HUBBLE TELESCOPE

Forming galaxies spotted?

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FINDING one primordial galaxy would be a cause for congratulations, but finding a group of them would be grounds for celebration. Alan Dressler and collaborators claim to have done just that, using the unique imaging capabilities of the Hubble Space Telescope (*Astrophys. J.* **404**, L45–L49; 1993). The putative group was found as the astronomers examined a foreground galaxy cluster which was the original target of their study. This underlines the astronomer's watchword — to expect the unexpected.

One of the main questions in cosmology is when the first galaxies formed and how they subsequently evolved to their present diverse forms. To address this question, large ground-based telescopes are used as time machines. The finite velocity of light enables astronomers to probe ancient cosmic history by looking to enormous depths. Previous searches for young or 'primaeval' galaxies have been hampered by a lack of consensus as to the period during which such objects would be seen (that is the epoch of formation) as well as some uncertainty as to what they would look like. Naively one might expect a collapsing protogalactic cloud to be an extended region displaying intense emission lines of hydrogen heated by the young forming stars. Although some promising examples have been identified from radio surveys, their rarity indicates that these are unlikely to be the precursors of the bulk of the more numerous galaxies we see today.

The Hubble Telescope was not expected to play a significant part in this field, but Dressler's team argues that this reasoning prejudges what primaeval galaxies may look like. Suppose that, during the initial formation phase, the active sites of star formation are distributed as points of light within a dim cloud. The Hubble Telescope, even with its current optical difficulties, would be well-placed to spot these points of light and distinguish primaeval galaxies from the more numerous extended images of the foreground population.

The evidence presented for Dressler and co-workers' "cluster of nascent galaxies" is intriguing but more data will certainly be needed before sceptics are convinced of its importance. Within the image of the foreground cluster they originally set out to study, a small grouping of about 30 faint sources is seen whose colours are quite blue. A significant feature of these sources, which distinguishes them from the galaxies in the main cluster, is their small apparent size and bright point-like nuclei. Such detail is difficult to secure with even the best ground-based telescopes.

Tantalizingly, the distance to one of these sources is already known. By chance, during a spectroscopic survey with the Palomar 200-inch telescope, Dressler and James Gunn found one to be a quasar about four times farther away than the foreground cluster. The quasar lies near the centre of the distribution of faint sources and it is tempting to imagine that the group forms a physical association. If correct, the blue sources would be 11 billion light years distant, corresponding to a 'look-back time' about 80 per cent of that to the Big Bang itself. The group would be comparable in diameter to that of the Local Group containing the Milky Way and

Eminent Victorians and science at the grass roots

Rothamsted at the turn of the century: grass samples being sorted.

GILBERT and Sullivan are perhaps the best known of great Victorian duos, but Gilbert and Lawes also have a strong claim on history. On 1 June 1843 John Lawes employed Henry Gilbert, a chemist, to help with various experiments on his estate at Rothamsted, near Harpenden, just north of London. The event marks the advent of scientific rigour in agriculture — the two undertook a vast range of investigations into soil chemistry, plant and animal nutrition and crop production, in a partnership that lasted for well over half a century.

This summer Rothamsted Experimental Station, the modern incarnation of Lawes and Gilbert's research enterprise, puts out the bunting and celebrates 150 years since its founders got together. There is quite a bit to celebrate. Among the medals on Rothamsted's chest are that it was the home for the genesis of R. A. Fisher's revolution in statistical practice; for F. C. Bawden and N. W. Pirie, whose studies of tobacco mosaic virus were one of the strands woven into the field now known as molecular biology; and for the discovery of the pyrethroid insecticides.

In accord with the legacy of Lawes and Gilbert, one of the main characteristics of research at Rothamsted has been the acquisition of long-term, continuous data sets (that will be the theme of the 150th anniversary conference to be held on 12–14 July). The oldest come from the Broadbalk experiment, in which winter wheat has been sown and harvested continuously on the same experimental plots since 1843.

Rothamsted is supported in large part through the Agricultural and Food Research Council, and now also pulls in a healthy slice of contract work. Its continued existence seems assured, but inevitably money is another theme of the anniversary year — the aim is to raise £7 million for Rothamsted International, which will provide fellowships for scientists from developing countries. T. L.