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USSR Report

MILITARY AFFAIRS

(FOUO 31/79)

Pilot and Contemporary Warfare
(Moral-Political and Psychological Training
of Flight Personnel)

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PILOT AND CONTEMPORARY WARFARE (MORAL-POLITICAL AND PSYCHOLOGICAL TRAINING OF FLIGHT PERSONNEL)

Moscow LETCHIK I SOVREMENNAYA VOYNA (O MORAL'NO-POLITICHESKOY I PSIKHOLOGICHESKOY PODGOTOVKE LETNOGO SOSTAVA) in Russian 1976 signed to press 28 May 76 pp 1-224

[Book by Col V. S. Bruz, candidate of historical sciences; Col I. F. Vydrin, candidate of pedagogical sciences; Col B. A. Pikrovskiy, candidate of medical sciences; Col A. K. Sul'yanov (head of the group of authors), Voyenizdat, 24,000 copies]

CONTENTS PAGE

Annotation..... 1

Chapter I. The Contemporary Stage of Development of the Soviet Air Forces and the Training and Indoctrinating of Flight Personnel..... 2

1. Scientific and Technological Progress and the Growing Combat Capabilities of the Military Aviation..... 2

The Powerful Advance of Soviet Military Aviation..... 3

Missile-Carrying, Supersonic, All-Weather..... 6

2. The Nature of Modern Aerial Combat and Demands Made of the Conditioning of Flight Personnel..... 9

The Equipment is Altering Tactics..... 9

From Low Altitudes to the Upper Bounds of the Stratosphere..... 13

Chapter II. General Aspects of Moral-Political and Psychological Training in the Air Force..... 21

1. The Place of Moral-Political and Psychological Training Within the System of Training and Indoctrination for Flight Personnel..... 21

The Role of the Morale Factor in Contemporary Warfare (In the Air Battle)..... 21

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

CONTENTS (Continued) Page

2. The Content, Forms and Methods of Moral-Political Training for Flight Personnel..... 25
Indoctrinating Military Pilots in a Spirit of Soviet Patriotism and Internationalism..... 29
3. Basic Areas of Psychological Training for Flight Personnel... 32
The Development of Psychic Functional Realiability in Pilots..... 33
Improving the Emotional-Volitional Stability of Flight Personnel..... 37

Chapter III. Moral-Psychological Preparation for Flights in Adverse Weather and at Night..... 41
1. The Focus of Attention--On The Instruments..... 41
Man In the New Situation..... 41
The Pilot's Increased Pace of Action..... 42
2. On The Ground And In The Air..... 44
Practical Training in the Use of the Equipment--An Important Phase of Training..... 44
Flights In a Dual-Control Trainer..... 46
Under Nighttime Conditions..... 47
Cluds--A Major Test..... 48
Success Demands Confidence..... 53
Does a Pilot Experience Fear?..... 56
Illusions Must Be Resisted..... 58

Chapter IV. Combat Training Flights and the Moral-Psychological Conditioning of Flight Personnel..... 63
1. The Preflight Period..... 63
2. During the Performance of Flight Assignments..... 65
During Missile Launchings, Firing and Bombing Practice. 65
When the Target is on the Screen..... 70
Exercises--A Serious Test..... 72

Chapter V. Moral-Psychological Training as a Flight Safety Factor. 76
1. Flight Service Regulations--A Law..... 76
2. Psychological Analysis of Errors Committed by Flight Personnel on Flights..... 78
What Is "Human Error"?..... 78
Training In Focusing the Attention..... 81
Calmness Is Always Necessary..... 85
3. Flight Supervision and Psychology..... 87
Flight Supervision--Personnel Supervision..... 87
The Flight Operation Officer's Responsibility..... 92
4. When a Special Situation Arises..... 96
The Effect of an Emergency Situation Upon the Pilot.... 96
The Development of Psychological Stability..... 101

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

CONTENTS (Continued) Page

Chapter VI. The Moral-Psychological Conditioning of Flight Personnel During Their Training in the Operation of New Equipment..... 107
1. Retraining to Operate New Equipment--An Important Job..... 107
Motivating the Airmen to Master New Equipment..... 107
General Psychological and Pedagogical Peculiarities of the Retraining Process..... 109
2. In the Course of the Theoretical Training..... 113
The Increased Role of Theoretical Training..... 113
Pedagogics and Psychology Must Be Closely Linked..... 117
3. In the Practical Retraining Process..... 122
The New Equipment Is Necessitating Adjustments..... 122
Take the Individual's Psychological Peculiarities Into Account..... 125
Learning the Aircraft Cockpit..... 127
Caution! Negative Carryover of Habits..... 132
What Goes Into a Successful Solo Flight..... 137

Chapter VII. The Moral-Psychological Principles Underlying the Formation and the Work of Aviation Teams..... 143
1. Problems Involved in the Group Training of Crews Under Modern Conditions..... 143
The Crew Must Be United..... 143
The Comprehensive Approach--A Dictate of the Times..... 144
2. Ways to Strengthen the Aviation Team..... 145
What is Psychological Compatibility?..... 146
The Development of a Sense of Collectivity Among the Fighting Men..... 149

Chapter VIII. Certain Aspects of Moral-Psychological Training of Flight School Cadets..... 153
1. Training and Indoctrination--A Single Process..... 153
2. Psychological Aspects of the Cadets' Training..... 157
The Instructor's Personality--An Important Factor in the Training and Indoctrination..... 157
On Initiation and Checkout Flights..... 159
When Working on Complex Flight Elements..... 162
During the Solo Flight..... 165

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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ANNOTATION

This book discusses problems pertaining to the moral-political and psychological training of flight personnel of the air forces to enable them to perform under the conditions of contemporary combat. The main focus is on explaining how a communist world outlook, ideological conviction, a feeling of Soviet patriotism and internationalism, good morale, fighting spirit and psychological qualities are developed in military pilots.

The book was written for commanders, political workers, flight personnel, engineers and technicians of air units and subunits, as well as for instructors, students and cadets at military educational institutions.

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Chapter I. THE CONTEMPORARY STAGE OF DEVELOPMENT OF THE SOVIET AIR FORCES AND THE TRAINING AND INDOCTRINATING OF FLIGHT PERSONNEL

1. Scientific and Technological Progress and the Growing Combat Capabilities of the Military Aviation

Engaged in implementing the Program for Peace advanced at the 24th CPSU Congress, the Communist Party and Soviet Government have performed an enormous amount of work to create favorable foreign policy conditions for peaceful construction in our nation and in the fraternalist socialist nations and to insure peace and security for all nations. Considerable progress has been made toward establishing peaceful coexistence among states with different social structures and mutually advantageous cooperation on an international level, and toward the relaxation of tensions and the control of forces of war and aggression.

