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SPECIAL ESSAYS FOR THE 40th ANNIVERSARY OF THE REVOLUTION:
THE CHIEF DESIGNER DISCUSSES THE F-8 II AND FUTURE FIGHTER PLANES

by

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SPECIAL ESSAYS FOR THE 40TH ANNIVERSARY OF THE REVOLUTION:
THE CHIEF DESIGNER DISCUSSES THE F-8 II AND FUTURE FIGHTER PLANES

Wang Yawei

The name of Gu Song-Fen is well known throughout the Chinese aviation circle. He used to be one of the designers responsible for FT-1 and PT-6 trainer programs. In 1964, he was appointed as vice chief designer for F-8 supersonic fighter, and in 1981, promoted to be the chief designer for F-8 II program. Meeting the correspondent in the eve of 1988, he revealed the following information of F-8 II program. [Translator's note: This paragraph is the English introduction to the article; it has been transcribed verbatim.]

Gu Songfen, whom everyone calls "Chief Gu," is one of China's well-known airplane designers. Born in 1930 in Suzhou, Jiangsu Province, he graduated from the Aviation Engineering Department of Jiaotong University in Shanghai in 1951. Since 1956 he has been involved in the work of airplane design, participating in the design of planes line the Fighter/Trainer-1 and the Trainer-6; in 1965 he was appointed assistant chief designer for the F-8 fighter plane, responsible for aerodynamics and the general fuselage design; in 1981 he was appointed chief designer for the F-8 II. He is currently the assistant head of the Aviation and Aerospace Industry Ministry's Science and Technology Research Institute as well as professor at the Beijing Aviation and Aerospace University.

Chief Gu, although he has long been one of the right lights in Chinese aviation circles in the field of airplane design, has only achieved fame in the past two years. On New Year's Eve, Chief Gu granted an interview in his office to a special correspondent from the magazine Junshi Shijie [Military World]. During the course of the nearly two-hour interview, Chief Gu spoke on a wide range of topics. He gave special emphasis to the F-8 II; some of the information has long been known, but some was news. Chief Gu's analysis of the fighter technology of the nineties and his views on the development of China's Air Force weapons systems were presented carefully and in detail, and made a deep impression.

Our magazine, with the permission of Chief Gu and the editorial department of the Junshi Shijie, offers the reader a special publication of the full text of the interview.

Gu Songfen, chief designer of the F-8 II.

THE CHIEF CONTRIBUTION OF THE F-8 II IS AN INCREASE IN COMBAT STRENGTH.

The discussion naturally began with the F-8 II, for whose development Chief Gu had been responsible. The prototype of the F-8 had been under development since 1964, and made use of the aerodynamic design of the similar F-7, using however a double engine layout. The main performance requirements were excellent high-altitude, high-speed capabilities, a relatively long range, and a relatively high rate of climb. In 1966, the preliminary stage of design was complete; on 5 July 1967 the prototype made its successful maiden flight, and the plane was delivered for use. The development of the prototype was a victim of the "ten turbulent years," so the road to success was rough. The F-8 II is a new model fighter developed on the foundation of the F-8 prototype; it made its maiden flight on 12 June 1984. Its design has been finalized, and it is now in production.

The main difference between the F-8 and F-8 II is that the latter has improved combat capabilities. This improvement appears chiefly in the following six areas:

1. The forward fuselage has been redesigned, converting the plane nose air intake to a bilateral intake; this allows the installation in the nose of a larger radar antenna than in the prototype.

2. The engines in the F-8 II have a greater thrust-to-weight ratio.

3. Two outer mounts have been added and medium range guided missiles have been installed; on-board bombs can also be mounted, increasing the capabilities for aerial combat and ground attacks.

4. The aiming device has been replaced.

5. Electronic opposition capabilities have been strengthened, and the survivability of the plane in the environment of modern electronic warfare has been improved.

6. An automatic pilot has been installed.

THE GENERAL PERFORMANCE OF THE F-8 II SURPASSES THAT OF THE MIG-23.

