PHYSICS—MILITARY SCIENCE

Death Rays? No!

This Dreadful Weapon Will Not be Used in "Next War" Because no Ray is Known That Can Kill at a Distance

By DR. FRANK THONE

WAR rumbles persistently on the horizons of the world. Smaller nations go fighting in inaccessible places like the Gran Chaco, where nobody wants to get his boots muddy trying to stop them. Mussolini swaps support to the European status quo for permission to eat up the most ancient kingdom in the world, on the African uplands. Japan boldly filches chunks of territory from prostrate China, spits defiance at preoccupied Russia, snarls truculently at a bluffed Occident. Germany suddenly roars. All civilization has the jitters, and no wonder.

Visions of the last war are enough to give us all nightmares, at the prospect that they may become realities again with hardly a day's dazed warning. Horrible enough they are, even in fifteen years' retrospect: lacerating shellfire, choking chemical vapors, tanks like dragons breathing death, planes like evil pterodactyls swooping through the clouds, devilfish submarines, spies, lies, propaganda, hysteria and hate. Must we go through all that again?

Ah, but that isn't even the beginning of it! a whole school of prophets of the newer desolation hasten to assure us. When the world again goes to war, it will be a veritable apocalypse of unspeakable slaughter and destruction. With hoarse voices these Jeremiahs tell us, with the reddest of headlines they publish it over the land: aircraft poisoning whole cities with a few ounces of "secret" new poison gases, spy-distributed germs of a dozen deaths, "rays" (secret, again!) that will paralyze aircraft engines, detonate explosives in warships' magazines, sweep whole regiments down like flies before a flame.

Death rays seem to be a favorite stock-in-trade of the vendors of wholesale death. There is no distance too great for them, no task of devastation too impossible. Science, say these Wellsian imaginers, has already assured that the next war will be a thousand-fold worse than the last one was.

But what has science itself to say? Do the actual working physicists, to whom such almost supernatural powers are imputed, really accept this lofty though sinister compliment?

They do not.

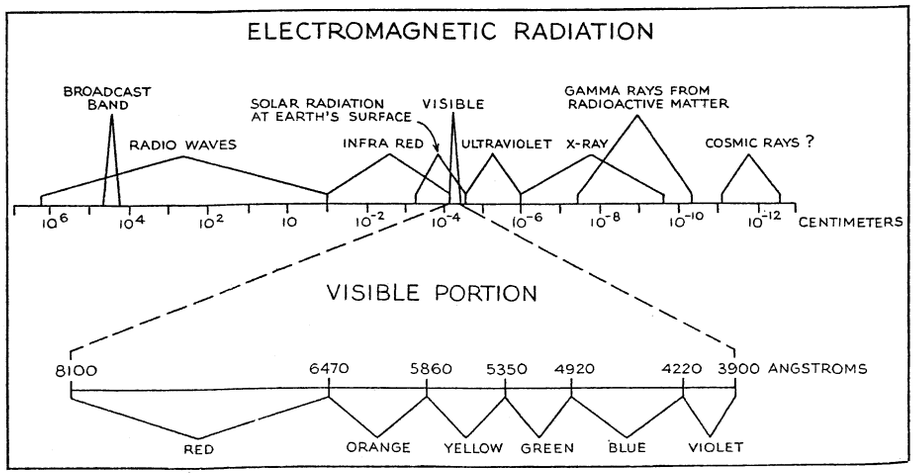
Most of them simply laugh robustly at the towering flights of fancy on the part of writers unhampered by any knowledge of science and its limitations. Some, reflective, wonder whether this persistent peddling of unreal terrors will not in the end result in a hampering of the work of science, already demanded by some of the less well-informed of humanists and legislators. But all agree in a single, forcible verdict: "Bunk!"

Not only are there no known rays that can be used to kill or destroy at a distance, but it is extremely unlikely that any such rays ever will be discovered. For scientists have made a pretty complete catalog of all possible kinds of rays, and nowhere among them is there a type that has all the requirements: long range, destructive energy at the far end of that long range, ability to pierce or break any defenses, simplicity in production, and safety to the "gun crew" directing the apparatus.

