tively normal tissue of the transplant and the sick environment of the patient, says Dr. Kayhoe, is a "very sophisticated research problem." So far, he says, physicians have not had long enough experience with enough transplant patients to draw reliable conclusions.

An immediately practical consequence of what Dr. Barnard says is that surgeons may not need to be so rigorous in selecting young donors if other factors, such as tissue type, are favorable.

"It was thought at the beginning," Dr. Barnard says, "that we needed young donors. But there is no real need for this, as a transplanted heart will last only five years. So we can use donors of 50, as long as their hearts are functioning normally."

(Meanwhile, in both Houston, Texas, and Sao Paulo, Brazil, surgeons performed unprecedented quadruple transplants of organs from single donors. In Texas, a 60-member team under Dr. Michael E. DeBakey used the heart, kidneys and one lung from a woman suicide.

In Sao Paulo, another gunshot victim provided a heart, kidneys and a pancreas for four patients in Das Clinicas Hospital.)

DISEASE DYING OUT

Cannibalism may spread kuru

Kuru, the fatal nervous system disease found in the Fore tribe of New Guinea is now dying out—as cannibalism declines.

Dr. R. W. Hornabrook, director of the Institute of Human Biology of New Guinea, says he is convinced the disease arises from ritual cannibalism, which has been disappearing from the highlands of eastern New Guinea since missionaries came.

When kuru first was found among the Fore tribe it was thought to be a genetic disorder because of the limited area in which it spread. But later research showed that it occurred occasionally among neighboring tribes and also among women who married into the Fore tribe. Doctors also were puzzled by the fact that after about 1960 virtually no children appeared to contract the disease, although earlier it had been common among them.

Anthropologists traced the course of the epidemic and established that it spread at a constant rate through the tribe. Although there has been no airtight evidence to prove it, a number of doctors have concluded that kuru was transmitted through the process of ritual cannibalism that required a family to eat any member who died.

Dr. D. Carleton Gajdusek, chief of collaborative and field research of the National Institute of Neurological Diseases and Blindness, Bethesda, Md., who has spent considerable time in New Guinea doing research on kuru, agrees with Dr. Hornabrook that ritual cannibalism could have played a role in the transmission of kuru.

Dr. Gajdusek, with Dr. Clarence J. Gibbs Jr., and Dr. Michael Alpers last

NIH

Human brain tissue gave chimp kuru.

year reported transmission of a syndrome closely resembling kuru in man, from chimpanzee to chimpanzee.

The affected chimpanzees belong to a large colony that had been inoculated with brain suspensions from human patients with multiple sclerosis, Parkinson's disease and other neurological ailments.

Dr. Hornabrook emphasized that kuru was the first neurological disease believed to be transmitted by an infective agent. The linkage with ritualistic cannibalism opens the way to further research on more common brain disorders, he declares.

Sir Macfarlane Burnet, Australian immunologist who won the 1960 Nobel Prize, believes, after touring the New Guinea highlands, that kuru "holds in unprecedentedly concentrated form, a manifestation of some of the most important problems in general medicine." Understanding the disease would be a major medical advance.

Kuru appears to destroy the brain in stages. First, patients lose coordination. Their legs tremble and the victim cannot stand or sit correctly. Finally there is difficulty swallowing and the patient eventually chokes to death or succumbs to starvation or pneumonia. Death occurs within a year.

Kuru is a Fore word that means trembling associated with fear or cold. Its common name is laughing sickness or laughing death, so-called because of the slack facial muscles of its victims, who seem, at one stage of the illness, to be laughing.

Investigators in England, Scotland and the United States have noted striking similarities between kuru and the incurable brain disease of sheep called scrapie (SN: 2/18/67, p. 167). Intense itching drives the sheep to scrape off their wool by rubbing against any firm object they can find. Brains of normal sheep have been injected with materials from the brains of patients who have died of multiple sclerosis, and some of them have developed a disease similar to scrapie.

The transmissible agent of scrapie is believed by some scientists to be a subviral basic protein. Others insist that the cause is a genetic abnormality.

METEOROLOGY

Hail-fighting plan

There are few meteorological phenomena in which the interplay of the macroscopic and the microscopic is more perfectly coordinated than the storms that produce hailstones. The range is from the miniscule scale of nucleation and crystal growth up to the sweeping drafts within the cloud.

Hailstorms cause between $200 million and $300 million in crop losses every year in the United States alone. The costs world wide cannot be estimated, but the economics are sufficiently severe to have caused at least five other countries to engage in large-scale projects to decrease hail.

