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ELECTRONIC WARFARE IN CHINA'S PAST, PRESENT, AND FUTURE

by

Xu Shaoxing

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By: Xu Shaoxing

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FORWARD

As far as the Gulf War, which was huge in scale and lasted more than a month is concerned, it made common people see with their own eyes electronic warfare artfully applied from beginning to end. What made people marvel incredulously was the rapid concentration of multinational forces, their sudden breakthrough and lightening attacks--several thousand aircraft bombing everyday. Iraqi communications were paralyzed. Command was ineffective... The whole country fell into confusion. Units that had invaded Kuwait lost contact, retreating in defeat again and again with large numbers surrendering and being captured. In the end, (illegible) the maniac of the this era--Iraq--had no choice but to accept United Nations documents declaring surrender. This electronic war gave people a new perception. Electronic warfare is a battle carried out between opposing sides making use of intelligence, equipment, and materiel within electromagnetic spectrum domains. It includes electronic countermeasures and electronic counter countermeasures. Various nations achieved a higher awareness during the Gulf War, giving extremely serious attention to electronic warfare. Various domestic departments also set up, opened, and developed electronic warfare research and applications enthusiastically, taking electronic warfare and spreading it to all weapons systems. From the heavens above to the waters beneath, it was a wave of electronic warfare everywhere.

THE HISTORY OF ELECTRONIC WARFARE

The history of electronic warfare in the world can be traced back to the First World War. On the battlefield, intercept and jamming were occasionally used, understanding the enemy situation and jamming enemy communications. This created electronic warfare. During the Second World War, electronic countermeasures development was rapid. Various specialized agencies and units were set up one after the other associated with communications countermeasures, radar countermeasures, and navigation countermeasures. Various types of equipment as well as tactics were also applied on the battlefield and developed. Brilliant successes were achieved in the war. The military departments of both hostile sides paid ever more serious attention to this. After the war, a good number of nations all had plans and /2 procedures to develop electronic countermeasure activities associated with various nations. In the fifties and sixties--on Korean battlefields, Vietnamese battlefields, in Middle East wars, the Malvinas War, and so on--electronic warfare also followed the course of modernization in weapons, equipment, tactics, and warfare and developed at a feverish pace.

CHINESE ELECTRONIC WARFARE IN THE PAST

Chinese electronic warfare has a recorded beginning in February of 1931. Before that war, personnel on our side maintained intercept of enemy stations for more than twenty days, grasping the enemy points of departure, times, routes, and causing our forces to achieve a very brilliant victory. Praise and commendation were received from Committee Member Mao and Commander in Chief Zhu.

During the more than thirty years of history from 1931 to 1965, this is the breeding period of Chinese electronic warfare. During the entire phase, it is possible to make use of the six characters--"analysis, renovation, system (illegible)"--in order to summarize the development of the specialty in question. There were no electronic countermeasures personnel in the early period. With study and analysis on the one hand and renovation of captured Japanese and U.S. intercept, reconnaissance, and jamming equipment on the other--eager to meet the needs of war--this equipment was put to new uses in battle. In application, there was familiarization, mastery, and study. In particular, during the ten or so years after liberation, stress was placed on the analysis of electronic countermeasures equipment on the U.S. P2V- 7 (illegible) low altitude reconnaissance aircraft and the U-2 high altitude reconnaissance aircraft as well as the Soviet built cp6-1 radar reconnaissance machine and cp6-5 radar jammer, communications reconnaissance, jamming devices, pulse analyzers, and so on, and so on. At the same time as this, a number of pieces of airborne, ground, and submarine borne reconnaissance and jamming equipment were manufactured in imitation. Characteristics of equipment in this period of time were narrow frequency bands, bad precision, and strong directional characteristics. Primary uses were for unit combat training. They laid a firm foundation for autonomous designs from then on. The characteristics of this period of time were:

