral olivines, which in Rokicky are entire as in Ilimaes, while in Admire they are broken and dislocated, with nickel iron filling the distance between the parts.

"Thus the nature of the olivine puts Ilimaes nearer to Rokicky than to Imilac. The nickel iron on the contrary resembles more that in Imilac; the strong development of wrapping-kamacite, its puffy borders against the fields, the lack of central skeletons, as well as the mode of occurrence of schreibersite is the same in both meteorites.

"With the pallasites of the Krasnojarsk group it holds few or no relations; of these pallasites only Alten (Finmarken) shows polyhedral olivines besides rounded ones.

"In summary, the new pallasite Ilimaes seem to be a distinct fall, appertaining to the Rokicky group."

With this important contribution from Dr. Brezina, we close our notice of the structure and contents of the Ilimaes pallasite. We wish to add a word as to the provenance of the meteorite in question. We have at the outset noticed the label upon the Copiapo mass with the locality Imalaes, as there given. A fortnight later, however, we met in the office of the Director of the School of Mines in the capital city, Santiago de Chili, Señor Don Emeterio Moreno, introduced as the finder of the pallasite in question, and as its donor to the Copiapo Museum. Señor Moreno told me of having himself found the meteorite about 1874 or 1875, at Ilimaes, on the desert of Atacama, about 12 leagues to the south of Taltal. This point corresponds closely with the locality of the Copiapo specimen, given me (in letter now before me) by Professor Domeyko—"Latitude 26°, longitude 70°," though he has labeled the mass Imalaes. Further, it is satisfactory to find, in a description of an iron meteorite acquired for the Vienna Museum in 1870, that Professor Tschermak notes that "the only

information as to its locality was given on a label, which stated that it was brought by Herman Schneider, a student from Valparaiso, from Ilimae, about 26° S. latitude and 70° W. longitude." Now, as this locality is geographically the same, it is undoubtedly, as Fletcher has noticed, a question of misspelling.

The distance to Imilac from Ilimaes is about 170 miles in a northeasterly direction. Other pallasite fragments of the Imilac group have been found still further north and northwest. A meteorite was, indeed, found in 1861, at Vaca Muerta, which is about 40 miles west-of-north of Ilimaes, and another in 1875, at Taltal, which is nearly the same distance to the north. But the former of these was a mesosiderite of the Grahamite group, and the other an aerolite, of which little is known. This still leaves the Ilimaes meteorite isolated by 160 or 170 miles from any other recorded pallasite locality. This distance, too great for the probable limits of a straggling member of a meteorite fall, adds further support to the differences in microscopical character, as before noticed, in considering our meteorite as distinct from Ilimac, and calling it from its place of find,—Ilimaes.

COBIJA.

In a short visit to the School of Mines in Santiago de Chili, in April of 1905, I was shown by Señor Julio Laso, the Mineralogist and Custodian of the Collections, two meteorites, a stone and an iron, which he informed me were new to science, having never been closely examined or described. One of these was found by Professor Laso himself, in February, 1892, on the pampa of Santa Barbara, in the Department of Antofogasta, a short distance eastward from the town of Cobija. The mass (Plate 25, fig. 1), which had the shape of a lengthened sphere, was about 14 x 12½ x 11 cm. in length, breadth and thickness, or about the size of a child's head. One side of the sphere was flattened, so that sections of the mass were of a certain horseshoe shape. One end is also flattened. Half of its surface, with a narrow strip leading along at right angles on one side, has a well-developed crust with a granulated pitting. The exterior surface of the main spherical portion of the mass shows a tendency to flake or shell off, although still firm in texture. This character is also manifest on the flat

end, where a portion 50 mm. in thickness has at some time been removed, naturally or by applied force. The whole exterior of the mass is of a dark brown color, slightly tinged with reddish hue at the more oxidized places. The color of the crust is somewhat darker and less dull than the balance. In fact, this crust is quite shining or varnished at places. The fractured stone is of a very even granular structure, with no separate or distinct crystalline surfaces, but it is lightened everywhere by very minute shining points which, even to the naked eye, show themselves as grains of bright metallic iron. Among these are other less bright points of troilite. Both are myriad in number, and together they constitute fully one-third in volume and more than one-half in weight of the whole mass. The silicates are bronzite and olivine, closely blended and chondritic in character. These chondri, clearly apparrent only with a glass, are so crystalline and firmly united that they break with the mass. This compactness is somewhat enhanced by a slight oxidation which has the effect of binding all closely together, and at the same time of obscuring the visible structure. We place Cobija unhesitatingly among the crystalline chondrites Ck. It very closely resembles both Klein Menow and Pipe Creek, but differs from the former in being more compact and from the latter in not being veined.

The weight of the original mass of Cobija was 3,690 grams. The largest remaining piece, weighing 1,805 grams, is in the Ward-Coonley Meteorite Collection.