While conducting a foreign policy of peace, our party and government are not forgetting that the enemies of detente still have considerable resources and are active in diverse ways and various areas, and that the nature of imperialism remains the same, although its possibilities for active aggression have now been considerably curtailed. In this situation our state has been forced to take essential steps to strengthen the Soviet Nation's defense capability and improve the Armed Forces. The 25th CPSU Congress stressed the fact that "our party will do everything possible to see that the glorious Armed Forces of the Soviet Union continue to have at their disposal everything necessary to fulfill their responsible task of guarding the peaceful labor of the Soviet people and serving as a bulwark of universal peace."[1]

The enormous scope of the scientific and technological revolution and our nation's great economic achievements have created the objective prerequisites for basic reforms in military affairs and in the development of the Soviet Armed Forces. These reforms have primarily consisted in arming the army and navy with nuclear missiles, improving the capabilities of conventional weapons and improving methods of warfare, the organizational structure of the army and navy and the process of training and indoctrinating the personnel.

Basic reforms have also been carried out in the military air forces. They have affected all areas of aviation affairs, primarily the development of aircraft themselves, their armament with powerful weapons and modern navigational and piloting equipment and the improvement of methods of combat employment and servicing of the aircraft equipment. Since the war the military aviation has taken an unprecedented leap in its development and combat improvement. It has become a missile-carrying, supersonic, all-weather aviation, equipped with nuclear weapons and the latest missiles and guns.

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The Powerful Advance of Soviet Military Aviation

The postwar development of the Soviet air forces can be divided into three main periods: period No. 1 (1946-1953), No. 2 (1954-1959) and No. 3 (since 1960). Each of them has its own specific features, but they also have a common feature--the application of the latest achievements of science and technology in all areas of aviation affairs and a continuous buildup of the military aviation's combat strength to meet the demands of the times.

The first period was characterized by the rearming of the tactical, fighter and bomber aviation with supersonic jet aircraft and an increase in the proportion of aviation in the Armed Forces. The accomplishment of tasks facing the military aviation involved enormous difficulties of an economic and technological nature. Specifically, it was necessary to set up the production of materials for jet aircraft, to restructure the aircraft industry and re-equip existing airfields. This required enormous funds and considerable time. It must not be forgotten that these difficult tasks were accomplished in a situation of postwar rebuilding and development of the national economy.

Extensive scientific research projects were launched at the instruction of the party and government. Scientific-research and other organizations were charged with special responsibility in this work. They made a large contribution to the elaboration of urgent problems pertaining to the future development of aircraft equipment and to the task of setting up the production of jet aircraft.

A jet air force was rapidly created as a result of steps taken by the party and government.

The first Soviet-produced jet aircraft was, of course, tested by G. Ya. Bakhchivandzhi, a graduate of the Orenburg Flight School, back in the spring of 1942. Two jet aircraft were flown in April 1946: a MiG-9 piloted by A. N. Grinchik and a Yak-15 flown by M. I. Ivanov. The La-15 jet aircraft was tested somewhat later. A group of jet aircraft took part for the first time in an air show in Tushino on 18 August 1946. Test-pilot I. T. Ivashchenko exceeded the speed of sound in horizontal flight for the first time in the world in a series-produced MiG-17 in February 1950.

At the beginning of the fifties, A. I. Mikoyan's design office was assigned the task of creating a fighter capable of flying faster than the speed of sound. This assignment was successfully carried out: the Soviet military aviation received the supersonic MiG-19 fighter.

The CPSU Central Committee and the Soviet Government also devoted a great deal of attention to rearmament of the bomber aviation. The Il-28 jet bomber was placed into series production in 1949. It flew twice as fast and had twice the range of the tactical piston-engine bombers and could carry three times the bombload, and was armed with more powerful guns.

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The aircraft was equipped with first-class navigational equipment, for that time, for night flying and for bombing invisible targets in difficult weather.

At the beginning of the fifties the Tu-16 jet bomber designed by A. N. Tupolev replaced the Tu-4 in the long-range aviation.

The naval aviation received jet aircraft, and the military transport aviation was re-equipped.

Equipment of the military aviation with jet aircraft required a qualitatively new approach to the training and indoctrinational process and considerable psychological readjustment on the part of the personnel, first of all, a change of attitude toward the new aircraft and toward the mastery of methods used for their combat employment and servicing. Further improvement of combat and political training and the training base in the line units and subunits played a large role in the accomplishment of these tasks.

First to master the jet aircraft were pilots I. P. Polunin, P. F. Chupikov, I. D. Koshel', S. D. Gorelov, N. I. Khramov, A. I. Babayev, Ye. Ya. Savitskiy and others. They boldly ventured into unexplored territory, revealed the secrets of flying at enormous speeds, achieved subtle control of the aircraft by means of the extremely complex equipment and found new methods of employing the equipment, which were later included in manuals and instructions.

Utilizing the experience of the jet aviation pioneers, many military pilots subsequently mastered the new military equipment with success. Hundreds of pilots, navigators, engineers and technicians were awarded orders and medals for their exemplary mastery of the equipment and their great skill. Test-pilots Colonel M. I. Ivanov, Major I. T. Ivashchenko, General P.M. Stefanovskiy and Colonel I. Ye. Fedorov were the first ever to be awarded the esteemed title Hero of the Soviet Union in peacetime.

Military aviation personnel began mastering night flying and flights in difficult weather conditions in 1951. Introduction of the achievements of electronics, radar and computer equipment in the aviation was highly important with respect to this type of training.

The outfitting of the aviation with new equipment required a higher level of theoretical knowledge on the part of the personnel. The personnel training system at military educational institutions and in the line units was therefore restructured in 1951-1953.

During those years the party and government took steps to provide material and moral incentives for the pilots, navigators, engineering and technical personnel.

By the end of 1953 the Soviet military aviation had thus undergone considerable qualitative and quantitative changes and had made a great advance in

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its development. At the same time, the complicated international situation and the development of military air forces in the armies of the imperialist states made it urgent to further improve Soviet aviation equipment and methods of employing them in combat.

The adoption of nuclear weapons in the soviet Armed Forces was the beginning of the second period in the development of the military aviation. At that time the Party Central Committee and the Soviet Government were devoting primary attention to the creation and mass production of supersonic aircraft, aircraft armed with nuclear weapons and missile-carrying aircraft for the bomber aviation.

Productive work was performed by the design offices of S. V. Il'yushin, A. I. Mikoyan, V. Ya. Klimov, A. M. Lyul'ka, P. O. Sukhoy, A. N. Tupolev, A. S. Yakovlev, O. K. Antonov and others. The fighter aviation received supersonic aircraft equipped with "air-to-air" missiles. The fighter-bomber aviation was created. Long-range air units received heavy jet bombers with a large load capacity and flight range. Substantial changes also took place in the military transport aviation's air fleet, permitting it to be made a separate branch of the Air Force.

Aircraft armament was successfully developing along with the creation and improvement of aircraft. "Air-to-air" guided missile systems with good performance features were rapidly created. Aerial bombs, missiles and atomic weapons of various caliber were improved. New sighting equipment was installed on the aircraft, making it possible to destroy targets from great altitudes, out of sight of land, as well as small and moving targets.