1. Electronic countermeasure specializations had just been set up. Technical levels were low. There was a lack of operational experience. The domestic electronics industry was relatively backward. Operations were very difficult.
2. Coordination of war requirements. Coordination of unit training, combat operation and counter jamming experience.
3. The primary purpose was to analyze and, in conjunction with that, carry out the operational steps of reverse demonstration and reverse design. This facilitated mastering the design concepts, methods, and key technologies. /3
4. Characteristics of renovated and copied equipment were:
   a. Reconnaissance systems were direct detection superheterodyne. Jamming systems were response type and suppression type noise jamming.
   b. Frequency bands were narrow, not continous, and directional characteristics were strong. Generally, they were short wave and ultra short wave--10cm and 3cm.
   c. Option was made for search type maximum signal methods of direction finding.
   d. Terminals were oscilloscope tubes. Lines reached a

maximum of five displays, audio frequency and video frequency magnetic tape recorders.

e. Option was made for use of a mixture of vacuum tubes and transistors. Jamming made use of "M" model return wave tubes.

f. Volumes were large. Weights were heavy. Reliability was bad.

CHINESE ELECTRONIC WARFARE TODAY

Starting from the middle of the 1960's, China's first electronic countermeasure research institute was set up and begun. It symbolized China's entering into a new phase of autonomous research, design, development, and production. The institute in question takes countermeasures and divides them into two large specialties, that is, radar countermeasures and communications countermeasures. In conjunction with that, starting out from optimum systems, optimum jamming prototypes, optimum jamming parameters, and optimum designs, highly effective development of electronic products is carried out. One after the other, in the area of communications, development was done of short wave aimed type jammers, frequency barrage type jammers, ultra short wave barrage type jammers, single side band communications jammers, parachute drop type jammers, navigation mode carrier jammers, as well as reconnaissance receivers, microwave communications reconnaissance equipment, TK series and TKB series jamming equipment, and so on, and so on. In the area of radar countermeasures, development was done of high sensitivity microwave reconnaissance receivers, portable miniaturized reconnaissance receivers, flashlight type reconnaissance equipment, shipborne reconnaissance, warning, and jamming equipment, airborne reconnaissance, warning, and jamming equipment, surface reconnaissance, warning, and jamming equipment, as well as passive reconnaissance and jamming equipment, artillery shell fuse jammers, guidance jammers, and so on, and so on.

In these pieces of equipment, application was made of relatively advanced technology for that time: azimuth search and nonsearch techniques, passive tracking, automatic identification of main and auxiliary lobes, transient frequency measurements, and radar signal selection, see through techniques, digital and computer technologies, single pulse passive tracking, three system coordinated YIG tracking, superheterodyne receivers, side lobe suppression techniques, wide band and super wide band microwave field effect transistor amplifier technology, /4 channelized reception technology, multichannel specific amplitude direction finding technology, orthogonal polarization technology, various types of jamming form modulation technology, rapid frequency guidance techniques, reception-transmission isolation technology, and so on, and so forth. At the same time, the Chinese electronics industry was spurred on to stride toward a higher level.

The primary characteristics of the autonomous design phase are:

1. Basic research results are many. Equipment developed and put into production is numerous. These systems have already equipped various sea, land, and air units. At the same time, they have expanded into necessary departments in space, under water, and so on, and so forth.

2. Autonomously developed products have partially reached am advanced world level. Our products are already exported one after the other. The distance between Chinese electronic warfare technology and the most advanced nations in the world is in the midst of shrinking. In the world, we are already no longer unknown. Some of all China's electronic warfare devices and systems technology is already running neck and neck with the world's advanced nations.

3. Domestic electronic warfare has not only developed in electronic countermeasures. Advances in counter jamming technology have also been spurred. In both the areas of radar and communications, a good number of this type of artificial jamming technique and equipment have been produced. Counter jamming technology has the targets. It has the foundation. In addition, with common study, common discussion, common research, common development, and common improvements in order to raise the efficiencies of currently existing weapons, it has played a positive role.

4. As far as the domestic electronics industry is concerned--in particular, the basic components industry--it has lagged the advanced nations for more than twenty years. For the last several years, we have struggled vigorously and have achieved very great successes. However, existing problems are still bad structures and industrial techniques, bad reliability, backward inspection means, relatively low efficiency, and excessive waste. With the opening up of reforms in the last few years, there has been a very great increase in the absorption of foreign technology. However, changes in basic industry appear to be lagging. The tasks are still extremely formidable. In this regard, due to the special requirements of electronic warfare-- whether much or little--everything will be influenced.

