with positrons of the same maximum energy, making a maximum total energy of 7 GeV. Modifications to the radiofrequency units that accelerate the particles, the magnets that bend and focus their paths and the operating procedure, yielded total energies up to 10 GeV.

The improvements were completed in April and the upsilon search began. In the changed arrangement DORIS operates as a single ring, rather than a double ring. One bunch of electrons and one of positrons circulate (in opposite directions) in a single ring and collide at two "interaction points." So two detectors, PLUTO and DASP, were set up. Success came quickly enough that Burton K. Richter of the Stanford Linear Accelerator Center in California could mention it in his talk on electron-positron facilities at the American Physical Society meeting in Washington at the end of April. Now further data are available, and an announcement from DESY states that the upsilon "has now been produced for the first time in electron-positron collisions, where it can be studied much better [than in proton-nucleus collisions]."

The "PLUTO collaboration" (Ch. Berger of the Technical University of Aachen and 46 others) and the operators of DASP (C. W. Darden of DESY and the University of South Carolina and 14 others) are publishing separate papers in PHYSICS LETTERS. This does not quite amount to two independent experiments; it's more like one and a half. But the detectors provided data, which, when interpreted by the two groups, yielded identical values for the upsilon's mass: 9.46 ± 0.01 GeV.

The interpretation placed on the upsilon up to now, namely that it is a bound state composed of a new variety of quark and its complementary antiquark, is supported by the DESY results. Quarks are the objects out of which most of the subatomic particles are believed to be built. Nobody has yet seen direct evidence for a quark, but there is enough indirect evidence for them that their existence commands widespread respect, and the particle physics game nowadays is largely motivated by a desire to find out how many quarks there are and whether they behave as theory says they should.

Until the upsilon appeared, there was experimental evidence for four kinds of quark. Each kind is named for a particular property (quantum number) of particles that it represents in the Shivaistic dance of combinations and recombinations that builds up the individual kinds of particles. The four are up, down, strange and charmed. Theory right now envisions six, and to those four it adds a t quark (prosaically called "top," but the more philosophically inclined say "truth") and a b quark ("bottom" or "beauty"). The DESY interpretation agrees with that of the Fermilab discoverers in calling the upsilon a bound state of b and anti-b, although in Hamburg they say beauty, in Illinois bottom. □

Spelling out a plant disease agent

Big problems can come in little packages, or in no package at all. Viroids, which cause seven economically important plant diseases, are the absolute minimum among infectious agents. Each viroid is a naked ring of single-stranded RNA. Unlike a true virus, a viroid doesn't even have a protein coat.

The exact nucleotide sequence of a viroid, the one that causes potato spindle tuber disease, is reported in the May 18 NATURE. It has 359 subunits (only one-tenth as many RNA nucleotides as the three-gene bacterial virus analyzed previously by Belgian scientists [SN: 3/5/77, p. 148]. Within that short sequence must be all the information for the survival and propagation of the viroid.

The newly elucidated sequence indicates the structure, if not the workings, of the viroid. Earlier experiments, including electron microscopy, showed rod-like shapes. Heinz L. Sänger of Justus-Liebig University in Giessen and Hans J. Gross and colleagues at the Max Planck Institute in Munich, West Germany, now predict that structure from their sequence data. They first arrange the RNA ring to give the maximum number of stable pairs between nucleotides (as nucleotides pair in a double-stranded helix), and then they adjust their model to expose known sites where enzymes break the ring. The result is a rod in which 68 percent of the nucleotides are paired in double helical sections linked with short single-stranded loops.

So far, solving the sequence gives few clues to the enigma of how viroids work. One feature that may be important is a string of 18 purines, mainly adenosines. Gross has found similar sequences in other viroids.

Virus genetic material contains information for virus-specific proteins, but the researchers do not yet know whether viroid RNA codes for any protein. AUG, the most common "start" signal for peptide or protein production, is absent from the viroid RNA, although there are seven possible GUG start signals and six possible stop signals.

The researchers also find several aspects of the viroid structure that seem to preclude its instructing protein production. They suggest that viroids, instead, may depend entirely on plant enzymes for their replication and cause disease by directly interfering with the operation of plant components. Somewhere in the sequence of the viroid RNA are the sites for those interactions. □

Infant formulas: Threat to Third World?

Are infant formulas replacing breast feeding in the developing countries? Is such a replacement harming infants in those nations? Is the trend toward formulas in those countries due to heavy promotion of formulas by the companies who make them? The answer to all three questions is yes, according to doctors and nurses testifying last week before the Senate health and scientific research subcommittee, chaired by Edward M. Kennedy (D-Mass.). The answer to all three questions is no, according to formula manufacturers who also testified.

Ten million cases of malnutrition and diarrhea in developing countries can be attributed to inadequate bottle feeding, and most of these cases could be avoided by a return to breast feeding, charged Derrick B. Jeliffe, former director of the Caribbean Food and Nutrition Institute in Jamaica and now with the University of California at Los Angeles. One reason infant formulas can cause malnutrition among infants in developing countries, Allan Jackson of the University of West Indies in Kingston, Jamaica, explained, is that many parents in those countries cannot afford formula and overdilute it to make it last longer. One reason formulas cause diarrhea among infants in those countries, Fatina Petal, a nurse from Lima, Peru, explained, is that mothers often add polluted water to formula rather than go into the jungle, chop wood, bring it back and start a fire to boil the water. As for formula use in developing countries, it is definitely due to overpromotion by formula manufacturers, charged Navidad Clavano, a physician from the Philippines. Such companies offer cocktail parties and company plane flights to medical officers in developing countries, he said.

There is no proof that the use of infant formulas has led to a decline in breast feeding in the developing countries, countered David O. Cox, president of the Ross Division of Abbott Laboratories, which has about 10 percent of the formula market in developing countries. There is also no proof, he asserted, that formulas worsen problems presented by dirty water and unsanitary conditions. And as for formula overpromotion, Cox said his company has adopted a code of marketing ethics for developing countries designed to restrict promotion to health care officials and to affirm the superiority of breast milk for most infant feedings. Bristol-Myers Co. and American Home Products Corp., makers of infant formulas, reported similar practices.

Obviously hard scientific evidence, rather than allegations like those above, will be needed to clarify the impact of formulas on developing countries. □