Describing this period in the development of the aviation, well-known Soviet aircraft designer A. S. Yakovlev wrote: "We had modern jet combat aircraft in large-series production in the fifties: the MiG-19, a tactical fighter; the Yak-25, an all-weather, night fighter-interceptor; the Il-28, a tactical bomber; and the Tu-16 long-range bomber. These aircraft formed the basis of the Soviet Union's air power until the end of the decade, when they were replaced with new and modernized high-speed, high-altitude jet aircraft."[2]

The third period of development of the Soviet military aviation, which is still in progress, has been characterized mainly by its large-scale armament with new weapons--airborne missiles of various classes and for various purposes and supersonic missile-carrying aircraft, and continued improvement of the combat capabilities of aircraft equipment. The good aeronautical engineering features of modern aircraft have been convincingly demonstrated by world records for flight speed and altitude and rate of climb set by Soviet pilots. Hero of the Soviet Union A. V. Fedotov, honored test-pilot, for example, reached an altitude of 36,240 meters in a Ye-266, and Hero of the Soviet Union P. M. Ostapenko, honored test-pilot, gained an altitude of 30 km. in 3 minutes 9.7 seconds in the same aircraft.

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Missile-Carrying, Supersonic, All-Weather

The military aviation of the sixties and seventies is an aviation unhampered by weather conditions, capable of flying at supersonic and transonic speeds, at minimum and stratospheric altitudes, with large payloads and at great flight ranges. Today's combat aircraft are armed with powerful, highly accurate weapons, mainly missiles of various classes and for various purposes. They are capable of destroying targets covered by a strong air defense on land and at sea, and air targets out of visible range. The realization of new designs in the creation of aircraft has considerably simplified the aviation's basin requirements.

A single aircraft or a small group of aircraft with conventional ammunition can now inflict the same damage as was achieved by forces several times greater during the past war. With respect to the performance of combat missions by aircraft carrying nuclear weapons, their superiority is hundreds of times greater.

The following data confirm this. During the Great Patriotic War the range of fire at air targets with Yak-3 and La-7 fighters equipped with cannons, was ordinarily 150 to 200 meters and the probability of destroying the enemy was 0.25-0.3. A modern fighter has incomparably greater combat capabilities for destroying air targets.

During the last war bridges presented a very difficult target for bombers. Dozens of aircraft had to be assigned to hit a bridge with a bomb and destroy it. A missile-carrier can now put a bridge out of operation by launching an "air-to-ground" missile several hundred kilometers away, that is, without approaching the target and entering the range of air defense weapons providing immediate coverage of the target. The situation is the same with respect to destroying ships at sea.

Mention should be made of the enormous achievements made in the development of military transport and passenger planes and helicopters. Everyone has heard of the Soviet air giants, the "Antey," Il-62, Il-76, Il-86 and Tu-114 and their junior "brothers," the Il-18, Tu-104, Tu-134, Yak-40 and Tu-124 and others, as well as helicopters designed by M. L. Mil' and N. I. Kamov. They have increased hauling capabilities and transport materiel and personnel more economically. They are also capable of flying long distances at adequately high speeds with corresponding loads.

The development of the modern military aviation has been characterized by the creation of VTOL aircraft as well as multipurpose, variable-sweep combat machines. These are long-range aircraft, capable of developing speeds in excess of Mach 2-2.5. They have powerful engines, good horizontal and vertical maneuverability and good takeoff and landing characteristics; they can carry the most diverse systems of modern weapons and can be used to perform diverse combat missions.

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The significant increase in flight speeds of modern aircraft, their improved takeoff and landing characteristics and maneuverability have been achieved primarily by means of fundamentally new power units, the various types of jet engines used in aviation.

The performance data for these engines have been improved significantly in the past 10 to 12 years, and their designs have grown more complicated. The increased complexity of design and of the physical processes occurring in the engine's operation are related to changes in the basic parameters, such as increased pressure in the compressors, increased turbine input gas temperatures; the employment of afterburners, adjustable compressors and input and outlet devices; the use of various automatic adjustment and control equipment, and so forth.

While in the past, three to five automatic control devices of relatively simple operation and design, such as a propellor regulator and a mixture and supercharging control device and several simple electric instruments for controlling the work of the engine, were installed on piston-engine aircraft of the Tu-2, Il-10 and La-5 type, modern engines are equipped with a large quantity of testing and measuring devices and regulating equipment of complicated design and operating principles. These complex devices include fuel-flow regulators, speed regulators, automatic acceleration control devices, automatic starting and booster fuel-control devices, automatic devices for the compressor, the input system and the exit nozzle, and so forth. The totally automated engine start-up system requires the use of complex airborne and ground energy units, electric and turbine starters.

The improvement of aeronautical engineering characteristics resulted in the rapid development of aircraft armament systems. The caliber and weight of the weapons and their firing rate and accuracy changed. This led to replacement of the simple collimator sights installed on the piston-engine aircraft with complex automatic sights consisting of electronic-optical-mechanical systems with computer devices, gyroscopic assemblies, radar rangefinders, electrohydraulic drives and other assemblies. This is especially typical for the long-range bombers, which carry target detection radar sets with a large amount of complex electronic equipment. This makes it possible for flight personnel to perform the most difficult missions successfully.

Aircraft armament systems have developed into special complexes, which include elements of airborne equipment and the destructive devices themselves. Each of these elements consists of complex electrical-radar mechanical systems requiring a high level of engineering and technical servicing and operation.

The quantity and complexity of radio and radar equipment are increasing rapidly in the development and improvement of aviation equipment, both airborne and that designed for remote flight-control. By the end of the Great Patriotic War airborne radio equipment consisted of communication and

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some radar equipment, whereas equipment for various purposes has now been added: equipment for identifying and determining the national origin of aircraft, jamming equipment, equipment for warning of a danger of attack, and so forth.

As the number of radio units has increased on aircraft, they have also become more complex. While there were only three radio units with 30 electric vacuum devices on the Tu-2, aircraft of this class now carry from 15 to 25 radio units with 2,000 or more electric vacuum and semiconductor devices. The number of such devices for each radio unit has greatly increased.

The increased complexity of airborne equipment has in turn resulted in a considerable increase in the number of controls and regulated parameters. The preflight inspection of aircraft such as the Il-10, La-7 and Tu-2 involved checking five to eight parameters, whereas there are 250 to 300 controls and parameters to be checked on a modern fighter.

Basic changes have also been made in aircraft equipment. Modern combat aircraft contin such a large amount of equipment that its arrangement and servicing are difficult. Suffice it to say that the combined power of all sources of electric energy on certain modern aircraft amounts to 150-300 kw., compared with 0.3-3 kw. in 1945.

Totally new aircraft equipment systems have come into being: automatic engine control, sighting-navigation and instrumentation, instrument landing and automatic aircraft control systems and systems insuring normal working conditions for the crews. Complex airborne systems for obtaining and processing information are extensively used on new aircraft. The separate systems are being integrated. The precision and reliability of the information presented by all of the aircraft instruments have been improved.

The equipment of cockpits with various instruments and devices for remote-control of the aircraft systems has considerably increased the sensory-motor load on the pilot during a flight. At the same time, the increased speeds, the expanded range of flight altitudes and the increased number of essential operations have resulted in a sharp reduction in the amount of time available to perform them and the shortage of time has increased.