"In comparison with the main fighter planes in service world-wide, what is the level of the F-8 II?" Chief Gu replied unequivocally: "The performance of the F-8 II, both in its subsonic and supersonic ranges, surpasses the Soviet Union's Mig-23 fighter. In comparison with the fighters of the West, the F-8 II is clearly superior to the U.S. F-16 and the French Mirage 2000 fighters in the supersonic range; in the high subsonic speed ranges, however, it does not match them in maneuverability." Chief Gu is of the opinion that the F-16 excels mainly in its high-subsonic maneuverability, but has almost no supersonic combat capability, while the overall arrangement of the F-8 II is relatively more rational, with its maximum Mach number and ceiling both greatly beyond that of the F-16.

Why is it that the maneuverability of the F-8 II at high subsonic speeds does not match the F-16 and the Mirage 2000? Chief Gu believes that this is because, in order to maintain its excellent supersonic capabilities, the F-8 II uses triangular wings with a small aspect ratio; the inherent deficiency of this kind of wing is that it is not advantageous for achieving good high subsonic maneuverability. Chief Gu also stated that our on-board electronic equipment was not as sophisticated as that of the Western countries, and that in a variety of equipment there was a considerable gap. For example, our

radar is heavy, and its effective range is far less than that of Western products. For this reason, we are considering the installation of advanced foreign electronic equipment in our F-8 fighter; its cost, however, will be very high.

THE F-8 II IS A PRODUCT FEATURING 100% DOMESTIC DEVELOPMENT.

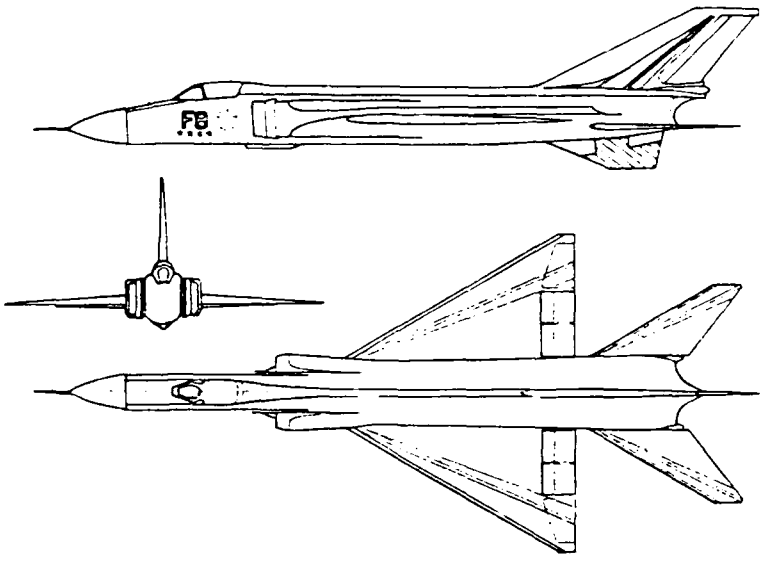
During our conversation, this correspondent raised a question that people find very interesting: "During the course of developing the F-8 II, did you import advanced foreign technology?" Chief Gu answered categorically: "In our development, we did not make direct use of any foreign technology. The F-8 II was developed completely independently. As regards drawing lessons from the experiences of others, we only referred to published foreign material; there was no restricted information or transferred technology." Chief Gu went on to describe in some detail how the development personnel whom he led went through a process of repeated trial-and-error and experimentation, and successfully solved key difficulties one by one. For the wings of the F-8 II, tapered rotation was used, increasing the range. The change in the F-8 II to bilateral air intakes was the most difficult problem; 10 years were spent on it. With the current air intakes, the level of air intake at both subsonic and supersonic speeds is relatively high, and the air intake adjustment system for supersonic speeds is very simple indeed.

THERE IS STILL ROOM FOR IMPROVEMENT IN THE F-8 II.

