take much more time. This is not such a problem, however, for the Polish climbers who, in most cases, are allowed fully paid leave of many months. Apart from the financial factor such expeditions enjoy a complete freedom of movement and are able to escort their equipment, otherwise exposed to some danger of being stolen, lost in the mails or blocked in the customs. They also learn much more about the geography of the countries visited.

It was not so long ago when we were on the verge of pooh-poohing a project employing motor-bikes but, before long, were surprised to discover how well they withstood all the tests. These were used in the course of our expeditions to the Andes in 1972 and to the mountains of Patagonia in 1973/74. The goal of one of these parties was a reconnaissance into some regions unknown to Polish climbers to derive information for possible future expeditions. The bikes employed proved to be very useful as they afforded possibilities for fast, synchronized activity by small groups in different regions. They also enabled us to penetrate along the valleys to a distance of about 10km from the base camps established on the spots accessible to the lorries. During these adventures some of the bikes reached a height of over 5300m. Being much faster and more manageable than the lorries they are also extremely helpful in reconnoitring badly marked tracks and roads in the course of long rides of several days. They are indispensable when looking for bivouac sites, inquiring for or buying food. They are economical and easy to park and so help a lot to get about big towns when dealing with the unavoidable formalities.

In the course of our many expeditions plenty of vehicles of various Polish makes were used. Among those worthy of mention are the splendid, 6 wheel 3 axle driven lorries (Star 56 and Star 266)—capable of forcing water obstacles 1.80m deep. As for the motor-cycles, the light sports models WSK 175 Sport and WSK 125 Sport proved to be unfailing and most reliable on the roadless, mountainous tracts of South America.

Of course, it is necessary to have an expert mechanic on such an expedition, but nowadays it is very easy to find specialists in all the fields of human knowledge among alpinists.

Wandering a bit away from the point we would like to stress that an immense development in mountaineering during the past 20–30 years took place thanks only to the adoption of the modern techniques, materials and equipment and to an increasing trust in their efficiency. Planes and helicopters have been tried already. Now we should be prepared for further progress by employing newer and newer means of transport like specially designed tractors or hovercraft.

