is colossally laborious; having done this, the hapless researcher then has to analyse every base pair in every gene to find out if it is altered in people with the disorder. If a gene can be identified that is always changed in affected (or carrier) individuals, but never in unaffected individuals, this is formal proof that the gene contributes to the disorder. Finding the culprit gene in any area is enormously difficult and heartbreaking — all except one will usually turn out to be merely a disease-associated 'candidate', not a causative, gene.

Hence the significance of the new map[1,2]: we now know the location of about half of our genes, making the task of gene-finding much easier. Instead of laborious, 'wet' research work, we can use a computer to do part of the job and carry out electronic gene-hunting in the gene-location database[2]. Of course, half our genes is better than none, but what about the other half? Fortunately, the authors have made it possible for you to do your own analysis of the radiation hybrid DNAs and to use two web-based analysis programs[5,6] to locate your own favoured gene — an enormously powerful tool that is a new feature of this map compared with some previous ones.

Virtually all of the common single-gene disorders have yielded their causative gene, however, and the rare ones are just that — rare. Why spend the money on this latest exercise in genetic cartography? One reason is because the really common genetic disorders, such as diabetes in its various forms, some cancers, asthma, migraine and coronary heart diseases, do not result from changes in a single gene but from changes in several genes. This makes the task of locating the genes much harder and, for technical reasons, the location much less precise. This in turn implies that researchers have to search a larger region and therefore sequence even more genes. Making this process more efficient will be a great help in understanding these common conditions.

A second reason is that the results of gene-mapping act as signposts in human DNA. We now have a far better framework for positioning the huge mass of base pairs that are coming out of the dozen or so genome-sequencing centres, and that are inexorably, and excitingly, accumulating towards the total of 3,000 million. Genes and computers are going to be an integral influence on our lives as scientists, patients, parents and citizens for many generations to come. □

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Galaxies

New members of the Local Group

Sidney van den Bergh

Three nearby galaxies have been discovered, by Armandroff *et al.*[1] and by Karachentsev and Karachentseva[2]. All three are faint dwarf galaxies that lie within the Local Group[3], the small cluster of galaxies dominated by three spiral systems — Andromeda (M31), Triangulum (M33) and our Milky Way. The discovery confirms that these dim dwarf galaxies are common in the Universe, but also raises questions about how many galaxies exist that are even less luminous.

The newly discovered galaxies are 'dwarf spheroidals', much smaller than the more familiar spiral galaxies and large ellipticals. They also differ from other dwarf galaxies — dwarf irregulars — in that they are no longer forming stars. One of the two main sub-clusters of the Local Group, centred on the Milky Way system, is known to contain eight dwarf

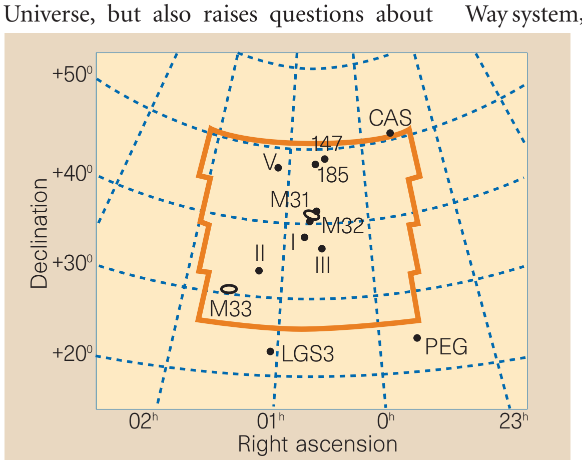

Figure 1 **Companions of Andromeda (M31). The recently discovered dwarf spheroidal galaxies And V, Cassiopeia and Pegasus are even fainter than And I, And II and And III, which I discovered in 1971 in a survey of the outlined area[4].**

100 YEARS AGO

The following interesting announcement appears on a page in the catalogue of Messrs. Johnson, Matthey, and Co., Hatton Garden, London – "In furtherance of scientific research, Professors and recognised scientific investigators will with pleasure be supplied with metals of the platinum group, in moderate quantities, and for periods to be arranged, free of charge, on condition that the precious metals are ultimately returned (in any form), and that the results of the investigations are furnished."

