jointly interested in using nuclear techniques for study and control of parasitic diseases. Some vaccines produced by the use of radiation have already brought good results in animals.

In making a workable vaccine against parasites, scientists do not have a choice between killed and weakened live organisms as in polio. Killed organisms cannot be used because they do not stimulate production of antibodies.

What has been done is to weaken the parasites with a low X-ray dosage so that some of them can be used as a vaccine. They live long enough to make the vaccinated animal immune.

For several years the University of Glasgow (Scotland) has been in the forefront in perfecting a vaccine against lungworm disease. Dr. T. A. Miller of the Burroughs Wellcome & Co. Laboratory at the university, and Prof. W. Mulligan now have produced a successful vaccine against canine hookworm, soon to be on the market.

Perfection of a human hookworm immunization cannot be expected overnight, and some scientists are dubious about the element of risk in what is still an unpredictable technique, but laboratories in this country as well as abroad are at work on various methods.

Promising results in immunization against three other parasitic diseases besides hookworm were reported.

"The radiated vaccine definitely shows protection against the malarial parasites of rodents," Dr. Tromba says. "It is reasonable to believe that the methods used to produce vaccine against parasites in animals can eventually be adapted for human beings."

Immunization against trypanosomiasis (sleeping sickness in man and nagana in cattle) was reported in Vienna. The gapeworm, a serious pest in poultry, has also been conquered.

But hookworm is one of the most damaging parasitic diseases. Each female hookworm produces about 9,000 eggs a day that pass to the outside with excreta and hatch into worms. When a bare foot contacts the worms, they burrow through the skin and enter blood vessels.

The blood carries them to the lungs, where they burrow through the delicate tissue and migrate up the windpipe, down to the esophagus and through the stomach and intestines. Here they attach themselves to the intestinal wall and begin to suck blood.

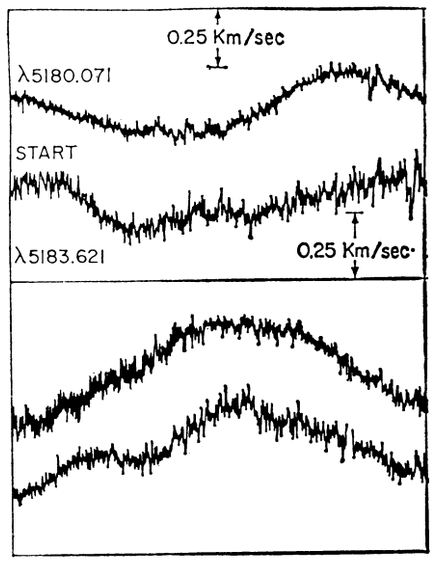
While a person seldom dies of hookworm, the parasites weaken resistance to other diseases and cause a victim to become lethargic. Treatment with drugs is possible, but the best method until now has been prevention, through sanitary toilets, wearing shoes and public education. ◈

ASTRONOMY

The Noisy Sun

In addition to pouring out an entire spectrum of radiation ranging from radio waves to cosmic rays, the sun has now been found to emit deep rumbling sound waves. The discovery may explain a long-standing astronomical puzzle.

Sound waves from the sun were so unexpected that Dr. Robert F. Howard of Mt. Wilson and Palomar Observatories first thought they were caused by instrumental or seeing defects. However, more than 250 hours of observing time, combined with analytical help from a computer and independent observation, has now convinced him that the sun radiates acoustical waves.



On the large waves, jitters of sound.

The waves are too low in frequency to be audible. They have been observed in bursts of about two minutes' duration in the hot gases of the solar photosphere, the sun's bright visible surface. Dr. Howard calls them SPO's, for short period oscillations.

The subsonic waves were detected with an instrument that records both the solar magnetic field and the vertical movements of solar gases. The motions appear as ripples, with periods of about two to three seconds, atop slower waves in the sun's atmosphere that are some 50 miles high, rising and falling at the rate of 1,000 miles an hour every five minutes.

Dr. Howard said that his observations show the ripples start at one point and spread in all directions, as sound waves should. The amplitudes of the waves are the same on all parts of the sun, whether detected toward the edge or in the center, also expected of sound waves.

There is no known connection between the large waves having a period of five minutes and the subsonic motions of two or three seconds. The mechanism that triggers the sound waves is not known, and the discovery is so recent that even speculation concerning a cause is not available.

Since the sun has acoustical waves, other stars should also have them. If they do, the sound waves may explain an old quandary—the perplexing "line broadening" observed in the spectra of many stars.

Much information about stars is contained in their spectra, which consist of the stars' light sorted into wavelengths. Superimposed on this rainbow of colors are many dark lines, each of a different wavelength and each representing a specific chemical element.

The dark lines are arranged in patterns that reveal the star's chemical composition, as well as the motions and temperatures of its gases. The puzzle has been that these lines for many stars appear to be broader than they should be, and also tend to have fuzzy edges.

A small, constant vibration in a star's atmosphere, the kind Dr. Howard found in acoustical waves on the sun, could produce this effect, thus accounting for line broadening.

Dr. Howard reported to a meeting of astronomers in Budapest on The Structure and Development of Solar Active Regions, held Sept. 5 to 8, that Dr. William C. Livingston of Kitt Peak National Observatory in Tucson had independently observed the same oscillations at the same times he had. ◈

ASTROPHYSICS

Ion Signals Across Space

Slightly less than four years ago astronomers were elated by the discovery of another chemical besides hydrogen emitting radio waves in space (SN: 11/23/63)—the hydroxyl ion, part of the water molecule.

The finding ended a long search for hydroxyl, not yet seen optically, and scientists were excited because it opened possibilities of a wide variety of new investigations of interstellar space, including charting the distribution of both hydrogen and oxygen and relating this to galactic or stellar evolution.