In discussing the prospects for the export of the F-8 II, Chief Gu said optimistically, "Even though this model was principally developed for our Air Force, we are willing to export it too.

"The reason for this is that the F-8 II's performance is completely comparable with that of the fighter planes of countries like the U.S., the U.S.S.R and France that are now in service, but the F-8's price is relatively low because it does not have installed equipment that is not directly related with combat. As regards our export targets, they are naturally mainly

countries undergoing development. The developed countries generally have their own products or traditional import sources; they would not provide a market without serious consideration. The developing countries that in the past have bought China's F-6 and F-7 fighter planes are currently looking at the situation for retrofitting and replacing the old products, and the F-8 is a suitable item that would satisfy their needs. We ought to seize this good opportunity."



Three views of the F-8 II fighter plane.

"How can we promote and expand export of the F-8 II?" Chief Gu replied, "Right now, it is necessary for our outstanding technical experts and aviation personnel to spread the news to foreign countries by all available means, and to demonstrate the sophisticated capabilities of the F-8 II fighter, with demonstration flights for our customers, so that even more of them will be familiar with China's latest fighter. For the export F-8 II model, Chinese on-board equipment can be chosen, as well as foreign equipment, in accordance with the needs of the purchasing country." Chief Gu believes that as long as our advertising and marketing are carried out properly the F-8 II fighter will have a relatively good export outlook.

FUTURE FIGHTER PLANES AND ULTRA-RANGE-OF-SIGHT PLANES

When the conversation turned to future fighter planes, Chief Gu said: "The development of fighter planes and changes in the battlefield and in tactics are all very rapid, but all of these things depend on technological

progress. As electronics and propulsion technology continue their rapid development, the aerial battlefield will emphasize ultra-range-of-sight combat; the focus will be on middle and long range combat, and close-range fighting will no longer be the only emphasis as it is today. Future fighter planes will thus have to be able to undertake supersonic flights of long duration and continuous supersonic maneuvers, and to have the capacity to perform speed-loss maneuvers. Only in this way is there any guarantee that they will they be able to overtake and strike the enemy in ultra-range-of-sight combat."

Chief Gu continued with concrete examples of the technology that the future fighter plane would require for ultra-range-of-sight combat:

- Aerodynamic design must first be able to satisfy the requirements of supersonic performance; in general, the planes will be designed with long, slender fuselages, and their supersonic lift-drag ratios will be raised significantly, from the present 3-4 for combat planes to 6-7.

- They will be provided with high-performance long-range radar and guided missiles to ensure detection and firing in advance of the enemy. The missiles will have omnidirectional attack capabilities; the planes will attack and run, avoiding any delay on the battlefield.

- They will preserve their excellent subsonic performance, to guarantee that when the two sides are engaged in an aerial battle, after continuous reduction of speed, close-range combat will be possible. This will require raising subsonic mobility by one order of magnitude.

- It will be necessary to have highly reliable engines with a thrust-to-weight ratio of up to 10; and the engines will have to be able to continue functioning normally under conditions of large angles of attack, large lateral glide angles, and excessively unfavorable air intake flow fields. Low fuel consumption will also be required.

- Use and maintenance will have to be simple, so that the plane provides a relatively high rate of service. This condition will require a simplification of techniques in the area of manufacture as well as a reduction in costs; the quantity of planes produced may increase.

- Short-distance take-off and landing capabilities will be required. Long, slender fuselage models ordinarily have a taxiing distance of over 1,000 meters; it is necessary to assume a limit within 300 meters, to guarantee that the plane can continue to be used when its airfield has been bombed.

- Stealth capabilities are extremely important for ultra-range-of-sight combat. It is necessary to lower to its minimum the radar and infrared recognition signal of the aircraft. This requirement may eventually produce several relatively important changes in the aerodynamically designed exterior.

- The engines must feature thrust change of direction capability. While fighting at subsonic speeds with large angles of attack, and under conditions of small velocity pressure, it is necessary to guarantee flexibility of combat. Reliance on aerodynamics alone is not enough; it is necessary to use thrust directional change.