The modern equipment and weaponry installed on aircraft have greatly increased their combat effectiveness. The equipment of fighter-bombers with special navigational equipment and means of detecting and destroying ground targets, and the employment of modern bombing techniques have greatly increased their combat capabilities.

At the same time, the complexity and the integrated nature of aircraft equipment require great stability of aircraft flight-performance data and equipment characteristics, as well as precise interaction among all elements of control of aerial combat operations.

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We know that fighter-interceptors perform their tasks in organic interaction with ground-control stations. Furthermore, the characteristics of the separate elements of the intercept systems are strictly coordinated and interrelated. Acceptable deviations lie within a very narrow range. If the characteristics of any element deviate beyond the established limits, this can reduce the system's effectiveness. Because of this, special importance is attached to the precise functioning of all elements of the intercept system.

In conclusion, it should be pointed out that as a result of rapid scientific and technological progress pertaining to the mastery of nuclear energy, production automation and mechanization, the introduction of radioelectronic equipment, the creation of high-polymer chemistry and the extensive use of jet and missile equipment, aircraft equipment and armament are being continuously improved and becoming increasingly complex, effective and diverse. At the same time, the development of equipment and its greatly improved combat efficiency do not mean that the equipment and weapons have now become a dominant and self-sufficient force, which under modern conditions would destroy the dialectical unity and interdependency between man and the new equipment. Man has been and remains the crucial factor in the combat employment and servicing of the equipment.

2. The Nature of Modern Aerial Combat and Demands Made of the Conditioning of Flight Personnel

The Equipment Is Altering Tactics

The devebpment of aviation equipment and the creation of new aircraft with good aeronautical engineering features, modern equipment and armament have increased the combat capabilities of aircraft and changed the tactics and nature of aerial combat.

Modern aerial combat is characterized by great spatial scope, rapid changes in the situation, powerful counteraction by the enemy's air defense facilities and the employment of various types of bombs, missiles and guns. Interceptions in the clouds, day or night, bombing with complicated types of maneuvering, "hunting freedom," combat action at extremely low altitudes and in the stratosphere, lengthy bomber flights with aerial refuelings, penetration of the enemy's air defense and the delivery of strikes at enemy air, missile and naval groupings, the covering of ground troops, the conduct of aerial reconnaissance, airborne landing operations and other missions and types of flights all impart an extremely decisive, sharply dynamic and fierce quality to the battle. This in turn requires unlimited courage, initiative and a steadfast will to win on the part of the crews, and considerable, frequently maximum, exertion of moral and fighting abilities and psychological qualities.

"We know," writes three-time Hero of the Soviet Union, Colonel General of Aviation I. N. Kozhedub, "that each air battle is a great test of the airmen's

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will, political, moral and psychological tempering, courage, military and flight skill.... The winners have been those who have handled the aircraft and weapons with excellence, were first to attack the enemy, employed proper maneuvering and seized the initiative."[3]

Modern combat involves the use of various types of missiles of various ranges. This keeps the crews in a constant state of tension, because the enemy can launch missiles at a target without seeing it.

The role of information, guidance and tactical control have increased greatly in modern aerial combat. The crews now obtain information by means of a special display from the radar observation and control system. This, in combination with the airborne electronic equipment, permits them to "see" further and "see" more. And the earlier the pilot identifies an enemy, the more time he has to appraise the air situation and make immediate preparations for the attacks, which, due to the great speeds and swiftness of the engagement in modern warfare, may be the only one. It will not always be possible to carry out a second attack.

While the task of vectoring was formerly a matter of guiding a fighter to within visual range of the enemy, in modern aerial combat, the main task is one of bringing the missile carrier, a "flying battery," to within target detection range by means of airborne interception radar. In addition, there is frequently no need for abrupt maneuvering by the fighter for selecting the direction of attack. Missiles with homing heads supplement aircraft maneuvering.

Radar countermeasures are extensively used in modern combat, which considerably complicates the crew's functions in working with the radar equipment and may make it ineffective for a certain time and jeopardize the combat mission. Such a situation requires maximum concentration of volitional capacities on the part of flight personnel, as well as the ability to withstand stress and the ability to employ antijamming means with technical competence and use the stand-by systems with maximum effectiveness.

The use of information obtained from instrument readings does not reduce the importance of caution and visual observation, especially in low-altitude flights, in a maneuvering air battle and when operating in the enemy's rear area. Caution has been, is and will continue to be a reliable weapon for pilots.

Airmen do not always give proper attention to caution, relying mainly on information from ground and on their intuition, which can have negative consequences. This is well illustrated by the account of two-time Hero of the Soviet Union, Major General of Aviation P. Golovachev: "We flew out that day as an escort for bombers. We did not have to worry about courage or a desire to engage in battle with the enemy. Ideological conviction and hatred for fascism increased our strength tenfold. Enemy fighters attempted to attack the bombers over the front line. An air battle ensued.... I

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rapidly found a 'Messer' in my sight and pressed the button. The enemy aircraft burst into flames and plunged toward earth. I do not need to tell you what exultant joy filled my heart. This was my first battle victory. I had the ability to gain this victory but, unfortunately, my combat experience and caution proved inadequate in the subsequent action. I should not have relaxed my combat alertness. After all, a battle was underway! When I saw the fascist vulture fall, however, I forgot about everything else on earth and did not notice the leader fall behind and another Hitlerite take his place. I was brought to my senses by a fascist round of fire which slashed through the cockpit. I was seriously wounded in the arm and head. The aircraft began to roll. Seriously wounded, I 'made it' back to our territory with great difficulty and made a 'forced' landing."[4]

Aerial combat of maneuver has undergone certain changes: speeds and altitudes and the duration and degree of stress have increased. The pilot's tactical skill and his ability to utilize the capabilities of boosted engines and the combat machine's special equipment and armament are of paramount importance. In certain stages of the battle maneuvering will be carried out in maximum, near-critical regimes, and this requires a thorough knowledge of aerodynamics, superb piloting techniques and good psychological conditioning on the part of the pilot.

Modern aerial combat may involve a single battle or a group of battles. While in the last war an air battle was begun by fighters as a group, it frequently broke up into pairs during the fighting. Group coordination, an element of combat perfection, has now developed into combat maneuvering in pairs, flights and squadrons. Combat maneuvering in a group makes it possible to carry out powerful, concentrated strikes against both ground targets and enemy planes and helicopters in the air.

The nature and peculiarities of modern combat places great demands on the pilot, primarily the level of his piloting techniques. In such a battle, it is important not simply to control the aircraft but also to execute combat maneuvers in order always to have superiority over the enemy, to be ready for immediate employment of all the aircraft missiles and guns and to be able to fly with various, even maximum, load factors, the range of which has expanded considerably. This permits the pilot to occupy the most advantageous position for the attack, to forestall the enemy and make full use of all the aircraft's capabilities.

