



MIRRORS INVISIBLE LIGHT

Dr. Hammond Vinton Hayes, veteran Boston electrical engineer, adjusts his new type of radiation receiver which is more sensitive than photoelectric cells, or the best vacuum thermocouples, for invisible infra-red rays. The device makes possible signaling with invisible light. The rays are caught by the concave mirror at the left above and focused on the small cylindrical receiver. Electricity from the receiver runs through a shielded cable to an amplifying set where finally the signal is read with the microammeter on which Dr. Hayes' hand rests.

PHYSICS

Develops Ray Receiver for Signaling With Invisible Rays

A RUGGED, simple signaling device with which a mere Army private could communicate on invisible rays, a possible mechanism for detecting the presence of enemy ships off a fog-bound coast and a highly sensitive apparatus for use in atomic research are among the potentialities of a new receiver of radiation invented by Dr. Hammond Vinton Hayes, veteran electrical scientist of Boston, who was formerly chief engineer of the American Telephone and Telegraph Company.

Dr. Hayes, made cautious by a lifetime of experimental research, makes none of these claims for his new invention with the exception of the possibility of the signaling. But the implications of the discovery are clear.

Where many scientists nowadays ever seek the new to make research advances, Dr. Hayes goes back to a phenomenon first noted by the inventor of the telephone, Prof. Alexander Graham Bell. Before the meeting of the American Association for the Advancement of Sci-

ence in 1880, Prof. Bell told how incident radiation sets up compression waves in the air.

Using this fifty-six-year-old knowledge, Dr. Hayes has built a receiver of invisible heat rays which appears to be much more sensitive than highly delicate thermocouples. It can be used by almost anyone, as contrasted with the specialized technique required to perform experiments with thermocouples.

Dr. Hayes' receiver looks like an oversized tomato can in its physical appearance. The receiver's opening is placed at the focus of a concave mirror which collects the radiation energy and reflects it on the receiver. From the back end of the receiver runs a snake-like, electrically shielded cable connected to a radio-type amplifier. The amplified current can be read on a milliammeter.

The rugged receiver operates by having the incident radiation produce compression waves in air within the apparatus. These waves move a thin disk which is part of the electrical circuit.

The disk movement changes the electrical capacity of the circuit and thus varies the amount of current flowing in it. After amplification this minute change of current actuates the measuring meter.

Facing the ray-gathering mirror is the window end of the receiver, made of rock salt or other material capable of transmitting infra-red rays. The radiation, passing through this window, enters a small chamber containing a carbonized material which Dr. Hayes—for want of a better term—calls "fluff." Fluff is made by treating a pappus of a flower so that it yields a light, porous black substance that resembles soot.

Liberates Gas

Trapped by this porous material, the rays cause the fluff to liberate gas and set up compressional waves in the chamber. The waves move a thin aluminum diaphragm which is part of a standard telephone receiver. And the diaphragm's slight movement varies the capacity of the circuit as already mentioned.

Reporting his invention in the physicists' technical magazine, *Review of Scientific Instruments*, (May) the Boston scientist declares:

"The receiver is more sensitive than a photoelectric cell for waves of radiation longer than the visible (region of the spectrum) and is not affected by background light or heat, except when the background change is rapid. Moreover, it is insensitive to background noise."

For wartime signaling, it can be realized, such freedom from intense sounds in the background is a highly desirable attribute.

For use in signaling the method might well be to set up a source of invisible heat rays such as an electric heater which need not even be glowing at its ordinary cherry red temperature. Rays from this source would be focused by a concave mirror and transmitted as a narrow beam to the receiving equipment.

Interrupt for Code

Interruption of this invisible beam with the hand or a metal shield could be used to send messages in code. Movements in the recording electrical meter follow the on-and-off shutter motions.

"It is of interest to note," concludes Dr. Hayes in his report of the invention, "that the new receiver responds effectively when a body colder than the ambient temperature is substituted for the radiation source."

This might be construed to mean that one could do the signaling with a piece of ice, if necessary, (*Turn to page 352*)

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but such use would be more novel than of practical significance.

The great sensitivity of the new receiver led Dr. William M. Hall of Massachusetts Institute of Technology to develop electrical circuits with which the equipment might be used for exact, quantitative studies of radiation energy in research problems.

As an accompanying paper in the *Review of Scientific Instruments*, Dr. Hall reports his findings on experiments to test the sensitivity of the device as compared with other standard type of infrared receivers.