- Intelligent systems must be provided. Pilots today make their combat decision on the basis of the corresponding conditions of friendly and hostile planes displayed in the cockpit. In cockpits of the future, there must be a large fluorescent screen, capable of displaying the corresponding measured conditions of friendly and hostile aircraft as well as information processed by a computer; it must also be able to indicate what kind of combat operations the pilot should select. This is to say, computers with special systems and artificial intelligence will eventually replace the pilot in the area of decision making.

AFT REPRESENTS THE DIRECTION OF FUTURE FIGHTER PLANES

This correspondent asked Chief Gu to discuss his opinions of the French "Zhenfeng" [literally, "gust of wind"], the Western European EFA, the Swedish JAS 39, and the American ATF; these are the fighter planes of the nineties, currently under development. Chief Gu is of the opinion that the thinking behind the design of the "Zhenfeng" and EFA generation of fighter planes should rather be considered as typical of the seventies, and that the planes are products of the eighties. The reason for this is that the planes do not emphasize supersonic cruising and supersonic maneuvering capabilities, so that it will be difficult for them to satisfy the requirements for ultra-range-of-sight combat. It must be admittee that these two kinds of fighters have further improved their subsonic ma .euverability, and that the composite use of a variety of technologies is also tending to maturity, in comparison with the Mirage 2000 and the "Kuangfeng" [literally, "full gale"]; but it is doubtful that they are suited for the next generation of combat style. The French are hesitant about continuing development of the "Zhenfeng." Chief Gu is critical, and believes that mistakes have been made. These two planes are likely to be treading the same path as the unsuccessful European "Kuangfeng" fighter -- even if carried out, they will be obsolete. (For the "Kuangfeng," at a time that the U.S. and the U.S.S.R. had abandoned the variable sweep wing design and turned to new arrangements, the Europeans started a project of designing variable sweep wings; later, because they had already invested a large amount of money, their only option was to carry on with a stiff upper lip. The result was that the plane's wing load was very large, and the product had no great success.) Regarding the Swedish JAS 39, Chief Gu believes that it is a class lower than the other two. Summing it up, the question of whether the "Zhenfeng" and the EFA are likely to become a "generation" in the history of the fighter plane is apparently open to doubt.

Chief Gu has a good appreciation of the ATF fighter plane that the U.S. is now developing. He says, "From the material that has been published, the ATF, on the basis of existing performance capabilities at high subsonic speeds, has emphasized supersonic cruising and supersonic mobility. The most

important thinking behind the design is directed at attack capabilities, based on the idea of successful detection followed by attack." At this point, Chief Gu briefly reviewed the developmental history of the American fighter plane. In the sixties, when the Americans were developing the F-4 fighter, they took into consideration reliance on guided missiles for ultra-range-of-sight combat, so only missiles, and no guns, are mounted on the F-4. At that time, however, the reliability of missiles was not high. In the Vietnam War, because the capacity to distinguish between friend and foe was deficient and subject to interference, it often occurred that friendly planes were damaged during middle and long range combat. Over 20 years have passed, and the conditions are basically different: The operation of missiles has passed from transistors to integrated circuits, and reliability and recognition capabilities have been greatly improved. Chief Gu describes how, in the 1982 Bekaa Valley War between Israel and Syria, Israel used F-15 and F-16 planes with Sparrow-3 guided missiles for an enormous 55-to-0 victory over the Syrian Air Force Mig-21's. Syrian pilots later said that they were hit by the enemy missiles before they even saw them. Because the ATF will use stealth technology, its reliability in ultra-range-of-sight combat will be further increased. At lower speeds, the ATF can substitute for the F-16 in combat, so the ATF is a new generation of fighters using advanced technology. Chief Gu pointed out that our acquaintance with the ATF is based only on reports; verification will come with actual use. A more serious question is that the price of a high-technology plane like the ATF is very high; even countries like the U.S. may not be able to field a great number of them. This question of economics must be taken into consideration.