Science Notes 1976

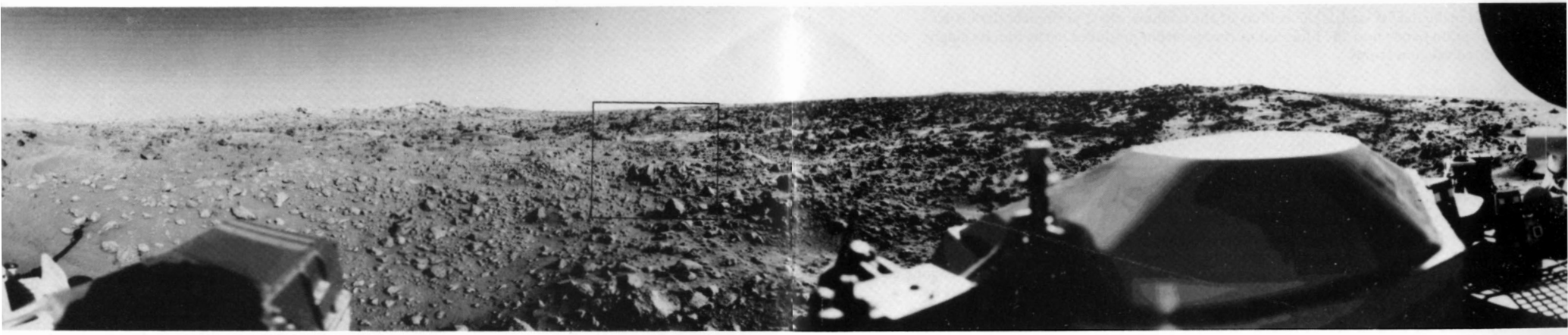
Peter Stubbs

Undoubtedly the scientific event of 1976 was the doubly successful voyage of the 2 Viking spacecraft to Mars, and the landing of the 2 soft-landers in separate regions of Mars. Man's first close-up look at our neighbouring planet revealed boulder-strewn surfaces interspersed with sand dunes and gravel patches resembling a typical desert of the kind found in the western USA. The surface was truly red, and the boulders angular and often pock-marked, implying a volcanic origin; rocky outcrops appeared to be formed of lava. The soil of the undulating landscape was much shallower than that of the Moon. There was little sign of the smaller craters typical of the lunar surface, though the rims of larger ones could be made out in the distance

In the Martian summer at Chryse, the landing site of Viking 1, and Utopia, the site of Viking 2's landing, winds reached a mere 5 to 25 mile/hour—small beer compared to the 200 to 350 mile/hour winds which apparently run riot in the unfavourable season, and probably shape much of the Martian topography. Surface temperatures measured by the Vikings ranged from -86°C to -30°C and the atmospheric pressure close to the surface was a mere 7.7mbar. In the high atmosphere, temperatures recorded between 250km and 135km were substantially lower than on Earth at comparable heights.

The Vikings proved that Mars contains some 2.7 per cent of nitrogen and less than 2 per cent of argon in its atmosphere—both factors important in deciding how the planet evolved (95 per cent of the atmosphere is carbon dioxide). The presence of nitrogen raised hopes initially that life forms might be found on Mars and, indeed, the first experiments of the life-seeking equipment looked decidedly hopeful. However, the biochemists were misled by exotic chemical processes of unknown origin in their surface soil samples and the final conclusion about life on Mars turned out to be a negative one: there was no photosynthesis on Mars.

Other new results won from the Viking missions were the surprise that the Martian poles are glaciated with water-ice, not frozen carbon dioxide as supposed. Temperatures recorded by the orbiters' infrared detectors were too high for solid carbon dioxide. In fact, it begins to look as if Mars may be completely coated in a permafrost mantle of water-ice beneath its rocky surface. Certainly there is no extensive reservoir of carbon



109 Martian panorama (Photo: NASA)

dioxide to create large pressure changes from time to time on Mars, as some workers have speculated. Curiously, too, Mars exhibits no seismic activity, a conclusion at odds with the presence on its surface of what look like giant volcanoes, and with terrain which seems to be intensively faulted by parallel rifting.

Glaciology

There have been several conflicting theories of the causes of ice ages recently but careful observation of deep-sea cores by climatologists has now singled out one as the prime contender. This is the theory, based upon periodic variations in the Earth's motion, put forward by the German meteorologist Alfred Wegener (the first proponent of continental drift, also) and afterwards taken up by the Yugoslavian Milutin Milankovich. According to him, 3 terrestrial motions combined to produce the alternation of glacial and interglacial intervals. These were: the ellipticity of the Earth's orbit; the tilt of its axis to the plane of the orbit; and the wobble of its axis. Records of temperature changes in Ice-age deep-ocean sediments, based upon the ratios of oxygen isotopes, and on microfossils particularly sensitive to temperature changes, were collected by researchers in Britain and the US. Results clearly revealed the respective characteristic periods of these motions—eccentricity 100,000 years, roll 42,000 years, and wobble (the precession of the equinoxes), 2 component periods of 23,000 and 19,000 years, respectively.

A follow-up study from a physicist's viewpoint, made by the Director of the Meteorological Office has established that the changes in solar radiation resulting from the Earth's periodic motions match quantitatively what is known about the extent of the advances and retreats of the ice-age glaciers and ice-caps.