Some rays are destructive, but they are short-ranged. Some are penetrating, but relatively harmless. Some are long-ranged, but have no penetrating or destructive power. And so it goes. If a ray meeting all the requirements needed to make it even as useful in war as a small-caliber field gun is ever to be devised, it will have to come from outside the present knowledge of the combined brains of the best physicists in the world. They know of nothing of the kind, and they do not ever expect to know.

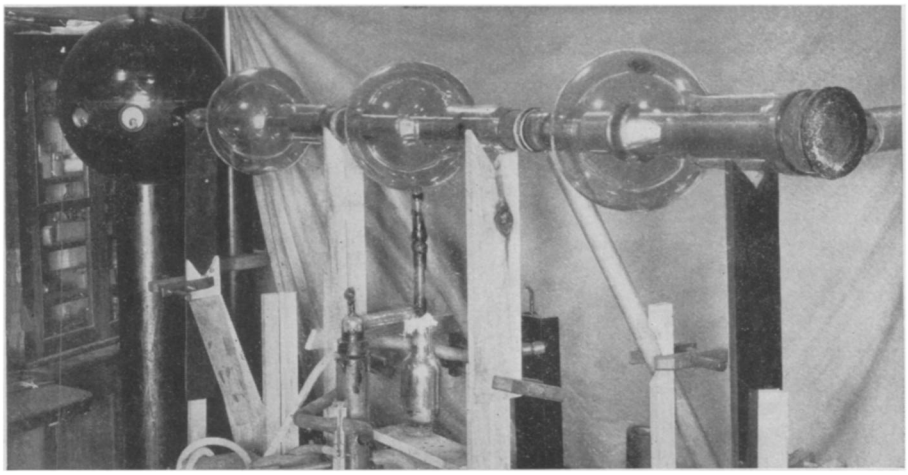
The physicists make no secret of the kinds of rays they know about, as do the proclaimers of the "secret" rays of death. They spread the catalog out, for the whole world to see, and explain each kind of ray patiently to anyone who will listen.

There are three general classes of things that may be called rays. First and largest and best known is the class called the electromagnetic waves. This includes all vibrations in the hypothetical "ether," from the mile-long radio waves through visible light out into ultraviolet, X-rays and the highly penetrating radiations known as cosmic rays. Second is a class of things that probably should be called sprays or streams instead of rays, for they consist of jets or beams of particles rather than waves like light. This class includes things never seen outside the laboratory: alpha and beta particles, electrons, neutrons and things like that. Third is a class that can be called "rays" only by courtesy; it consists of narrow beams



RANGE OF RAYS

All known kinds of electromagnetic rays are represented on this physicist's chart. None of them is in any military sense a "death ray."



NOT A WEAPON

Looking at the "muzzle" of the most powerful Coolidge cathode ray tube. Its range is only a few feet, and its construction is obviously most un-military.

of directed sound waves, and waves resembling sound but so rapid as to be unheard.

All known "rays" are included in these three classes, and there are none among them that can be called deadly, at least in any military sense.

Let us look at a few of them, one by one, in greater particular.

Suppose we start with the most familiar of the electromagnetic rays, the ones our eyes can see, which we class together as "visible light." Nothing deadly here. Light has long enough range to suit the most exacting of gunners; it goes with unimaginable speed in a direct line through quintillions of miles of space. But it kills nothing, destroys nothing.

Yet, curiously, the only successful "death ray" ever used, if somewhat hazy history can be credited, was sunlight. When the ancient Romans were besieging Syracuse (Sicily, not N. Y.), the great Greek mathematician and physicist Archimedes aided the defenders with many ingenious devices, among them mirrors, which directed the sun's rays on the Roman ships and caused them to take fire. It is not impossible that Archimedes, who was a sort of early Edison, might have known the trick of focusing light to a burning point with concave mirrors. But such use of sun-rays for death-rays was practicable only in the days of close-up sword-and-spear fighting.

