the first evidence that social insects use pheromones to advertise their territories and deter invasion by members of other colonies.

The colonies of weaver ants, including queens, were collected in Kenya and transported to Harvard University laboratories. There the worker ants wove their characteristic nests of larval silk and leaves on potted grapefruit and fig trees. The ants weave by holding small larvae in their mouthparts and moving them back and forth, like shuttles.

When the researchers extended the area available to a colony, ants deposited large drops of rectal fluids randomly over the new territory. Since other ant species fastidiously discard fecal material in a restricted garbage pile outside the nest, the researchers suspected that weaver ants were posting a specific scent.

To test their suspicion, Hölldobler and Wilson watched ants explore territory marked by members of a different colony. Even if no alien ants have been in the area for the previous 12 hours, the intruding ants display great caution and frequent aggressive posturing, opening their mandibles and lifting their abdomens vertically, as shown in the photograph. The exploring ants also stop often to inspect the marked spots.

The researchers observed fierce territorial battles when they allowed members of two colonies to enter simultaneously an area previously marked by members of one colony. Although in nature battles rage for hours or even days, the researchers interrupted the laboratory match after 30 minutes. At the interruption the investigators determined which side was ahead by the number of ants present from each colony and where the battle lines were drawn.

"That initial outcome is not necessarily the final outcome. We haven't followed these battles all the way through with our colonies because they're too valuable," Wilson says. "The ants look identical. The only way you can identify them is by watching where they're coming and going, the columns streaming back and forth." In all cases the initial victor was the colony that had marked the floor papers with pheromone.

The researchers determined that the territorial pheromone at least partly originates in an ant's rectal sac. They are now beginning an investigation of the chemical nature of the substance. Exactly how ants produce and recognize chemicals unique to members of a colony is one of the most intriguing problems in the study of social insects, Wilson says. He predicts the answer will include genetic factors, as well as differences in diet and even in the materials of the nest.

The question remains whether the territorial pheromone will be found in other insects or whether it is a peculiar adaptation of the exceptionally aggressive weaver ants. □

Possible heavy lepton in Russia

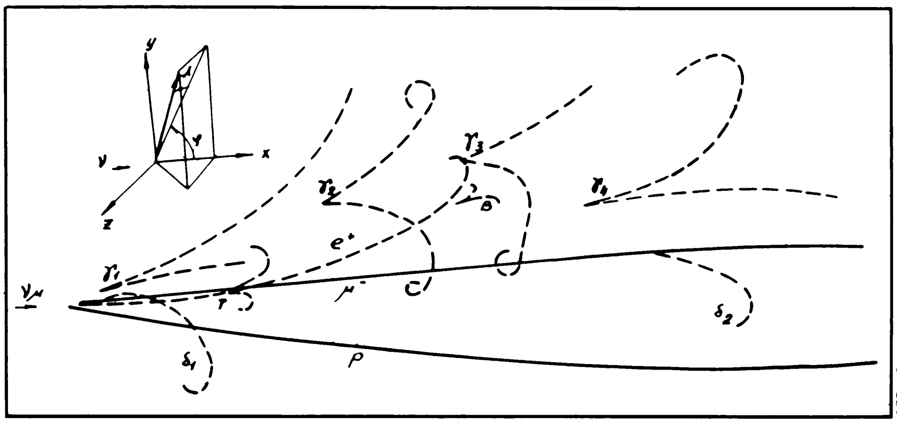

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Diagram of Serpukhov event has proton, positron (e^+), and negative muon tracks.

Heavy leptons are among the most sought-after objects in particle physics. The existence of such particles, heavier relatives of the electron and the muon, is postulated by the new unified theories that have particle physicists very excited, and a final proof of the existence of heavy leptons would be a strong point in favor of the theory. Evidence for the apparent existence of heavy leptons has recently come from laboratories in the United States and West Germany (SN: 5/21/77, p. 325; 5/28/77, p. 341). Now there is an apparent heavy-lepton event reported from the other side of the world, Serpukhov in Russia.