5. Technological Characteristics of Electronic Warfare Equipment:

a. Frequency coverage ranges are wide. Reconnaissance warnings are from short wave - 40GHz. Jamming frequencies are from short wave and ultra short wave - 18GHz. Transient /5 frequency coverage ranges reach several times frequency ranges.

b. As far as reconnaissance receiver systems are concerned, from direct detection type, superheterodyne, high speed tuning to transient wide band reception, intercept sensitivities and discovery probabilities have been raised. It is possible to receive conventional systems and even communications and radar signals associated with special systems--for instance, frequency modulation, amplitude modulation, single side band messages, voice, frequency expansion and skip frequency communications signals. As

far as radar is concerned, there are such signals as single pulse, continuous wave, skip frequency, frequency diversity, frequency expansion, compression, vibration, variable frequency, variable wide pulse, and so on.

c. In terms of direction finding, general use is made of maximum signal methods. Tangent side lobe techniques lower false alarm probabilities. Besides this, adoption is made of four channel, eight channel, and sixteen channel specific amplitude direction finding, increasing real time characteristics. There have been breakthroughs in passive tracking and single pulse direction finding techniques, making jamming powers increase several fold.

d. There has been step by step application of digital and computer technology, strengthening signal processing capabilities and improving parameter measurement precision and automation levels. Self-adjustment capabilities of equipment have increased, taking the original single pieces of equipment and turning them into a system and increasing coordinated combat capabilities.

e. Although jamming systems are still reply type deception jamming and suppression type noise jamming, there has, however, already been a transition from (illegible) model return wave tubes to standing wave tubes as the primary form of master oscillation and amplification. Jamming pulse powers reach 5KW. Continuous wave jamming reaches several hundred watt levels. Application is made of reserve frequency techniques, shortening reply type jamming time periods.

f. Option is made for the use of thermistors and high altitude low pressure sealed heat dissipation technologies, shipborne biaxial stabilization techniques, as well as vehicle borne and navigation mode carrier jamming technology.

g. Basically, there are capabilities for the development and production of wide band antennas and micro (illegible) microwave components. The electronic vacuum components and semiconductor components required in electronic warfare have a domestic foothold.

h. In the areas of passive jamming and photoelectric countermeasures, various types and sorts of ground, vehicle borne, and shipborne launch systems and jamming artillery shells have been developed, as well as the development of ground jamming rockets and shipborne jamming rockets.

As is widely known, electronic warfare is a specialization only used in absolute military security. A blockade of foreign technology and components makes the development of China's electronic countermeasure activities more difficult. However, during the more than sixty years of history from 1931 to now, Chinese electronic countermeasures have vigorously developed from none until today. In particular, after liberation, development has been even more rapid. Its ranks have grown even more in strength. Up to the present time, there are already twelve research institutes, nine specialized plants, and eight /6 institutes and schools engaged in research, production, and training associated

with this activity. The ranks of specialized technological personnel have already reached over several hundred thousand people. As far as China is concerned, it has already leaped into the ranks of the world's advanced nations in electronic warfare technology.

THE FUTURE OF ELECTRONIC WARFARE

In real combat environments, electronic warfare production and utilization have grown in strength. In the three dimensional warfare of today, fighting for supremacy in the electromagnetic spectrum has become key to success or failure in war. From now on, electromagnetic spectra will be even more complicated. Struggles in it will also be even more profound in such areas as radar, navigation, communications, identification friend or foe, strategic and tactical command, and so on, and so on. Competition associated with new knowledge and new technologies will become more and more intense in order to seize the initiative in warfare, vanquish the enemy, gather more complex electronic intelligence day by day, draw up optimized jamming plans, and suppress and destroy various types of enemy radio equipment, making them malfunction and lose their effectiveness. These are the current pressing and critical tasks of electronic warfare. As far as confronting wars of the future is concerned, electronic warfare has no choice but to use new requirements in order to meet this type of new challenge.

These new requirements and characteristics are:

1. Multifunction Integration It is already impossible for single devices to complete modern mission requirements. It is necessary to take several devices and form them into systems. In the first place, this facilitates management of friendly electromagnetic spectra. In the second place, it is also possible to effect coordinated combat operations of multiple weapons, and, going a step further, completing missions of higher difficulty.

