several classes for embryological work and for studies of the thick-walled endosperm. Dr. Gilbert further states that the walls of the endosperm have proved to be unusually good material for the study of the plasmodesmus.

V. H. YOUNG
DEPARTMENT OF PLANT PATHOLOGY,
UNIVERSITY OF ARKANSAS

SPECIAL ARTICLES

THE OCCURRENCE OF THE PLATINUM METALS

RECENTLY I have had the opportunity of studying the results of some forty analyses of the Canyon Diablo meteorite, both of the iron and of the so-called shale-balls. The latter appear to be merely the oxidized iron, as some of them still have an unoxidized iron core. The analyses were made by at least eight different analysts, including Dr. J. W. Mallet, H. H. Alexander, A. H. Phillips, G. H. Clevenger and myself, and included the content in platinum, iridium and in some cases palladium.

There have been but two references in literature to the occurrence of platinum in meteorites.[1] Trottarelli reported palladium in the Collescipoli stone, and J. M. Davidson found the Coahuila iron to contain 39 parts per million of platinum and 2.44 parts iridium. In the Toluca meteorite sufficient platinum was found to give a precipitate of potassium chloroplatinate, which from its color probably contained iridium. No quantitative estimation was made.

The Canyon Diablo analyses, weighted according to my best judgment, average as follows:

Platinum	11.2 parts per million
Iridium	5.8 parts per million
Palladium	2.1 parts per million

The ratio of platinum to iron in the shale-balls corresponds closely to that in the unoxidized meteorite, the ratio of iridium to iron is lower and that of palladium to iron somewhat higher.

The average amount of nickel found in all the analyses, not weighted, is 6.44 per cent. Clarke gives the average nickel for 318 meteorites as 8.52 per cent., and in the Ovifak iron 2.95 per cent.

It may be considered probable that platinum, and doubtless all the platinum metals, would be found in all meteorites if analyses were made with this end in view, though the estimation of three or four tenths of an ounce of platinum and iridium to the ton of meteoric iron is no simple task. It may be noted that in dissolving the iron in either sulfuric or in hydrochloric acid, some of the platinum and iridium will go into solution, and this doubtless accounts for the varying results on the Canyon Diablo iron where such a method has been used.

Attention has been called by many observers to the association of the metals of the eighth group in nature. In 1891 Daubrée and Meunier noted the occurrence of metallic iron containing traces of platinum in the gold washings of Berazovsk in the Ural, and also that many meteorites resembled rocks with which platinum is generally associated in nature.

It may be worth while to attempt a rough approximation of the relative amount of the metals of the eighth group, assuming that the iron of the interior of the earth contains the same proportion of the platinum metals as the Canyon Diablo meteorite. For this we can use the calculation of F. W. Clarke for the earth as a whole:

Iron	67.2 per cent.
Nickel	4.0 per cent.
Cobalt	.277 per cent.

Average cobalt in 318 meteorites: 0.59 per cent.

Clarke gives the analyses of 8 native platinums and 3 iridosmiums, and Kemp gives 42 analyses of native platinum and 12 of iridosmium. From these we derive the following weighted averages:

	Native platinum	Iridosmium
Platinum	89.88	.48
Iridium	4.88	60.37
Osmium	1.92	33.53
Rhodium	2.47	3.59
Palladium	.83	Trace
Ruthenium	.011	2.05

Recent figures[2] give the composition of Russian crude platinum as: platinum, 83 per cent.; iridium, 2 per cent.; palladium, 0.5 per cent.; rhodium, 0.6 per cent.; iron, etc., 13.9 per cent. It is doubtful if these figures can be relied on as general.

An approximation of the amount of iridosmium compared with platinum can be made from the amount produced over a long period of years. The present proportion (1925) of 9 per cent. as much iridosmium as platinum is obviously too large, owing to the stimulation of production by the abnormally high price of iridium, while the earlier production of 1 per cent. to 3 per cent. is as obviously low, from the slight market demand for iridosmium and the metals obtained from it. We may fairly assume 5 per cent. as about the proper proportion of iridosmium to platinum. On this basis, our figures for

[1] Trottarelli: *Gazz. chim. ital.* 20 (1890), 611; Davidson: *Amer. J. Sci.* (4), 7 (1899), 4.

