

brought little change in results: Most of the students — black, white and Mexican American — exhibited either no change in interracial attitudes and contact or more negativism than before integration.

"The results ... indicate that desegregation had little effect on self-esteem and interethnic contact, but it did cause blacks and whites who had previously attended segregated schools to evaluate both in-group [members of their own ethnic group] and out-group members more negatively," the researchers report in the October *JOURNAL OF EDUCATIONAL PSYCHOLOGY*.

The "most important" aspect of the results, Stephan told *SCIENCE NEWS*, is that the attitudes triggered by desegregation are not necessarily aimed solely at other ethnic groups. "There are negative *interpersonal* attitudes during the first year of desegregation — they do not seem to like *people* as much," he said. The psychologist attributes much of the phenomenon to the "fallout of a tense, hostile ... situation."

Still, the data — drawn from a total sample of 309 blacks, 487 Mexican Americans and 528 whites — "show that each ethnic group had much more contact with members of their own group than with out-group members," say Stephan and Rosenfield. "Clearly, the minority students in this study have more positive attitudes toward in-group than out-group members."

The negativism was more pronounced among blacks and whites from segregated backgrounds than among those from previously more integrated backgrounds. (Mexican interethnic attitudes did not change appreciably, perhaps because those students underwent "limited" desegregation.) The researchers theorize that integration was more stressful for such youngsters. This idea seems to be supported by a recent Illinois study indicating that children who start out in integrated schools develop more positive attitudes than do those who switch from segregated schools (SN: 8/27/77, p. 133).

In personal self-esteem (which may not necessarily be related to in-group attitudes) blacks ranked the highest and Mexican Americans the lowest. This, along with similar findings in several other studies, suggests that "if it were ever true that blacks had negative self-images ... it is probably not currently the case," say the investigators.

Stephan suspects that the negativism apparent during the first year of desegregation may yield to positive changes once the school system has become stabilized — a contention that he says is consistent with the results of a six-year follow-up study of desegregation efforts in Riverside, Calif. However, because of the "sensitive" nature of Stephan's study, he says school officials in the city he examined have refused to allow him to pursue a follow-up.

"If desegregation has positive effects," he says, "it is probable that it takes more than a year or two for them to evolve." □

## Not with a bang, but a twist

The discovery that there is a dynamic operating in the history of the universe, that it had a beginning and that it may have an end is one of the two or three most significant scientific developments of recent decades. As Robert Jastrow has pointed out in more than one recent writing, it is a revolution that overthrows astronomers' almost universal preference for a static, unchanging, nonexpanding universe, and it makes them unhappy.

Unhappy though they be, astronomers now mostly agree that the universe began in the explosion of a tiny, unimaginably dense bundle of energy, the event called the big bang. There is less agreement as to how it will end. Will the expansion that the big bang started stop, and will a recollapse lead to another bang? Or will the expansion go on forever? John D. Barrow of the University of Oxford and the University of California at Berkeley and Frank J. Tipler of the University of California at Berkeley have done a study of the future of possible open, endlessly expanding universes, and, in the Nov. 30 *NATURE*, they conclude that the fate of such universes is a new version of the "heat death" propounded by 19th century natural philosophers, to which is added a new twist, a vorticity that alters the shape of the universe, turning it from a sphere to a cigar or pancake shape. (All this is in four dimensions, of course, and trying to imagine the shapes could bring heat death to the mind. Cosmologists don't. They derive numbers from equations and say "such a number means a spherical shape," "such a number means a cigar shape," and so on.)

The universe as we have it now seems to be spherical and isotropic; that is, the same in all directions. Putting it another way, the equations used to describe the relationships of things don't have to take account of the direction one looks; one can use the same relation for any direction. That is a convenient universe to live and work in, and, because it seems a highly special case, a lot of ingenuity has been devoted to demonstrating that it could come about.

Even if isotropy can come about, Barrow and Tipler show that the class of universes in which it can appear are unstable with regard to their future, and lose it as they age. As the universe gets older, matter gradually falls into black holes. Over eons of time, black holes evaporate, releasing swarms of subatomic particles. But there is no bar in general relativity against these particles forming mini black holes of their own. If a proton and an electron form a hydrogen atom, this can collapse to a black hole of its own, and, when it evaporates, two photons come out.

Ultimately everything becomes photons and neutrinos, a universe made only of radiation. This is the point of "death" where the entropy is a maximum, and the

possibility of further change is at an end. The 19th century natural philosophers had come to the conclusion that this would happen by considering the second law of thermodynamics. Barrow and Tipler use the laws of gravity and speak of the "entropy of the gravitational field." They compare their picture to Eddington's view of an ever-expanding ball of dead radiation.

But with a twist. The very process of black hole evaporation introduces a vortical instability into space and time — the intimate connections among space-time, matter and the gravitational field make such things possible — and the universe twists out of sphericity and isotropy, endlessly.

How long will it take? Bismarck is supposed to have said that if he heard the world was about to end, he would go to Mecklenburg because everything happens 50 years later there. Time depends on where you are and how you are looking. In the proper time of these universes, the time built into them and represented in their equations, the future expansion seems to go on infinitely. But if you measure time extrinsically, if you choose a "physical time" that is tied to the sequence of physical changes that take place, you can get a finite answer. Physical time may slow down with respect to proper time in the future.

One way to measure physical time is called York time, and Barrow and Tipler point out that "If York time measures physical time in the far future, then an ever-expanding universe, which exists forever in the future proper time, will continue to exist for only a finite physical time. Vaguely speaking, only a finite number of changes will occur in the future..." □

## Levich gets out

Benjamin Levich, a physical chemist who for many years symbolized the plight of outspoken Soviet scientists and dissidents, left Moscow for Vienna with his wife on November 30 — six years after they first applied for exit visas. In September, Senator Edward Kennedy met in Russia with officials to discuss the emigration of 17 "refuseniks" (Jews refused emigration) and their families. At that time, Soviet President Brezhnev promised all 17 cases would be reviewed. To date, only the Leviches, who will settle in Israel, and the Katses — now in Boston — have been allowed to leave.

Levich was told by Soviet officials only a few years ago that he could "never" leave. Robert Adelstein, a cochairman of the Committee of Concerned Scientists, credited his release to the vigilant campaign by outside scientists on his behalf. CCS is a New York-based human-rights group. □