Braided channels cut by past water flows.

Photos: Viking 1/NASA

Mars "Island" with seven laminated layers.

such strong flows may have plucked whole boulders from their beds, leaving the holes (which show in the photos by their much larger rims of dark sediment) and the boulders themselves to threaten the descending spacecraft.

There is a counter-theory (one of many in Viking's huge scientific staff), although it appears to be a declining view, that even the large flow features need not have been caused by "castastrophic" flooding episodes. Substantial erosion by small, gradual trickles certainly is common on earth, and a less torrential water supply would fit more comfortably with the present Martian climate (Mars also shows signs of slow water erosion), but evidence for strong flows is compelling, and it, too, has its terrestrial counterparts. Masursky notes, for example, that in Washington State during the retreat of the last major ice age, an event called the Spokane Flood took place when an ice dam burst and released the waters of Lake Missoula, apparently cutting a major river in three and a half days (SN: 10/19/74, p. 250).

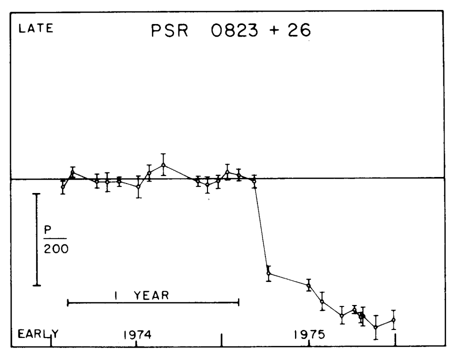
For some reason, Mars is still occasionally referred to as "moonlike," a generalization that becomes less applicable with each new Viking photograph. The Red Planet does have its craters, however, including such classics as Yuty (named after a village in Honduras), an 18-kilometer-wide ring with the characteristic central peak of an impact feature and ejecta blanket whose steep outer edges are further testimony to the erosive power of water. A difference from lunar crater fields may turn out to be that the smallest-size impact craters are absent on Mars, since even the present thin atmosphere would have destroyed most small meteoroids. A thick, primordial atmosphere, in fact, might have had a similar effect on larger projectiles, and if, as many researchers believe, much of the solar system's meteor bombardment was concentrated in a single early episode, Viking's mission becomes all the more important. It could prove necessary to recalibrate crater-counting as virtually the only method available for dating planetary surface features, at least on Mars, without sampling them.

With so many unknowns in its equations, the Viking team expanded its landing site search to include an area to the northwest of the original prime site and closer to the center of Chryse basin. Because the "Northwest Territory" is farther from the channels that open onto the original site, the hope was that only finer sediments would have settled there, perhaps providing a less rugged surface. The previously planned backup site at Tritonis Lacus, more than 12,000 kilometers around the planet, was also being considered, as well as an area near it called Isidis Planitia, and even a possible return to the prime site. Landing dates would range from July 9 for the prime site to July 21 for the backup site to July 22 for the Northwest Territory and even later for Isidis. The calendar is tight, because there's a lot of mission to be run before solar conjunction cuts off communication for a month beginning in early November. And—just to keep the pressure on—Viking 2, due in orbit Aug. 7, is on its way. □

Anti-glitch snags pulsar theories

Astronomers are unveiling a whole new can of worms in pulsar behavior which is guaranteed to give any theorist in the field gray hairs. In 1968, when pulsars were first observed, theorists instantaneously assigned the phenomenon to spinning neutron stars. They envisaged the pulsing to be a lighthouse effect caused by a cone of radiation emitted by the star. In 1969, the Crab and Vela pulsars (among the most studied pulsars) exhibited sudden increases in their pulsing frequency, later dubbed "glitches." After some momentary head-scratching, theorists decided that glitches are probably caused by "starquakes." Following a starquake, they reasoned, the star would settle down, under the influence of its own gravity, to a smaller diameter. The effect on the spin rate would be the same as for a spinning ice skater who suddenly pulls in his arms. In fact, this explanation has successfully described, in impressive detail, most of the pulsar glitches since observed.