However, such noble goals are still distant; observations in the intervening years have continually deepened the mystery of the origin of the OH radical and the mechanism by which it emits radio waves. Little, if any, astrophysical information has resulted,

Dr. Alan H. Barrett, physics professor at Massachusetts Institute of Technology, reports in the Aug. 25 SCIENCE.

Dr. Barrett speculates that the puzzling observations could be the result of attempts at interstellar communication by some advanced, far-distant civilization. He stresses that there is "no evidence that the OH radiation is really interstellar signaling," but notes that the radio frequencies of hydroxyl "might be prime candidates for interstellar communications when one considers the following questions:"

- If one civilization wanted to attract the attention of another, what better way would there be to attract attention than to violently upset the expected intensity ratios of the four OH lines? (All observations have shown the intensities to be way out of predicted balance.)
- If the hydroxyl ion in interstellar space acts as a maser (as has often been suggested), then these frequencies would be likely ones to be used for transmitting information over interstellar distances. A maser, acronym for microwave amplification by stimulated emission of radiation, depends on the emission of electromagnetic waves by an atom or a molecule when excited by some external energy source.
- If the signals detected in hydroxyl frequencies change within periods as short as days, would this not mean an attempt to convey information?

Dr. Barrett states that the OH emissions have many of the properties originally suggested for interstellar signals, and sought in the search for such signals in Project Ozma (SN: 4/30/60). These properties are strong intensity, narrow bandwidth, origin from regions of extremely small size, strong polarization and, perhaps, variation with time.

He notes that the possibility of an accidental discovery of interstellar communications, such as with the hydroxyl ion, is rarely considered. Dr. Barrett, therefore, makes a strong plea for an international agreement setting aside the radio frequencies of the OH radical, from 1612 to 1720 megacycles, exclusively for use by radio astronomers. The 1963 convention protecting the hydrogen line frequency of 1420 megacycles contains a footnote promising that further attention would be given to the allocation of frequencies in the 1600 megacycle range at the next international conference.

Dr. Barrett's speculation is believed to be the first mention of the possibility of interstellar communication using the hydroxyl ion in a scientific journal, although there have been many reports, most recently including two in NATURE for Aug. 26, on the temperatures, motions and size of OH sources. ◈

ENTOMOLOGY

Fruit Fly Furor

The administrators and the officials wrangled, but the bugs bred happily on.

"Make no mistake," a Florida peach grower said, "the situation is desperate. We cannot understand why so little concern has been shown by both state and Federal officials."

In the 1930s the pest had vanished without human action. "We hoped this time it would also go away," said a U.S. Department of Agriculture official. But it hasn't.

The villain is the Caribbean fruit fly, a scourge introduced into Florida, where its appetite for peaches and similar fruits appears to be broadening into a taste for the state's essential citrus crops.

Appeals to state and Federal authorities for emergency action have been answered with a mild attack against the flies which the embittered growers say is "like trying to fight a forest fire with a garden hose."

This invasion of the flies was first noticed about two years ago near Miami International Airport. Apparently they were brought in by planes from the West Indies. They've since spread into 25 counties causing fruit and vegetable destruction that some growers now estimate exceeds $50 million. The bulk of this has been in private rather than commercial plantings.

A warning that the swiftly expanding Florida peach industry faces destruction unless emergency action is taken came from Tom Huston, president of Huston Research Corp., Miami; which owns 800 acres of peach groves.

"Florida's peach industry hangs in the balance," Huston said. "All peach and certainly other fruit growers, including those who raise citrus, are extremely alarmed. We cannot understand why such little concern has been shown over these highly destructive pests by both state and Federal officials.

"There's nothing to prevent this Caribbean fly from marching right on through the great peach belts in Georgia and the Carolinas. They could even spread into the fruit groves of the Gulf States and on into south Texas."

Although USDA men believed two years ago when the Caribbean fly was first noted that it could never stand even the mild winter of south Florida, it has been able to survive and even flourish with the thermometer occasionally dipping to the freezing level.

The fly was found in Florida in 1930, observes Donald Shepherd, acting director of the Plant Pest Control Division of the USDA's Agricultural Research Service. It went away by itself then, he notes.

In Puerto Rico, where it is a common pest, the Caribbean fruit fly does not attack citrus fruit, Shepherd explained. Thus, USDA officials hope it will also ignore Florida citrus. They are, however, aware of the growing danger to the peach crop.

"We're still hoping that the population will go down," he continued. "There is really no thought at this time of a program of eradication."

One hope for halting the fly's expansion came from the discovery, a few weeks ago, of several of them clearly killed by a fuzzy-looking fungus. Dr. Richard Baranowski, of the Subtropical Research Station, Homestead, Fla., identified it as Entomophthora, which literally means "insect eater." The fungus is a natural enemy of the Caribbean fly.

The dead specimens were flown to the USDA research laboratories at

Fungus-furred Caribbean fruit fly.

Beltsville, Md., where specialists confirmed the identification. Now they must determine whether the fungus kills the flies before they reach the adult stage and lay eggs that hatch into fruit-destroying larvae. If this does not occur, the fungus may be useless as a control measure.

Researchers in the USDA's fruit fly laboratory in Mexico City have been instructed to quickly try to synthesize the chemical used by female Caribbean flies as a sex lure.

Research involved could take a year or more. And with no sizeable state or Federal spraying appropriation yet in sight, any new program must be paid for at the local county level, and so will necessarily be limited.

A spraying experiment will be undertaken by a USDA plane. Six square-mile plots, each with a half-mile buffer zone between, have been laid out mainly in the city of Hialeah, adjoining Miami International Airport where the fly infestation is exceedingly heavy. The