Serpukhov is the site of the Institute for High Energy Physics, which has a 70-billion-electron-volt proton synchrotron that was once the most energetic accelerator in the world. One of the experiments now running there uses the proton beam to make a beam of high-energy neutrinos. The neutrinos are fed into a bubble chamber full of a heavy liquid to see if and how they interact with neutrons or protons in the atomic nuclei in the liquid. The first runs of the experiment yielded about 25,000 pictures. Scanning of half of these has produced 500 that show neutrino interactions taking place. One of those 500 can be interpreted as showing the production of a heavy lepton in the neutrino-nucleus collision.

The chief reason for suspecting the formation of a heavy lepton is the appearance of a negatively charged muon and a positron, which theoretically would be the heavy lepton's decay products, among the particles coming out of the interaction. The heavy lepton suspected in this case would be electrically neutral and so would not make a track in the bubble chamber even if it lived long enough to travel a measurable distance.

The favored interpretation of the event is that the neutrino-nucleus collision produces the heavy lepton (designated M^0) and a proton plus two neutral pi mesons. The heavy lepton then decays into a muon, a positron and another neutrino. The mass of the heavy lepton would be something between 1.4 and 2.1 billion electron-volts. Its lifetime would be about 6×10^{-12} seconds.

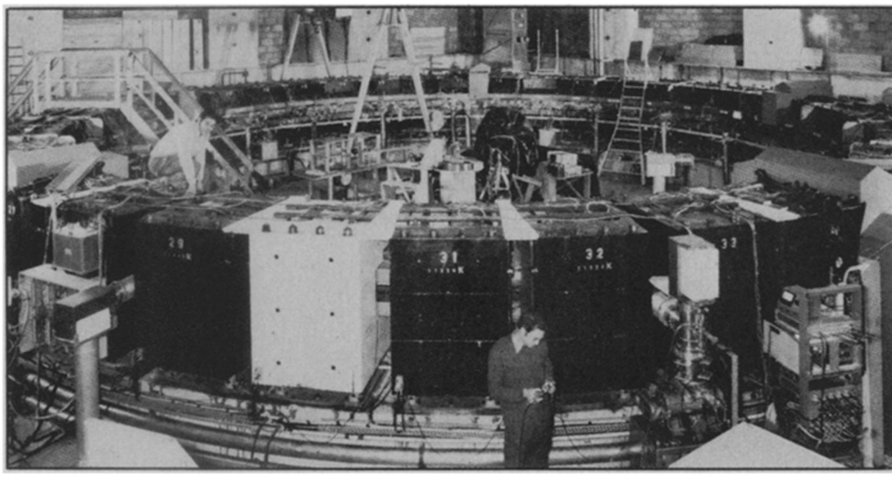
There is another possible interpretation of the Serpukhov event, which would be equally interesting to particle physicists. That is that the neutral particle produced in the neutrino-nucleus collision is a neutral charmonium meson (called D^0). (There is also American evidence for the D^0.) Any other interpretation of the Serpukhov event is judged to have a very low probability. □

New measurement of muon magnetism

Somewhere in physicsland the value of the intrinsic magnetism of the muon, the muon's magnetic moment, should be etched in stone. The number is, as the May CERN COURIER puts it, "an acid test" of the accuracy of quantum physics calculations, that is, the use of the basic dynamical theory of subatomic physics as a predictor of measurable physical quantities. The long history of experiments to measure this number has also been a strong test of experimenters' ability to devise ever more precise measuring techniques as theorists keep refining their calculations.

Over the years, one series of muon-magnetic-moment experiments has been done at the CERN laboratory in Geneva. The results of the latest one are now in, and they represent an improvement in accuracy by a factor of 38 over previous experiments. This brings the precision to a point where the effects of some very fine-scale and touchy corrections of the total number must be taken into account.

According to the simplest ideas about the electromagnetic behavior of subatomic particles, the muon's magnetic moment, usually designated by the letter *g* because its other name is gyromagnetic factor,



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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 ± 0.000000009, which, says the CERN COURIER, "could hardly be closer to the predicted value of 0.001165921 ± 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,