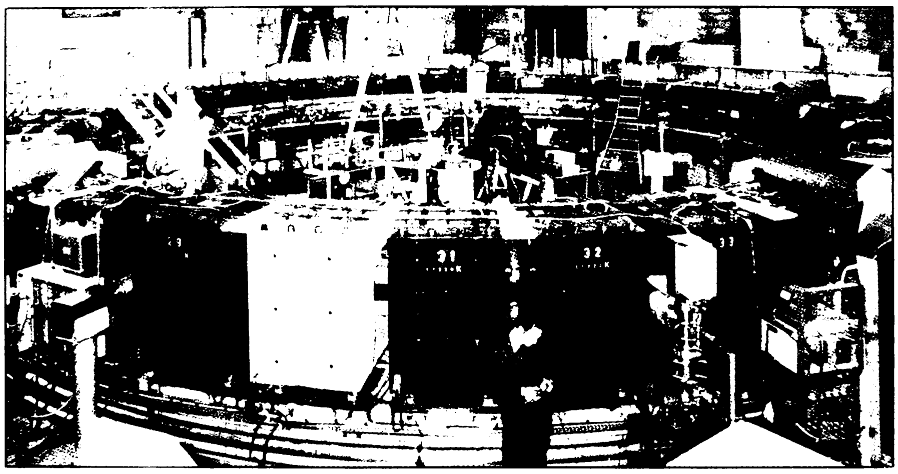

The 14-meter storage ring used 40 magnets to measure the muon's magnetic moment.

should be equal to 2. (The unit is Bohr magnetons, which relate the magnetic moment directly to other important properties of subatomic particles, but have a complicated relationship to the units used for measuring macroscopic magnetic fields.) Corrections due to the more detailed and involved theory add a certain amount, the so-called anomalous part of the g factor, to this value of 2. It is this anomalous part, or rather half of it, given by the formula $(g - 2)/2$, that is the object of measurement. The current CERN experiment makes this number, usually designated a, to be $0.001165922 \pm 0.000000009$, which, says the CERN COURIER, "could hardly be closer to the predicted value of $0.001165921 \pm 0.000000010$."

Most of this amount is due to detailed corrections to the muon's electromagnetic behavior (the so-called radiative corrections), but for two small pieces of it the effects of two other kinds of force, the weak and the strong subatomic interactions, have to be added in. The strong interaction contribution comes from the existence of "virtual hadron states"—the possibility of particles like protons and neutrons appearing out of the vacuum when the necessary amounts of energy are stored in the force fields present. This strong interaction correction amounts to 0.0000000667. The weak interaction contribution is about 0.000000002.

To such fine-pointed calculation corresponds a sharp experiment. Because the muon is a tiny magnet, its spin axis will precess (wobble) in a magnetic field just as the spin axis of a top precesses in the earth's gravitational field. For this experiment a storage ring 14 meters in diameter was constructed. Pions were led into the storage ring. The pions decay to muons, which go around the ring in a magnetic field of 1.47 Teslas. Eventually the muons decay into electrons and neutrinos. Variations in the rate of electron production depend on how the muons' spin axes are precessing, and so from the electron counts the anomalous magnetic moment can be determined. □

Spotting invaders: Which cells decide?

The body's defense against invaders enlists an army of cells. Only one type of cell produces the antibodies that immobilize invaders, but other cells assist in the action. Researchers are asking which cells call the shots in the complex defense strategy. New evidence indicates that even the macrophage cells, formerly thought to simply grab molecules and present them to more discerning cells, have a say in which foreign molecules are recognized and attacked.

Instructions for recognizing invaders are coded into a cell's DNA. Biologists have identified specific genes that control the immune response to certain foreign molecules. Normally all the cells in the immune system would contain the same genes, and thus would agree on which molecules should be attacked. However, in laboratory experiments investigators can mix cells from animals carrying different genes. Then the experimenters can observe the outcome of dissension in the ranks of the immune system.

Alan S. Rosenthal, Marcello A. Barcinsky and J. Thomas Blake of the National Institute of Allergy and Infectious Diseases have examined the responses of cells isolated from two different strains of guinea pigs. Although the immune systems of both groups respond to the foreign protein pork insulin, Barcinski and Rosenthal showed previously that part of the response is based on different criteria. Cells from one type of guinea pig recognize the protein as foreign on the basis of three amino acids on one of insulin's two chains, the A chain. Cells from the other guinea pig strain react to amino acids in a region of insulin's other polypeptide chain, the B chain.

