call the Russian paper "titillating" and "fascinating," while also pointing out that it is unconvincing without further details.

Dr. James T. Grace, director of the Roswell Park Memorial Institute in Buffalo, N.Y., says that similar experiments have been conducted at Roswell and other U.S. institutions. But he cautions, "They were tried on very, very sick children, in only a limited number of cases, and the results are so inconclusive that we really can say nothing yet."

In animal tests, however, transplanting live cancer cells from one leukemic mouse to another has been successful. "Mouse cancers are caused by viruses and we believe the virus itself may be the antigen that stimulates an immune rejection process when it is transplanted from mouse A to mouse B," says Dr. Grace. "Though we do not know that human leukemias are virus-caused, there may be a similar response that we can capitalize on to get an effect. If it works empirically, we do not have to wait until we find a virus or identify the mechanism before we use it."

The possibility of activating a weakened immune system by specifically teaching lymphocytes to reject cancers is also being explored as a route to anti-cancer treatment. At Institut de Cancerologie et d'Immunogenetique in Villejuif, France, Dr. Georges Mathé extracts lymphocytes from leukemia patients, primes them to fight tumors by exposing them to cancer cells in culture, and then gives them back to the patient from whom they came (SN: 8/26, p. 88). Still highly experimental, the procedure shows some promise. ◇

TECHNOLOGICAL AND THEORETICAL

Gaps in high-energy physics

"There are two kinds of physicists," says Dr. H. J. Lipkin of the Weizmann Institute in Rehovoth, Israel, "STU physicists and IBY physicists." The initials stand for mathematical symbols that each group uses in its work.

Physically, the STU people use a dynamic approach; they study what happens when particles collide with one another. The IBY physicists try to predict the properties of elementary particles by mathematically grouping them in categories rather than by watching them collide. Their chief theoretical tool is the quark, a hypothetical sub-particle thought to make up other particles.

"STU physicists and IBY physicists don't talk to each other," says Dr. Lipkin. They work quite independently of each other. The analyses of STU physicists do not need quarks. If the quark people try to calculate dynamic situations using their elusive, theoretical particle, they run into trouble because the dynamic properties of quarks, especially their mass, are not specified in the quark theory. "You can make the dynamical properties be anything you want," says Dr. Lipkin. "You can fit everything and therefore predict nothing."

Physicists now believe a balanced approach, in which the two routes can be combined, is necessary. And Dr. Lipkin feels the particles called exotic resonances may be the key to the combined approach.

Resonances are extremely short-lived particles, and exotic resonances are those that would have combinations of characteristics forbidden by the quark theory.

The experimental STU approach allows exotic resonances, but none has been found. This is a lack which, in fact, is held to support the quark theory.

Dr. Lipkin feels that a higher, more complex symmetry than any now used may unite the two approaches.

The key to the higher symmetry may be the exotic resonances, Dr. Lipkin thinks. If some of them could be found at a higher order of energy and observational refinements than are now used, they might show what sort of higher symmetry is needed. But finding them requires more powerful accelerators and finer experimental techniques than are now available.

The technology gap in physics is not peculiar to exotic resonances. It is especially apparent in work involving interactions that are governed by the so-called weak subatomic force. At the Boulder (Colo.) Conference on High-Energy Physics last week there were many papers dealing with the strong subatomic force, but almost none dealing with the weak.

"I ask whether this is a sign that the weak interaction is not only weak but dying," says Dr. Lincoln Wolfenstein of Carnegie-Mellon Institute. People are rather ashamed to propose new experiments, he suggests, because it takes 10 minutes to write down a description of an experiment which would take five years to do.

The theorists of the weak interaction have worked out a theory that has done quite well as far as it goes. In their theory the action of the weak force is analogous to the already well-known electromagnetic force; electromagnetic theory is successful, says Dr. Wolfenstein, and you can repeat successes.

The theory helps physicists to understand many of the weak force processes they see, but it begins to break down in just those areas of higher order energy mentioned by Dr. Lipkin. The most striking example of this breakdown is in the failure of certain radioactive decays of K mesons to respect the so-called CP symmetry, the principle that nature is evenly balanced between matter and antimatter.

Try as they might to find evidence for breakdown of CP in any other particle event, the physicists have not found any. They now believe, in fact, that the failure in K-meson decay is connected with a very small difference between the masses of two kinds of K mesons.

This mass difference between K mesons is just the sort of thing that would appear at higher orders of energy, and some theorists feel that this particular one is fortuitously large enough to be seen at current energies. If they could find other, smaller higher-order effects, they feel they might be able to explain the CP violation and have a better picture of the nature of the weak interaction.

Here too, says Dr. Wolfenstein, the theory may not be correct but only an approximation. The real theory, supposing higher-order experiments can find it, may be quite different, he says.

Therefore physicists are waiting impatiently for the completion of the next generation of particle accelerators, one of which will be the 200-400-billion-electron volt (GeV) synchrotron now under construction at the National Accelerator Laboratory in Batavia, Ill. The 200-400-GeV machine is not expected to operate before 1972. Meanwhile there is an intermediate-generation machine, 76-GeV, at Serpukhov, U.S.S.R.

Serpukhov already gives bad news for those who would like quarks to be real physical particles instead of merely convenient mathematical counters. The latest quark experiments there, says Dr. Alan D. Krisch of the University of Michigan, who visited Serpukhov earlier in the summer, have set a much lower probability than before that free quarks exist. The probability that they will be produced in particle interactions, customarily measured as a cross-sectional area, is now down to 10^{-39} (one thousand-billion-billion-billion-billionth) of a square centimeter.

In a more hopeful vein, Dr. Krisch reports that Russian physicists at Serpukhov are eager for contact with Western colleagues and are very hospitable to those who visit. An agreement between the U.S. and U.S.S.R. Governments now makes it possible for an American physicist to go to Serpukhov for three or six months and do an experiment. It is not yet possible, says Dr. Krisch, for an American team to go to Serpukhov with its own experimental equipment as some Europeans now do. A new agreement will be necessary for that. ◇