ferences, or supposed differences, between the nature of the pebbles (which are placer deposits) and that of similar *in situ* material within the mass of the nearby Josephine Peridotite. The Josephine Peridotite, partly unaltered harzburgite and partly serpentinite, is apparently a segment of ophiolite emplaced by obduction. All parties agree that it contains awaruite in parts and that awaruite is formed by the serpentinisation of ultramafic rocks. They likewise agree that the Josephine Peridotite is the source of the pebbles.

But the consensus then breaks down. Dick and Gillete claim that both the *in situ* material and the pebbles are awaruite and (bearing in mind the nearness of the pebbles to a zone of intense shearing, serpentinisation and igneous intrusion within the Josephine Peridotite) that both are the products of low-temperature hydrothermal metamorphism and serpentinisation of the peridotite. Such differences as there are between the two (for example, it is acknowledged that the pebbles have unusually large grain size) represent varying conditions imposed by igneous intrusion during serpentinisation.

Bird and Weathers, on the other hand, claim that the differences between the pebbles and *in situ* material are serious enough to imply a different origin (and to require separate names) for the two. Having acknowledged that the source of the pebbles is the Josepine Peridotite, having agreed that the *in situ* awaruite is the result of serpentinisation and having proposed a core origin for the pebbles, this would appear to put Bird and Weathers in the position of saying that the Josephine Peridotite once contained (and perhaps still contains) two distinct but closely related nickel–iron alloys whose zones of origin were separated by more than 2,000 km vertical distance.

Obviously it is possible. For example, a mantle plume could have been feeding the accreting plate margin from which the Josephine Peridotite is derived. But is it credible? If so, the exciting possibility of core material at the Earth's surface remains. If not, the balance of the argument must be in favour of Dick and Gillete who in any case have Occam's Razor on their side.

Millikelvin technology

from P. V. E. McClintock

A Europhysics Study Conference on Dilution Refrigeration and its Applications was held at Lancaster University, UK, on September 25–27 1976. The meeting was organised by D. Thoulouze (Grenoble) and G. R. Pickett (Lancaster).

It is now more than a decade since the first dilution refrigerators were built. During this period the machines have become the standard means of reaching temperatures between 10 and 300 mK in a continuously operating mode and, moreover, the technique has spread far beyond the area of purely low temperature physics and is being widely used in a number of other fields.

Dilution refrigerators operate on a mixture of liquid ^{3}He and ^{4}He making use of the property that, at low temperatures, the liquid separates into two phases, usually known as the concentrated phase and the dilute phase. The concentrated phase consisting of almost pure ^{3}He floats on top of the dilute phase, which is composed of a gas-like assembly of ^{3}He atoms moving freely in a "background" of superfluid ^{4}He. Thus the movement of ^{3}He atoms from the concentrated to the dilute phase is very much like the evaporation of an ordinary liquid, and is accompanied by a similar cooling effect.

The conference started with an introductory session led by H. E. Hall on what has become accepted as the conventional cycle: the "General Motors, rear-wheel-drive refrigerator", as he called it. In this cycle, ^{3}He is drawn out of the dilute phase by a heated still and the cooling effect arises from a balancing flow from the concentrated phase. The process is sufficiently well understood that machines capable of reaching 10–12 mK are available on the commercial market. The two sessions which followed led by G. Frossati (Grenoble) and A. Th. A. M. de Waele (Eindhoven), discussing the optimisation of this technique, provided what in many ways formed the high spot of the conference. It was particularly impressive to hear that the machines developed in Grenoble are able to reach 4 mK (not very far above the liquid ^{3}He superfluid transition) as a matter of routine and, furthermore, that their performance is in reasonable agreement with calculation.

On the second day some of the recent practical applications of dilution refrigerations were described in sessions led by R. E. Packard (University of California, Berkeley) and T. O. Niinikoski (CERN), and included details of a number of sophisticated applications in nuclear physics. Following on from this, M. Loponen (Otaniemi) introduced a lively debate on the problems and pitfalls of secondary thermometry.

One of the most fascinating, and perhaps also the most important, topics of the conference was reserved for the final day when K. W. Taconis (University of Leiden) and F. A. Staas (Philips, Eindhoven) talked about the new cycle in which instead of extracting ^{3}He from the dilute phase in the mixing chamber using a still, ^{4}He is pumped in through a superleak. This technique offers the great advantage that the dilute and concentrated phases counterflow in the same tube, rather than in separated tubes, so that no heat exchangers are needed. The simple Leiden machine, which reached 8 mK very soon after having been commissioned, was discussed in detail. Hybrid machines in which a "Leiden" mixing chamber is piggy-backed on a conventional refrigerator, and both ^{3}He and ^{4}He are separately circulated, as developed at Philips and Grenoble, were also considered. The meeting ended with an all-too-short session presided over by E. J. Varoquaux (Orsay) on the actual practical problems associated with operating refrigerators.

Notwithstanding the astonishing progress of the past 10 years, the dilution refrigerator is clearly still capable of significant improvement. If, as one suspects, commercial machines capable of reaching 5-6 mK soon appear on the market, it will be very largely a result of the beautiful research and development work currently in progress on this side of the Atlantic. □

A hundred years ago

Russian newspapers announce the death of M. Chekanoffsky, who, exiled in Siberia, has spent more than ten years in the geological exploration of the country, and recently returned from his travels on the Olenek and the shores of the Polar Sea, to St. Petersburg, where he was engaged at the Academy in the description of his immense collections. He was found on October 10 dead in his room, and it is supposed that he poisoned himself.

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