CHANARAL.

In the mineral collection of the School of Mines at Santiago de Chili, is a small siderite which is especially interesting by reason of its form and perfection of surface markings. I owe to Professor Julio Laso, the able and courteous custodian of the collections, the privilege of photographing the specimen, together with a fragment for analysis and for my own collection. Professor Laso informed me that this iron was found in 1884 by Don Roberto Bugde on the desert of Atacama, a short distance in the interior from the Port of Chanaral. This is latitude 26° 30′ S. and between longitude 70° and 70° 30 W. In fact, it is very near to the locality before given for the pallasite Ilimaes. The meteorite

(Plate 25, fig. 2) is in the shape of a sickle, with a main arm five centimetres wide, tapering thence along its curve to a sharp point. Its length across the curve is 12.7 cm., and vertically 7.8 cm. Its average thickness is 3½ cm. Its weight is 1,207 grams.

This is singularly well preserved, with no signs of oxidation and without marks or bruises upon one of its faces. That face is sculptured over its entire area by a series of shallow cavities or pittings, which are in general rudely circular and about 1 cm. in diameter, but a few of them along the outer curve of the mass are so lengthened and confluent that they produce two shallow valleys 1 cm. in width and prolonged for 6 cm., with a sharp crest about 8 mm. high between them. These valleys are in their turn replete with many small folds or wrinkles not more than 2 mm. in height. A crust or skin of a fine black color covers this entire face. The opposite face is covered over its upper or peripheral portion with pittings which are somewhat larger (8 to 10 mm.) across, with proportional depth, and in all cases with circular rims. The lower half of both limbs is, upon this rear side of the mass, worn or decomposed away, the pittings being dimmed or entirely obliterated. The small fragment which I possess of this iron shows on its etched face of 3 square centimetres, well-marked Widmannstäten figures with lamellae running very evenly 1 mm. in breadth, thus giving this iron place as a medium octahedrite in Brezina's classification. An analysis made by Professor Henry W. Nichols, chemist of the Field Museum of Natural History of Chicago, gives:—Nickel, 5.37 per cent., Iron, 95.97 per cent.

One-fourth natural size.

ILIMAES METEORITE.

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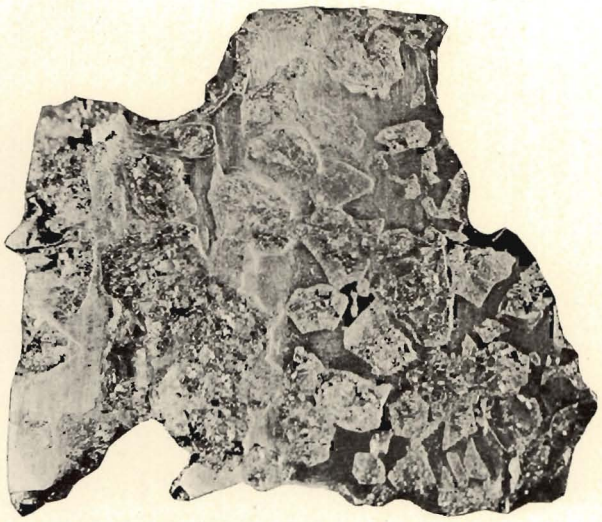

FIG. 1. SECTION OF ILIMAES.

FIG. 2. SECTION OF IMILAC.

SECTIONS OF ILIMAES AND IMILAC METEORITES.

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FIG. 1. COBIJA METEORITE.
Two-thirds natural size.

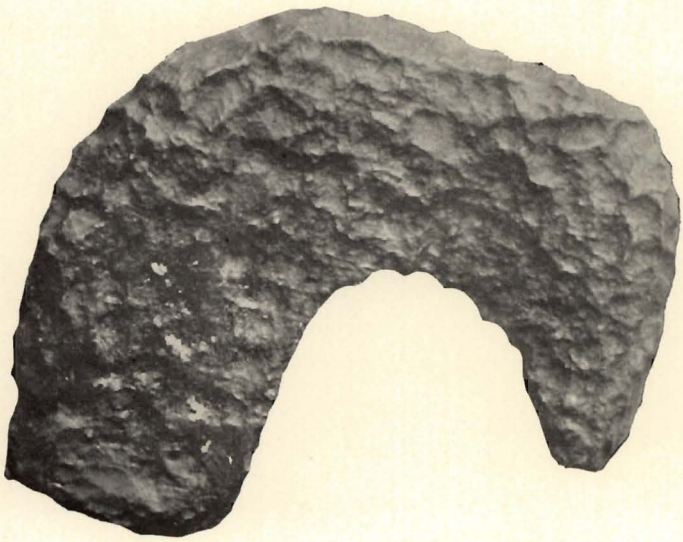

FIG. 2. CHANARAL METEORITE.
Two-thirds natural size.

COBIJA AND CHANARAL METEORITES.

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