BIOLOGY

The muscle in blood

Keeping in shape is essential to red blood cells. They have to pass within narrow capillaries and squeeze through small passages in the spleen. Yet red blood cells need to have strong membranes to return to their natural shape. The biconcave disk is best for providing oxygen to the body's cells.

The mechanical force red blood cells use to maintain shape comes from molecules similar to those that produce contractions in muscle cells, report Michael P. Sheetz, Richard G. Painter and S. J. Singer of the University of California at San Diego.

In muscle, two complex molecules, actin and myosin, are responsible for contraction. One protein associated with the inner side of the red blood cell membrane is a type of actin, the researchers report in the Oct. 5 BIOCHEMISTRY. This protein forms filaments identical in appearance to muscle actin and can substitute for muscle actin in an important biochemical reaction.

Two other components, called spectrin, are similar, but not identical, to muscle myosin. Antibodies to myosin react weakly, but specifically, with spectrin. Spectrin and muscle myosin may be members of a family of proteins that work with actin in various cells.

The studies of red blood cells add to the evidence that the mechanical forces in all cells depend on molecules similar to those in muscle (SN: 7/19/75, p. 39). The same basic mechanisms may underly cell shape changes, chromosome movement during cell division, cell migration and other types of biological motion.

Dreams can't keep you warm

Sleep is a cyclic experience. During a night's slumber there are periods of dreaming, characterized by increased and variable blood pressure, breathing and pulse rates. These phases alternate with periods of more constant, decreased physiological activity (SN: 7/19/75, p. 36).

Body temperature also changes with sleep state. Some temperature change is due to variation in muscle tension and blood flow. However, researchers have now discovered that body temperature control by the central nervous system also changes dramatically with specific sleep states.

Steven F. Glotzbach and H. Craig Heller of Stanford University implanted thermodes in the brains of kangaroo rats to directly control the temperature of the hypothalamus. In an awake animal, lowering the temperature of the hypothalamus increases the animal's metabolic rate, thus increasing its temperature.

The researchers analyzed more than 270 series of wakefulness, slow-wave sleep (or deep sleep) and paradoxical sleep (also called REM sleep). The response to experimental cooling of the hypothalamus was much less during slow-wave sleep than during wakefulness.

In paradoxical sleep, however, Glotzbach and Heller saw no change at all in body metabolic rate, even when the hypothalamus was cooled 4°C below its normal temperature. They conclude in the Oct. 29 SCIENCE that the central nervous system's temperature regulatory system is completely inactivated during paradoxical sleep, the time when dreaming occurs.

Temperature partly determines how sleep time is divided. Studies on cats and rats have shown that at lower external temperatures, animals spend more time in slow-wave sleep and less in paradoxical sleep.

Glotzbach and Heller now offer an explanation for this change. Because only slow-wave sleep allows the hypothalamus to regulate body temperature, increasing the proportion of slow-wave sleep allows maintenance of an active defense against cold without reducing total sleep time.

SPACE SCIENCES

From the annual meeting of the International Astronautical Federation in Anaheim, Calif.

Space colonies and the law

The concept of permanent colonies constructed in space raises a number of unusual legal questions regarding property rights, sovereignty and other issues. Although such colonies are probably several decades away, the years of wrangling that have gone into the Outer Space Treaty of 1967 and the still-unratified Draft Treaty Relating to the Moon have prompted some legal researchers to take an early look at possible snags.

The currently most-discussed colony concept—that associated with Princeton professor Gerard K. O'Neill—would be preceded, for example, by the establishment of a facility on the moon to extract and deliver about 12 million tons of lunar material to the colony site for construction and other purposes. According to Stephen Gorove, chairman of the Graduate Program in Law at the University of Mississippi, the draft version of the lunar treaty stipulates not only that the resources of the moon are the "common heritage of all mankind," but also that a state establishing such a facility is to use only the area required for the needs of *that station*. Some feel, says Gorove, that the "common heritage" reference bans any country from transferring such resources, to the earth at least, for its own exclusive profit, leaving final authority to some international regime that remains to be established. If lunar resources are deemed to be less than inexhaustible, he says (and the squabbles over seafloor mining rights raise that possibility), there may also be a ban in the language of the existing Outer Space Treaty.

Sovereignty of and responsibility for the space colony itself raise additional questions. The Outer Space Treaty regulates objects and personnel launched from and returning to the earth, Gorove says, but it has not yet been interpreted with regard to objects launched from either the moon or a space colony, nor to the actions of people who live on a presumably permanent—and thus perhaps independent—installation in space.

One proposal for dealing with such issues is the establishment of an international "Committee on Cosmic Enterprises," suggested by Laurence M. Berlin and Leslie I. Tennen of the University of Arizona College of Law in Tucson. To be closely affiliated with the United Nations, such a body "must have broad jurisdiction and should be the sole coordinator for all major space activities emanating from earth," complete with authority to act in emergencies, independently of the UN Security Council. Direct-broadcast satellites, air/space sovereignty questions and similar matters would be much of the committee's concern, the authors suggest, but "it is clearly time for lawyers interested in the development of the future of outer space to take the initiative and lay foundations for a comprehensive, coordinating agency for cosmic affairs."

Orbiting vacuum facility proposed

An ultrahigh-vacuum facility in orbit, capable of sustaining vacuums with fewer than 1,000 molecules per cubic centimeter, has been proposed for such applications as the production of extremely pure materials and vapor-deposited devices such as solar cells. The facility, which could be deployed either on a long boom from the space shuttle or as an independent satellite, would consist primarily of a hemispherical shell whose open side would face away from its direction of travel in orbit. Experiments mounted within the shell would be subject to gases given off by the inside of the shell, as well as by the equipment itself, says Leonard T. Melfi Jr. of the NASA Langley Research Center, but selected materials and altitudes should keep the total within the 1,000-molecule threshhold.