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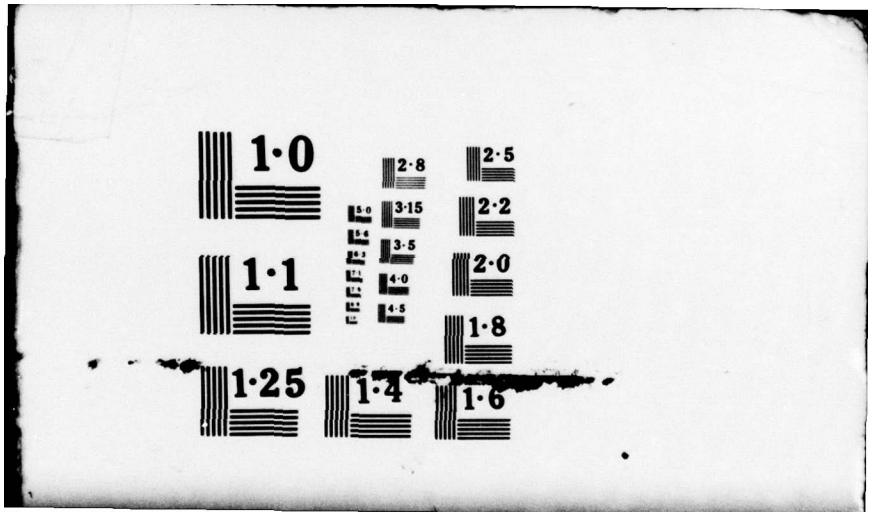
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FOREIGN TECHNOLOGY DIVISION

"ELECTRONIC EYES"

By

Edward Frankowski

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EDITED TRANSLATION

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"Electronic Eyes" by Edward Frankowski

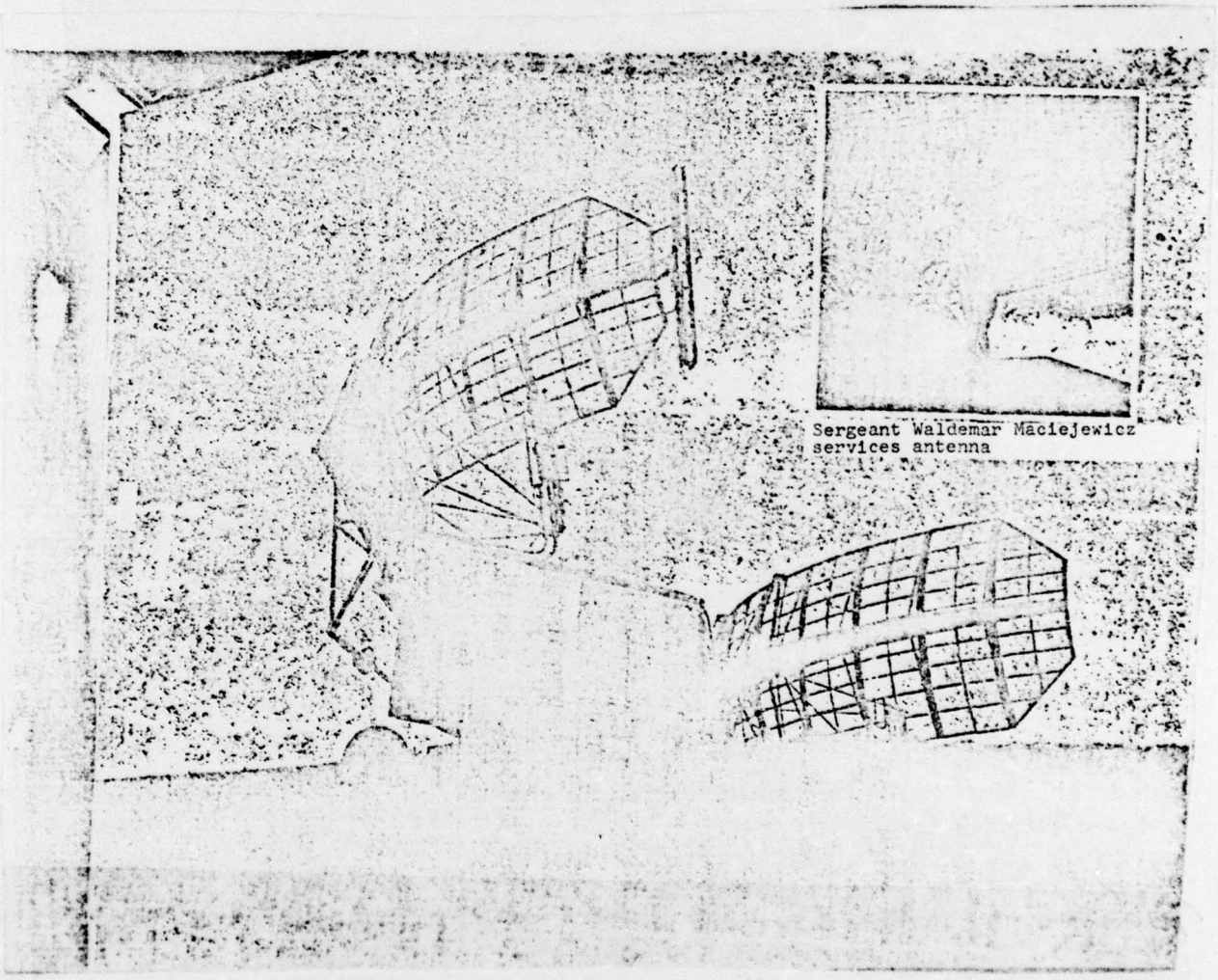
At the beginning of World War II German submarines spread great devastation among allied navies. Only in 1941 were English aircraft equipped with special radar apparatus for the detection of naval units and the detection of submarines.

