THE KAROONDA METEORITE

The Karoonda meteorite is an aerolite of uncommon type. Interest in it is further increased by reason of its fall having been observednand the phenonema associated having been ably recorded by Professor Kerr Grant and Mr G F Dodwell. It was observed to arrive as a brilliant fireball,witnessed over a radius of more than 250 miles in southern South Australia,at about 10.53 p.m. on the evening of 25 November 1930. After examining the evidence, Grant and Dodwell conclude that"the meteorite appears to have descended at a steep angle of about 70 degrees with the horizontal. When first seen it had an altitude of 150 miles or more, and the duration of the fall was approximately six seconds. It traveled in an east-south-east direction.

"When first seen the meteorite compared in brightness with a star of first or second magnitude but rapidly (in a few seconds)increased to a brilliancy which gave an illumination comparable to that of daylight, even in Adelaide. It was described by many observers as an immense ball of bluish-white color, equal in diameter to the full moon, and having a luminous tail several degrees in length. As it approached the earth showers of sparks issued from the main body."

Observers within a few miles of the location of the fall reported a loud rumbling or roaring noise. Messrs Honeyman and Millard, of Karoonda,who were nearer to the locality of the fall than any other observers(2¼ miles distant),give the following account:--"...the disappearance (*cessation of luminosity due to impact with the ground..D.M.*) of the meteorite was followed by a loud detonation as tho a very heavy charge of explosive had been let off underground. This caused a distinct vibration of buildings nearby. This sound was followed,at an interval of about three seconds, by a loud cracking and rending sound from the sky in the direction in which the meteorite was last seen, then by a low rumbling of thunder which gradually died away in the distance."

Visible and audible phenomena pointed to impact having taken place in the vicinity of Karoonda, and with a view to retrieving the meteorite,Professor Kerr grant and Mr Dodwell led a search party from Adelaide. On the third day of search they were successful in locating the fall at a point 2¼ miles east of the township of Karoonda. The meteorite was lying in sandy farm land. "It had made a crater-like hole in the sand eighteen inches in diameter and about the same depth, with a surrounding ridge of sand three feet six inches across."

"The meteoritic stone had shattered on striking the earth,and numerous fragments were scattered over a radius of four or five feet. The bulk of its mass however, was within the crater, the largest fragments being on the east side and pointing nearly vertically down. In addition to pieces varying from an ounce or two to seven pounds in weight, there were very numerous smaller fragments and much finely pulverised material mixed with sand. The whole was collected and the mete[illegible] material separated from the sand in a magnetic separator.The total weight of the meteorite was thus ascertained to have been 92 pounds."

As it was shattered on impact, the original shape of this meteorite is not known. One large fragment exhibits portion of two original faces.The deeply scored nature of the face exposed to the rush of air is very noticeable, as it is seamed with deep, oval pittings. The other smooth face was evidently in the rear of the advancing meteorite, Just around the edge where the side and rear face meets is a thickening of the scoriaceous crust, representing an accumulation of fused matter swept back from the friction-stressed, forward-facing part of the mass. (Fig. I)

The fusedf crust is of a dark grey to nearly black color,being distincly blacker on the rear face, where it is thicker. It usually exceeds 1mm in thickness, on the latter face, whist on the forward faces it is scarcely more than a varnish, being less than 0.5 mm thick.It is everywhere only loosely adhering to the meteorite substance within, and readily scales off.

The material of the meteorite itself is of a medium- to dark-grey color, and is rather friable. This friability is doubtless due,at least in part, to the effect of the violent impact with the ground. Porosity is more marked than in the case of normal terrestrial rocks, but this may be due to the shattering effect of shock. No obvious nickel-iron is observable in the microscopic examination. It is practically an all-stone meteorite with abundant rounded chrondi which on fracture faces stand in relief (fig.II),the chrondi not breaking with the matrix.

