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50 & 100 YEARS AGO

50 YEARS AGO

The appearance of Radiocarbon Supplement Vol. 1 of the *American Journal of Science* marks an important step forward in the publication of radiocarbon dates. In the past, date lists have appeared at irregular intervals in a number of journals, making it difficult for potential users of the dates to keep themselves fully informed of all the work in this field ... The editors ... are to be commended on this project, which provides a single, relatively inexpensive, annual publication specifically for radiocarbon dates and associated measurements. This first volume contains 13 date lists and one paper ... devoted entirely to measurements on samples of known age. This aspect of radiocarbon dating research ... yields information on the past and present distribution of radiocarbon in the carbon exchange reservoir, and this is of particular importance when one is concerned with the attainment of the highest possible accuracy in radiocarbon dates.

From *Nature* 28 November 1959.

100 YEARS AGO

A flying-fish flew on to the lower deck last night about 8.30p.m. The deck is 20 feet above the water-line, and the railing is 4 feet 6 inches above the deck, but it is possible for it to have flown through the railing; the fish measured 17¼ inches from tip of nose to tip of tail. I forgot to weigh it before it was cooked. It was the largest flying fish I have ever handled. Could any reader of NATURE kindly inform me what is the largest size known? We were about fifty miles north of Teneriffe when it came on board. The species up here appear to be larger than those in the tropics and near South America. I have seen large ones in the Gulf of Aden, but never caught one, though I am inclined to think this was a larger species. The longest flyers always appear to be the largest fish: the longest flight I have seen has been about 400 yards.

From *Nature* 25 November 1909.

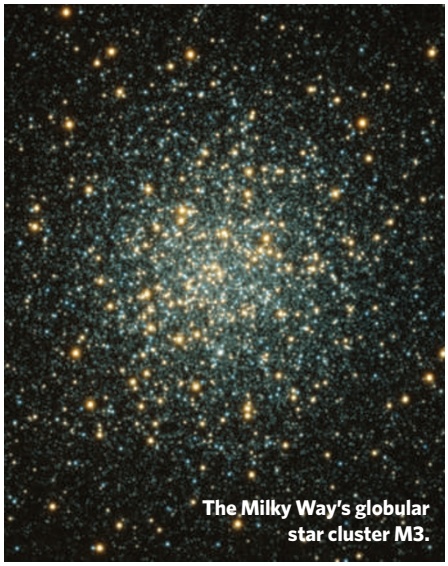
into two subpopulations of different calcium abundances. Two very recently completed spectroscopic studies[6,7] detect star-to-star variations in iron abundance in M22 for smaller samples of red giants. It seems that M22 will join M54 as the only remnant of the disruption of an entire dwarf galaxy in the halo of the Milky Way.

Lee and colleagues[3] go further, claiming that they can detect multiple stellar populations with smaller but still statistically significant variations in calcium abundance in more than half of the systems in their sample of 37 GCs. This is the most interesting and controversial part of their paper because, if they are correct, many GCs — not just a few outliers — must be pathetic remnants of much more massive systems that were accreted by the Milky Way halo during its formation. Although the authors' case for the system NGC 1851 seems reasonably secure, their claims for other GCs seem to be only marginally significant, and will require further confirmation. A previous investigation[8] has already ruled out variations exceeding 12% in Fe metallicity for the majority of the eight GCs that have been studied in detail by Lee *et al.*, demonstrating yet again that there is a high degree of uniformity in the abundance of Fe in most GCs throughout the stellar population.

Analysis of the current generation of high-quality images of GCs, whether taken by the Hubble Space Telescope or with ground-based telescopes equipped with adaptive-optics systems, has allowed exquisite data to be gathered for thousands of stars, and has enabled the discovery in GCs of subtle phenomena that previous studies missed. The GC NGC 1851 was found to have two branches of subgiant stars where there should just have been one[9]. And Piotto and colleagues[10] found that main-sequence stars — those in which energy is created through the fusion of hydrogen in the star's core — in the GC NGC 2808 are divided into three separate branches.

To this collection of abnormalities we can now add the discovery of two subgroups of horizontal branch stars (those that are powered by the fusion of helium in the core) in the GC Terzan 5 that is presented by Ferraro and colleagues[4]. This particular anomaly has never previously been seen in a Galactic GC. The authors[4] have also obtained spectra of a few horizontal branch stars in Terzan 5 that demonstrate that Fe metallicity varies by about a factor of three within this GC. So Terzan 5 must be yet another tattered remnant of a once much more massive system.

Potential causes for the bizarre behaviour of these GCs include helium-content variations (which must exist as a result of the same hydrogen-burning process that gives rise to variation among the observed light elements, but helium is extremely difficult to detect), age differences, and variations among the heavy elements. Another possibility, which was previously suggested[11] to explain the peculiar



The Milky Way's globular star cluster M3.

S. KAFKA & K. HONEYCUTT, INDIANA UNIV./WIYN/NOAO/NSF

case of NGC 1851, is extremely large variations among the light elements (particularly carbon, nitrogen and oxygen, the most abundant of these). All of these possibilities can also occur in combination, adding to the confusion. We know that age variations within GC systems are small, but of the order of 10%[12]. D'Antona and Ventura[13] suspect that, in some cases, very high helium abundances (up to 40%) are required to reproduce some of the observed irregularities. This is almost twice the primordial abundance of helium produced in the Big Bang, the relic of which is found in present-day, metal-poor stars, and there is no direct observational evidence to support such a high helium abundance in any GC.

As we look closer and with more precision, the model of the GCs in the Milky Way as simple, single stellar population systems is being severely challenged. Are the anomalies, which seem to be turning up with increasing frequency, confined only to the most massive of the Galaxy's GCs? Exactly how common and how big such deviations from uniformity are among the Milky Way's GCs, and how they relate to stellar streams in the halo, is a hot topic. ■

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1. Freeman, K. C. & Rodgers, A. W. *Astrophys. J.* **201,** L71–L74 (1975).
2. Norris, J. & Bessell, M. S. *Astrophys. J.* **201,** L75–L79 (1975).
3. Lee, J.-W., Kang, Y.-W., Lee, J. & Lee, Y.-W. *Nature* **462,** 480–482 (2009).
4. Ferraro, F. R. *et al. Nature* **462,** 483–486 (2009).
5. Denisenkov, P. A. & Denisenkova, S. N. *Astron. Tsirk.* **1538,** 11 (1989).
6. Da Costa, G. S. *et al. Astrophys. J.* **705,** 1481–1491 (2009).
7. Marino, A. F. *et al. Astron. Astrophys.* (in the press).
8. Carretta, E., Bragaglia, A., Gratton, R., D'Orazi, V. & Lucatello, S. *Astron. Astrophys.* (in the press).
9. Milone, A. P. *et al. Astrophys. J.* **673,** 241–250 (2008).
10. Piotto, G. *et al. Astrophys. J.* **661,** L53–L56 (2007).
11. Ventura, P. *et al. Mon. Not. R. Astron. Soc.* (in the press).
12. Marín-Franch, A. *et al. Astrophys. J.* **694,** 1498–1516 (2009).
13. D'Antona, F. & Ventura, P. *Mon. Not. R. Astron. Soc.* **379,** 1431–1441 (2007).