The coasts of Japan are particularly liable to incursions from spring tides, of which one occurring on June 15, 1896, in the course of eighteen minutes swept away 9381 houses and 6930 boats, killing 21,909 people and wounding 4398. To minimise the damage done to life and property by such inroads, protective forests have been planted at various places along the littoral. … The action of these forests is three-fold: they check the force of the tidal wave; they delay its advance, giving more time for saving the lives of inhabitants living behind the forest; and, lastly, they prevent houses and property from being washed away into the sea.
From *Nature* 27 October 1898.

50 YEARS AGO

The second season's work of the British–Kenya Miocene Expedition in the Kavirondo region of Lake Victoria has culminated in one of the most important discoveries yet made there. Dr. L. S. B. Leakey, the field director of the Expedition, has announced the finding on Rusinga Island on October 2 of the greater part of a skull of one of the species of Miocene apes belonging to the genus *Proconsul*, probably *Pr. africanus* (Hopwood). … [T]his new discovery for the first time provides information regarding the whole of the facial skeleton and much of the brain case. … Mrs. Leakey was actually the first to see some small fragments of the skull, where they had been washed out on the slope of one of the gullies which were being explored. She directed the attention of her husband who, cutting back into the beds, brought to light this most important, and indeed unique, fossil.
From *Nature* 30 October 1948.

spheroidal galaxies. So it was surprising that only three such objects were known in the second subgroup, around Andromeda — especially as Andromeda is more luminous than the Milky Way.

Looking in the Andromeda region, two groups of astronomers[1,2] used a digitized version of the Palomar Sky Survey to search for dwarfs that were too faint to be seen on the original photographic plates. Two of the newly discovered dwarf spheroidals are also outside the region originally surveyed[4]: the Cassiopeia and Pegasus systems both lie more than 200 kiloparsecs from M31 (Fig. 1). This means that they may not be satellites of Andromeda, but instead free-floating members of the Andromeda subgroup.

So the new discoveries reduce the apparent difference between the two local subgroups, and the discrepancy may be further reduced after some faint suspected dwarf galaxies in the direction of the Andromeda subgroup are studied in more detail later this year. Furthermore, measurements of the velocities of faint members of the Local Group should give us constraints on the dynamics and total masses of the two subgroups.

This is of more than local relevance. Inspection of the Palomar Sky Survey shows that a large fraction of all galaxies occur in small clusters that resemble the Local Group, so we can use our neighbourhood as a sample of the Universe as a whole. Of the 35 presently known[5] Local Group members, 16 are dwarf spheroidals and two are transitional objects somewhere in between spheroidal and irregular. This implies that half of all of the galaxies in the Universe may be dim dwarf spheroidals.

Could the fraction of dwarf spheroidals be much larger? Not according to a survey by Irwin[6], which appears to show that few additional faint dwarf galaxies remain to be discovered in the Milky Way subgroup of the Local Group — there appears to be a cut-off at a certain luminosity. This conclusion might be tested by the study of new dwarf galaxy suspects in the Andromeda subgroup.

If this cut-off is real, it may correspond to a lower limit to galaxy mass. The velocity dispersions of individual stars in dwarf spheroidals[7] have so far revealed no objects in which the total mass is less than ten million times that of our Sun. Is this a real lower limit to the mass of the dark matter in galaxies? Or it is due to the fact that all gas can escape rapidly from such low-mass galaxies before it forms many observable stars? Only future observations of even fainter dwarf galaxies will be able to answer these questions. □

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Neurobiology

In the mind's eye of the beholder

Robert Shapley

Where is colour — in the world around us or in our minds? Although we view colour as something objective in the world, students of visual perception have known for a long time that to perceive colour we need to make elaborate neural computations. The brain constructs a colour signal to recover, as well as it can, the true reflective properties of a given surface, independent of illumination or the surrounding colours. On page 896 of this issue, Cottaris and De Valois[1] report that they have used modern neurophysiological techniques to study how neural circuits in the primary visual cortex (V1) contribute to the mental process of constructing colour in the brain.

