regions where no massive stars have formed (less unlikely, but also hard to prove).

In summary, to conclude that the Milky Way is a normal Sbc galaxy and that the Sun is a normal G2V star, while philosophically satisfactory, leads to unexpected difficulties in understanding the scale of the Universe and the evolution of our Galaxy. This discussion may remind some readers of the revolutionary hypothesis advanced by Richard Armour³¹ that *Julius Caesar* was written neither at the end of Shakespeare's first period nor at the beginning of his second period (an ancient topic of controversy) but, rather, between two periods. If so, the blame attaches entirely to the present writer and not to those working on problems of stellar and galactic classification. □

Virginia Trimble is Professor of Physics at the University of California, Irvine, CA 92717, and Visiting Professor of Astronomy, University of Maryland, College Park, MD 20742.

Astronomy

Latin-American gathering

from W.H. McCrea

THE latest in a series of regional meetings on astronomy, the third Reunion Regional Latinoamericana de Astronomia, in Buenos Aires, 28 November–3 December 1983, was yet another illustration of the value of these conferences, held under the general auspices of the International Astronomical Union. The meeting was attended by about 200 astronomers from at least six Latin-American countries as well as several invited speakers from North America and Europe. Although the general objective of the organizers is to hold regional conferences in this series at intervals of two years, the next meeting is to be late this year in Brazil.

The function of the meetings is twofold:

to give the communities of astronomers in the countries of Latin America a sense of belonging to a larger community; and to provide Latin-American astronomers, sometimes hindered by geography and problems of foreign exchange from attending the periodic general assemblies of their union, a sense of belonging to the international community.

In the past decade, Latin-American astronomy has been stimulated by the interest of astronomers from elsewhere who go to Chile to work in the new optical observatories in the Southern Hemisphere, as well as by a number of interesting bilateral collaborations with North American and European astronomers such as that between the Max Planck Institute for Radioastronomy (Bonn) and the Instituto Argentino de Radioastronomia on long-baseline observations.

On this occasion, Jorge Sahade (Argentina), a former vice-president of the union, was chairman of the scientific committee, which included Manuel Peimbert (Mexico), a vice-president of the union, and Victor Blanco (Chile), recently director of Cerro Tololo Inter-American Observatory.

The meeting showed that Latin America as a whole is active in most fields of astronomical research with current interest, both observational and theoretical. Clearly, this community has benefited from some access to the large internationally controlled telescopes in Chile and to some spaceborne facilities, the International Ultraviolet Explorer satellite for example. Many of the papers presented included co-authors from other parts of the world, but it seemed a pity that only a few of the astronomers from outside who make their observations in Chile were actually present in Buenos Aires.

In Argentina itself, astronomy has strong traditions in stellar astrophysics and in the studies of galaxies and galactic systems, centred particularly on the Córdoba and La Plata Observatories, as well as the radioastronomy institute. The observatories of Córdoba, La Plata and San Juan are to share in the use of a new 2.15-m optical reflector, the erection of which is nearing completion at El Leoncito in the approaches to the Andes. The dates of the conference had been chosen as near as practicable to the centenary of the founding of the La Plata Observatory in November 1883; some of the proceedings were designed to honour this occasion. Incidentally, this observatory has always included a strong geophysical section. □

W.H. McCrea can be contacted at 87 Houndean Rise, Lewes, Sussex BN7 1EJ.

Shock waves from a bullet

SOME of the earliest photographs of the shock waves generated by a speeding bullet were taken in the laboratory of Ernst Mach at the German University of Prague in the winter of 1888. In 1884 Mach had tried to record such waves, using the schlieren technique and target pistols, but had failed because the muzzle velocity was subsonic.

At his behest, P. Salcher and S. Riegler at the Royal Imperial Naval Academy, in what is now Rijeka, Yugoslavia, experimented with larger projectiles and higher velocities and obtained successful photographs in 1886. In the same year, working with his son Ludwig on the artillery range at Meppen, Mach found that at any velocity v_p of the projectile greater than the speed of sound v_s in the medium, trailing shock waves formed a constant angle α with respect to the direction of motion regardless of the projectile's size, whence the equation: $\sin \alpha = v_s/v_p$.

When the Machs returned to the Physikalische Institute of the University of Prague,

they gradually improved their apparatus in which a test bullet is illuminated by the brief spark discharge from a Leyden jar. In the photograph shown here, the bullet is a blunt cylinder of brass, 23 mm long and travelling at a speed of 520 m s⁻¹. The vertical white lines are copper wires, 0.5 mm thick, connected to opposite terminals. The bullet shorts the circuit. The original photograph, taken on Schleussner's extra-sensitive dry plates with an exposure of about 2 μ s, measures only 1 cm across.

The hyperboloidal leading wave looks merely hyperbolic in cross-section because the three-dimensional shell is too thin to reflect much light except when seen edge-on. Similarly, the trailing waves, which always point at a more rakish angle than the leading wave, are really cones seen in cross-section.

The Machs' experiments, and those by C.V. Boys the following decade, had repercussions beyond experimental physics. The fact that sharper bullets yield fewer eddies and lower drag, for example, was of considerable significance for artillerymen. Mach was quite aware of the military implications and once commented sardonically, "To shoot in the shortest time possible as many holes as possible in one another's bodies is the most important affair of modern life".

Jon Darius

One of the photographs in an exhibition 'Beyond Vision' at the Science Museum, London from 19 April. A book of the same title will be published in April by Oxford University Press. The photograph is reproduced by courtesy of the Ernst-Mach-Institut, Freiburg, FRG.