ward slowly, rotating sinistrally; and India collided with and underran Asia.

So much for the relative motions; but Dietz and Holden have also, for the first time, been able to trace continental drift on an absolute geographic coordinate system, by taking the Walvis thermal centre (hot spot) in the mantle as a fixed geographic point since its formation in the late Jurassic. This is, of course, an arbitrary assumption, but it is taken to be reasonable by Dietz and Holden who assume that the Walvis hot spot is produced by magma from a deep mantle source which remains essentially immobile with respect to the crust. For the time before 135 million years ago (that is, before the formation of the hot spot) dead reckoning was used to determine the absolute position of Pangaea in the Permian and Triassic, assuming that, during this period, the drift of West Gondwanaland was in the northward direction only.

The state of knowledge in the Earth sciences is changing so rapidly that few people would dare to insist that Dietz and Holden's reconstruction will remain unmodified for ever. But, if the basic concepts of the new global tectonics are right, continental drift according to Dietz and Holden is sure to be regarded as definitive in its overall conception for many years.

ASTEROIDS

Survey of Faint Minor Planets

by our Cosmology Correspondent

DURING the past decade, the statistics on which theoreticians could base their analyses of the behaviour of asteroids came largely from the survey down to 16 mm carried out from 1950 to 1952 at the McDonald Observatory. Even using these data, several groups and streams of asteroids have been detected, some of which may be associated with the perturbing influence of Jupiter.

Now, a new survey has been carried out with the Schmidt telescope at Mount Palomar. This covers minor planets in the range $16 \leq m \leq 20$ (Van Houten *et al.*, *Astron. Astrophys.*, Suppl. 2, 339; 1970). The survey includes 1,814 new asteroids, and indicates that the major features (such as the Kirkwood Gap) are still well defined for very faint minor planets, although some of the groups and other detailed associations are rather different.

Perhaps the most important result immediately clear from the survey is that above $m \sim 11$ there is no longer a monotonic increase in the number of asteroids found per unit interval in magnitude. Van Houton and his co-workers suggest that this arises because the asteroids are split into two groups, one of them representing the left-over rubble from the formation of the solar system, while the other has been accumulated since then. Planetary astronomers will also be interested to learn that these latest data suggest that the value of $\beta+\gamma$ (β being the longitude of the proper perihelion of an asteroid's orbit and γ the longitude of its proper node) may not provide a reliable indicator that a set of asteroids do or do not belong to a particular family. There still seem to be no asteroids outside the orbit of Jupiter.

More definite conclusions will only be possible when the statisticians have had a chance to digest this new information and relate it to the earlier surveys of bright minor planets.

ATOMIC BEAMS

Laser to separate Isotopes

by our Solid State Physics Correspondent

So many areas of physics and chemistry have been revolutionized by the development of the laser that it is easy to become numbed to the possibility of yet another new application. The suggestion of A. Ashkin (*Phys. Rev. Lett.*, **25**, 1321; 1970) that the force exerted by a laser beam on a stream of atoms can, in the right circumstances, be strong enough to separate out atoms of different isotopes is, on the face of it, however, at once important and suggestive. The lack of charge on an atom makes it impossible to use electromagnetic means of separation and although Ashkin makes no suggestion that the laser may eventually replace the centrifuge or the method of gaseous diffusion as the means of bulk isotope separation, the potential of the system is still quite unexplored. Ashkin has restricted himself to theoretical argument but maintains that the magnitude of the force from the laser beam should, if the conditions are right, be sufficient to fan out a stream of atoms into different paths according both to their isotopic states and to their speeds.

The feasibility of this scheme derives from the existence of what is known as resonance radiation pressure. This occurs when the frequency of light coincides with the separation in frequency between the ground state and an excited state inside an atom. The result is a sudden increase in the force experienced by the atom in the direction of the light beam. When laser light is directed at right angles to a stream of atoms a central force is created which acts only on that species of atom which has the right separation of energy states to experience the resonance pressure of the light. It is then possible, Ashkin argues, to develop either a high resolution velocity analyser for a type of atom which is "tuned in" to the light, or an isotope separator in which the "tuned" atoms are directed out of the beam.

An important limitation, of course, is that the frequency of the laser light must be such as to coincide with an energy gap in the required atoms. This restricts the possible application of the technique according to the types of laser available. Ashkin has calculated, however, that it should be possible to separate off about 30 mg of isotope for an expenditure of about 1 kW of power over an hour if the atoms are travelling at a speed of 200 m s^{-1}. He points out that it is important that the transverse component of the velocity of the atoms should be small to prevent the Doppler effect shifting the atoms out of resonance.

As a velocity analyser, the system has focusing properties analogous to those in other systems based on a central force, with atoms entering at different speeds being focused at the output. Ashkin has calculated the effect on a beam of sodium atoms of sodium D_2 resonance light, and suggests that this technique can be used to supplement existing atomic beam methods for studying hyperfine structure, nuclear magnetic moments and atomic orientation by optical pumping.