Piloting practice develops in the pilots skills in steering an aircraft along ascending and descending flight paths with extreme changes in pitch angles, speeds, altitudes and load factors, develops in them such volitional qualities as determination, boldness, purposefulness, courage and initiative, and develops emotional stability.

As a rule, modern aircraft are flown at transonic flight speeds, which are characterized by certain aerodynamic peculiarities: speed and load ("pick-up") instability and unbalanced negative pitching. Bringing the aircraft

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to near-critical and critical attack angles presents certain difficulties. In certain regimes, this approach can be determined by a warning buffeting, the aircraft's rocking from wing to wing. There are certain conditions under which an aircraft may reach critical attack angles without any special warning signals. A pilot with a good knowledge of flight dynamics and the nature of these phenomena can overcome them successfully while engaged in combat.

When engaging in aerial combat with the enemy the pilot employs maneuvering approaching the tolerance level, with the maximum possible stress factors. Otherwise he may find himself in a disadvantage, which the enemy will immediately seize upon.

Utilizing the aircraft's good maneuvering and speed capabilities, in addition to switching on the afterburner and altering the sweep, the pilot must conduct a determined and vigorous battle and attack the enemy at long and short ranges, using missiles and guns in an attempt to destroy the enemy. Such a battle can be conducted by the individual who constantly develops his will, builds up determination and boldness and builds up reliable resistance to overloads by means of special physical exercises and systematic training flights, striving for thorough competence, proper psychological conditioning and a solid knowledge of aerodynamics. In the process of performing the exercises in piloting and aerial maneuvering combat, the cardiovascular system is conditioned and the necessary breathing rhythm and emotional stability are developed.

Like all flight work, it is difficult to imagine an air battle not involving risk. One must be prepared at each moment for any sort of unexpected developments in the air, for which a pilot prepares himself, possibly throughout his entire life, and, employing the "one hundred and one" alternatives latent in his consciousness, he emerges victorious from even the most severe test. Recklessness, a childish devil-may-care attitude, bravado and the desire to expose oneself to danger aimlessly are not signs of bravery, courage or strong will on the part of a pilot. On the contrary, such actions may be considered a lack of discipline and an inability to control oneself.

It is difficult to imagine an air battle without dramatic situations involving combat losses. After losing a friend, pilots are frequently required to fly out again immediately, subjecting themselves to risk, to throw themselves into the face of danger. And the individual who is in good control of himself will not lose his head in the battle or permit his will to weaken. In such a situation, commanders and political workers must take advantage of breaks between flights to work on the morale of the pilots, to help create positive emotions and confidence in victory, preventing a psychological breakdown.

The arming of modern aircraft with "air-to-air" missiles, the equipment of ground forces with "ground-to-air" guided missiles and the dynamic nature of modern aerial warfare have considerably changed the factor of surprise in an aerial contest. It helps to seize the initiative in a battle and to

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assume a more advantageous initial position for the attack, reduces the effects of enemy fire, makes the attack swift and overwhelming, and creates conditions for achieving superiority in the battle. Surprise is insured by timely and complete information on the enemy, concealment and proper, vigorous maneuvering, great approach speed and the ability to take advantage of the flight altitutde and weather conditions.

Unexpected enemy missile and aircraft activities can, in turn, complicate the accomplishment of a mission and threaten the lives of the crew. Modern aerial combat contains dozens of hidden, unknown factors, which may have a considerable affect on the pilot. While in time of peace the individual experiences new flight conditions for which he has prepared in advance, as a rule, an unexpectedly change in the situation in a battle may take the individual unawares. A pilot's lack of psychological preparedness for unexpected changes in battle conditions results in a sharp increase in emotional tension and can lead to a psychological breakdown.

Unforeseen obstacles arising in a battle and the newness of the situation may demand of the individual not only enormous willpower and maximum mental concentration, but also drastic alteration of his dynamic stereotype. It is not always possible to achieve the latter within a short period of time, however, since a restructuring of the system of conditioned-reflex associations and habits for adapting to a new type of activity is inconceivable without certain drills, which are repeated over and over, as a rule, or extremely difficult acts of willpower. This is why the conditioning of the will in time of peace is an intrinsic element of flights made in a situation of risk, in complicated circumstances approaching actual combat to the maximum possible degree, which helps to develop and improve such volitional qualities as courage, determination, boldness and initiative in flight personnel.

From Low Altitudes to the Upper Bounds of the Stratosphere

The development of radio-technical means of detecting and combating aircraft has forced pilots to make more extensive use of low, even minimum altitudes. In modern warfare low-altitude flights help to overcome the enemy's air defense without detection, to strike unexpectedly and leave the target rapidly. While only tactical fighters operated near the ground in World War II, as a rule, all branches of aviation can now perform combat missions at low and minimum altitudes.

Flights at transonic and supersonic speeds near the surface of the earth increase stress on the pilot's cardiovascular system and results in rapid tiring, weakening of the eyes and considerable emotional stress, since control of flight conditions, spatial orientation and aiming are carried out both visually and by instrument. We know that it requires at least 2 to 3 seconds to take the instrument readings properly after switching one's eyes from the earth to the cockpit, during which time an aircraft covers 560 to 840 meters, flying at a speed of 1,000 km. per hour. The pilot therefore keeps most of his attention free for observing the earth's surface.

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The increase in low-altitude flight speeds made it necessary to use automatic control systems, which make it possible to accomplish the basic tasks involved in piloting, combat employment and navigation by automated means. Without them, it would be extremely difficult to fly certain types of aircraft at low and minimum altitudes, at night and in the clouds, and practically impossible in limited visibility.

The sensation of the earth's nearness, the possibility of striking it if there is an error in piloting techniques and the extremely rapid pace of action resulting from the extraordinarily rapid switching of attention from the earth as it zooms by to the instruments, and vice versa--all of this requires that the pilot be capable of suppressing a desire to increase flight altitude, and good volitional qualities, so as not to lose self-control for a single second.

In the summertime, low-altitude flights are characterized by air turbulence, which frequently creates continuous, changing stresses. This causes the pilot to tire considerably sooner, leads to premature fatigue and increases reaction time.

Constant glimpses of the terrain zooming by during low-altitude flights distorts one's perception of altitude. Special flying skill acquired in the process of control flights in a "dual-control" trainer, as well as during independent exercises in this type of flights, with the difficulty gradually increased, is required for accurate determination of altitude.

The circumstances surrounding the pilot's mental work during low-altitude flights have become more complex. In addition to the conventional processing of various types of information, it is necessary to program the subsequent flight mentally, because the conditions may change at any moment. The pilot involuntarily attempts to see as far as possible in front of his aircraft, in order to follow the proper course and reach the target precisely. Constant visual contact with the earth's surface speeding by beneath the aircraft requires extraordinary exertion of the entire psychological system and mental calculation of flight time and distance to the target, because the use of radio-technical navigation systems is limited at low altitudes.

Anticipated enemy counteraction with fighters, ground-to-air guided missiles and individually employed homing missiles will contribute to the intensification of psychological tension.