New studies of the air trapped initially in snow and later in the ice of glaciers show that it actually dissolves in the ice. This, naturally, provides a means of looking at the composition of past atmospheric constituents frozen into the ice. US Army workers, using long ice-cores taken from the Antarctic at Byrd Station and penetrating to over 2000m, found that below 1100m bubbles disappear. However, on storing, the 'fizz' does come out of the ice because of decompression. Detailed examination revealed a total absence of microscopic bubbles in the deep ice and the US team concluded that air below 1100m is chemically bound in the ice as a hydrate of composition (N_2 and O_2). $6H_2O$. Antarctic ice at these depths is several thousand years old.

An off-beat bit of science to do with ice comes from a US solar physicist who has shown that hoar frost can serve as a primitive solar spectrometer. On very cold days recent snow or hoar frost can display a kind of earthbound rainbow known as a 'dewbow'. This can be seen early or late, particularly when the Sun is low in the sky. The refraction responsible is due to the individual ice crystals acting as tiny prisms. Close observation by the Kitt Peak National Observatory astronomer disclosed that he could make out, as well as the colours of the rainbow, the 2 prominent dark solar absorption bands near the blue end of the spectrum produced in the Sun by singly ionized calcium atoms.

Physiology

The adaptive response that enables Sherpas to perform high-altitude labours so much more easily than their lowland employers continues to baffle physiologists. It has been evident for some years that the oxygen-carrying capacity of their blood is somehow enhanced. New work by Italian researchers confirms that, compared with Caucasians, Sherpas certainly do manage to assimilate more oxygen into their blood. They do not do it, though, by stepping up the number of red blood cells, nor by manufacturing larger amounts of haemoglobin. Somehow the haemoglobin itself appears to increase its oxygen affinity. The snag is why, if it soaks up oxygen more readily, it is still able to release it again easily to the tissues. It seems that Sherpas must have some undetected biochemical oddity in their blood because their haemoglobin looks much like anyone else's.

Related to the problem of oxygen uptake in the tissues are new experiments by New York workers on myoglobin, the molecule supposed to store oxygen in muscles. By measuring oxygen uptake rates at different pressures in isolated bundles of muscle fibres, this team has shown that myoglobin has more than a purely passive role. While at high oxygen pressures the uptake is independent of the myoglobin, at medium pressures the myoglobin molecules appear to aid in transporting the oxygen to the cells.

When you next pause to throw off a sweater as the Sun, or you yourself, rise higher, consider how fortunate is Man in his ability to keep cool both through the advanced evolutionary means of perspiring, and by using his intelligence to alter his insulation at will. Unlike the lizard or the dog his panting is devoted to ends other than thermoregulation; he need not suffer the primitive indignity of licking himself; nor the worse one practised by some cranes of urinating down his legs. Nor does he have to carry around with him a large specialized tail for the purpose—for that, it now transpires, is how small kangaroos contrive to remove their surplus heat. The potoroo, claims an Australian zoologist, has sweat glands only in his tail which he wags about to cool himself down.

Modern work has revealed that birds use a variety of cues for navigation including some recognition of the patterns of the night sky. But, since the sky rotates they must see different stars at different times of the night. Do they then, like ourselves, appreciate the unique position of the Pole Star? It seems hardly credible. And research last year at the University of Frankfurt proved that robins, at least, manage to align the night sky by a magnetic sense of some kind. Captive birds tested for migratory behaviour against a mock starry sky, but with the Earth's magnetic field annulled by screening, showed random activity; when the magnetic field was restored they indicated a clear tendency to their normal northerly migration mode. And, in subsequent magnetic field-free experiments they maintained their (learned) sense of orientation. The big question, of course, is how living creatures might detect magnetism.

Earth science

With disastrous earthquakes in Guatemala, Italy, China and Turkey, 1976 seemed to mark the advent of a new phase of global violence. It was, however, just extreme bad luck, expecially so for the Italians of the province of Venetia who had not known such a large shock for more than 75 years. Such earthquakes are the final throes of the Alpine mountain building movements which reached their culmination some 25 million years ago. The Udine district where the epicentre of the earthquake lay was a somewhat unusual place, too. Active crustal lines mark either side of the Adriatic—Skopje, the scene of another relatively recent major shock, lies to the E of these lines—but Udine is situated athwart the more stable block of crust separating the two.

