between the bills.

The last and most difficult compromise was whether the EPA administrator required a court injunction to halt or limit manufacture of new chemicals. The final bill states that the administrator can either get an injunction or put an administrative order into effect. Even with the order, EPA must go to court if the manufacturer objects to the ruling.

Another compromise makes allowances for small businesses. They are partially exempted from the reporting requirements and will pay only $100, rather than $2,-500, for registering each new chemical.

The final bill had the support of the Manufacturing Chemists Association and some labor and environmental groups.

The toxic substances law leaves much to the discretion of the EPA administrator. The question now is: How much preventive action will he take? □

Quantized light-emitting diode

It was a relationship among light, solids and electricity, the photoelectric effect, that introduced the concept of the quantum of energy into physics. Light falling on certain solids will eject a stream of electrons, an electric current, from their surfaces. But for each substance there is a threshold frequency, below which the light does nothing; above the threshold electrons come off. This led to the notion that light contains discrete quanta of energy, and that to get loose an electron had to swallow a whole quantum of appropriate size or nothing at all. The energy of the quantum is porportional to the frequency of the light, and the relevant equation is the famous $E = h\nu$.

At the research laboratories of the Ford Motor Co. in Dearborn, Mich., John Lambe and S. L. McCarthy have developed a species of solid-state sandwich that emits light in a kind of converse to the photoelectric effect. Diodes that emit light are not new, but a class that shows a quantum relationship between the frequency of the emitted light and the voltage applied to the diode is unusual, Lambe says.

The diodes are a form of tunneling junction, a device in which electric current "tunnels" its way through a thin insulating layer between two conductors. In each case that Lambe and McCarthy experimented with, one electrode was aluminum. The insulating layer was aluminum oxide formed on the surface of the aluminum. Against this were placed various electrodes of silver, gold, lead or indium. When a voltage was applied, light was emitted from the entire junction area.

These junctions radiate a broad spectrum of light up to a certain cut-off frequency. The cut-off frequency bears a quantum relation to the applied voltage. The energy of the cut-off quantum is equal to the energy of the electron in the current driven by the given voltage, or Planck's constant times the cut-off frequency equals the absolute value of the voltage times the electron's charge. The absolute value comes in because the polarity of the voltage does not matter.

The effect of variation of the cut-off frequency with voltage was plainly visible: "One could observe the emission color change from deep red at low voltage to orange to blue white as the voltage was increased," Lambe and McCarthy report in the Oct. 4 PHYSICAL REVIEW LETTERS. "This showed the effect of the change in [cut-off frequency] in a very striking way."

Lambe and McCarthy attribute the phenomenon to a relationship between the current electrons driven by the applied voltage and plasmons in the surface of one of the electrodes. Plasmons are collective oscillations of electrons within a solid. They have been a little difficult to study, but Lambe and McCarthy were able to make them react with the passing current by roughening the surface of the electrode slightly. So this phenomenon should provide a means for the study of plasmons.

Lambe also expects that devices of this sort, because they introduce a calculable quantum relation between voltage and light frequency, will be useful as secondary voltage standards for calibration and comparison. They will also be useful in a new kind of spectrometer, and in fact one such spectrometer was built as part of the present experimental program. Applications could also extend to places where other forms of light-emitting diodes are also used. □

Mars soil similar at two Viking sites

The two Viking spacecraft on the Martian surface are some 7,400 kilometers apart, on opposite sides of the planet. Lander 2 is more than 1,400 kilometers closer to the north pole than is its predecessor, and the more northerly atmosphere seems to contain at least three times as much water vapor. Yet despite these seeming grounds for difference, and despite the widely divergent appearance of the two sites in Viking orbiter photographs, the first analysis of a surface sample by lander 2 has revealed an uncanny similarity with the soil studied in the Chryse basin by lander 1.

If one selected two earth rocks for the same kind of analysis, says a member of Viking's inorganic chemistry team, he would be hard-pressed to find a pair that matched as closely as the Martian samples. Both are rich in iron, with near-carbon-copy amounts of calcium, silicon, potassium and other elements. The lander 2 sample was taken from an area topped with a crusty layer possibly due to evaporites formed by water-soluble salts. Yet sulfur and chlorine, two elements cited as candidates in such processes, are present in amounts almost indistinguishable in the first few days of study from those in the lander 1 sample.