The primary visual cortex does much more sophisticated image processing than we ever imagined. V1 is the first stage in the cerebral cortex to analyse visual signals from the retina. These signals are relayed to V1 by the lateral geniculate nucleus (LGN) of the thalamus. In humans, V1 is located just under the occipital bone in the back of the head, and it provides the adjacent visual cortical areas with all that they need to know about the visual world. It used to be thought that V1 acts simply, like a cortical retina, mapping the visual scene point for point and doing relatively benign operations (such as spatial filtering) on the representation of visual signals. But more recent research has shown that visual cortical cells may be understood better as dynamical systems rather than static receptive fields. Indeed, cortico-cortical interactions are thought to be important in the response of the primary cortex to visual scenes[2–4]. ▶

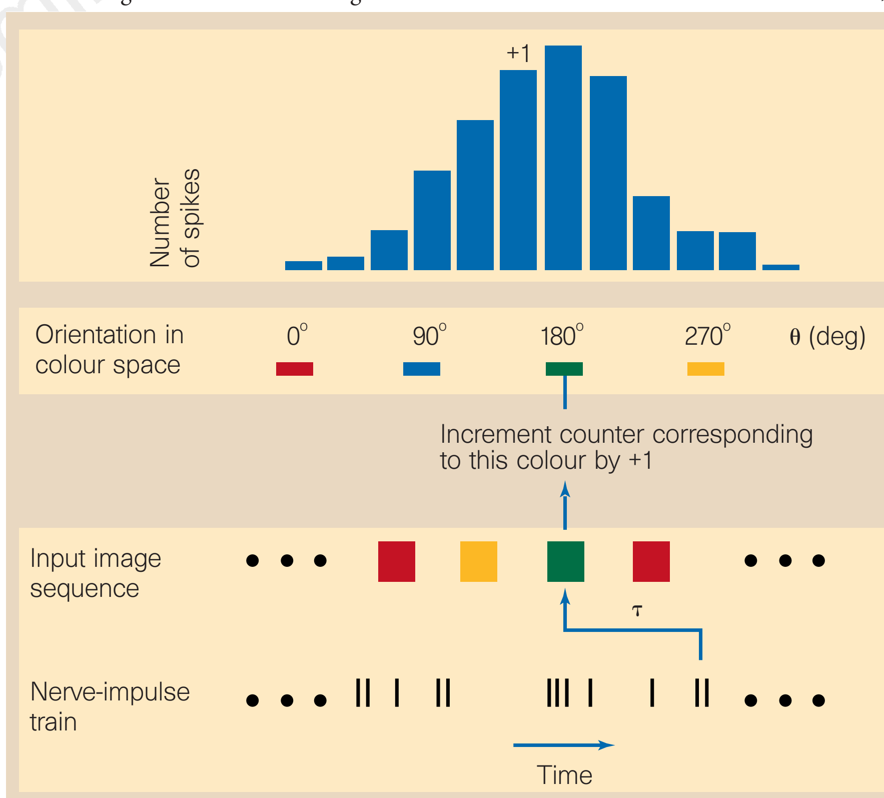

Figure 1 **The 'reverse-correlation' approach to studying colour processing in cortical neurons used by Cottaris and De Valois[1]. A sequence of coloured images is shown to a monkey and the action potentials from neurons are recorded. At delay time τ the coloured image preceding each spike is found and the counters in the histograms are increased once for each spike preceded by that colour. The resulting histogram is the distribution across colour space of the response for τ. This correlation is done for all values of delay to construct a response surface in the dimensions of colour–space angle and time delay.**