thus differ by 5 to 6 nm in the wavelength of maximum absorbance. Earlier, in 1986, Neitz and Jacobs suggested that men fall into two clear groups on the basis of their subjective colour matches[14]. The finding has been controversial[15], and at the recent meeting of the Association for Research in Vision and Ophthalmology, J. Neitz implicitly withdrew the claim[16]. What he and his colleagues now suggest is that a subset of men carry copies of two forms of the long-wave gene, expressing them in different cones. Such 'pseudo-heterozygotes' may reveal themselves by changes in their colour matches after selective colour adaptation. It was in these pages 110 years ago that Lord Rayleigh suggested that different observers may live in slightly different perceptual worlds[17], and some of this variance can now be traced to variations in heptahelical receptors. Perhaps polymorphisms of other heptahelicals account for some of the variation that is observed in people's mental worlds. □

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1. Hall, Z. *Trends Neurosci.* **10**, 99-101 (1987).
2. Lefkowitz, R. J. *Nature* **351**, 353-354 (1991).
3. Dryja, T. D. *et al. Nature* **343**, 364-366 (1990).
4. Bhattacharya, S. *et al. Lancet* **337**, 185 (1991).
5. Mollon, J. D. & Jordan, G. *Die Farbe* **35/36**, 139-170 (1989).
6. Neitz, M., Neitz, J. & Jacobs, G. H. *Science* **252**, 971-974 (1991).
7. Nathans, J., Thomas, D. & Hogness, D. S. *Science* **232**, 193-202 (1986).
8. Jacobs, G. H. *Vision Res.* **23**, 239-248 (1983).
9. Jacobs, G. H., Bowmaker, J. K. & Mollon, J. D. *Nature* **292**, 541-543 (1981).
10. Mollon, J. D., Bowmaker, J. K. & Jacobs, G. H. *Proc. R. Soc. Lond.* B**222**, 373-399 (1984).
11. Sakmar, T. P., Franke, R. R. & Khorana, H. G. *Proc. natn. Acad. Sci. U.S.A.* **86**, 8309-8313 (1989).
12. Nathans, J. *Biochemistry* **29**, 937-942 (1990).
13. Dartnall, H. J. A., Bowmaker, J. K. & Mollon, J. D. *Proc. R. Soc. London.* B**220**, 115-130 (1983).
14. Neitz, J. & Jacobs, G. H. *Nature* **323**, 623-625 (1986).
15. Jordan, G. & Mollon, J. D. *Investig. Ophthalmol. vis. Sci.* **29**, suppl., 164 (1988).
16. Neitz, J., Neitz, M. & Jacobs, G. H. *Investig. Ophthalmol. vis. Sci.* **32**, 1092 (1991).
17. Rayleigh, Lord *Nature* **25**, 64-66 (1881).

COSMOLOGY

A beast in the menagerie

Simon Lilly

If bright astronomical objects are telling us that something special is going on elsewhere in the Universe, then the exceptionally luminous object that Rowan-Robinson *et al.* describe on page 719 of this issue[1] is well worth noting. Designated 10214+4724, the object has a redshift of 2.286, indicating that it is among the more distant known objects and that we are seeing it as it was when the Universe was between a sixth and a third of its present age. It was found through the systematic identification of over a thousand sources catalogued in the Faint Source Survey of the Infrared Astronomy Satellite (IRAS). Its infrared luminosity, which exceeds a hundredfold its optical luminosity, is equivalent to that of 3×10^{14} Suns and exceeds by a small margin, the authors say, that of any other known object.

The discovery of such an object immediately raises the question of its cosmological significance. Where does this object fit in to the menagerie of high-redshift objects and what if anything does it tell us about the formation of galaxies and galaxy clusters in the early Universe?