THE KEY TO THE DEVELOPMENT OF CHINA'S AIR FORCE WEAPONRY IS BASIC RESEARCH.

Finally, this correspondent asked Chief Gu, "What do you think is the key for developing our Air Force weapons systems?" Chief Gu answered with assurance, "We can rely only on our own strength; the key is in intensifying preliminary research on new technologies."

"We have been reforming and opening up for 10 years; in these years, our country's door has been opened. We are able to make contact with things which we could not come into contact with in the past. Ten years' experience shows that we cannot rely on import and purchase to obtain first-rank aviation technology. We can only obtain the obsolescent items of other countries. For example, at the end of the seventies, the head of our Aviation Ministry took an inspection team to France; they did not let us see the Mirage 2000, which was then under development, but only gave us a model of the plane. Naturally, taking advantage of the new open conditions, we must seize the opportunity when it is offered to import foreign technology. Nevertheless, speaking basically, we must rely on ourselves to solve the most important problems.

"For the sake of self-reliance, we must cleave to basic research on the key technologies. Designing planes these days is not what it used to be, when you could just draw it out on your drawing board. Key technologies have to undergo much hard work and repeated experimentation before theories can be converted into reality. A great number of new technologies must go through composite experimentation before they can be used on new planes."

Considering our country's current economic and technological capabilities, there is no way we can make all the new technologies of a future fighter plane targets of our basic research. Chief Gu believes that we should work first in the following areas:

1. Engines with a large thrust-to-weight ratio and low fuel consumption.

2. Electronic aviation equipment. The most prominent is the development of Doppler pulse radar that has downward observation capabilities and can distinguish targets in motion near the ground.

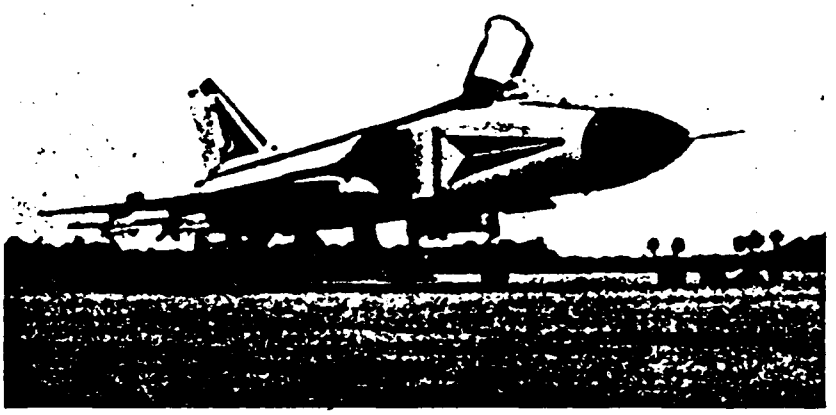
3. Sophisticated medium-range guided missiles. We must accelerate the pace of our own research on its existing foundation.

4. Electronic transmission operating systems, so that the plane can implement control on its own initiative and guarantee that the pilot is able to fly without thinking about it, concentrating completely on combat.

5. New materials. We must use more composite material construction to reduce the weight of the plane.

Chief Gu earnestly hopes that our military and industrial ministries will work together, drawing up in unison the next step for the developmental plans for China's Air Force weapons systems. He told this correspondent that the Science and Technology Research Institute of the Aviation and Aerospace Ministry is exerting its energy in promoting preliminary research for advanced aviation technology. He expressed a willingness to work even harder on behalf to basic research.

When the interview came to a close, Chief Gu expressed full confidence in the future of the development of China's fighter plane. He said, " I think back on the three years of natural disaster, and how difficult it was for us in Shenyang -- we didn't have enough to eat, and suffered bitter cold. We were a bunch of 30 or so young people, completely confident about designing and developing a new plane. Conditions now are much different; we have the policies of reform and opening the country up, and the strong support of the government. Our engineers and designers can certainly develop and bring to production an even better fighter plane."



The F-8 II supersonic fighter plane.

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