The only way to map the hard surface of Venus beneath its all-embracing cloud cover appears to be by radar using the world's big radio telescopes. Last year 2 surveys, respectively by NASA's Goldstone radio dish used for deep space data reception and by the 300m Arecibo dish in Puerto Rico, both succeeded in penetrating the Venusian clouds. Unlike the Moon and Mercury, Venus shows signs of tectonic activity—perhaps as befits Earth's sister planet. Mountain arcs, a rift valley, and one large volcano showed up on the radar maps. One 1500km long feature was compared by the radioastronomers to the East African Rift. The volcano was some 300km in diameter.

Do rocks gradually evaporate? It sounds preposterous, yet a scientist at Scripps Institution of Oceanography, La Jolla, California, has put forward the serious suggestion that, like solid carbon dioxide and iodine crystals, many silicates might slowly sublime into the atmosphere. He makes the suggestion to explain why the order of abundance of the heavy metals follows a global distribution—without the intermediary of the atmosphere, one would expect the distribution to follow local geological abundances. The abundances also match the pattern to be expected from their high-temperature volatilities.

Electrics

That luminous, brush-like, and sometimes audible electrical discharge called St Elmo's Fire has recently been synthesized under laboratory conditions by Soviet scientists working in Novosibirsk. St Elmo's Fire, traditionally associated with ship's masts, also occurs on parts of aircraft, summit crucifixes and other projecting objects among mountains. It is produced by strong electrical gradients during thunderstorms, snow showers and even dust storms. Its exact origin thus seems to be somewhat various. The Soviet workers generated a stream of charged droplets about 10 microns in size, flowing at around 5 cm per second. When they put objects in this stream they glowed brightly over a volume of some 20 cubic cm. Sharp objects yielded a fan-shaped glow in the direction of the droplet stream; shielding an object from the stream caused the glow to fade. Two oppositely charged streams, however, failed to produce a glow where they

met; on the other hand, a stream of (presumably neutral) emulsion injected into the droplet stream glowed at its end.

Proof positive of the reality of that never-quite-believed-in phenomenon called ball lightning appeared in the respectable journal *Nature* last year. A lady in Smethwick was burned by it and earned herself scientific immortality thereby. The bright blue sphere, interrupting her at her kitchen stove, burnt a 4-inch hole in her dress and left a swollen hand in evidence of its passage. The dress fabric was not charred although shrivelled, and showed no traces of radioactivity. The ball, a physicist calculated, must have delivered substantially less than the one megawatt of power anticipated by some theories of ball lightning.

In Arizona, in a sandstone cliff, a geophysicist from Caltech discovered the first fossilized thunderbolt. A lightning discharge may represent an electric current of some tens, or even hundreds of thousands of amperes. The associated magnetic field is sufficient to magnetize the rocks at the impact point and would be expected to do so in a particular pattern. Sampling the cliff on a grid revealed such a pattern of fossil magnetizations.

Alpine Club Notes

Meetings of the Alpine Club 1976

13 January	Modern ice climbing—Alan Rouse
17 February	A winter ascent of the North Face of the Eiger and other climbs—Joe Tasker
16 March	Avalanche rescue technique—Dr Walter Lorch
6 April	Gasherbrum III—Alison Chadwick-Onyszkiewicz
4 May	Climbing in Kenya, Tanzania and Uganda—John Cleare
14 September	The Himalayan frontier—Peter Lloyd
12 October	Volcanoes and associated phenomena—Peter Francis
26 October	Members' slides; Jack Longland, George Steele, Charles Warren, John Harding, Ernst Sonderheimer
16 November	AMA and Royal Nepalese Army expedition to Everest—Tony Streather and others
6 December	Annual General Meeting and President's Valedictory Address
7 December	Annual Dinner

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