Nature, however, seems to have reaffirmed its supremacy over the mortal deliberations of the theoretical scientist. Gordon E. Gullahorn and John M. Rankin of Cornell University reported at the meeting of the American Astronomical Society last week in Haverford, Pa., observations using the Arecibo radio telescope that show some anomalous pulsar behavior. They have seen several examples where a pulsar frequency suddenly decreases. This is totally contrary to the established quake model. The observation seems to suggest (if one maintains the starquake picture) that the star suffers a physical change that increases its effective diameter. Under the effect of a pure gravitational field, such a distortion is not energetically preferred.



Suddenly, a pulsar sends signals early.

The same two observers also report that the pulsar PSR 0823+26 not only has "anti-glitched," as described, but also has undergone a sudden "phase jump," so that suddenly, one day, its pulses began to arrive earlier than expected (see diagram). The anomalies don't even stop there, however, because whatever caused this pulsar's sudden phase jump has left its frequency unchanged. By the admission of several experts in the field, these observed peculiarities may portend the death of the standard starquake model.

If you were playing the stock market, "you'd begin to sell this [theory] short," says Malvin A. Ruderman of Columbia University, a recognized pulsar expert and creator of the standard starquake theory. In his opinion, the theory, however, was in trouble with the Vela pulsar long before these latest revelations. The history of the Vela pulsar is in dramatic contrast to the past records of other known pulsars, which glitch infrequently and when they do, have their spin rates changed by only a few parts in a billion. The frequency and strength (a part in a million every several years) of the Vela pulsar glitches have never been adequately accounted for by the starquake model, says Ruderman. Thus the "theory wasn't all that good for quite awhile," he continues, and if the latest observations are substantiated, it would seem "you don't have a healthy theory anymore."

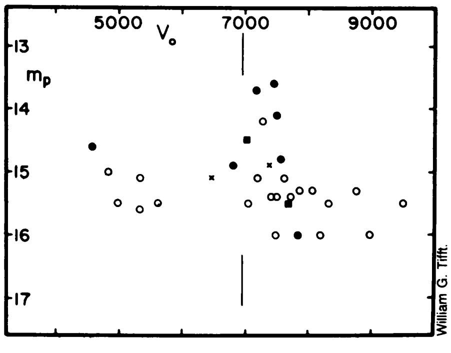
Although gravity alone does not energetically prefer a star to "settle" into a larger effective diameter, Ruderman explains, "one can imagine" the star's magnetic field playing a role to accomplish this. At that point, however, one is straining the theory and it "becomes very much less attractive." Furthermore, referring to the case of an apparent phase jump without an associated frequency shift, Ruderman asserts, "I do not know of any theory by anyone which predicts that." If one thing is clear from all these remarkable events, pulsar theorists needn't fear for their job security for quite some while. □

Redshifts: Case for quantization?

One of the long-established "truths" in astrophysics is that measured redshifts are due to either relative motion or a gravitational potential, called the Doppler shift and "gravitational" (or accelerational) redshift respectively. Now an astronomer is suggesting the possibility of yet another cause of redshifts that are presently interpreted as conventional Doppler shifts. In 1973, William G. Tifft of the Steward Observatory reported that the redshifts of a group of galaxies in the center of the Coma cluster separated into three distinct bands when plotted against the galaxies' apparent magnitudes. He reported that the "high, middle and low" bands thus formed were significant with a confidence level in excess of 99 percent.

At the American Astronomical Society meeting last week at Haverford, Pa., Tifft reported on his newest observations, which extend the scope of his initial study. He has categorized into three groups a complete sample of galaxies taken from the Zwicky catalog which lie within 3° of the center of the Coma cluster. The first group contains all the galaxies that emit radiation in the radio continuum. The remaining two groups are populated by those that emit a strong hydrogen spectral line (the H-beta line) on the one hand and those with a weak or absent H-beta line on the other. He contends that the whole of the data reinforce the original observation of the three discrete bands.

