summer of 1967 marked the reversal; Dr. King's assassination accelerates its downward course.

"The Negroes who still believed in America were those who believed in Dr. King," says Dr. Pettigrew. "For them the assassination is more crushing than for Black Power types.

"Dr. King was the only symbol of integration, black or white, who commanded the loyalty and attention of Negroes of many different political backgrounds . . . he was the only one with a span of charisma."

The terrible irony of Dr. King's assassination is that the United States was beginning to look as though it were turning a corner, Dr. Pettigrew points out. The riot commission's bold message of white racism seemed to be making a difference with middle class whites.

Suddenly the Senate had come to life with an open housing bill. Then President Johnson moved for peace in Vietnam—a move highly relevant to internal U.S. conditions; war is often the spark to second stage reversal. The poor usually suffer greater economic disadvantages from war and relative deprivation between classes is suddenly raised to intolerable levels.

"I am afraid that that Thursday night wiped out those gains," says Dr. Pettigrew. "With Dr. King's shooting, frankly, I don't have the courage anymore to stand up in front of Negro audiences and tell them to continue to believe."

The four conditions bred by progress and leading to revolt are:

- Living conditions improve at a much faster pace for the dominant group than for the subordinate group. In every realm from housing to health, the absolute gains of Negroes in the 1950's "pale by comparison" to white gains, says Dr. Pettigrew. The riot commission noted that income gaps between black and white had risen from $2,174 in 1947 to $3,036 in 1966—this despite the fact that income for both groups was, and is, rising rapidly.
- Expectations in the lower class outpace real changes. In 1963 an overwhelming majority of Negroes—73 percent of those surveyed in a national sample—thought white attitudes toward black would be better in five years. More than 60 percent expected their income, working situation and housing accommodations to be better in five years; only two to three percent expected them to be worse.
- Status inconsistencies, as between educational achievement and job level, increase. "Negro attainments in education had already exceeded occupational status in 1940 and the discrepancies have grown since then," says Dr. Pettigrew. Recent years have brought some reversal of this trend, but Negroes with equivalent education still make considerably less than whites; in a survey of Newark rioters, 70 percent felt their level of education warranted better jobs, higher wages and more responsibility.
- Members of the lower class broaden their perspective and begin to compare their conditions to those of the dominant group. Formerly, "many Negroes working as domestics knew full well the wealth of their white employers, but did not see this as a relevant comparison to their own lives," Dr. Pettigrew points out. But with migration to northern cities and mass media, particularly television, lower class Negroes now use white living standards for comparison and, in the process, discover social injustice. Life in a northern ghetto opens up just enough slots to reveal the promise of American life; not enough slots to reach it.

Whether these conditions find their complete expression through looting and violence now hangs in the balance. Social scientists have been predicting interracial war as the next grim step and have believed that violent reaction among whites will be the instrument of that war.

This notion, however, is challenged by Dr. John P. Spiegel, director of the Lemberg Center for the Study of Violence at Brandeis University, as a "common fantasy." The Lemberg Center, with a range of research projects underway and data on close to 200 disorders, is one of very few research facilities geared to continuing study of social violence. "I'm inclined to think interracial war will not happen," says Dr. Spiegel. "Black people are not that interested in violence. Whites aren't all that interested either." Some white gangs might be ready to make trouble, but Dr. Spiegel believes local police will restrain them. Moreover, he says he does not find widespread evidence of police departments gearing for battle.

But Dr. Pettigrew suggests another possible outcome of the current crisis.

Negroes can move toward whites, against them or away from them, says Dr. Pettigrew. If they find riots do not work better than the Civil Rights Movement, they could well withdraw into worsened social conditions, alcoholism and addiction. Withdrawal will come, he says, if the country does not move to close gaps between black and white—a prediction much like the riot commission's grim forecast of two societies, separate but unequal.

Dr. Pettigrew draws his conclusions from a long history of developing social theory. From that background, he was able to answer the question, "Why the 60's?" and add a perspective not found in the commission's report on civil disorders.

But in no way does Dr. Pettigrew's analysis change conclusions reached by the commission, for the simple reason that both recognize the same central theme of civil crisis in the United States —the existence of mass relative deprivation, created and extended by racial prejudice.

The commission reached this conclusion through techniques more akin to journalism than social science. Although it employed social scientists in the riot investigation, the two did not work well together *(see page 386).*

PULSARS

The continuing search for an explanation

Even though many astronomers are willing to accept them as pulsating white dwarf stars (SN: 4/6 p. 326), new suggestions regarding the nature of the recently discovered pulsating radio sources are still coming in.

One of the first theories, now somewhat rejected, was that the objects, whose radio output pulses once in about 1.3 seconds, were neutron stars.

As if one neutron star apiece weren't enough, a group of Cambridge University astronomers now suggests that each of the strange sources consists of two neutron stars—rotating rapidly around each other. Drs. William C. Saslaw, John Faulkner and Peter A. Strittmatter propose this in the March 30 NATURE.

The sharp increases in radio intensity recorded from these objects is due, the Cambridge astronomers say, to a gravitational lens effect. When one component of the binary passes in front of the other, its intense gravitational field will bend and focus the other's radiation.

The stable periodicity of the pulsation would result from the stability of the system's rotation. To get the proper effect, the authors figure, would require a pair of bodies, each with a mass half of the sun's, rotating around each other at a separation of about 3,000 kilometers. The period of rotation would be once in three seconds to yield radio pulses at about 1.5 seconds.

The orbital speed of the stars would be about one percent of the speed of light.

But when they had this figured out, Dr. Saslaw and his colleagues discovered that bodies of this size going around as fast as this would radiate gravitational waves at a furious rate.