[2] *Afr. Mining Eng. J.* 38 (1927), 123.

the relative amounts of the platinum metals in nature, considering platinum as 100,000, become:

Platinum	100,000
Iridium	8,793
Osmium	4,046
Rhodium	3,947
Palladium	924
Ruthenium	236

Using the estimate of these metals in the Canyon Diablo meteorite, and combining it with Clarke's estimate of the relative amounts of iron, nickel and cobalt, we arrive at the following figures for the amount of the metals of the eighth group in the earth, considering iron as 1,000,000,000.

Calculating from *platinum* in the Canyon Diablo meteorite:

Iron	1,000,000,000
Nickel	59,524,000
Cobalt	4,122,000
Platinum	12,043
Iridium	1,055.1
Osmium	488.5
Rhodium	343.6
Palladium	106.8
Ruthenium	28.3

If the calculations are based on the *iridium* reported in the Canyon Diablo meteorite, the figures become:

Iron	1,000,000,000
Nickel	59,524,000
Cobalt	4,122,000
Platinum	70,926
Iridium	6,236.6
Osmium	2,868.0
Rhodium	2,094.7
Palladium	656.8
Ruthenium	167.9

but owing to the difficulty of determining iridium accurately, it is doubtful if these figures can be considered reliable.

If calculation were made from South African iridosmium, the osmium figures would be larger, as this iridosmium apparently runs much above the average in osmium; on the other hand, osmium analyses are apt to be low, owing to volatilization. The palladium is lower than would be anticipated; in the Sudbury ores the palladium runs much higher in proportion to the platinum. The ruthenium is unexpectedly low, but is probably approximately correct.

JAS. LEWIS HOWE
WASHINGTON AND LEE UNIVERSITY,
LEXINGTON, VIRGINIA

THE ENCYSTMENT OF PARAMOECIUM IN THE RECTA OF FROGS

So far as I know *Paramoecium* has not been definitely shown to encyst in nature nor in laboratory cultures. In fact, most of the investigators who have worked with this organism state that they have never seen it encyst and are of the opinion that it does not possess the ability to do so. Hence the following observations, though incomplete, seem worthy of record.

Two to three c.c. of rich, milky-white cultures of *Paramoecium* (species not determined) were injected (by attaching a short catheter to a syringe) into the recta of frogs, with the result that encystment occurred in about two per cent. of the frogs injected. In all, encystment has been observed in three frogs. When it was first observed, two hours had elapsed since the paramoecia were introduced into the rectum. When a portion of the rectal contents was examined a fair number of individuals were observed in what later seemed to be the beginning of encystment, although at first they were very nearly overlooked for *Opalina.* More careful observations, however, disclosed a very thin membrane-like substance surrounding them. By continued observations it was finally possible to observe six individuals regain their normal *Paramoecium* shape, appearance and activity by freeing themselves of the peculiar substance enclosing them. It was really not possible until the organisms had freed themselves of the membranes to determine whether I was observing *Paramoecium,* some undescribed parasitic ciliate of frogs, or *Opalina* in an abnormal condition, because they presented a very unusual appearance due to the fact that they were folded and rounded so as to occupy about half their normal space. Others, however, were not able to free themselves and, after an hour or two, became more and more rounded and definitely enclosed within what, by this time, could be called a definite membrane—perhaps a cyst membrane.

In another frog which was examined five and a half hours after injection per rectum only encysted paramoecia were present. These were placed in three depression slides, four organisms on one slide and several on each of the others, and kept in a moist chamber and observed several times daily. No change was noticed for the first three days, but on the fourth day some of the cysts were undergoing fission, and on the fifth day two organisms were seen within a single cyst. A fairly heavy cyst wall was clearly visible. On the fifth day some paramoecia excysted.