Systematization Collection of gathered intelligence from reconnaissance satellites, reconnaissance aircraft, reconnaissance ships, ground reconnaissance equipment, jamming satellites, jamming aircraft, jamming ships, ground jamming equipment, radars, optical instruments, communications, and so on, and integration of command orders to organically control battlefield environments that are more complicated by the day.

2. Development into Outer Space Outer space will be the primary domain for the forward march of electronic warfare. It is not limited by territories, air space, national boundaries, weather, or time. It is a vast realm to fight for future electronic warfare supremacy.

3. Broadening Out in All Directions As far as satisfying the requirements of three dimensional warfare, precision direction finding, positioning of targets, and guiding hard weapons to destroy targets are concerned, electronic warfare will shift from soft kills and damage to hard kills and damage. In this are

included multichannel specific amplitude direction finding and lens feed multiple beam direction finding. Among future high speed precision positioning systems, indispensable interferometer and phase control array direction finding /7 technologies have considerable appeal. Outside China, direction finding precision of 0.1 degrees have already been achieved.

4. Broadening Out to All Frequencies Communications frequency bands go from long wave to microwave. Radars increase discovery probabilities from 0.5GHz - 40(illegible)GHz, causing tiny enemy changes. In all cases, it is not possible to escape the sharp "eyes" of the friendly side. Nowadays, original frequency measurement methods and equipment will advance in the directions of miniaturization and microturization, and, besides that, making use of radio frequency storage devices to measure frequencies is a new path to be exploited in the future. Within transient band widths of 500MHz, degrees of frequency measurement precision reach 1KHz or even more precise. Under certain conditions, it is possible to substitute for IFM. At the same time, it is possible to make some signal fingerprint analysis. It is a prelude to digital receivers--also high stability digital oscillators.

5. As far as the appearance of computers is concerned, automatization of electronic warfare is presenting a new face. In the next step--in such areas as signal correlation, identification, fingerprint analysis, self-adjustment, power management, jamming form control, and so on--it will play a renovating role. Distribution type processing, imbedded type processing, computer networking, expert systems, and artificial intelligence will all penetrate deeply into electronic warfare systems, making the degrees of system networking expand. However, system response times will clearly speed up.

With regard to system controls, the original handles, needles, gauges, and oscilloscopes will evolve into such advanced man-machine interface screen command systems as graphs, charts, speech sounds, and so on. System autoinspection is clearly strengthened. System reliability MTBF rises to several hundred hours from the original 50-100 hours.

6. New components emerge in an endless stream. In particular, all the phases used by microwave integrated circuits, specialized integrated circuits, microwave firmware, phase control arrays, and multiple beam jammers are uniformly traveling wave tubes and high efficiency wide band traveling wave amplification chains of high power and ultra high power.

7. Spectrum calculation algorithms will move to engineering applications from theoretical (illegible) of educational institutions in order to change spacial direction finding and positioning precision, improve signal processing environments, shorten time periods, and speed up system responses. Going a step further, in the processing of special signals (for instance, skip frequency, diversity, expanded frequency, zig zag, and so on, and so forth), resources are conserved and signal identification reliability is increased. /8

8. Industrial techniques and structures develop in the directions of standardization, modularization, assembled structures, small volumes, and light weights. Even more miniaturized systems are developed and produced in order to satisfy requirements for space, airborne, man pack, horses, and camels and to deal with the requirements associated with various types of adverse environments.

Electronic warfare is an old and new subject. Electronic warfare technology will also follow along with modernized society and modernized warfare, and become modern. It will stimulate applications of the electromagnetic spectrum in all walks of life. There will be uniting in mutual aid, reciprocal assistance and support, and shared improvements. In China, the various specialties of reconnaissance, counter reconnaissance, jamming, and counter jamming, tactics and technologies, must be closely coordinated. Academies, institutes, and plants must cooperate with each other, causing Chinese electronic warfare activities to be more perfect, more complete, and more suited to the requirements of future warfare.

Electromechanical Department,
Research Institute No.29
Lab 1 Xu Shaoxing
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