Meditation: Let's sleep on it

Transcendental meditation, or TM, has become a household word and a big-time, big-bucks operation during the past several years. One reason for its success is that TM, as brought to the United States by Maharishi Mahesh Yogi, has received considerable support in scientific literature. Beginning in 1970, respected journals (SCIENCE, SCIENTIFIC AMERICAN, the AMERICAN JOURNAL OF PHYSIOLOGY) published reports suggesting, among other things, that TM brings about physiological changes that might be beneficial in counteracting the effects of stress. Among the changes reported were reduced oxygen consumption, increased skin resistance, increased alpha activity, decreased heart rate and decreased blood lactate. Now some researchers are taking a more critical look at meditation.

TM and a variety of meditation techniques have been around for a long time, especially as a part of Oriental philosophies. But no matter what its beneficial effects might be, meditation never really caught on in the West until science added its stamp of approval. With scientific evidence to back some of their claims, the teachers and sellers of TM in the United States increased their following phenomenally. From a few hundred in 1965, the number of TM practitioners grew to 240,000 in 1973 and to a present estimate of more than 900,000 (according to the TM organization).

While some research has challenged the results of previous physiological studies, the relaxing effects of TM seem to be confirmed. An ongoing reassessment of TM, however, coupled with more rigorous research, suggests that there is still much to be learned about meditation. One question has to do with the causes of the reported physiological changes. In the Jan. 23 SCIENCE, it is suggested that these changes are not the direct result of meditation but possibly of sleep during meditation. The work was done by Robert R. Pagano, Richard M. Rose, Robert M. Stivers and Stephen Warrenburg of the University of Washington in Seattle.

Five meditators, four of whom were teachers of TM and all of whom had more than two and a half years' experience with the technique, took part in the experiment. During 10 daily sessions, physiological measurements were made. At five of the sessions, the subjects were asked to meditate in their accustomed sitting position. For the other five sessions, they were asked to nap, lying down on a bed in a dark room. The subjects did not eat or take coffee or tea for two hours before each session and did not participate if they had not had a normal night's sleep.

"The most striking feature of our data," report the researchers, "is that meditators spent appreciable amounts of time in EEG sleep stages 2, 3 and 4 while they were meditating." According to conventional EEG sleep designations, the meditators were asleep, on the average, 40 percent of their meditation time. When meditation and nap sessions were compared, no significant differences were found for amounts of time spent in sleep as measured by EEG.

What the researchers did find was a high degree of variability in the time spent in different EEG stages, both for a single subject (from meditation to meditation) and between subjects. One person, for instance, slept during only one of the meditation periods. Another slept more than half the time of each meditation session. "What emerges from these EEG findings," say the researchers, "is that meditation is an activity that gives rise to quite different states both from day to day and from meditator to meditator."

It is possible that meditation produces an altered state of consciousness that allows a subject to be awake even though the EEG record indicates sleep. But this does not appear to be the case. Subjects reported having slept in 12 of 13 of the meditation sessions in which EEG sleep patterns appeared. Subjects further reported, after 7 of 13 sessions during which sleep stage 2 was observed, that the meditation had been typical.

The researchers caution against the conclusion that meditation and napping are the same or even produce identical distributions of EEG stages. Instead, they suggest that the meditation period is not spent in a single, unique, wakeful, hypometabolic state—as some earlier researchers have claimed. And it is still an open question as to whether the beneficial effects reported for meditation are due to the sleep that occurs during meditation or to some other function of the process. □

How ribosomes help make proteins

Although ribosomes are among the cell's most crucial chemical machinery, constituting one-fourth its mass and churning out polypeptide chains every 10 seconds, molecular biologists have had trouble uncovering their actual mode of operation. Now a major advance in understanding what goes on—specifically, how a molecule of messenger RNA interacts with the ribosome at the beginning of polypeptide chain manufacture—has been made by Joan Argetsinger Steitz of Yale University and Karen Jakes of Rockefeller University.

They report their findings in the December PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. As Steitz told SCIENCE NEWS, "We consider this an important conceptual as well as technical advance."

Not until the early 1960's did biologists really unravel the genetic code, that is, find that genes are made of molecules of DNA in the cell's nucleus. Then they discovered that a molecule of DNA passes instructions for the manufacture of a polypeptide chain, the basic constituent of proteins, to a molecule of messenger RNA. The mRNA catapults out of the nucleus into the cell's cytoplasm, where it attaches to a ribosome. The mRNA moves across the ribosome, reading off its genetic instructions for a polypeptide. Molecules of transfer RNA then arrive on the scene. One by one they attach to the ribosome-mRNA complex, and, according to mRNA instructions, each deposits an amino acid. The ribosome then links the amino acids together by covalent bonds—and lo, a polypeptide chain is formed.

Precisely how the mRNA and ribosome interact to start making a polypeptide chain, however, eluded molecular biologists. They were sure that the mRNA attaches to the ribosome, but they were not sure to what part. Was it the protein subunit or the RNA subunit? They were inclined to favor the former. Then two Australian investigators suggested that it was probably the RNA subunit, and that ribosomal RNA and mRNA actually come together to make a double helix, their nucleotide strands complementing each other just as two nucleotide strands complement each other in the double helix of a DNA molecule.

Steitz and Jakes tested this hypothesis, using bacterial and bacterial-virus RNA's, which are far less complex than those of mammalian cells. And indeed, the researchers have now provided the first experimental evidence that the mRNA and rRNA do come together in this manner. The complex spans some 30 to 50 nucleotides, and it appears to be maintained by hydrogen bonds at seven of the nucleotides.

The reason, Steitz explains, that she and Jakes were able to demonstrate that this complex exists, is not that they used any exotic techniques but rather that they believed that the hydrogen bonds holding the two RNA's together would be tough enough to withstand analysis. Their conviction paid off; they were able to confirm the existence of the elusive complex.

The question of whether mRNA and rRNA interact has now been satisfactorily resolved, they believe. Still, they admit that more remains to be learned about the role of ribosomal proteins and other protein factors during the beginning of polypeptide chain assembly, as well as about the fine interplay of mRNA, rRNA and tRNA's during such assembly.

"We also have to find out whether ribosomes in mammalian cells behave just as they do in bacteria," Steitz says. □