In June 1942 in the vicinity of Cape Matapan (Greece) the Italian fleet unaware of their enemy lost two cruisers struck by artillery shells. Similarly sunk was one of the largest German vessels the Bismarck. An artillery shell shot from an English vessel, located beyond the reach of visibility, fell into the ammunition magazine of the Bismarck and after a powerful explosion the ship sunk.

Were these the usual accidents? To obtain an exact hit on an ammunition magazine one must acknowledge its accidental character, however the same fact of the sinking of vessels from more than a 40-kilometer distance was not the result of any supernatural power, rather, it was the result of a new technological achievement, namely, of radar.

In the Soviet Union radar appeared as a defensive warning means prior to an attack by enemy aircraft. In the first years of the existence of radio the level of aircraft development was low. Aircraft flew without great speed, at low altitudes, in the daytime and in favorable weather. In these conditions there was no question of surprise. Aircraft could be seen and heard long before their appearance over a defended objective.

In the course of development the speed and ceiling of aircraft increased dramatically. They began to fly independently of the weather and time-of-day. At that time optical and



Sergeant Waldemar Maciejewicz services antenna

acoustical observation began to fail. This produced a demand for better means of discovering air pirates. Radar fulfilled these tasks.

Emitted by the means of an antenna, electromagnetic waves going out at the speed of light (300 thousand km/sec.) after encountering the target reflect from it and return to the receiver. The distance to the target is defined on the basis of the time of wave run, and the direction on the basis of the attitude of the radar antenna.

At present, the first warning station contacts an adversary at long-range. After detecting its aircraft, it informs the nearest airfield from which an interceptor takes off, tracks its flight and leads it to the enemy. When the intercepting hunter-aircraft finds itself in the vicinity of the target, it employs its own vectoring station, exactly determining the position of the opponent. Thanks to this it may go into battle in fog or at night. The radar station in effect substitutes for it because of its most sharpened vision.

Special operators also play a great role in bombers and fighter-bombers. Radar stations fix for them a circular observation. A group of radar waves falls successively without interruption on separate areas of the terrain, thanks to which there appears on the display screen a moving map of the region.

Radar operators supply specialized calculation sets into which instantaneous coordinates of the target are fed as well as the up-to-date data of the flight and the suitability of ballistic bombs as well as the direction and speed of the wind. This arrangement by itself actively performs the necessary

calculations and determines the moment of the bomb drop seen on the radar operator's screen.

These operators are made use of during navigation as well. In this case, the aircraft crew a re provided with a radar map of the terrain, received as a result of photographic indicators. On the map the geographic specifics of the terrain are correspondingly borne out. The crew, comparing its image with the map, can determine the aircraft's position.

On interceptors, specialized radar equipment is adapted, which not only facilitates the search for the target, but provides the range to the attacking aircraft.

Radioelectronic equipment are installed as well on fighter aircraft, making possible the guidance of missiles to terrestrial objects. Thanks to this an aircraft may destroy its target without entering the antiaircraft zone of defense. The principle of operation of this system depends upon the aid of long-range radar equipment which discovers the object of attack as well as launching a missile in a given direction and guiding it by radio waves.

Radar provides a significant service in the discrimination of our own aircraft from strangers. This is done by an interrogation-response set. This consists of senders and receivers, located on the aircraft and installed on land and sea radar stations. In the intervals between impulses there is sent the interrogator code. Our own aircraft receives it and sends a response signal, received form the track by the interrogation station. Of course, an alien aircraft may not receive the encoded signals and may not send the identification signal.

Plotter records current combat situation.

