PHYSICS

New Infra-red "Eye" Pierces Through Haze and Smoke

Combined With Telescope or Microscope, This New Device Will Find Many Scientifc and Other Uses

THE NEW super-penetrating eye of science that pierces palls of haze and smoke, which was demonstrated before the American Association for the Advancement of Science, by Dr. V. K. Zworykin of the Radio Corporation of America, will have its first use in the confines of a biological laboratory, searching out new facts about life processes.

Important military and navigational applications of this new eye of science are, however, causing excited comment among the scientists. The new device, which looks like a telescope from the outside, does its seeing by the infra-red rays that the unaided eye cannot see.

The heart of the new infra-red "eye" is a thin film of caesiated oxidized silver, deposited on a metal plate. This substance is specially sensitive to infra-red light, from the lower limit of visibility, at about 8,000 Angstrom units, down to about 10,000 Angstrom units.

When the infra-red image of some object, either giving off infra-red rays itself or reflecting them from an infra-red searchlight, is focused on this special film, it gives off a stream of electrons from all the lighted parts of the image. These shoot up a tube, passing through a series of electrically charged rings, which bends them as a lens bends light. This part of the apparatus Dr. Zworykin calls an "electron lens."

The focused stream of electrons, now arranged in image form again though still invisible, strikes on a second screen, this one covered with a fluoresent substance, working on the same principle as the ordinary fluoroscopes used in hospital X-ray rooms. This turns the invisible electron image into a visible light image, very clear and distinct. The process is thus summed up in three steps: first, the infra-red rays from the object itself; then, the translation into electrons; finally the second translation of electrons into an image in visible light.

The uses of the new infra-red "eye," in both peace and war, are manifold, though the usefulness of the device is limited to conditions under which infra-red rays will travel through the atmosphere. Infra-red will easily penetrate haze and smoke, but fog stops it because the water-particles in fog are too big to let the rays pass. They might get through very thin fog, but the real fog menaces to air and sea navigation are still baffling, Dr. Zworykin and his aides said.

Wartime uses that suggest themselves are obvious. Warship funnels and airplane engines emit infra-red rays, so even at night they can be detected. It would do them no good to screen themselves in chemical smoke, for infra-red rays pass through that easily. All that gunner, torpedo-man or bombing pilot would need do would be to aim at that spot of infra-red that betrayed hot exhaust gases. A different wartime use could be in signaling. Enemy watchers could not see an infra-red flashlamp unless they had an infra-red telescope and knew exactly where to point it.

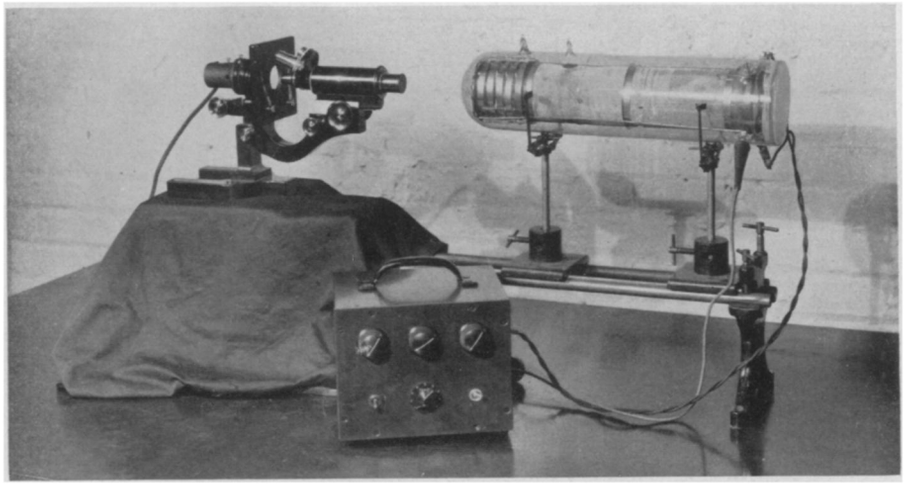
More peaceful uses range from aviation and astronomy to zoology. A series of infra-red beacons could be used as landing lights when haze obscures the ground, or the buildings or other landmarks of the airport could be floodlighted with infra-red.

Astronomers can study changes on the sun's rim during an eclipse, through haze or smoke or thin clouds that hitherto have defeated them. The device may also be used on stars and nebulae, since these also radiate infra-red.

A highly practical use that has been suggested is the detection of forest fires. Often during forest fire season in the west, the air is so thick with smoke and haze that the lookouts on their towers have a hard time telling where the fire really is. With an infra-red telescope they could sweep their horizon and actually see the flames through the smoke.

A more strictly scientific use is the one in which the device will first find employment. Many microscopic details of plants and animals are invisible under ordinary light, but show up under infra-red. Infra-red microscopes will therefore be very useful. Furthermore, many of the smaller animals are either kill by visible light or so repelled by it that they persistently flee from the microscope's field. With the new device adapted to microscopic viewing, these light-shy creatures can be studied without their knowing it.