Special difficulty and psychological tension are created by low-altitude flights in clouds, out of sight of land, when the plane is piloted by means of instruments alone and the assigned altitude is maintained by means of data provided by barometric and radio altimeters. The slightest error in their readings or a piloting error can complicate the flight drastically, and this is why the pilot exercises such self-discipline, why his will is totally activated and his sight strained to the maximum.

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In the conduct of their combat operations pilots not only fly in the clouds at low altitudes but also locate air targets by means of aircraft radar sights, approach and attack them. Successful accomplishment of the assigned missions is insured to a considerable degree by the pilot's ability to make maximum use of the capabilities of the airborne radar equipment and to consider its functional features when flying near the earth's surface.

An attack on maneuvering targets is greatly complicated if the fighter pilot, not knowing the direction of their maneuvering, belatedly begins to make turns or change altitude. This, in turn, can lead to failure to intercept the target, which creates additional mental stress because of the pilot's responsibility for the mission.

High-altitude flights and flights in the stratosphere (up to 30-35 km) are also typical for the modern aviation. Such flights represent one of the most difficult types of flight training and require great physical stamina, emotional and volitional stability and the ability to perform in rarified air on the part of the pilots.

We know that barometric pressure, air density and temperature, and engine thrust are reduced with an increase in altitude, solar radiation, increases and visual observation is complicated considerably. The thought process slows, memory, especially visual memory, deteriorates, and fluxing ("erosion") of attention occurs during hig-altitude flights.

The problem of oxygen deficiency, occurring with depressurization of the cockpit (due to equipment failure, and under combat conditions, to penetration by missile or shell fragments, and so forth) becomes especially acute in high altitude and stratospheric flights. An oxygen deficiency produces a large number of disturbances of the psychophysiological functions, resulting from insufficient saturation of the blood with oxygen due to a reduction in its proportional pressure in the inhaled air (2-fold at an altitude of 5 km, and 4-fold at 10 km). This causes disturbances in the functioning of the cerebral cortex and the central nervous system.

An oxygen deficiency is dangerous in the fact that it does not become apparent immediately but rather gradually, unnoticed by the individual, weakening his will and disrupting the psychophysiological processes. This leads to deterioration of the ability to function and then to loss of consciousness.

The pilot must prepare carefully for each high-altitude flight, thoroughly checking the oxygen and high-altitude equipment. Modern pressure suits reliably protect the individual against the adverse factors of altitude, but at the same time they create a number of inconveniences for the pilot: limited mobility, a reduced field of vision of the air and the cockpit equipment, possible fogging of the faceplate, and so forth. The high-altitude equipment somewhat reduces reaction precision, especially complex and motor reactions, and increases reaction time. It is markedly more

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difficult to breathe under the extra pressure inside a sealed helmet, and training is required on the ground to adjust to forces making it difficult to exhale and to the conduct of radio communication under these conditions.

It is considerably more difficult to perform various maneuvers at high altitudes, because of the aircraft's inertia and delayed reaction to rudder deflection, as well as to control the engine, as a result of a possible increase in temperature with the change in its operating conditions. A great deal of attention must be given to the degree of rudder deflection, because even the slightest error can result in loss of altitude, rocking and wing stall. This forces the pilot to carefully monitor the aircraft's position relative to the horizon, which in turn greatly increases his emotional stress, compared with that experienced in flights at medium altitudes.

The great flight altitude, the enormous space, the considerable distance from the earth's surface and the reduced noise level can all create a feeling of aloneness on the part of the pilot and in pilots lacking the special psychological training, even a feeling of fear or terror.

Our pilots successfully master the art of flying at high altitudes and in the stratosphere and perform confidently in the high-altitude equipment while bombing, conducting aerial combat, launching missiles and engaging in field firing practice. Before ascending to altitudes of many kilometers, however, they thoroughly prepare themselves for the performance of such responsible and complex missions, the preparation including psychological training and developing in themselves the necessary emotional and volitional stability.

The development of aviation equipment has made it possible to increase the duration of flights for all types of aircraft. The long time spent in the same position, the monotony of the situation, the pressure exerted against certain parts of the body by the special equipment and straps, the breathing of pure oxygen for many hours at a time, flights over the sea or over enemy-held territory and concern about the possibility of being hit by guided missiles both from the ground and from the air all subject the crew members to severe psychological tests. As the duration of flights increase, especially during the second half of the flights, the crew's efficiency is reduced, reactions slow, volitional activeness drops, keenness of vision and auditory and muscular sensitivity are reduced, coordination deteriorates, memory "lapses" and drowsiness occur, the attention span narrows, and there is an increasing number of errors in the control of the aircraft and engines and in the use of the various equipment. Emotional and physiological fatigue cause the airmen to become irritable and quick-tempered.

During a prolonged flight great psychological stress occurs at the most responsible stages: during aerial refuelings, the repelling of fighter attacks and missile launchings and bombings.

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Considering the peculiarities of prolonged flights, commanders and political workers persistently develop good moral-political and psychological qualities in the airmen and strive to see that throughout the flight each crew remains combat-ready and capable of performing the mission under the most difficult conditions. A spiritual closeness, a feeling of comradeship, support and mutual assistance, a desire to help a comrade--these are solidly entrenched features of the Soviet pilot, his extra weapon in combat.

The increased flight speeds and altitudes, the diversity and complexity of the tasks have sharply increased the stress on the airmen, creating considerable, sometimes maximum psychophysiological tension during certain phases of a flight. There are as many as 280 to 300 control, signal and monitoring elements in the cockpit of a modern aircraft, and this, combined with the supersonic speeds and the increased range of altitudes, has greatly increased the individual's pace of work. He frequently finds himself with a severe shortage of time, which demands extreme concentration of attention, memory and thought.

The decisiveness and the dynamic nature of modern warfare demands great maneuverability of the aircraft. Combat maneuvering is employed in piloting, during practice launchings of missiles at ground targets, bombing with changes in the flight path, and so forth. The maneuvering of an aircraft always involves a change in speed per unit of time, that is, acceleration, which affects the individual's psychophysiological functioning. The term "load factor" has frequently appeared in the literature, in the analysis of accelerations, a term which indicates how many times the force created by the acceleration exceeds the weight of the body. The load factor is measured in units equaling multiples of body weight on the ground.

When an individual experiences an overload in flight, certain of the physiological functions affecting his efficiency undergo changes. An overload causes the pilot to experience a feeling of heaviness and a limitation of motor functions, reduced keenness of vision, and sometimes, pains in the area of the chest and stomach as well. The individual's auditory and speech abilities deteriorate under prolonged 4- to 5-fold overloads, which may disrupt radio communication, lead to distortion of commands, and so forth.

Acceleration alters blood circulation and results in a buildup of blood in certain parts of the body (in the extremities in the case of a positive load factor, and in the upper part of the body, with a negative load factor). The disturbance of circulation leads to a deterioration of vision. It also becomes more difficult and takes longer to read the various gauges and instruments. Temporary loss of sight is possible at 5- to 6-fold overloads, which is not restored for 15 to 20 second. This can result in premature disengagement from the battle and to loss of aircraft control. A disturbance of visual perception has a negative effect on the individual's psychological state, causing overstress.