The Martian samples involved, however, are not whole rocks, but "fines" or dust. In fact, says team leader Priestley Toulmin III of the U.S. Geological Survey, the likeliest implication of the data is that the material must represent the well-mixed products of weathering rather than simply broken up primary rock fragments. Such mixing, he says, would seem to take place on a planetwide scale, and very rapidly compared with the rate at which the weathering products are produced in the first place. "Indeed," he adds, "that inference might lead further to speculate that the entire weathering process is an ancient one, and that what we are now seeing is only a redistribution—mixing and homogenization—of those very ancient weathering products around the planet."

The team's X-ray fluorescence spectrometer, however, measures only elemental abundances; it does not tell how they are combined. That is the job of the human end of the experiment back on earth. "The best agreement that we can find in attempting to model the mineralogy to the chemistry," Toulmin says, "seems to include . . . a very large proportion of iron-rich . . . clays of the montmorillonite group. These are clays which on earth are generally the product of alteration or weathering of mafic, igneous rocks, such as basalts especially. They form either by weathering at the surface or by hydrothermal alteration connected with mineralization." Though they also have been found in deep-sea oozes, he says, their best known source is in the Red Sea, in an area where submarine hot springs have apparently altered the chemistry of the bottom sediments.

The weathering products suggest that, as with the lander 1 samples, the material came from basaltic rather than granitic parent rocks. "The implication would be that if the weathering products are widespread on a planetary scale, their source region must be similarly wide," Toulmin says. "That in turn implies that there must not be a large amount of granitic-type rock exposed at the surface and available for weathering which would go along with the idea that the planet is by no means so highly differentiated as the earth."

The lander 1 samples, meanwhile, under study for a longer time, are starting to reveal their more detailed secrets, notably including trace elements such as rubidium, strontium, yttrium and zirconium. All four have now been detected, but at extremely low levels compared with most terrestrial igneous rocks. Ultramafic igneous rocks and meteorites often show such low trace concentrations, but so do, notably, some weathering products. Thus the trace elements are one more bit of evidence suggesting that the Viking landers are not studying material peculiar to their disparate locales so much as a homogeneous mixture that tells of a rugged evolution perhaps representing conditions over much of the planet's surface.

The search for organic materials continued in vain early this week, with negative results from the first of two runs at 500° C by lander 2's gas chromatograph/mass spectrometer, following similar findings in runs at 200° and 350°. In what is likely to be a last-ditch effort for the lander 2 site, Viking engineers were also working to collect a sample from beneath a rock, in hopes that the rock might have lain where it is long enough to have blocked possibly damaging solar ultraviolet radiation since the time when a thicker Martian atmosphere might have done so on its own. Though it sounds like a simple task, the rock-rolling plan involved the efforts of more than a dozen people, plus consultations with numerous others, for more than three weeks. The lander has but one digging arm, and no one was about to risk it in a hasty or ill-conceived maneuver.

The first attempt was a failure. The selected rock was ironically the same one that had blocked the way to lander 2's originally chosen digging site, and when the arm was sent back to it for the rock-rolling effort, it "struck back," says one engineer, by refusing to budge. There were passing suggestions that the rock might have been cold-welded or evaporite-glued to the surface, but others concluded that a large piece of the rock was probably buried and holding it in place. "It seems to me pretty clear," says Toulmin, "that the tip-of-the-iceberg theory is overwhelmingly the most likely explanation for its intransigence."

The second choice was a rock known as "Mr. Badger," one of four dubbed by Henry J. Moore II of the USGS with names from *Wind in the Willows*. (The others are Mr. Mole, Mr. Rat and Mr. Toad.) When Mr. Badger obligingly sidled aside, engineers were elated. "We were even popping the cork a little," says Leonard V. Clark of the NASA Langley Research Center, head of the team responsible for the fragile but capable sampling arm. Even as the soil was being sampled from beneath the rock, plans were already being made to carry out a similar roll-and-dig maneuver to obtain a sample for the lander's biology instruments.