Visible light is only a very small part of the whole range of electromagnetic vibrations. Beyond the dullest red that our eyes can see is a fairly wide sector of "infra-red" rays, loosely definable as heat rays. Some of these are useful in medicine; in judicious doses they bake various aches and ails out of our afflicted flesh. As with all medicines, overdoses are harmful. Too much infra-red, and you burn to death. Probably the larger part of the mischief wrought by Archimedes' semi-legendary mirrors was done not by visible sunlight but by invisible solar infra-red. But nobody has ever suggested any way of concentrating these rays at a distance with sufficient intensity to do an enemy any harm.

As visible light merges into infra-red, so the latter rays at their lower margin merge into the radio waves. These have the widest range of wavelengths in the whole electromagnetic series, from a small fraction of an inch to an extreme of several miles. Only a small fraction of known radio wavelengths are used in broadcasting. The shortest radio waves are also used in medicine, to create artificial fevers that help cure certain diseases. Presumably too much of such radio-fever might be fatal to a man. But to get such a rise in body temperature at all, the patient must be at very close quarters with a very powerful generating set. It would be too much to ask of any soldier, to expect him to walk up to a shortwave set and stand there an hour or so while it cooked him inside.

So from visible light on down to the longest known radio wavelengths, there are no death rays in sight. What about the other half of the electromagnetic wave series?

Immediately above the highest visible violet, there is a fairly wide region, the ultraviolet. The shorter ultraviolet waves are known to be distinctly harmful, even in relatively small doses. Their effects we term, loosely, sunstroke and snow-blindness. But nobody has yet devised any ultraviolet projector that will blind or knock out a man in a moment at even a moderate distance. Ultraviolet lamps will probably continue to be boudoir rather than battlefield equipment for some time to come.

Both Good and Evil

Ultraviolet, at its upper border, gives way to X-rays, which like all the rays in the series carry either blessing or bane, according to the manner of their use. They are so powerful as to be dangerous: unless the manipulators protect themselves properly. They can even penetrate metals, in their shorter, "harder" wavelengths. But they do not act quickly enough to have military value, their range is comparatively short, and they require ponderous, delicate, easily dislocated machinery for their generation. They are true death-rays in the laboratory, but not in the field.

Beyond the X-rays, and overlapping them to some extent, are gamma rays from radium. Gamma rays have also been produced by artificial laboratory means during recent years. These rays are even more penetrating than X-rays, and they are capable of doing a good deal of mischief. Only there is such a limited quantity of radium available, and it is so terrifically expensive, and the range of the gamma rays is so short, that it would on the whole probably be cheaper and more productive of results to go out and hew at your foeman's head with a battleax than to try to kill him with these rays.

Most Penetrating

Beyond the gamma ray range there are no known rays except cosmic rays. Nobody knows exactly what their wavelengths are, but they are exceedingly short—probably on the order of a millionth of a centimeter. They come from parts as yet quite unknown, but not unlikely at immense distances in space, so that their range is possibly as long as that of light. They are the most penetrating things known anywhere: they will pass through feet of solid lead, through scores of feet of water.

And they are completely harmless. Millions of them drill straight through our bodies every day, and we never feel or know it. It has even been suggested that we need them in order to remain alive.

So we have ranged through the whole known electromagnetic wave

series, and not found a possible death ray anywhere. How about the second class, the rays composed of streams or jets of atom-fragments or other minute particles?

There are a number of these, some of them of quite recent discovery, so that not all their properties are exactly known. These particle-projectiles include such things as electrons, protons, positrons, neutrons, deutons, positive ions and alpha particles. They consist variously of single fragments of atom construction (electrons, positrons, etc.) or of atoms that have lost a small part of themselves (alpha particles and positive ions). They may have high velocity, but usually low penetrating power, and without exception their ranges are short—seldom more than a fraction of an inch. Obviously not much military possibility there.