Now Rosenthal and co-workers report in the May 12 NATURE that macrophages appear to be involved in recognition. The researchers mixed macrophage cells isolated from one strain of guinea pig with another cell type from the offspring of a mating between one guinea pig of each strain. These offspring cells, T cells, contain genes for both criteria of recognition, so they should respond to either site on the insulin chain. In the presence of a recognized invader, T cells proliferate and help another group of cells make antibodies.

In Rosenthal's experiments the key site for the response was identified by comparing the reactions to insulin from different species (pigs, cows and sheep) that have different amino acids in the crucial A chain area, but do not differ in the B chain.

When the researchers mixed T cells that could respond to either site with macrophage cells that could respond to only one insulin site, the area recognized depended on the genes of the macrophage. Therefore, at least some of the recognition instructions come from the macrophage cells.

Although they cannot exclude the possibility that the genes involved in recognizing invaders also function in the T cells, the researchers suggest that macrophages have a fundamental role in selecting what chemical groups will be identified as foreign. Rosenthal proposes that the genetically different guinea pig macrophages either chemically modify the insulin molecule to different forms, which the appropriate T cells can recognize, or that each type of macrophage has a class of receptors on its surface that orients the insulin in a particular way, so that T cells can recognize the crucial area. □

Common death trends in early tribes

Certain groups of humans, both in North America and the Sudan between A.D. 700 and 1450, shared not only the same lifestyles (agricultural) but apparently the same death patterns as well. University of Colorado anthropologist Steven Clarke reports that a survey of data on 1,724 skeletons from five seperate populations reveals a high mortality rate among all groups between the ages of 2 and 6 (after the weaning period) and between 20 and 30.

In the May HUMAN BIOLOGY, Clarke analyzes data from previously reported studies on the five groups: Two Meinarti populations from Sudanese Nubia (A.D. 1050-1150 and A.D. 1150-1300); two groups from Dickson Mound in Illinois (A.D. 700-1000 and A.D. 1000-1350), and a Point of Pines (Arizona) population (A.D. 1000-1450).

In constructing paleodemographic life tables from the data, he found a mean mortality rate in the 20 to 30 age bracket of 24.3 percent, ranging from 13.2 to 35.6 percent among the groups. "Another trend, which is more intriguing," he says, is the "significant amount of mortality" in two to six year olds. The mean mortality in that group was 14.5 percent, ranging from 8.9 to 23.3 percent.

Clarke concurs with others that the previously recognized phenomenon of high mortality in the 20 to 30 range may be largely due to the trauma of childbirth. He notes that a larger proportion of females than males died during that interval. Warfare and/or hunting are hypothesized as contributors to the male death rate.

The anthropologist postulates that the high mortality percentage among youngsters is "the result of post-weaning nutritional stress. . . . The years immediately following weaning are years during which individuals are extremely susceptible to stress and thus an increased rate of mortality." Various types of cranial lesions—spongy, pitted or perforated skulls—were found among many of the skeletons, particularly younger ones, Clarke notes. He suggests this may be due to iron deficiency anemia, malnutrition, parasites or other nutritional, post-weaning disorders.

Clarke's work ties together the various findings of George Armelagos, Ken Bennett, Alan Swedlund and John Lallo, who performed the studies that Clarke surveyed. "More important about these prehistoric populations than their proximity in time to each other is their common [agricultural] way of life," Clarke says. The combined evidence demonstrates "the general etiology of nutritional disorder and parasitic susceptibility to all of the populations under consideration," he adds.

Clarke says that similarities in the "cultural-ecological" patterns of such early agrarian societies may have contributed to their susceptibility to certain diseases, and he suggests further studies in that direction. ☐

Ho hum–cholinergic nerves are the culprit

Urbá-Holmgren et al./Nature

Physostigmine-induced yawning in a rat.