The gravitational radiation would carry a great deal of energy from the system, causing the two stars to grow closer together. As they got closer their rotation period would change. This would change the frequency of the radio pulses, an effect that is not observed.

To save the situation they propose that orbits of the binary stars should be gravitationally quantized as the orbits of electrons in atoms are electromagnetically quantized. A series of discrete stable orbits would be allowed, and when they were in these orbits they would not radiate gravitationally.

A similar idea saved atomic theory at a time when classical electromagnetism predicted that electrons revolving around nuclei would radiate electromagnetic energy the same way as the binaries are supposed to radiate gravitational energy; this would cause the atoms to collapse. Atoms manifestly do not collapse, and the quantum theory was invented to explain why.

Quantization of gravitational effects is accepted by modern theory, but the quanta are supposed to be so small that their effect on systems like binary stars cannot be observed. What Dr. Saslaw and his colleagues propose is to change the basic theoretical size of the quantization so that it should show up in such systems.

Another theory of the pulsating sources—this one appears in the same issue of NATURE and is by Dr. Jeremiah Ostriker of Princeton University—uses only one star to get the pulsating effect; the one star is a white dwarf.

Other white dwarf theories assume that the whole star pulses and the pulsations in radiation output come from pulses of the star's mass. Dr. Ostriker suggests that the white dwarf doesn't pulse at all. Instead it has a radio bright spot—like a sunspot or something similar—that is carried around by rotation of the star. Earth-based telescopes receive bursts of radiation when this spot points at us each time around.

Dr. Frank Drake, director of the Arecibo Ionospheric Observatory in Puerto Rico, doesn't really believe any of it.

His data, he said last week at the American Geophysical Union Meeting in Washington, is strongly against such pulsar explanations as intelligent civilization, rotating stars or binary stars and "completely kills gravitational focusing."

He has no pet model of his own, but will hold still for a pulsating object of any type, including a neutron star or white dwarf. At least one member of the present Cornell group, however, Dr. Thomas Gold, is holding out for a rotating neutron star, with a sunspot like Dr. Ostriker's dwarf. ◇

BLACKOUTS

Human error; slow construction

Electric power is such an integral part of American life, that, to keep the nation functioning, the supply must be reliable. Two incidents in recent years have shown that it isn't, and that local breakdowns can black out large areas.

Last week the Federal Power Commission reported on the latest of the major blackouts, which pulled out the plug in large parts of Pennsylvania and New Jersey and parts of Maryland and Delaware on June 5, 1967. The cause: human error, compounded by systems inadequate to carry extra loads and protect against emergencies.

The June failure started when too much power was inadvertently switched into a high-power 230 kilovolt line between Nottingham and Plymouth Meeting, Pa., carrying power from the Conowingo plant. The overload on the line caused it to heat and sag; at one point it shorted on a nearby low power-line.

When the line shut down, power from four big generators at Muddy Run had nowhere to go. Ironically, the four-state system was on the point of hooking in a 500-kilovolt transmission line which had been delayed in construction past its scheduled 1966 completion. The Muddy Run plant was only temporarily on the Nottingham line, but when that line closed, the plant was automatically shut down.

At this point, the disadvantages of big, interconnected power systems suddenly outweighed the advantages.

Two economic factors have led American power companies to band together in these big regional service areas. Since peak demands vary from time to time and place to place, a station not marketing its full power locally at any one time can send it along to another area that has a big demand. Interconnected systems also allow companies to build very large generating plants, which are more economical than smaller units. In addition, a failure in one area can be, and often is, replaced by another station without any loss of service.

When increased power is demanded from a station, its generating turbines slow down, and the frequency drops from 60 cycles per second. This can be corrected by stoking the furnace a bit (or increasing the water flow in a hydroelectric plant).

But if the drop is too much or too sudden, it can damage or destroy the generator. In that case, safety devices shut the plant down first.

When the Nottingham-Plymouth Meeting line went out, it put a strain on a system that was already operating close to the edge of collapse. Incomplete transmission lines designed to take the load off the Nottingham line, were paralleled by unfinished generating units, totalling 2,440 megawatts.

As a result, some power stations connected to the pool started disconnecting automatically to keep from being shut down by excess demand. An isolated area, including Philadelphia and Newark, suddenly had to depend on its own generating capacity alone; the demand was too great, and within eight minutes of the first disturbance, the whole area was shut down.

Startup of the system was made fairly easy since the generators which had cut loose from the pool remained in operation and were available to provide priming power to get the knocked-out turbines turning again. But disturbingly, a second switching error caused another cascade of failures two hours after the first one. Bringing restored power into the blackout area too fast, operators put too much power into a smaller line, which sagged into a tree and shorted out.

Service was finally restored completely by 8 p.m., 10 hours after the first breakdown.

Although the 1967 blackout was not as serious as the one that plunged New York, New England and Ontario into darkness in November 1965, the FPC's comments and recommendations were disquietingly similar in both cases. The earlier blackout, caused by a defective relay that incorrectly switched a big surge of current from one transmission line to another, wouldn't have happened if adequate facilities had been available.

If, instead of shutting down, generating plants could simply douse the lights in part of the system, the pool of interconnected generators wouldn't be knocked out of operation like a row of dominos. Once the emergency is over—a few minutes, usually—the partial blackout could be lifted quickly, without having to start up the turbines again. The trouble is that the domino effect takes place so fast that manual load dumping may not be possible.

The commission recommended in 1965, and repeated its recommendation last week, that automatic load dumping systems be installed. That recommendation, it reports, is being carried out, but installation is a fairly lengthy process.