system will operate in a synchronous orbit: that is, it will move at just the right speed to match the rotation of the earth so that it will stay in the sky over the same spot continuously. Signals from transmitters will be picked up by the satellite, amplified and relayed to the receivers.

While military spokesmen are cautious and security-minded about details, the feeling is that the tactical satellite may revolutionize military operations. Dr. William W. Ward of Massachusetts Institute of Technology's Lincoln Laboratory, where the test satellite was built, says it will bring command and control down to new levels, "making all the difference in the way wars are fought, aggression is deterred, and peace is kept."

The TacSatCom, as it is acronymed, is a small-scale system which should be in the field soon. A longer and much more expensive effort is just getting underway at Fort Monmouth under the name of Project Mallard, which is aimed ambitiously at field communications on the international level. Australia and Canada are cooperating with the U.S. on Mallard.

METALLURGY

Ductile, Strong Steel

Fundamental scientific knowledge of the behavior of metallic crystals has led to the design of a new series of alloy steels, stronger and tougher than those now available.

The new alloys can be stretched from two to five times more than previous ones, yet also have high strength, being ductile up to 300,000 pounds per square inch. The alloys, called TRIP steels, are produced by a process known as Transformation Induced Plasticity.

Key factors in the development are recent advances in the knowledge of submicroscopic structure and behavior under stress of metal crystals, combined with application of other metallurgical knowledge from the past 25 years.

The high ductility will extend the usefulness of steels in such widespread and important applications as prestressed concrete, chemical processing equipment and containers.

The process was developed by members of the University of California College of Engineering in the Lawrence Radiation Laboratory, Berkeley, as part of a research program supported by the Atomic Energy Commission. Drs. Victor F. Zackay, Earl R. Parker and Raymond Busch, with graduate student Dieter Fahr, report details in the summer issue of TRANSACTIONS QUARTERLY of the American Society of Metallurgists.

As conventional steels increase in strength, they become more brittle. The strongest, with strength levels above 200,000 pounds per square inch, have a ductility of only about 10 percent, barely adequate for structures.

Structural engineers would prefer a ductility of three or four times this amount, but to attain it by conventional methods, the alloy strength must be reduced to about 100,000 psi.

The University of California metallurgists used as their starting point a class of alloys known as "ausform steels," a type Dr. Zackay helped develop about 10 years ago while he was with the Ford Motor Company.

Metallic crystals are made of orderly lattice arrangements of atoms. Perfect crystals have extremely high strengths, but so far have been made only in the laboratory. All other alloys contain defects, called dislocations, that permit deformation among the crystals when a metal is under stress (SN: 8/5).

Metallurgists have recently concentrated on deliberately making more complex defects by stretching the alloy during processing, as in the ausform process. The stretching results in dense and tangled patterns of defects that are more resistant to movement.

In conventional high strength steels, however, the strengthening due to stretching is too low to achieve high ductility.

The researchers overcame this limitation in designing their new process. During the stretching of the new alloys, a chemical reaction takes place, one that transforms the crystal structure, austenite, into another, martensite. This reaction greatly increases ductility —up to 50 percent—at strength levels above 200,000 psi.

The finished alloy has a built-in self-healing mechanism at the atomic level. When a crack starts to develop, an internal reaction takes place that blunts the crack and actually makes the metal stronger.

CRYOBIOLOGY

Lindbergh Still Pioneers

You have to be at least 50 to remember in all its vividness the national thrill when Charles A. Lindbergh flew the Atlantic solo 40 years ago. "Who was Lindbergh?" a 20-year-old asked the other day when he was shown a picture of the latest version of the scientific pump that Lindbergh developed while a "guest scientist" of the Naval Medical Research Institute's Tissue Bank.

In 1935 Lindbergh, with Dr. Alexis Carrel, pioneered a perfusion pump that maintained a cat's living thyroid for 18 days. Lindbergh's newest version of the pump has maintained contractions of whole monkey hearts during a series of experiments for periods up to 64 hours.

At the fourth annual meeting of the Society for Cryobiology (low temperature applications to living systems) in Washington, D.C., Drs. Vernon P. Perry and Theodore I. Malinin of the Naval Medical Center described the new pump.

Because of this pump, Dr. Malinin says, his team has been able to keep the monkey heart pulsating for days. "We hope to extend the life of the kidney to 48 hours," he says. "Without freezing, the kidney must now be transplanted within two hours."

The second Lindbergh pump has simplified the mechanism of the original one. It is more flexible and economical, provides a capacity for larger organs, and permits an increase in the number of experiments that can be conducted in organ perfusion studies.

The principle of operation is based on pulsating pressures exerted on two flexible plastic bags immersed in liquid upon which air impinges at controllable pressure rates. The pump duplicates the action of the heart and drives—or perfuses—fluid through the organs.

ETHNOLOGY

Vitamin D, Key to Color?

The amount of vitamin D synthesized by the human skin under ultraviolet radiation, may be a key factor in the color of different races, Dr. W. Farnsworth Loomis of Brandeis University, Waltham, Mass., reports in the Aug. 4 SCIENCE.

A lack of vitamin D results in rickets, now eradicated from the world through artificial fortification of milk and other foods. However, too much vitamin D can cause serious complications, usually resulting in death from kidney disease.

The production of vitamin D is regulated by the dermis, the "true" skin that lies just beneath the epidermis, or outer skin. Dr. Loomis believes that as early man moved northward into less sunlit regions, the darker, more pigmented elements of the population became extinct due to rickets, allowing the less pigmented to establish, by progressive selection, the white race in northern Europe.

"The known correlation between the color of human skin and latitude," he states, can be explained in terms of "two opposing positive adaptations to solar ultraviolet radiation, weak in northern latitudes in winter yet powerful the year around near the equator."

Selection against the twin dangers of rickets on the one hand and toxic doses of vitamin D on the other would, thus explain the correlation between darkness of skin and proximity to the equator.