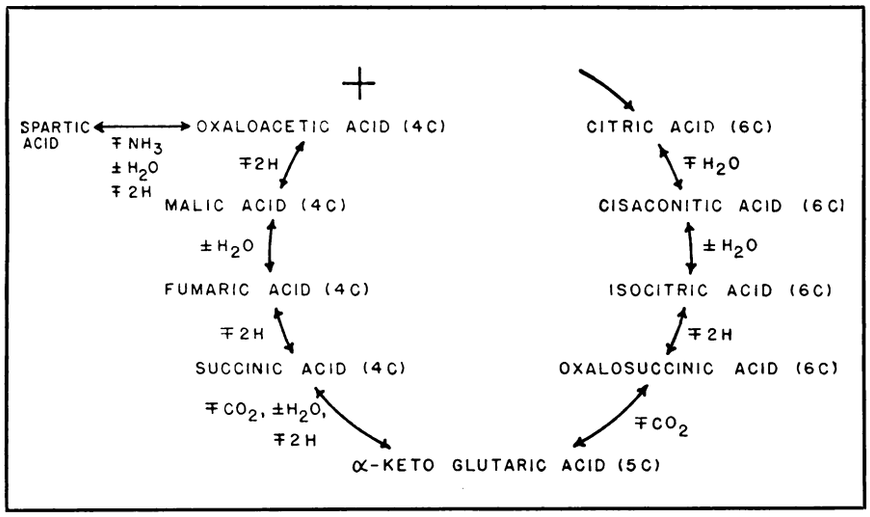
Krebs cycle and the primordial soup



All the chemicals in the Krebs cycle, with the possible exception of alpha-keto glutaric acid, were produced outside cells under early earth conditions.

Products of one of the most crucial biochemical pathways of modern cells —the Krebs cycle—have been produced outside of cells under conditions that simulate those thought to have existed in the early stages of the earth's history. Up to now, only amino acids, the building blocks of life, and components of nucleic acids, the genetic material of life, have been so synthesized.

The finding, by Cyril Ponnamperuma and his associates at the University of Maryland's Laboratory of Chemical Evolution, was reported this week at a regional meeting of the American Chemical Society in Wilkes Barre, Pa.

Ponnamperuma, one of the pioneers in the study of the evolution of prelife chemicals on the primitive earth, considers his team's discovery "a very interesting and important new development." It suggests that "when life began, it did not perhaps invent the cycle, but used the pathway that was already there chemically."

Scientists believe the earth is about 4.7 billion years old, and that the first forms of life were present on earth 3.5 to 3.2 billion years ago. So they are anxious to know what happened during the preceding 1.2 billion years. They want to know what chemicals in the primitive earth atmosphere or ocean became the building blocks and genes of life. To find out, they've conducted various experiments under simulated early earth conditions and have discovered that amino acids and nucleic acids could have indeed been formed under such conditions.

Major components of nucleic acids are chemicals known as pyrimidines. Ponnamperuma and his co-workers were looking for a prebiotic (early earth) source of malic acid that is believed to be a prebiotic precursor of the pyrimidines. They already knew that malic acid can be made from acetic acid, and that acetic acid can be made from methane, ammonia and water—purported components of the primitive earth atmosphere. So in a series of experiments they took acetic acid and exposed it to radiation. One of the products they got was expected: malic acid. Malic acid is also one of the products of the Krebs cycle. But they also got what they didn't expect: other products of the cycle—citric acid, cisaconitic acid, isocitric acid, oxalosuccinic acid, succinic acid, fumaric acid and oxaloacetic acid. The only product of the cycle they are not sure they got is alpha-keto glutaric acid.

"It is something that fell on us," Ponnamperuma recalls. "We were not looking for the Krebs cycle acids."

The Krebs cycle is the powerhouse of the cell. Proteins, fats and carbohydrates are broken down into pyruvic acid and acetyl coenzyme A. They then enter the Krebs mill whereby, in the presence of oxygen, they are changed into citric acid, cisaconitic acid and the other compounds with high-energy potential.

So if these preliminary results are extended and confirmed they strongly suggest, as the Maryland chemist says, that "life did not have to invent these metabolic processes, but took up sequences that were already available." In other words, the Krebs cycle may be used by modern cells because the first cells on earth used chemicals that were easily available to them in their environment. □

Westar and the war of the talksats

After seven years of tedious, albeit sometimes heated, deliberation, the Federal Communications Commission decided last September that any qualified corporation would be eligible to operate a commercial satellite communications system in the United States. The race was on. RCA made the first splash in January by leasing space on the Anik II satellite of Canada's Telesat system (SN: 1/19/74, p. 41), and now the first U.S. commercial comsat for domestic use is in orbit.