Dr. Hall tested the sensitivity of the device and obtained values measured in volts of electrical potential per watts of incident energy falling on a given unit area (one square centimeter) of receiver.

PSYCHIATRY

Political Control of Mental Disease Hospitals Denounced

AGRUESOME but appropriate punishment for politicians who seek to control hospitals for mental disease was suggested by Dr. Clarence O. Cheney of New York City at the meeting of the American Psychiatric Association in St. Louis. In his address as retiring president of the Association, Dr. Cheney denounced political control of such institutions in the following vigorous words:

"I have been able to imagine no more demoralizing influence to psychiatric hospitals than to have appointments made or persons removed from service because of politics.

"We do not wish to seem too harsh but at the same time we say with a strong conviction that if there is no other way for politicians to keep politics out of psychiatric hospitals, then we can only wish for them that they or their own families, visited by mental illness, would be placed in charge of those untrained, uninformed persons who have come to such a position of authority through political means. Then perhaps they would see the light and know that decent care of the mentally ill who have no votes and cannot speak for themselves is one of the prime functions of government, requiring experience and training no less than decency in those responsible for that care and that whoever has no realization of such prin-

If that sounds technical, do not worry too much about the exact way of expressing sensitivity. Scientists have to have some numerical values in order to compare different instruments built to do the same thing. And these comparison numbers have to be specified in predetermined and agreed-upon units. That is where the volts per watt per square centimeter come in.

Important are the figures themselves. The theoretical maximum sensitivity is .70 for a thermocouple with tellurium-bismuth junctions operating in a vacuum. By comparison the sensitivity of the new Hayes' receiver is 126. Thus, the Hayes' instrument is 180 times as sensitive as the best vacuum thermocouple and 900 times as sensitive as some other types such as the constant-manganin junction couples.

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ciples is unfit to represent even the lowliest in the community."

Encouraging is Dr. Cheney's suggestion that the future will see a decrease in the ever-increasing burden of state budgets for the care of mental patients.

The decrease foreseen by Dr. Cheney may come as a result of the increasing tendency to care for the mentally sick in their homes under the supervision of private physicians, clinics and public health nursing and social service. Dr. Cheney also believes that in the future more of these patients will be cared for in general hospitals. All of this will tend to reduce the number of patients to be cared for in the state-supported hospitals for mental disease.

The increase in population of these hospitals does not mean, in Dr. Cheney's opinion, an increase in the number of persons suffering from mental disease. Instead he attributes it to an increasing familiarity with mental hospital care and its possibilities, changes in economic conditions and increase of urban over rural populations.

The idea that the stress and strain of modern living has increased the amount of mental disease was contradicted by Dr. Cheney, who pointed out that there are no actual facts to support this assumption, which was brought forward as early as 1734.

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NAVIGATION

New Type of Sextant Is Suitable for Use in Air

ONLY in the last few years has aviation reached the stage where the pilot could do more than devote his entire efforts to the problem of takeoff and keeping his plane in the air.

With increased mechanical perfection and all manner of automatic apparatus to take over increasing duties of flight, the present era of aviation is marked by increasing attention to duties comparable with those of a captain on a ship at sea. Particularly has navigation—the problem of telling where the plane is over the surface of the earth—become a major job for the pilot. Moreover, navigation is an aviation problem which it seems doubtful will ever be taken over by automaton devices.

As pilots attempted navigation with the mariner's usual device—the sextant—it became immediately clear that the method, while correct, was too slow and cumbersome. Seagoing "water cooled" methods of navigation had to be replaced with speedier "air-cooled" techniques. Typical of changes made necessary is the new equipment in which a small bubble of fluid takes the place of the whole ocean. The new apparatus has been built from plans submitted by the Bureau of Aeronautics and Lieut. Commander P. V. H. Weems.

The new equipment, now used by the Government, is known as the Aircraft Bubble Sextant and is designed for "shooting" the stars and the sun when no horizon is visible.

Bubble for Horizon

A tiny bubble, inside the compact instrument, takes the place of the sea horizon. From simultaneous readings on the artificial bubble horizon and the position of the heavenly body, quick calculation deducts the position of the aircraft even though the whole surface of the earth may be hidden beneath clouds.

While designed primarily for aircraft, the apparatus, produced by Bausch and Lomb, is equally useful for surface vessels during the long period between evening and morning twilight when the stars are visible but there is no horizon, or on occasions when the sun can be seen through rifts in the clouds but there is no horizon from which to measure the angle of the sun's elevation.

To "shoot" the sun or stars with the new instrument, the observer looks through the eyepiece. There he sees the