a $250 million effort to promote sales.

"We believe the next step is the publication of tar and nicotine content," Gardner said. The Federal Trade Commission has a laboratory in which it plans to test all cigarettes for tar and nicotine content. Its findings will be published quarterly, indicating results by brand name. Hopefully, this will stimulate competition among tobacco companies for a "safer" cigarette, Government officials say.

Another Government report issued last week linked smoking to loss of work time. Smoking workers spend a third more time away from their jobs because of illness than nonsmokers, according to a survey conducted in 1964 and 1965 by the National Center for Health Statistics.

Surgeon General William H. Stewart announced the survey of 42,000 homes. It shows for the first time, he says, the extent of the relationship between illness, disability and smoking. Survey statistics show that smokers and former smokers of both sexes are more likely to suffer from heart disease, emphysema, sinusitis and peptic ulcers.

The Tobacco Institute, Inc. of Washington, D.C. was quick to criticize the survey, charging "most of the information in the report is based on self-diagnosis and secondhand information."

## Viruses and Cancer

Cancer researchers have entered a new round in their fight against the still elusive human leukemia.

By pitting one type of cancer virus against another, they have found new techniques that enable them to isolate and identify leukemia-causing viruses in chickens and mice. Now, they plan to use these sophisticated methods to study viruses in dogs and cats; they are moving up the mammalian ladder to their eventual goal—man.

**Striking similarities** between leukemias in chickens and mice were reported at the annual meeting of the National Academy of Sciences in Washington, D.C. "We have everything going for us to indicate that leukemias and sarcomas in several species of animals are likely to make a common pattern in the mammalian kingdom," says Dr. Robert J. Huebner of the National Institute of Allergy and Infectious Diseases. The trick is to use the sarcoma virus to reveal the presence of the evasive leukemia virus.

Leukemia is a cancer of the blood-forming organs. A sarcoma is a malignant tumor made up of connective tissue such as muscle. It is only within the last few years that scientists have shown certain sarcoma viruses, such as the Rous Sarcoma Virus, are defective—that is, they lack some genetic component essential to their ability to reproduce. The defect can be compensated by a helper virus that completes the defective virus by becoming its coat or envelope, thereby enabling it to replicate. Apparently, some leukemia viruses can play the role of helper to the defective Rous Sarcoma.

University of Wisconsin

The bottom of the research ladder.

**This knowledge,** verified by tests on chickens and mice, lies behind methods used to discover elusive leukemias. The defective sarcoma virus reproduces when wrapped in the viral coat of the leukemia virus. Dr. Huebner and others have used this test to hunt for various leukemia viruses. On a limited scale, Dr. Huebner plans to study human leukemias and sarcomas in tissue culture, though chances are slim there will be a pay off in human studies until more is learned from animal work.

## Time Reversal Search

The idea that time's direction of flow cannot be determined by any physical experiment was once deeply ingrained in the thought and theories of scientists.

That was the case until, in 1964, physicists found that time might sometimes be a one-way street. Since then, they have searched long and hard for confirmation or disproof of the indirect evidence that, under certain conditions, time has a preferred direction of flow.

**Scientists say** that time is a sequence of events that customarily follow one another. If this sequence can be made to reverse itself, as was suggested by the 1964 experiments, then to physicists and the subatomic world in which they work, time would be running backward.

Equipment is not yet sufficiently sensitive to make a direct test for time irreversibility, but experiments now underway are seeking additional, although still indirect, evidence.

At Howard University last week Nobelist Dr. C. N. Yang of the State University of New York at Stony Brook outlined four kinds of experiments being conducted at various laboratories for proof or disproof of time reversal invariance among the so-called weak interactions, such as occur in radioactive decay or when some subnuclear particles disintegrate.

All four involve the breakup of the K-2 meson, a member of the family of particles that act as nuclear glue, binding neutrons and protons together so that they form nuclei.

A different kind of an experiment looking for time reversal invariance, but in electromagnetic interactions, is underway at Los Alamos Scientific Laboratory. The electromagnetic force acts between charged particles, as in holding negative electrons in orbits around a positive nucleus.

Dr. Enloe T. Ritter reported to the American Physical Society meeting in Washington (SN: 5/6) preliminary results of experiments he and Dr. Roger B. Perkins are conducting to test time reversal in the radioactive decay of rhenium. He said that the first results from a month's run suggested that time was not reversible in this electromagnetic reaction. The experiment will last a total of six months.

All the fundamental laws of physics, including relativity and quantum mechanics, are time-reversible. That is, the same physical laws apply whether the sequence of events runs backward or forward, in somewhat the same sense that actions in a motion picture are reversed when the film is run backward.

**That time is not reversible** is difficult for scientists to believe. There is "no conceivable proposal" to cover such an eventuality, says Dr. Yang.