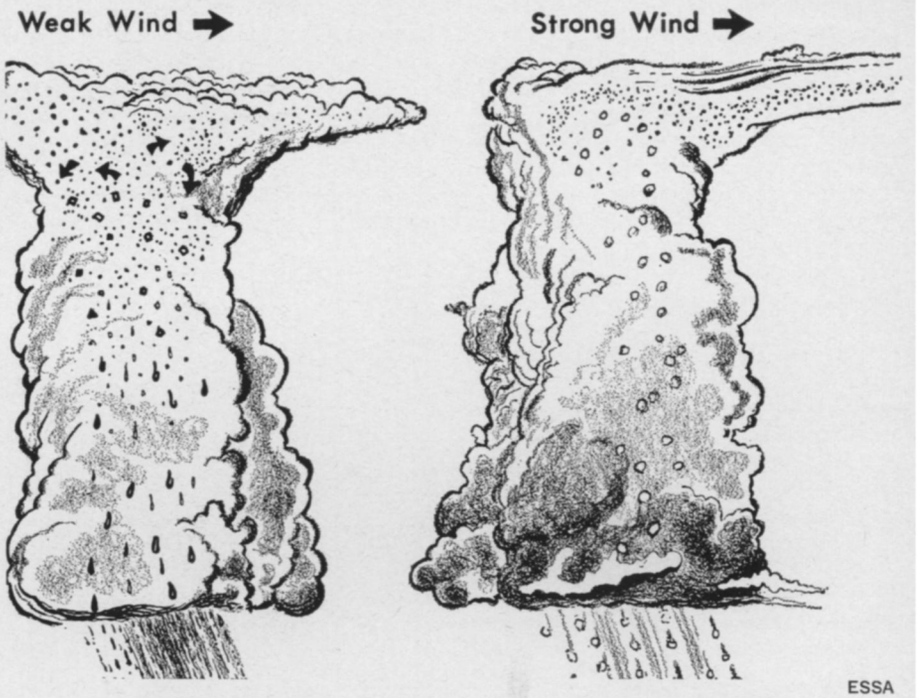
They are the Soviet Union, France, Kenya, Canada and Italy.

Until now, U.S. projects on hail suppression have been fragmented; in response to a recent request from the Federal Council for Science and Technology, the National Science Foundation has come up with a national plan for attacking the problem.

The program, developed by the National Center for Atmospheric Research, is now under review by the FCST. It calls for spending $3 million to $4 million a year during the next five to ten years, in an effort to modify hail formation.

In the pilot project next summer, Colorado State University scientists will rocket explosive nose cones into the center cell—the hail-producing core—of thunderstorm clouds. Detonation of the cones, containing lead iodide as a seeding agent, will be timed by command from ground radar.

The idea is to cause the formation of many more hailstones than would other-



ESSA

Strong winds aloft augment hail formation; weak winds give melting and rain.

wise occur, and to do this at the earliest possible time after radar shows that hail is forming, to keep the stones small.

Lead iodide is used as a seeding agent instead of the more usual silver iodide because it is easier to pack into the rocket's nose cone and disperses more readily in the cloud's hail cell.

Dr. Peter H. Wyckoff of NSF says the U.S. plan is based on the one being used in Russia, but will use air-launched rockets instead of ground-based artillery to place the seeding chemical in the cloud.

Even though no one understands why it works, the results of the Soviet's hail suppression program are sufficiently impressive to convince U.S. meterologists that this country should try to duplicate it.

In Russia, reports Dr. G. K. Sulakvelidze, director of the High Altitude Geophysical Institute at Nalchik, "hail suppression has proved very successful." This year, for instance, some 5 million acres in the southern U.S.S.R. were protected from hail by seeding.

Dr. Sulakvelidze reported to this summer's International Conference on Cloud Physics at the University of Toronto that hail damage in the protected areas had been reduced by at least 80 percent. That figure is based on comparing crop damage in two adjacent areas for which monetary losses were known for 10 years before seeding was started, when they amounted to 6.8 percent of total crop value. After the hail suppression program started in 1964, damage dropped to 0.02 percent, he said, while that in the adjacent control areas increased to 8.5 percent. Hailstone size was reduced from five or six centimeters to one or one and a half.

However, Dr. G. G. Goyer of NCAR notes, crop damage depends on other factors besides hail. Insects, diseases and winds, for instance, all have an effect. Therefore, he says, one aim of the U.S. program is to delineate a model for evaluating the effectiveness of hail suppression.

Dr. Helmut K. Weickmann, director of the atmospheric physics and chemistry laboratory of the Environmental Science Services Administration's research laboratories in Boulder, and president of the International Conference on Cloud Physics, is optimistic about the future of hail suppression over the Great Plains within the next 10 years.

He bases this hopeful outlook on an extensive field study, completed this summer, of hailstorms over the high plains of Colorado.

Rather than defining one peculiar characteristic that distinguishes a hailstorm from a normal thunderstorm, Dr. Weickmann and his co-workers believe that a number of interacting cloud properties are at work.

