stimulation—activate muscle fibers needed for quick action, such as lifting weights, throwing a rock or running after a purse snatcher. But do different patterns of nerve stimulation (electrical stimulation) affect muscles at the biochemical level? And if so, how? This is what Riley is trying to determine. He has made progress in that direction, thanks to his feline charges.

He stimulated the nerves innervating the muscles in the cats' tails. The nerves in turn stimulated the muscles, as they normally would have had they not been silenced. He used either tonic or phasic electrical programs, and found that both kinds of stimulation affected the muscle fibers at the biochemical level. The patterns activated the specific energy-deriving enzymes that one would expect.

Tonic bursts activated oxidative enzymes. These are the enzymes that, with the help of oxygen, convert glycogen stored in muscle into ATP (energy molecules). Tonic stimulation is known to be involved in ongoing muscle activities, and oxygen is the most efficient source of energy metabolism. So understandably stimulation of oxidative enzymes would give muscles the efficient source of energy needed to carry out long-range activities.

Phasic stimulation, on the other hand, stimulated glycolytic enzymes. These enzymes can convert glycogen to ATP without the presence of oxygen. This is a much less efficient source of energy than oxidative glycolysis. Yet during rapid motion, muscles do not get enough oxygen for enzymes to use for energy conversion. So glycolytic enzymes probably have to be switched on for emergency energy use.

Although Riley's work is basic research, he thinks his findings have implications for everyday human muscle activity. "We have units of muscle fibers that are rich in oxidative enzymes, and units that are rich in glycolytic enzymes," he says. "The former are called into action for long-range muscle use, and the latter for short bursts of action. If you train for long-distance running, you call on your oxidative enzymes. If you train for weight lifting, you call on your glycolytic enzymes."

Riley hopes to look into the effects of nerve firing on diseased muscle. In chronic spasticity such as Parkinson's disease, nerves fire continuously or more often than normal. It is quite possible, Riley speculates, that an overabundance of tonic stimulation leads to the tremors (muscle contraction) associated with the disease. At first muscles fatigue from being required to continually contract. But they eventually build up enough oxidative enzymes to provide the energy necessary for chronic contraction. □

## An entire observatory under computer control

Astronomers have long used computers for computation and for such other matters as directing radio telescopes. Now the Massachusetts Institute of Technology claims the world's first completely computer-controlled astronomical observatory. It is the George R. Wallace Observatory located in Westford, Mass., about 40 miles from the MIT campus. Its director is Thomas B. McCord, associate professor of planetary physics. The observatory was dedicated on Oct. 14; its 24-inch computer-controlled telescope was turned on Oct. 31.

All the astronomer has to do is pick a star; the computer does the rest. The astronomer types identification coordinates for the star he wants into the main computer, a Datacraft 6000. The computer searches star catalogues in its memory for the location of the star. It then brings the telescope to bear on the star and instructs a slave computer to track it. Meanwhile the main computer takes data, analyzes it, performs whatever experiments the observer wants and reports back to him.

One of the main reasons for automating an observatory is the current crush on telescope time. There are many more astronomers with observations that they want to do than there is telescope time to accommodate them. As McCord puts it, "So much time must be spent positioning the telescope, aborting observations because of poor guidance, adjusting experimental instruments for each observation and recording useless data because the astronomer can't know when he has all he needs. The MIT telescope system reduces or eliminates all these problems, making it possible for more astronomers to use a single telescope."

The computerized telescope can also do some things that conventional ones cannot. It can find invisible infrared objects even in the daytime; it can conduct precise scans of the sky for mapping, and it can quickly reposition itself for multisource observations. The computer system cost $500,000, of which $300,000 was given by a retired industrialist from Fitchburg, Mass., George R. Wallace. The 24-inch telescope is not large as telescopes go, but the installation may indicate the way to go to apply computerization to larger installations. □