Until 1957, scientists had considered three symmetries to be inviolate. They believed reactions between nuclear particles could not be distinguished from their time-reversed, antimatter or mirror images. This is called the CPT theory.

The C, or electric charge, is a way of distinguishing matter from antimatter. The P, or parity, tells right-handed from left-handed, and the T, or time, distinguishes the direction in which a sequence of events occurs.

Then scientists discovered in 1957 that a particle and its mirror image do not follow exactly the same rules—parity is not invariant in all cases. Dr. Yang and Dr. T. D. Lee of Columbia University shared the 1957 Nobel Prize in Physics for suggesting the search for examples of nonconservation of parity.

The shock wave following this dis-

covery soon calmed to a ripple when scientists found they could return to a symmetrical subnuclear world by considering parity and charge together instead of separately.

This was called the CP rule and it held until 1964, when doubt was cast on the CPT theory by experiments at Princeton. Scientists there discovered that the neutrally charged K-2 meson sometimes decays, in what they term a forbidden manner, into a positively and a negatively charged pi meson. This mode of decay, which was found twice in every 1,000 events is called forbidden because it should not have occurred at all—it violates the CP rule.

Since CP and T are interdependent, violation of one could not have occurred unless the other had also been violated. It is an effort to confirm this hypothesis that is the focus of the current experiments.

## SST Flies to Hill

Four months after the winners were picked in the expensive, hard-fought supersonic transport contest, President Johnson finally moved on April 29 to award the prizes: contracts to build two prototype aircraft that will ultimately cost at least $1.2 billion. Two days later the official documents were signed by the Federal Aviation Agency, and Congress began to consider whether or not to appropriate $198 million as the Government's share in the next phase of development.

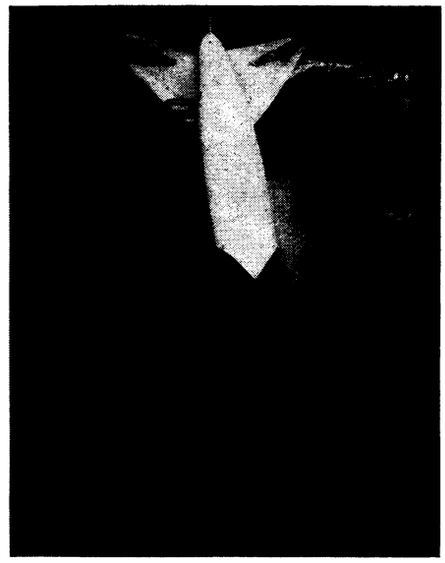
**If the President** spent his four months as well as some observers think he did, Congress's decision is almost a foregone conclusion. Though the SST program is a controversial one, its promise of improving the U.S. balance of payments by some $15 billion, combined with substantial lightening of the Government's cost burden in the program since the contractors were chosen last December, give the SST an excellent chance of flying through Congress at supersonic speed.

One gain made by the President in the pre-announcement negotiations was that if costs rise above present estimates, the Government, which presently foots 90 percent of the bill, leaving the rest to the manufacturers, will cut its share back to 75 percent. In addition, both prime manufacturers—Boeing for the airframe and General Electric for the engines—have agreed to forego the 10 percent management fees they had originally asked until the Government's investment is entirely repaid.

**The SST still faces** a major problem, however, in its own sonic boom. Redesign of leading wing and tail edges along with other modifications has slightly reduced the strength of the boom, but even Transportation Secretary Alan Boyd admits that if the sonic boom proves to be an insurmountable problem, the SST will have to be confined to flights over uninhabited areas.

Even if it is limited to over-water flights, the SST could pay for itself. The Government's break-even point is 300 aircraft, which conveniently matches Boyd's estimate of the plane's minimum likely sales in the event that it is used only for transoceanic runs.

The first prototype flights of the SST are expected to be made during 1970, with commercial service beginning four years later. The aircraft has been designed to carry from 300 to 350 passengers at 1,800 miles per hour. Boeing was selected over Lockheed (SN : 1/14) largely because of its greater commercial jet experience and because its variable-sweep wing design offered



Boeing

SST—The prototypes are coming!

slower takeoffs and landings and less noise around airports than Lockheed's "double delta" system.

**The U.S. SST's chief rival** will be the European Concorde, which, because it will be made of aluminum instead of titanium, will be limited to about 1,400 mph. In addition, the Concorde will be a much smaller aircraft, carrying only 141 passengers, fewer than some U.S. Boeing 707 and Douglas DC-8 jetliners. The Concorde has a commercial advantage, however, in that it is expected to be on the market as much as three years before the U.S. version. The Russian Tu-144 is little or no commercial threat in the U.S., since airlines here could not under present restrictions buy one even if they wanted to (SN: 3/18), but it could make a dent in the foreign market, which so far accounts for 58 out of 113 planes ordered. Boeing has predicted a market for as many as 1,200 U.S. SSTs.