Yawning, a universal human and mammalian function, consists of an involuntary opening of the mouth, usually accompanied by breathing. It may be a sign of drowsiness or depression and is often sparked by the power of suggestion. Frequent yawning has also been mentioned as a symptom of certain central-nervous-system diseases, notably tumors of the frontal area of the brain and encephalitis. Beyond these insights, however, little has been known about the behavioral and physiological functions of yawning.

Now some new information about yawning is reported in the May 19 NATURE by Ruth Urbá-Holmgren, Rosa Maria Gonzalez and Bjorn Holmgren of the National Center of Scientific Investigations in La Habana, Cuba. They have found that yawning involves certain nerve fibers; that the yawning mechanism matures at an early age; that it seems to be more common among males than females, and that the involved nerves are probably in the central nervous system.

During the course of research into the effects of certain drugs on infant rats' behavior, the investigators noticed that the drugs seemed to induce yawns. These were drugs that alter cholinergic nerve fibers—nerve fibers that use acetylcholine as their nerve transmitter. So they decided to further study the yawn phenomenon.

They injected one drug that affects cholinergic nerves—physostigmine salicylate—into 62 rats 1 to 90 days old. They found that the drug triggered yawns in all the animals and that yawning was dose related. This result strongly suggests that yawning involves cholinergic nerve fibers. What's more, there was a difference in the frequency of yawning among the rats depending on how old they were, with the youngest rats actually yawning more than the older rats. Whereas rats aged 14 to 90 days produced two or three yawns within a 15-minute time span after drug injection, rats under 14 days of age produced 10 or 12 yawns. So the researchers conclude that yawning must be age-related and that the yawning mechanism matures at a very early age.

Even more intriguing, they found that yawns were far more frequent among male rats than among female rats regardless of age. Males yawned an average of 3.1 yawns during the 15-minute period after drug injection, whereas females performed only 0.5 yawns in the same time span. This difference is highly significant statistically. Although it is not known whether men yawn more than women do, the investigators do point out that male monkeys have been found to yawn far more frequently at their mirror images than female monkeys have.

Finally, evidence that the cholinergic nerve fibers involved in yawning are probably in the central nervous system rather than in the peripheral nervous system came when the scientists injected another drug that alters cholinergic nerve fibers—bilocarpine hydrocholoride—into infant rats. This drug, which induced as many yawns as physostigmine, is known to pass readily into the brain. In contrast, when they injected, into infant rats, still another cholinergic nerve-altering drug that has trouble getting into the brain, it produced only one-sixth as many yawns as physostigmine had. Thus it appears that yawning involves cholinergic fibers in the central nervous system.

All of these findings should put investigators in a better position to learn still more about the role of yawns in health and disease. ☐

Third Intelsat IV-A satellite launched

The third in the Intelsat IV-A series of multinational communications satellites was successfully launched on May 26, destined to be positioned over the Atlantic off the west coast of Africa. Like its two predecessors, it uses a cross-polarized antenna design which gives it about two-thirds more communications capacity than the satellites in the earlier Intelsat IV series.

The day after the launching, the satellite's built-in rocket motor was fired to change its orbit from a long ellipse to a circle nearly 36,000 kilometers above the earth. At that altitude, because the speed of the spacecraft nearly matches that of the earth below, the satellite is drifting very slowly—about 11.5° per day—relative to the surface of the planet. It will continue to drift until it reaches a longitude of 19.5°W, where it will go into operation in August, serving the 95 nations in the Intelsat consortium.

The cross-polarization technique enables the satellite to make the most of its power by focusing on the continents instead of spreading its efforts all over the ocean. From its lofty altitude, the latest probe will be able to "see" as far west as Mexico and as far east as Iran, serving countries in Africa, the Middle East, Europe, and North and South America. It has the capacity for about 6,250 two-way voice circuits as well as two television channels.

The last of the less-efficient Intelsat IV's was launched on May 22, 1975, and stationed over the Indian Ocean. The IV-A's were launched on Sept. 25, 1975, and Jan. 29, 1976, and positioned over the Atlantic at 24.5°W and 29.5°W respectively. Each of the big IV-A's is nearly seven meters high and weighs about 825 kilograms in geosynchronous orbit. The Intelsat member nations have invested about $295 million in the IV-A program, 30 percent of which comes from the United States through its investment in its own Comsat consortium. The next largest contributor is the United Kingdom, with 10.6 percent. ☐