Destructive Cathode Rays

The nearest approach to a "death ray" that has ever been made with these streams of electrical particles was the production of massive quantities of cathode rays, or electrons, into the air. This was done on a pioneer scale first by a German physicist, Lenard; then with an improved and much more massive apparatus by Dr. W. D. Coolidge, director of the General Electric research laboratories.

The Coolidge cathode ray tubes shot their streams of high-speed electrons out into the air to an extreme range of several feet. They did strange things to chemical substances, indicating that they might have deadly effect on living animals. The ear of a rabbit was placed in their path, with the rest of the animal shielded from the rays. The rays that went through the openings in the shield that protected most of the ear caused sore spots to appear, which presently healed over, leaving no trace except that the new hair was white. So not even the ponderous Coolidge tube could be counted a long-range death-ray producer.

Supersonic Killers

There remains, then, the third class of possible death rays, the highly intense beams of inaudible or shrilly audible sound waves, first used for experimental destruction in the private laboratory of A. L. Loomis, New York banker-scientist. These proved their power to kill such things as small fish, water plants, and (sometimes) bacteria; but they could not kill a mouse. Moreover, they could act only in water or other fluid, not in air, and had at best a range of mere inches, even though enough power was poured into them to run a full-sized broadcasting station.

So our survey of the whole field of rays of all kinds yields us not one that holds out any possibility of being a genuine death ray. If the youth of the present generation must presently go to the trenches, they will have to be contented with modification and improvements of the lethal toys their fathers and uncles used in 1918. The lightnings of Jove are still denied to war-making earthlings.

This article was edited from manuscript prepared by Science Service for use in illustrated newspaper magazines.

Science News Letter, March 23, 1935

BOTANY

Famous Insect-Eating Plant Catches Many Spiders

See Front Cover

VENUS' flytrap might with equal correctness be called a spider-trap. This famous insect-catching plant, once called by Darwin "the most wonderful plant in the world," has been re-studied recently by Prof. Robert F. Griggs of George Washington University. He discovered that the largest single class of animals among its victims consists of spiders. Examination of hundreds of its trap-like hinged leaves showed that spiders formed 28 per cent. of all its catch. Flies were a close second, with 24 per cent.

Other prey included beetles, ants and roaches. There was one tiny toad, a scorpion, a couple of snails and one daddylonglegs. In general, the plant's victims were mainly insects that fly little or not at all; there were few highly active fliers like bees and wasps.

Prof. Griggs made an effort to find an answer to the old question of what use the plant's carnivorous tendencies are to it; for though it secretes a ferment like the gastric juice, it has never been proved that it uses the captured victims for food. He was not able, however, to arrive at any completely conclusive findings, for specimens grown in various types of soil, some fed and others kept without insects, all throve about equally.

It is probable that the species once had a far greater range than its present restricted area of about a hundred-mile radius of semi-swampy costal plain around the city of Wilmington, N. C. Its nearest existing relative is found in Europe. Two colonies of it were experimentally transplanted into bogs far to the north of its present habitat some years ago. One of these is in Maryland just outside the District of Columbia, the other in Virginia. Both colonies survived the severe winter of 1933-34, which was far colder than anything these plants have been called upon to endure for probably thousands of years.

Prof. Griggs expressed the wish that people generally might abandon the rather awkward and unbeautiful name, Venus' flytrap, and adopt the more euphonious botanical name, *Dionaea,* for common use, as they have already englished such strictly scientific names as chrysanthemum, rhododendron and gladiolus.

One of Prof. Griggs' photographs, taken in the native haunts of *Dionaea,* is shown on the cover of this issue of the SCIENCE NEWS LETTER. It shows the hinged halves of a leaf as they slowly open, disclosing the empty shell of a luckless large fly that was not quick enough to escape the snap of their trap-like action. Wind or a raindrop will clear away the victim's carcass, leaving the hungry leaves ready for another catch. In the meantime, two other empty leaves wait with deadly patience.

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