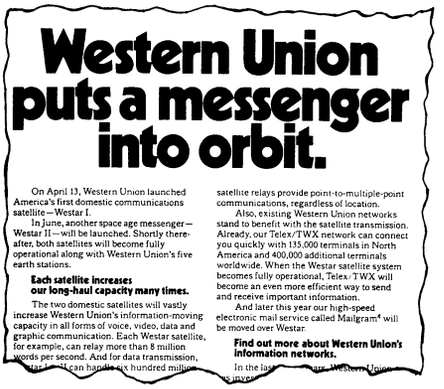
Westar I went into space on April 13, owned and operated by Western Union, which has lost no time in publicizing the accomplishment. This summer, Westar II is scheduled to follow.

Commercial comsats are the latest threat to American Telephone and Telegraph's virtual monopoly in U.S. telecommunications. The competition is brutal: RCA's leased satellite circuits offer savings sometimes exceeding 25 percent over land lines. American Satellite Corp., which has apparently dropped plans to orbit its own satellites, is leasing space on the Westars, at a rate believed to be 36 percent less than the Canadian charge to RCA. Next year, RCA will tighten things further by launching two satellites of its own (with twice the capacities of the Aniks and Westars), and AT&T will try to reassert its position when it joins with General Telephone and Electronics to lease all the space on three satellites to be launched in 1975 and 1976 for COMSAT General. (COMSAT General is the domestic subsidiary of COMSAT Corp., the U.S. member of the multinational INTELSAT Corp.) The AT&T-GT&E alliance is the improbable offspring of a bitter rivalry in which each company had planned to orbit a satellite system of its own.

Private personal phone calls may be least affected by the domestic satellite revolution. Private business circuits, now largely land lines leased from AT&T, are a more likely target, as are military and business data links, which have been predicted to grow into a $5 billion annual market by 1980.

It looks like trouble for Ma Bell, and probably will be, but the future is not all golden for the proliferating satelliters either. It may take seductively low rates and high-presure salesmanship, for example, to interest the major television networks in substantial usage of domestic satellites; news and sports events happen in so many different places that the cost and practicality of portable ground equipment to reach the satellites could be a major factor.

Furthermore, it may be a case of



Western Union puts a messenger into orbit.

On April 13, Western Union launched America's first domestic communications satellite—Westar I.

In June, another space age messenger—Westar II—will be launched. Shortly thereafter, both satellites will become fully operational along with Western Union's five earth stations.

Each satellite increases our long-haul capacity many times.

The two domestic satellites will vastly increase Western Union's information-moving capacity in all forms of voice, video, data and graphic communication. Each Westar satellite, for example, can relay more than 8 million words per second. And for data transmission, [illegible] can handle six hundred million

satellite relays provide point-to-multiple-point communications, regardless of location.

Also, existing Western Union networks stand to benefit with the satellite transmission. Already, our Telex/TWX network can connect you quickly with 135,000 terminals in North America and 400,000 additional terminals worldwide. When the Westar satellite system becomes fully operational, Telex/TWX will become an even more efficient way to send and receive important information.

And later this year our high-speed electronic mail service called Mailgram® will be moved over Westar.

Find out more about Western Union's information networks.

In the [illegible] are Western Union

Ad touts Westar's talksat potential.

damned if you do and damned if you don't. If everybody's satellites find plenty of business, there may be a traffic jam on the airwaves that can be resolved only by negotiations that will make past talks seem like a mutual admiration society. The Canadian operators of the Telesat system, for example, have requested that future communications satellites serving North America maintain at least a calculated minimum spacing between their orbital positions. A NASA study indicates that the proposed numbers of satellites are likely to far exceed the number that would make such future spacing possible.

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Exactly a week after Westar I opened the domestic talksat race in the United States, the Soviet Union added a link in its own domestic network, which began operation in 1965, the first of its kind. On April 20, a Molniya communications satellite was launched into a highly elliptical north-south orbit, to provide radio, television and other communications. Unlike the fixed, synchronous orbits of the Intelsats and Westars, the satellites in the Soviet Orbita system use the long ellipses to give each Molniya several hours over Soviet territory, so that three of them can cover the entire Soviet Union. The latest Molniya, for example, was put into a 40,713-by-646-kilometer orbit in which it circles the globe every 12 hours and 18 minutes, covering all of northern and central Asia. □

Rewarding study in depression

The Old Testament's Book of Job contains a classic description of one of the most common of mental disorders—depression. Even the earliest medical chronicals discuss manic-depressive illnesses. But only recently have scientists begun to get some understanding of how to effectively treat depression. Two of the researchers responsible for much of the work that has led to advances in the control and prevention of depression have been selected to receive the Kittay International Award for 1974. The $25,000 prize, the largest in psychiatry, will go to John Cade of Australia and Mogens Schou of Denmark for their psychopharmacological work with lithium.