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The effects of overloads depend upon their intensity and duration. A 2-fold overload presses the pilot against the seat; it is difficult for him to make even small motions with the hand to control the aircraft in the case of 4- to 5-fold overloads; and his breathing rhythm is disturbed, his breathing becomes shallow and there may be a temporary loss of consciousness with a 5- to 6-fold overload. A dark film covers the eyes with a 5-fold positive overload, and the pulse rate increases to 120-180. With a 2-fold negative load factor the blood rushes to the head and the pilot experiences pain around the eyes and slight dizziness.

It is important that each pilot know these things and bear them in mind during the performance of missions.

During a flight, the individual, sometimes without even being aware of it, is constantly interacting with equipment, with dozens of instruments, buttons, levers, assemblies and systems, reacting to their signals, sometimes barely discernible, sometimes "screaming" and demanding special attention. The stability of this contact is directly dependent on the depth of his knowledge and the degree to which he has developed his skills in working with the equipment. The individual with a good knowledge of the equipment immediately makes the proper decision at the first, sometimes barely discernible, signal, without thinking about it for long, instantly manipulates the control elements and carries out visual, audial and instrument monitoring of the functioning of systems and units, flight conditions and radio communication. A solid knowledge of the equipment frees the pilot's attention in flight and greatly helps him to concentrate on what is most important, to react correctly and rapidly to unexpected equipment failures, to prevent the development of a state of stress in emergency situations.

Modern aircraft with their large number of radioelectronic instruments, several hydraulic systems, oxygen equipment, automation, guns and missiles, require especially thorough checking and testing of the special equipment prior to a flight. During the last war, after the engine was revved up and checked and the functioning of the panels was checked by a mechanic, the pilot inspected the aircraft, the propellor and tire pressure in the landing gear and tested the rudder deflection and the loading of the aircraft armament, which took 3 to 5 minutes. It takes longer and requires several special machines and a large number of specialists in various areas to check a modern missile-carrier.

It is impossible to check and test an aircraft prior to takeoff unless the pilot and navigator have a good knowledge of the checking equipment and the basic technical characteristics of the aircraft systems and control elements, since even a slight deviation from the standard on the part of a single parameter for a unit can result in failure to complete the mission and in a breakdown of flight safety. A superficial knowledge of the equipment and poor skills in working with the control elements create psychological incompetence and lead to blurring and uncertainty of volitional action and, naturally, make it unstable and short-lived.

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During one of the formation flights, young pilot X changed his bearing on the route and found himself in the wake of the lead plane. Feling the aircraft shake, he decided to escape the wake by falling behind. Lacking a thorough knowledge of and skills in working with the cockpit equipment on the aircraft, which was new to him, however, he mistakenly pressed the button for jettisoning the reserve under-wing tanks instead of the air-brake button, which would have increased his distance from the lead aircraft. Concentrating on retaining his place in the formation, the pilot did not notice the departure of the jettisoned tanks or the signal lights burning on the instrument panel, and continued the flight, attempting to maintain strictly the prescribed distances and interval.

The lieutenant paid the penalty for his poor technical preparation for the assignment immediately, when the lead plane executed a turn toward the airfield and noticed the absence of the under-wing tanks on the wingman's aircraft. When he asked how much fuel was left, the wingman answered with dismay: "The red light is on...." It was only then that he understood his error and lost his head completely. Attempting to reach the airfield as rapidly as possible, the pilot would increase his speed and catch the leadman, asking the commander each minute how far it was to the airfield. His voice was strange and he moved the controls excessively and unevenly.

The leadman understood his subordinate's mental state and did his best to calm him, reporting in his ordinary calm voice now the distance to an alternate airfield along the route, now the landing procedure, attempting to take the pilot's attention away from the signal light and the fuel gauge, on which the arrow was approaching the zero mark. And this helped the young pilot to come out of the difficult situation safely.

The successful fulfillment of assignments, both in a combat situation and under peacetime conditions, depends greatly on the physical conditioning of flight personnel. This is due to the increased flight speeds and altitudes, the intensity of modern aerial combat and the ever-increasing stresses involved in piloting an aircraft.

Today, a pilot performs the functions of an operator-monitor with ever-increasing frequency, integrating readings from the instruments and systems, and participates less and less frequently in control involving great physical exertion. While on the first jet aircraft, the air brakes, landing gear and flaps were activated by means of manually operated, hydraulic valves which required a certain amount of physical effort, the landing elements and wing control devices on modern aircraft are activated by applying slight pressure to a button or switch.

It would seem that the pilot's physical stress would have decreased with the introduction of automated aircraft control. This was not the case, however, due to the increase in flight speeds and altitudes, and stress factors, the use of pressure suits and sealed helmets, the increased number of flights performed at low and minimum altitudes and the large increase in the amount of information required.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Following flights on modern aircraft, the pilots frequently experience nervous, emotional and physical fatigue and exhaustion. The pilot's courage, determination and stamina now depend to a considerable degree on his physical endurance and conditioning. Systematic physical exercise helps flight personnel to develop the moral and combat qualities essential for the successful conduct of modern warfare. Regular exercises on a trampoline and on parallel and horizontal bars, jogging, sports, skiing and swimming develop resistance to stresses, motor coordination and good spatial orientation in the pilots.

A modern air battle is thus not just a duel between the technical capabilities of aircraft, their missiles, guns, bombs and radioelectronic weapons and tactical devices, but is primarily a struggle between pilots and their moral-political, combat and psychological qualities. The winner of an air battle is the individual who is able to impose his will resolutely upon the enemy, to suppress his spirit, to make him doubt his own capabilities, to create fear, desperation, a feeling of futility and confusion in him.

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Chaper II. GENERAL ASPECTS OF MORAL-POLITICAL AND PSYCHOLOGICAL TRAINING IN THE AIR FORCE

1. The Place of Moral-Political and Psychological Training Within the System of Training and Indoctrination for Flight Personnel

The Role of the Morale Factor in Contemporary Warfare (In the Air Battle)

Although the Communist Party and the Soviet Government firmly and consistently conduct a peace-loving Leninist foreign policy, they have not forgotten the fact that aggressive imperialist forces are still active on the planet, forces which are stubbornly opposing detente and intensifying the arms race, and have not given up their plans for armed aggression against the USSR and the other nations in the socialist commonwealth. In this situation our party and government have been forced to take effective steps to strengthen the nation's defense capability, to build up the fighting strength of the Soviet Armed Forces and to avert a new world war and the military conflicts kindled by the imperialists against peace-loving peoples.

A future world war, should the reactionary imperialist forces be successful in unleashing one, will, in political essence, be a decisive military confrontation between two opposite social systems--capitalism and socialism. This will result in a war of an acute class nature and in extremely determined actions by the belligerents.

In order to achieve victory over the enemy in a future war, the Air Force is expected to play a large role alongside the other services of the Soviet Armed Forces. It will be used to repel enemy air raids, to deliver powerful retaliatory strikes against the enemy, together with the Strategic Missile Forces, to conduct joint operations with the Ground Forces and naval forces, to conduct aerial reconnaissance, to land troops and equipment and to perform other missions.

