Parkinson's disease into the head of the caudate of the brain[14]. The success has been marginal. One patient showed no improvement (and no additional impairment) and the other has had some minor reduction of symptoms in the arms alone. Olson speculates that the caudate might not have been the right location for the graft to prevent motor symptoms; recent studies on monkeys have suggested that the putamen is the striatal site more closely correlated with motor function[15].

Despite these initial clinical failures, information from animal studies of neural grafting is accumulating rapidly. As work on the pathophysiology of Parkinson's and other neurodegenerative disorders progresses, investigators will test their new animal models with intracerebral grafts. It is likely that within a decade or two, neurologists will have another therapeutic option for severely disabled patients, and a new neurology. □

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Cosmology

Coloured comets

from David W. Hughes

WHAT colour is a comet? There is no easy answer. Visually, they are rarely seen in true colour because the retinal cones, which respond to colour, are usually swamped by the rods when it comes to the nocturnal vision of faint objects. George F. Chambers, a prolific cometary observer at the turn of the century, found that comets 'exhibit a more or less silvery-grey hue'. There were some exceptions. The sensational assertions of our mediaeval ancestors that comets had the colour of blood, or were fiery red, were discounted by Chambers, although tinges such as yellow, yellowish and ruddy were thought possible, particularly for bright comets.

A quantitative approach to cometary colour can be made by measuring their brightness through a set of filters, as used recently by William Hartmann and Dale Cruickshank (*Icarus* 57, 55; 1984). They analysed the V, J, H and K brightnesses of fourteen comets through filters centred on 0.55, 1.25, 1.58 and 2.2 μm. Defining an 'α index' as the position of a Solar System object on the J–H–K colour-colour diagram, Hartmann and Cruikshank find, crudely, that low (J–H), (H–K) brightness values (obtained by subtraction) are equivalent to high αs and vice versa. By looking at a range of asteroids, satellites and laboratory substances, the authors find that the α index increases both as a function of increasing albedo and as the ratio of ice to dirt area of the reflecting surface increases. The α index is also a function of colour, low values coming from dirtier redder surfaces, high values from bluer icier surfaces.

Data from the fourteen comets show clearly that cometary α indices increase as a function of heliocentric distance. Put simply, this means that as comets approach the Sun they become brighter and redden.

Unfortunately, the physical effects responsible for the α change are rather convoluted. First, changing the particle size distribution can change the colour, with the introduction of relatively more small particles causing reddening. Second, compositional changes can also affect the colour. Remote comets (such as Schwassman-Wachmann 1 at 6 AU) can release relatively stable icy-dust grains. When the comets are about 1 AU from the Sun, the ice component of the coma grain sublimates within less than an hour, so only the reddish carbonaceous dust remains to reflect sunlight. Notice that this mechanism could explain why the eruption of jets of fresh material from the nucleus can lead to sporadic colour changes — an injection of icier material turning the coma bluer. The third factor is phase. Asteroids certainly redden as they are observed at larger phase angles and comets could follow suit. Comets observed at similar phase angles do, however, exhibit significant differences in colour; the nature of the reflecting and scattering particles must therefore differ.

Hartmann and Cruikshank conclude that comets get redder as they approach the Sun and that this is not just due to a change of phase. The underlying cause is probably tied up with a decrease in the iciness of the dust being pushed away from the nucleus by momentum transfer from the sublimating gases. The closer a comet is to the Sun the hotter this dust becomes. Unfortunately we might have to wait for another brilliant daylight comet, the last of which was 1910 I, before we can see a blood-red comet with the naked eye. □

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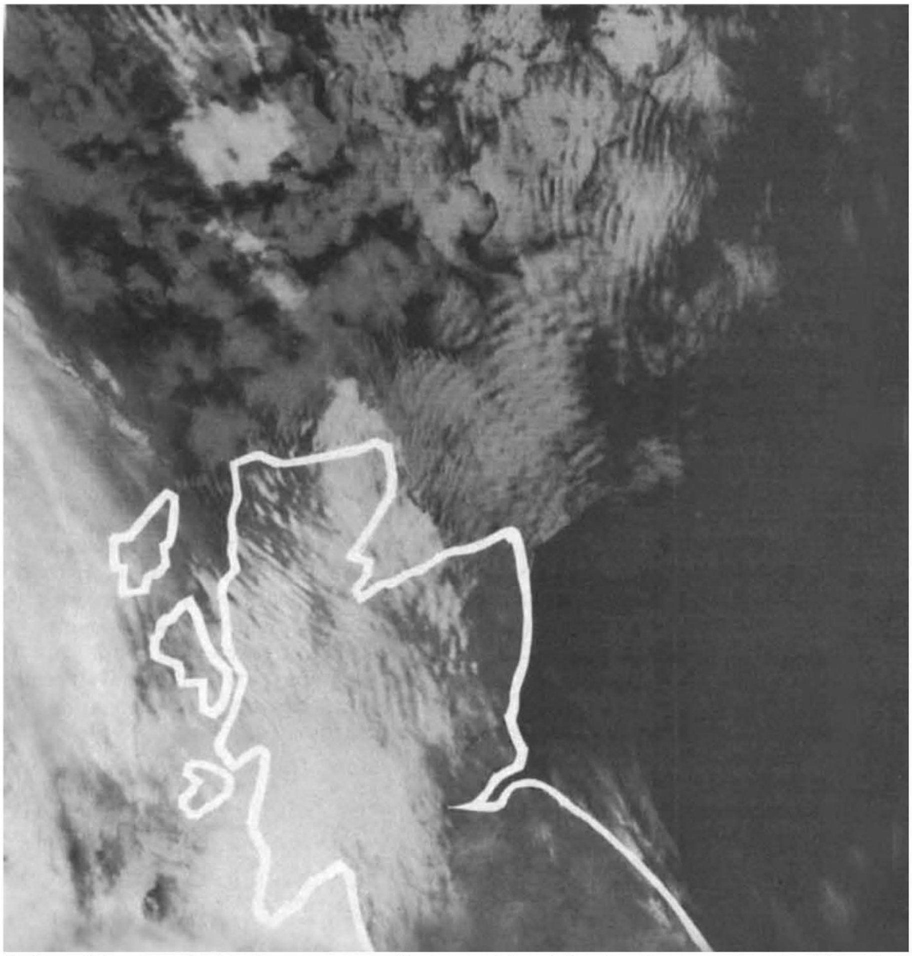

Infrared image of cloud structures off the north of Scotland, taken by the NOAA 5 satellite at 0335 GMT on 23 March 1982. The wave-like features are caused by buoyancy oscillations — 'gravity waves' — occurring in Arctic or polar maritime air masses. From a recent paper in *Meteorological Magazine* (113, 97; 1984) in which K.J. Weston relates oscillations in wind speed and direction measured at the surface, with periods of about 20 minutes, to such high-altitude phenomena. Photograph: University of Dundee.

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