And so, with the aid of radar equipment various tasks are realized; it provides observations of the current terrestrial, weather and sea situation for the detection of targets, the determination of their coordinates, composition and movement (direction, speed and altitude); it leads our own aircraft and vessels to the air and sea machines of the enemy, calculating the coordinates of these objects with the aim of their bombardment or bringing under fire; it directs the fire of our antiaircraft artillery, land and sea, and also the fire of our fixed aircraft weapons; it guides missiles to air, land and sea targets; it guides navigation in aircraft and on floating units by execution through unvarying operations; it confirms the facts for a topographic linkage of an artillery battle grouping and the positions of missiles in flight; it works out the meteorological conditions at various altitudes and distances, and also informs the armed forces of the imminence of natural disaster, such as: hurricances, storms, etc.; it recognizes enemy radar equipment and may jam its operation.

The radiotechnical tool enables the performance of group flights where visibility is lacking, the blind landing of aircraft and the takeover of the control of their movement in the area of the airfield, which allows the expansion of the admissability of takeoffs through the preservation of the aircraft security.

In artillery discrimination "radar" applies itself to the detection of moving terrestrial objects, nuclear explosions, shells shot from cannons and mortar shots.

The principle of determination of the location of the firing position is simple. As is known, the projectile after leaving the barrel sinks from its path consistent with ballistic laws. Observing several points of this curve one can determine the location of its origin, that is, the place from which the

projectile was launched even if the enemy shot from a concealed position. The equipment serving to this detection reminds us of antiaircraft artillery radar. The difference consists here mainly on the calculator which determines the projectile's track.

In contemporary armies radar has been found sufficiently of general application. There remains to be considered that the sphere of its use will be strongly increased and improved. For radar has become the electronic eyes of modern armed forces.

Radar appears unmistakable, where one looks at it from the side of the scientist's realm or we see it in the shape of antennas sweeping the airspace on some kind of "mountain" on the inside of which are hidden the stations. There on the "mountain" one sees it in each set, element, here however are people with scientific titles, examining something with the naked eye on the whole not perceptible, there nonetheless however through electromagnetic waves. Immediately apparent are the tools of their work, the arrangement of stations, automatic subsystems, the microwave laboratory. Here is the echoless chamber in which we recognize Major Andrzej Grubinski. The walls are built of the same cones, reminiscent of a fakir's bed. Examined here are the characteristics of antennas, microwave sets, tube elements.

We look at electronic measuring implements coupled with numerical registers, whether they be computers, oscilloscopes, spectrometers, numerical wave meters, or frequency meters for the examination of various waves. We visit the radar subsystems laboratory. We meet L.C., Master Engineer, Mieczyslaw Sitnik at an apparatus serving to tune the radar sets. He has served in the armed forces for 25 years. He is occupied with the investigative problem of electronic implements. Lately, near the end of 1977 along with his group he received the MON award of the 1st degree for the working out and bringing to production a new type of radar station.

Major, Magister Engineering Andraej Grudinski in the microwave echoless chamber

Colonels: Jan Bobrowicz and Krzysztof Tozinski at the command post.

Colonel Doctor Krzysztof Lozinski, who since 1952 has devoted himself to radar (graduated from Warsaw Polytechnical) explains:

——The radar station, which won the unit award of the Ministry of National Defense, is our newest achievement. It serves the detection of low-lying objects, distinguished by the great reliability of its work, its very good tactical-technical parameters. It works in diverse climatic and terrain conditions. It is relatively cheap to produce. Constructed from transistors, scaled circumferences, it assures a great degree of automation.

Colonel Lozinski is a MON laureate for the effecting of optimal investigative methods as well as the research and developmentto production of materials which absorb electromagnetic radiation. For this latest achievement he received as well an award of the Secretary of PAN. Moreover he was distinguished for the development and improvement of radar techniques.

——We examine, we measure—says the Colonel—for years, but considerably faster than heretofore. What aids us in this are the electronic supertechnics of 3 and 4 generations.

The constructors of these generations occupied themselves in the area of the problem of the reduction of the dimensions and the weight as well as the expansion of the reliability of radar stations. They considered that one could achieve the most radical resolution of these problems through the replacement of electronic lamps with semiconductors. Because of this, if the weight of the lamps amount to an average of 150 G., this weight replaced by an element amounting to scarcely a part of a gram is a hundred times easier. And further. If the worklife of electronic lamps does not exceed 2-3 thousand hours, the period of use of semiconductors amounts to 70-100 thousand hours, and hence several tens of time longer, moreover the energy to supply the semiconductors is thousands of times less than that of the same number of lamps.

Military scientists try to effect ever better apparatus, substituting the good—the improved, in which the abovementioned achievement is numbered. As detection achievements are essential for defense. let us witness the following example. Let us find that a radar station detects an aircraft at a range of 500 km flying at a speed of 1200 km/h. This rises the question, how long is his flight path from the radar station? From calcula tions of the result it is 25 minutes. This is a relatively short time, considering that the need to inform all of a threatening danger and to prepare for the repelling of the attack. This time will be that much shorter the later the target remains concealed and the sooner it advances. Here then is why scientists from each area of the radar establishments would like to do better.

Text and photos:
Edward Frankowski

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