There are two unresolved uncertainties concerning the object that need to be addressed before these questions can be answered definitively. First, where does all the infrared radiation come from? From dust surrounding and heated by a powerful primary source seems the most likely answer, although the infrared could be synchrotron emission from a highly self-absorbed, compact source of relativistic electrons. Second, if dust is responsible, what is the primary source? It could be a quasar-like galactic nucleus, in which case it must be as luminous as any known. Or the dust could be shrouding an outburst of star formation of enormous proportions, in which case the equivalent of 10^5 new Suns are forming every year, enough to make a very large galaxy in only 10^7 years.

Whatever generates the primary radiation, if dust is the source of the secondary, infrared radiation, as seems likely, then 10214+4724 contains an impressive amount of it. The mass can be estimated from the thermal spectrum if assumptions are made about the grain size and the spatial distribution of the dust, which affects its temperature distribution. (Unfortunately, IRAS could not see the coolest dust.) Making various plausible assumptions, Rowan-Robinson *et al.* estimate there are 4×10^8 – 10^{10} solar masses of dust, although this range could no doubt be extended both ways. Our Galaxy, by comparison, contains only 2×10^8 solar masses of dust; its total metal content, comprising elements synthesized in stellar burning, is roughly 4×10^9 solar masses; this resides mostly in formed stars. So, according to Rowan-Robinson *et al.*, a significant fraction of the metals that we see in a typical galaxy now had already been produced by the time of 10214+4724, perhaps 2.3 billion years after the Big Bang.

There are other indications that gas in the Universe was significantly enriched with metals at these high redshifts. For instance, the emission-line spectra of quasars at redshift $z > 4$ indicate normal relative abundances[2] (although the abundance relative to hydrogen is poorly determined). Distant galaxies associated with powerful radio sources seem already to contain the bulk of the (enriched) stellar population of a distant giant elliptical galaxy[3]. And the cos-

RÉSUMÉ

Rat hole

Ship rats (*Rattus rattus*) were curiously absent from the city of York in the Dark Ages (fifth–eighth centuries AD), even though they were common in Roman times and again during the ninth-century Viking period. "Absence of evidence is never conclusive evidence of absence" says T. P. O'Connor (*J. Zool.* **224,** 318–320; 1991), "though in this case it is quite compelling". Analysis of an eighth-century deposit revealed abundant bones of mice (*Mus spp.*) but no rat material whatsoever, an observation that carries statistical weight because of the conspicuous presence of rats at other times. It seems that rats introduced by the Romans subsequently disappeared, though no Pied Piper has yet been identified.

Inhibited hopes

Tergeminin, echistatin, eristicophin, barbourin — these resonant names attach to a series of snake venom proteins, all of them antagonists of the integrin family of cell-surface receptors and known accordingly as disintegrins. Their activity centres on three residues, which are also the sequence that the integrins recognize in adhesion proteins. The venoms inhibit platelet aggregation, by binding to a glycoprotein complex, but the therapeutic potential of a disintegrin of broad specificity is limited because of the mayhem it would cause elsewhere. Now, R. M. Scarborough *et al.* (*J. biol. Chem.* **266,** 9359–9362; 1991) have brought to light barbourin (courtesy of the southeastern pigmy rattlesnake). In barbourin the inhibitory sequence Arg-Gly-Asp has become Lys-Gly-Asp, and this is highly specific for the platelet receptor — which should commend it to clotters everywhere.

Standard deviation

Are the first cracks showing in the standard model of particle physics? Workers on the ALEPH experiment at CERN's Large Electron-Positron collider reported data to a CERN seminar last week that could suggest so. Out of 200,000 Z^0 particles detected at ALEPH, 35 decayed by an unusual route to produce a pair of leptons (an electron, muon or tau and its respective antiparticle) and a short-lived photon. Of these few decays (actually an unexpectedly large total), more resulted in tau particles (15) than electrons or muons (10 each), where the reverse pattern was expected. With such a small sample, statistical fluctuations could be laying a false trail, but ALEPH workers say there is only a 1 in 100 chance this is so. With further data being analysed, confirmation or refutation may soon be at hand.