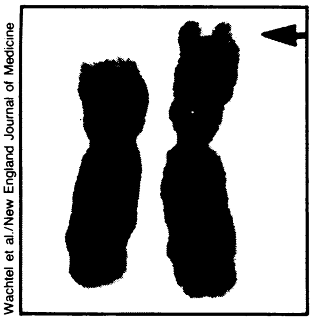
The landers are only part of the Viking fleet, however. The mission's geologists have just begun looking at the spectacular photographs taken by the two orbiters during their respective "walks" around the planet. Yet even an early look at the orbiter 1 photos has revealed:

- Stunningly sharp images of the huge volcano known as Ascraeus Mons, whose primary crater is flanked by a pair of distinctive "side-lobes." The resulting formation, peeking through the global dust storm photographed by Mariner 9 in 1971, was one of the first clues that such volcanoes existed on Mars at all. The Viking photos, however, says Harold Masursky of the USGS, are about 50 times sharper than Mariner 9's due to a combination of refined engineering and, more important, cleaner air.
- A virtual chronology of the dramatic geologic evolution of the vast bulge known as the Tharsis uplift, highlighted by a broad lava flow that apparently flooded all but a craggy central portion of the region's original cratered terrain.
- A photomosaic showing pronounced signs of ice-related flow features (see cover), at a latitude more than 45° away from the north pole. "They resemble earth features where near-surface materials flow *en masse* very slowly, aided by the freeze-thaw of interstitial ice," says an orbiter team member. Another Viking geologist goes even further: "This," he says, "is the best photographic evidence we've ever had of real, large-scale glacial flow on Mars."

The images from orbiter 2's circumplanetary sojourn were just getting their first perusal early this week, but hopes were high at Viking headquarters for clear photos of the Martian north polar region, most of which was seen only poorly by Mariner 9.

The genetic basis of hermaphroditism

Scientists have long been puzzled by the genetic basis of hermaphroditism, a condition in which a person has both male and female organs or some lesser mingling of both male and female traits. As far as they have been able to determine, hermaphrodites carry two X chromosomes, the sex determinant of a female, but rarely a Y chromosome, the male sex determinant. So how does the hermaphrodite end up with male as well as female characteristics?



Wachtel et al./New England Journal of Medicine

Arrow indicates a piece of Y chromosome attached to one of a subject's two X chromosomes.

An answer may have been found by Stephen S. Wachtel of the Memorial Sloan-Kettering Cancer Center in New York City and his colleagues and is reported in the Sept. 30 NEW ENGLAND JOURNAL OF MEDICINE. Although hermaphrodites may not carry a complete Y chromosome or even a sizable piece of one, they still possess the tiny gene from the Y chromosome that determines the male sex. This gene may have become erroneously attached to one of the X chromosomes or one of the nonsex chromosomes, before conception, that is, in the father's sperm.

In the past, researchers have used rather unrefined techniques to look for the presence of a Y chromosome in hermaphrodites. But chromosome identification techniques have improved considerably during the past three years. Advanced immunological tests have also allowed Wachtel and his colleagues to identify the gene on the Y chromosome that is responsible for conferring male traits (SN: 12/6/75, p. 357). So they decided to use improved chromosomal identification techniques to look for a Y chromosome in hermaphrodites, and to use the latest immunological methods for identifying genes to see whether hermaphrodites carry the Y chromosome sex determinant gene.

They studied seven subjects from ages 2 to 46, all with XX chromosomes. Three were true hermaphrodites in that they had ambiguous genitalia. The other four had masculine genitalia but certain female sex traits, such as lack of facial hair, a high-pitched voice, small testes or sterility. The Y chromosome sex determinant gene was identified in all seven of them. Specifically, the protein that is encoded by this gene, the so-called H-Y antigen, was present in cells from all the subjects. Two of the subjects also had a Y chromosome or at least a sizeable piece of a Y chromosome in their cells. A piece of the Y chromosome could actually be seen translocated onto an X chromosome in one of these two subjects.

In view of the minuscule size of this Y segment and of the even smaller probable size of the sex determinant gene itself, the investigators say it is reasonable to suppose that in some XX males or XX true hermaphrodites, Y-X chromosome translocation or translocation of the Y chromosome to a nonsex chromosome would not be detectable even with the latest, most refined chromosome banding techniques. So in these cases, Wachtel and his co-workers believe, H-Y antigen expression is probably the best clue to the presence of a Y chromosome or its particular sex determinant gene.

Only further studies, they admit, will show whether the Y sex determinant gene identified by Wachtel and his colleagues is always the basis of hermaphroditism. It is possible, for example, that an environmental factor might alter the genes on the X chromosomes so that they express male rather than female characteristics. □