A combined electric eye and amplifier that promises to speed television was also demonstrated by Dr. Zworykin. This device not only converts light into electricity like conventional photoelectric cells but steps up the current mil-



TO SEE DARK "LIGHT"

Dr. V. K. Zworykin's electronic image tube as used with an infra-red microscope. This same tube may be used with a telescope.

lions of times, all within a single tube.

Immediate practical applications to electrical gadgets, to television and to facsimile transmission of messages and pictures are foreseen.

The new electron multiplier works equally well with direct current or alternating current of any frequency. It utilizes what electricians refer to as "secondary emission." A stream of electrical particles is generated by light hitting a metal plate and then this electricity releases other electrons from a series of plates in ever increasing volume, all within one tube.

In one demonstration a phonograph recording was converted into fluctuating light which was picked up by the new electron amplifier some distance away in order to operate a loud speaker directly without intervening tubes.

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PHYSIOLOGY

Capacity for Work Measures Body's Resistance to Colds

A MEASURING stick for resistance to cold and possibly pneumonia seems to have been found in the capacity of the body to work. Experiments indicating this were reported by Dr. Arthur Locke of the Western Pennsylvania Hospital Institute of Pathology, Pittsburgh, to the Society of American Bacteriologists.

This does not mean that hard workers are necessarily the most resistant to colds and pneumonia, Dr. Locke explained. It is the body's ability to do work, rather than the person's inclination to work, that is important. Dr. Locke sees resistance or defense against invading disease "germs" as an activity that involves work. "Every phase of the activity which is necessary for the support of life requires an eventual expenditure of work," he said.

Rabbits able to perform quickly the simple task of warming up after chilling are also able quickly to get invading pneumonia germs out of their blood, he found.

This warming-up time is a good index of the rabbit's resistance, but it is not a practical measure of man's resistance. Instead, Dr. Locke uses for man the amount of oxygen consumed in a minute while the man is riding a bicycle as hard as he can.

The work on men has only just begun. Already, however, Dr. Locke found that persons who use about two quarts of oxygen—2,000 CC—in a minute during hard work have fewer and less severe colds than those who use less than this amount of oxygen. Because he has been able to study only 39 people during two months, Dr. Locke hesitates to draw any definite conclusions. The studies with humans will be continued during the winter.

Here, it appears, is pioneer work that may make it possible in future for patients to have a simple test of their resistance to cold and pneumonia made in the doctor's office.

What to do in cases that show a low measure of resistance is the next point to be studied. Work with rabbits suggests that the solution of this part of the problem may be concerned with diet.

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DENTISTRY

Cavities in Teeth Due To Number of Causes

CAVITIES in teeth, most frequent cause of dental woes, are not due to a single cause but to a whole complex of causes. It is worse than useless to over-simplify ideas of causes and prevention of decaying teeth, as is often done in toothpaste advertising, and in "health week" slogans as well.

This appears to be the consensus of opinion of a group of dental scientists who held a discussion of dental troubles and what can be done about them, during the sessions of the American Association for the Advancement of Science.

Dr. Charles F. Bodecker of the Columbia University dental school classified cavity causes into three groups: systemic predisposing factors such as dietary unbalance and hereditary defects, local predisposing factors such as an improper chemical state of the saliva, and the immediately exciting factors which are food retention and bacteria. The latter actually make the holes in the teeth, but can do so only if the other two factor groups have first been active.

A strong suspicion that the old-fashioned warning against too much candy really has a pretty close connection with tooth decay in children was put forth by Dr. Philip Jay of the University of Michigan dental school. Several groups of children on uniform controlled diets with little sugar, but with little else in common, had relatively little trouble with their teeth. This was especially marked in a group of diabetic children, who of course had to be kept on a minimum of sugar. On the other hand, children with free access to candy did have a good deal of tooth decay to contend with. Lactic-acid forming bacteria appear to be especially active in the presence of sugar, as enemies of tooth enamel.

The bacteria active in sore and bleeding gums are not at all the same as those connected with the decay of the teeth themselves. Dr. Theodore B. Beust of the University of Louisville school of dentistry reported a study of these troubles, in which the predominating microorganisms were bacteria of the "corkscrew" type, including spirochetes and spirilla, rather than the familiar rod-shaped bacteria of dental caries.

Glands, responsible for our bodily destiny in a thousand other ways, have their say about the development of our jaws and teeth, too, Dr. Isaac Schour of the University of Illinois school of dentistry pointed out. The principal glands whose activities in dental development have been most directly traced include thyroid, parathyroid, adrenals and the sex glands.

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BOTANY

Poison Ivy Can Have Five Leaves Too

POISON ivy, nobody's friend, occasionally tries to escape the stigma imposed by the old ready-recognition rhyme, "leaflets three, let it be," by growing five leaves instead. But without success, Fred A. Barkley of Washington University pointed out before the meeting of the Phi Sigma Biological Society.

Mr. Barkley, during examinations of many pressed specimens of poison ivy at the Missouri botanic gardens, found a number of these abnormal five-leaved poison ivy plants. Specimens grown from poison ivy seed also turned up five-leaved once in a while. But the five-leaved arrangement was unlike that of the innocent Virginia creeper or woodbine, so the deception did not work.

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