Lithium salts have been available to physicians for more than a century. The toxic effects of these salts kept them in disuse until Cade found that injections of lithium citrate protected guinea pigs from developing convulsions produced by urea. Cade concluded that the same drug might be useful in the treatment of manic excitement in humans.

Cade did show that lithium controls manic psychosis in humans, but not much came of his work. Doctors were still reluctant to use lithium as a medicine. It was Schou and his collaborators who finally proved the drug's efficacy, free of toxicity, in the treatment of depression. Schou further showed that continued lithium therapy serves as a prophylactic or protection against the recurrence of the disease. During the past four years the use of lithium carbonate has greatly increased in the United States and lithium has been compared to insulin in terms of its importance in the field of psychiatry.

In announcing the award George Serban, medical director of the Kittay Foundation, praised Cade and Schou: "Their combined discovery represents not only a revolutionary change in the treatment of an affective psychosis, but has also changed our concepts for understanding the nature of mental illness. For the first time it has been proven that a condition, which was previously considered by psychiatrists as environmental, is now shown to be biochemical." □

Flare on the sun: A whole new class

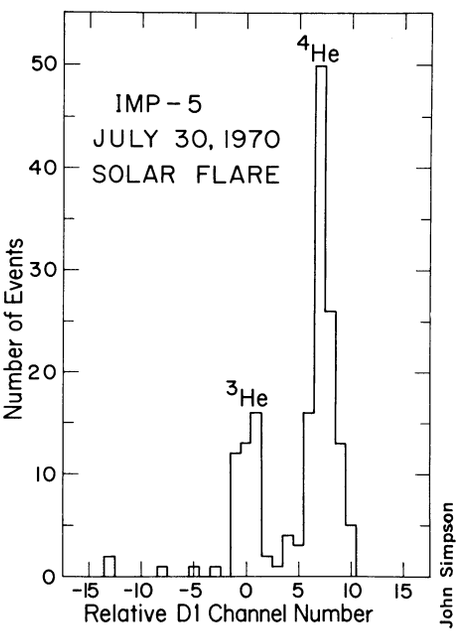
On July 30, 1970, a flare burst forth from the sun. It wasn't a particularly large flare, a smallish one in fact, certainly nothing to make history. The IMP-5 satellite, which had just passed its third birthday in orbit, noted the event, and added it to data on hundreds of other flares, to wait until someone with the inclination and funding wanted to take a look at the information.

In recent months, someone has looked. The result, says John Simpson of the University of Chicago, is the discovery of what seems to be "a whole new class of phenomena."

One of the rarer components of solar flares is a stripped-down isotope of helium called helium 3, or He^3. It is not produced at all in the sun proper, says Simpson; it is generated only in the nuclear reactions that actually produce the flares. Even in these reactions, He^3 has been thought to be extremely scarce, perhaps one part in 10,000, only about 1 to 10 percent as abundant as normal helium, He^4.

The little flare from four years ago has done away with that generalization, and in so doing it has demonstrated a need for rethinking some of the theories about how solar flare particles behave.

The discovery came when Simpson, who has been an experimenter with both the Pioneer 10 Jupiter probe and the Mariner 10 Venus-Mercury mission, was looking over some old data from a charged particle detector aboard IMP-5. Together with graduate students David Anglin and William Dietrich, he found that the 1970 flare has produced a surprisingly abundant crop of He^3. Deuterium (H^2) and tritium (H^3), two heavy hydrogen isotopes normally rare in flares, were in expectedly short supply, yet He^3 was mysteriously rampant.



Helium 3 flare: Cause for rethinking.

The tiny flare contained 54 percent as much He^3 as He^4, and at least 20 times more than either deuterium or tritium.

"These ratios for the abundances of normally rare isotopes," says Anglin, "provide a critical test for various models of solar flare particle interactions and acceleration mechanisms."

And the little flare is not alone. Simpson says a closer look since the original discovery has recently revealed six more of the He^3-rich prominences.

Slowed down by scientific jargon, "a critical test" is putting it mildly. Simpson goes a step further. "The present range of theories involving nuclear interactions," he says, "just isn't working." □