There are three main fields of air movement: the vertical field of motion that supplies energy to drive the storm; the horizontal field flowing into the storm, and wind shear aloft. Intensive hailstorms appear to be characterized by a strong inflow, powerful updrafts and strong wind shear with altitude.

Strong winds at the top blow off fine ice particles; only the heavier ones are left, and fall as hail. Weak winds leave the small particles in the cloud to compete for moisture so all stones are smaller and melt before they hit.

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meteorology

Gathered at the International Conference on Cloud Physics in Toronto

MODELS

Mine shafts as a physical facility

Mine shafts offer a means of simulating certain conditions in the atmosphere on a previously unavailable scale. They offer a wide range of conditions covering all the concentrations and sizes of water drops found in natural clouds.

Dr. A. E. Carte of the National Physical Research Laboratory in Pretoria, South Africa, reported his investigations of artificial rain formation in several shafts and of the fall rate of model hailstones made from polyethylene in six different shapes. He also tested replicas of hailstones of various irregular shapes, made of wax or epoxy resin.

He concludes that mine shafts are of doubtful value for studying the evolution of large raindrops formed by collision and coalescence of smaller drops. They are, however, useful for conducting free fall experiments with hailstone models or replicas.

CLOUDS

Ice crystal aggregation

Ice crystal aggregation is the result of a complicated process in which aerodynamic and electrostatic forces, as well as turbulence of the air stream, take a role, and is also affected by the variety of different shapes of the crystals themselves.

Dr. Josef Podzimek of the Czechoslovak Academy of Sciences in Prague has studied the growth of ice crystals through laboratory observations of how models of individual crystals move in a tank filled with glycerol.

In the case of two plate-shaped crystals of differing sizes, he finds that if the smaller one gets into the vortex region behind the larger one, it is drawn into the vortex and its fall slowed.

Drs. Pauline M. Austin and Michael J. Kraus of Massachusetts Institute of Technology outlined a numerical model of ice crystal aggregation based on a uniform distribution of size and type.

NUMERICAL SIMULATION

Computer models of drop formation

Progress in using computers to calculate how individual cloud droplets grow was reported by several meteorologists.

One study required seven hours on the CDC-6600 high speed computer at the National Center for Atmospheric Research in Boulder, Colo. The long computation time required for this simulation study makes it impractical to use this approach for larger cloud volume or longer times.

Drs. Pnina Kornfeld and Uri Shafrir of Tel Aviv University, Israel, and Milford H. Davis of NCAR nevertheless find their numerical experiments worthwhile:

"The extreme simplicity of this simulation process makes it possible to include additional parameters, such as turbulence, updraft and electricity, and to study their effects on the evolution of the spectrum of a droplet with time, as well as such complicated processes as charge separation."

Dr. Edwin X. Berry of the University of Nevada has devised a simple equation that summarizes growth of droplets in each of three distinct regions—the initial phase, an intermediate phase and a final one, in which the coalescence rate gradually decreases as larger drops are formed.

Dr. Berry's numerical model takes about one million computations for each time step.

Dr. Philip Duncan Thompson, scientific director of NCAR, has worked out a set of partial differential equations that cuts Dr. Berry's time for calculating drop coalescence to only 1,000 to 10,000 computations per time stage, a considerable saving in machine use.

INSTRUMENTATION

Distribution of aerosol size

An instrument adapted from the nuclear physics laboratory is making rapid determinations of the size distribution of the aerosol particles, the nuclei around which rain, hail and snow form, in the Los Angeles area.

Light reflected from the aerosol particles is registered by a photomultiplier detector; the resulting electrical pulses are amplified, then sized and counted automatically, using the physicist's multichannel pulse height counting technique.

Its advantage over previous methods is that a complete count of particles of every size can be made, which was not possible before.

Their preliminary results are still being analyzed, reported Drs. Franklin S. Harris Jr. and Frank L. Morse Jr. of the Aerospace Corporation, El Segundo, Calif.

PHYSICAL CHEMISTRY

Fertilizer proposed as seeding agent

The use of fertilizer as a seeding agent to wring rain out of warm clouds and feed crops is under study at the U.S. Naval Air Facility, Naval Air Station, Norfolk, Va.

Clement Todd says computer studies he and coworkers have made show that increasing the natural salts in warm clouds, around which raindrops form, from one part-per-million to fifty parts per million should result in rain. This level is much too low to be noticeable; as Mr. Todd points out, Colorado River water carries 500 parts per million of dissolved salts.

The idea behind using fertilizer, such as ammonium nitrate, is economic. Only a few grams of silver iodide, for instance, are needed to seed cold supercooled clouds. Warm clouds, on the other hand, need to be sprinkled with several hundred kilograms of nucleating agent before yielding rain.

Since farmers use fertilizer anyway, Mr. Todd's theory is to give a small part of it to their crops in the also-needed rain.