There is a twist, however, when he plots each of the three groups of galaxies separately. The "weak-emission line" data plotted alone seem to fill in only the middle redshift band with only a few "stragglers" in the high and low bands. The other two galaxy groups, however, each populate only the outer two redshift bands, the high and low ones. Tifft argues that this different behavior among the three groups would not be expected if the shifts were truly Doppler. In order to "save" the conventional view, one might envisage a number of separate "clouds" intervening between the observer and the Coma cluster. The clouds would be moving with just the right velocities so as to cause the Doppler shifts attributed to the galaxies which they front. Tifft argues against this hypothesis by first plotting the actual positions of his galaxies in relation to the center of the Coma cluster. He then finds that the galaxies in each of the three groups are uniformly distributed about the cluster's central region. Were the cloud hypothesis correct, one would expect the galaxies to lie in clumps corresponding to the "shadows" of the offending clouds.



William G. Tifft.

Redshifts appear to occur in bunches.

From Tifft's point of view, short of some contrived mechanism that would assign just the right systematic velocity to a galaxy depending on the type of radiation it emits, the Doppler shift interpretation appears untenable. Adding to the apparent mystery, Tifft reports that of the galaxies which emit line-radiation, 15 of the 17 in the high redshift band emit a stronger H-beta line than a particular oxygen spectral line, O-III, and four of the five in the low band demonstrate the opposite behavior.

Although Tifft does not deny that the effect may simply be a statistical aberration due to the sparcity of data, he believes that its ultimate explanation may "require extensions of our concepts of the nature of matter itself." He plans to elaborate on this suggestion in a series of three papers, the first of which appears in the May 1 ASTROPHYSICAL JOURNAL. The subsequent articles are expected in early 1977. □

Europe gets its 400 GeV protons

West European physicists now have 400-billion-electron-volt (400 GeV) protons to experiment with. On June 17 at 3:35 p.m., Central European Time, the Super Proton Synchrotron at the CERN laboratory in Geneva accelerated the first beam that reached its design energy of 400 GeV, announced John B. Adams, the executive director-general responsible for the project.

The latest CERN synchrotron is the counterpart to the synchrotron at Fermilab in the United States, which recently reached 500 GeV. The new CERN construction started later than Fermilab's, and it was slowed at the beginning by diplomatic difficulties that almost killed it before birth.

When European physicists expressed a desire to emulate the American project, Great Britain blew hot and cold, and some of the smaller nations in the CERN consortium could not see why they should take part in such an extensive undertaking. But after much diplomatic back and forth, three of the big nations decided to go ahead on their own, and then one by one the other nations fell into line.

Then there was a long difficulty over siting. Fermilab had siting problems too: Nearly every one of the 50 states submitted a site proposal, and the government dithered. According to the Washington murmur mill, the impasse was solved with a coup by the late Sen. Everett M. Dirksen. The Johnson administration needed Dirksen's influence for some project it wanted, and Dirksen got Fermilab for Illinois in return.

The CERN situation was parallel but worse. Nearly every member nation had a site proposal, and a choice involved touchy negotiations among independent sovereignties. After much struggle the list was pared to three (in France, West Germany and Italy), and a committee was appointed to choose one. They were variously called the "three wise men" or the Solomons, because they had to satisfy three prospective mothers with one baby. In the end they threw up their hands.

Then someone noticed that there was just enough room for the new machine in the suburbs of Geneva, just across the road from the original CERN site. The choice pleased everybody by satisfying nobody and also effected some economies in construction. Because land is scarce in Europe, the accelerator is built underground so that the surface can be used for other things.

The new CERN machine is the latest, and probably the last, installment in an informal race for particle-physics equipment among the United States, Western Europe and the socialist countries. The next big accelerator (physicists are talking of 10,000 GeV), if it is ever built, is likely to be a worldwide project. Meetings have already been held to discuss the feasibility of such a machine and the possibility of bringing the whole world into it. □