Mr A.R. Alderman M.Sc.,has made for the South Australian Museum a complete chemical analysis,indicating the following percemtages of composition:--

Silica (SiO_2)	34.6
Alumina (Al_2O_3)	5.55
Ferrous Oxide (FeO)	26.99
Magnesia (MgO)	24.85
Lime (CaO)	2.58
Soda (Na_2O)	0.71
Potash (K_2O)	0.26
Water (H_2O)	0.13
Titania (TiO_2)	trace
Phosphorous Pentoxide (P_2O_5)	0.25
Ferrous Sulphide (FeS)	3.98
Manganous oxide (MnO)	0.21
Chromic oxide (Cr_2O_3)	0.49
Carbon (C)	0.08
Iron (Fe)	0.42
Nickel (Ni)	0.02
Total	100.88

In this analysis the carbon was determined by F.L.Winzor,B,Sc. and the phosphorus by R.G.Thomas, B.Sc.

A specific gravity of 3.5 was obtained as the means of several determinations.In each case the meteorite fragments were first boiled in distilled water under reduced pressure, in order to eliminate the effect of the porosity of the meteorite.

The microscope section reveals a very fine-grained,brecciated structure with abundant chrondi scattered thru the mass. As seen in the microscope slide, some of the chrondi are perfectly circular in outline (fig.III),others are sub-circular, and all ar more or less rounded in outline. The mineral particles composing the chrondi usually appear as granular aggregates,but some are radial lamellar in structure. Chrysolite is the principal constituent of the chrondi. There is always present in some quantity an impregnation of troilite, which substance is prone to be concentrasted around the borders of the chrondi.

The brecciated material composing the bulk of the aerolite contai , some larger recognisable mineral fragments set in a denser base. The latter consists of small mineral particles, rendered dusty and more or less opaque by abundant impregnations of troilite,also scattered black opaque specks representing chromites, some magnetic, and what appears to be carbonaceous matter.

Tho crumbled chrysolite composes most of the base,there is some dusty glass and faintly doubly refracting mineral. Occasional particles exhibit faint polysynthetic twinning. The best example of this kind has the optical properties of a basic plagioclase. Acid attacks the weakly refracting mineral and it appears to be in the main some relative of the melilite group. The evidence of the microscope slide,therefore,is that the bulk of all alkalies, lime and alumina are combined with silica to form a little plagioclase felspar and larger quantities of an unsaturated silicate and (or) glass with a melilite composition.

The iron and magnesium is almost entirely present in the form of a highly ferriferous chrysolite. There are,however,insmall amount, particles appearing to have lower double double refraction and a higher resistance to acid,which qualities suggest hypersthene. The latter has the same straight extinction and sign as has the ferriferous olivine.

These observations, considered in conjunction with the analysis,suggest the percentage composition to be roughly as follows:---

Chrysolite (and perhaps a little hypersthene)..	82
A melilitic and felspathic fraction,say........	12
Troilite....................................	3.98
Chromite....................................	0.67
Apatite.....................................	0.67
Nickel iron.................................	0.44
Amorphous carbon............................	0.08
Magnetite,little but uncertain.................	?

As to the classification of this aerolite,if cataloged on the Rose-Tschermak-Brezina system it might be distinguished as a friable, dark-grey chassignitic chrondite;the chrondi not breaking with the mass and nickel-iron almost wholly absent.

Recognising however, that this system of classification ,so far as the division of chrondites is concerned,is unsatisfactory,it would seem that a more simple treatment of chronditic aerolites can be applied. The division of aerolites into two main groups, sidérititic and asideritic,respectively,would be a first step. The term asiderite has been applied to aerolites that contain no(or only traces of) metallic iron. Prior's scheme of classification for the sideritic chrondites would then apply so far as that division is concerned. The asiderites could then be listed as chronditic or achronditic, and further divided on the basis of mineral content or of relative values of the principal chemical constituents.

Simply described,ours would be a chrondritic asiderite.