Taking the objective patterns of warfare and factors contributing to the achievement of victory, the Communist Party proceeds from the assumption that the decisive force in combat is manned, ideologically and physically strong, able to handle the combat equipment and weapons perfectly and prepared to surmount all difficulties in order to defeat the enemy. In the Air Force it is primarily the flight personnel, those directly involved in employing the weapons in aerial combat. And the air fighter can perform a combat mission alone or as part of a small crew. He will not only perform as an active force but will also be the target of modern weapons. The successful performance of the combat mission will depend upon his moral-political and psychological qualities and his fighting efficiency.

Good morale helped Soviet pilots to emerge victorious from the difficult engagements of the Great Patriotic War. A clear understanding of party policy, of the objectives of war and the importance of completing each combat assignment gave them fortitude, valor and fearlessness in the struggle

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with the enemy. Our pilots demonstrated mass heroism in aerial combat, a willingness to sacrifice themselves and a determination to fight on in the air, even when their ammunition had been spent.

Appraising the role of morale in warfare, V. I. Lenin stated: "Victory in any war is ultimately determined by the morale of those masses who shed their blood on the field of battle."[5] This fact is of enormous theoretical and practical significance: It accounts for the accomplishment of many tasks involved in Soviet military organizational development and accounts for the objectives and the substance of moral-political and psychological training for personnel of the Armed Forces. The morale factor is manifested in a spirit of readiness and determination on the part of the fighting men to perform combat operations and in their capacity to bear all the trials of war for the sake of achieving total victory over the enemy.

Our army's morale is a direct reflection and a part of the Soviet people's morale. It cannot be separated from the state's social system, its policy and its social and economic relations. The troops' ideological conviction as to the justice of their cause, their social feelings and psychological conditioning are merged into one in their morale. All of this is reflected in the good moral-political qualities and the fighting efficiency of the personnel, which are essential to the successful performance of their combat missions.

The morale factor is in essence a moral-political factor, since the main indicator of its strength is the people's attitude toward the political objectives of warfare. "...An awareness by the masses of the objectives and the reasons for a war," V. I. Lenin stressed, "is enormously important and ensures victory."[6]

At the same time, structurally morale is an ideological-psychological factor. The ideological and social-psychological aspects are its main elements. They are closely unified and constantly interact and influence each other.

The role of morale has increased many times over in contemporary warfare, in air battles and engagements. There is a large number of reasons for this. These include, first and foremost, political reasons emerging from the social essence of a possible war. The greatest class confrontation between opposite social systems in the history of man predestines it to be an uncompromising war. It will make enormous demands of the morale and tremendous physical exertion by personnel of the Armed Forces, by the entire nation.

The altered nature of weapons and combat equipment, primarily the development of nuclear missiles, is an important factor contributing to the increasing importance of morale in a future war.

Air Force personnel will have to conduct combat operations in an exceptionally complex ground and air situation, faced by the threat of the enemy's employment

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of nuclear weapons, when the danger will pursue not only flight crews in the air but also those still at the airfield. Constant awareness of the nuclear threat will unquestionably have a great effect on the morale of the fliers, entail an enormous exertion of their spiritual and physical strength and demand special psychological stability of them.

One can imagine the effect produced on the morale of the flight personnel of air units and subunits by the enemy's sudden employment of the latest weapons, by the creation of enormous areas of devastation and fires, by the uncertainty of the situation due to the possibility of temporary loss of control. Exceptionally good morale and great physical exertion will be required of airmen operating from an airfield located in a zone of radioactive contamination. This situation can depress personnel, especially those who are readying the aircraft for flights and providing flight support.

Changes in methods of conducting combat operations will have a great effect on the morale of Air Force personnel. The dynamic nature of operations, the abrupt changes occurring in the situation, rapid switches from one type of operations to another, and the complexity of control will all increase the physical and morale pressure on the airmen considerably.

The moral-psychological tension of flight personnel is also increased by the fact that their combat missions involve the necessity of overcoming the enemy's air defenses and the performance of flights over great distances and at various altitudes.

The increased role of the morale factor in modern warfare, particularly in air battles and engagements, is making it necessary to raise the demands made of the moral-political and psychological conditioning of Air Force personnel and of the development of qualities and skills in them essential to the successful conduct of combat operations and to the achievement of victory over the enemy.

The Essence of Moral-Political and Psychological Conditioning of Military Fliers, and the Tasks Involved

The moral-political and psychological training of Soviet Air Force personnel refers to the aggregate of measures and activities designed to develop in the airmen the good political, moral and psychological qualities essential to the exemplary performance of their military duty in peacetime and in time of war. Moral-political and psychological training is a single, inseparable process, the definitive basis of which is the moral-political conditioning of the fighting men.

Moral-political and psychological training permeates all aspects of the training and indoctrination of the personnel and is an extremely important factor contributing to the continuous improvement of the combat readiness of the troops and to their successful performance of the missions assigned them. Moral-political and psychological training have a single, common subject, the

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

fighting men, as well as a single, common objective, that of actively influencing the intellect and psychic makeup of the men to develop politically aware, ideologically strong, bold and courageous armed defenders of the Soviet homeland.

The importance of moral-political and psychological training in the overall process of training and indoctrination for personnel of the Air Force is steadily increasing in the contemporary situation. This is due to many circumstances, primarily the nature of warfare, air battles and engagements, to the increased importance of the morale factor for achieving victory over the enemy, to intensification of the ideological struggle in the international arena, the high level of development of aviation equipment and weapons, and the continuing improvement of methods of employing them in combat and servicing them.

The process of moral-political and psychological training for Air Force personnel involves diverse tasks, which can generally be broken down into three groups. The first group of tasks includes the development of a communist world outlook and ideological conviction in the airmen. A high level of political awareness forms the basis of all of the personality features of the fighting man, of his spiritual being. Ideological conditioning provides the motivating force behind the productive service work of the airmen in peacetime and motivates the flying fighters to perform with determination and vigor in a combat situation.

The second group of tasks includes the development of social and political feelings and qualities in Air Force personnel. Primary among these are Soviet patriotism and socialist internationalism, fraternity with the armies of nations in the socialist commonwealth, avid hatred for the enemies of socialism, peace and progress, loyalty to military duty, a readiness to make self-sacrifices, and the desire tirelessly to strengthen military friendship and to assist comrades in the training and in combat.

The third group of tasks covers the development of emotional qualities in the airmen necessary for them to perform successfully in peacetime and in time of war. The main qualities in this category are emotional stability in the face of modern weapons, psychological preparedness to engage in combat and to achieve victory over the enemy, psychological compatibility, combat activeness, valor, boldness, self-control and performance efficiency.

The objective of all these tasks is to develop ideologically convinced Air Force fighters, devoted to the party, the government and the people, fighters able to utilize their spiritual strength and psychological qualities to achieve victory over the enemy, to employ the weapons and combat equipment effectively and to ensure flight safety.

Highly effective moral-political and psychological training of airmen is achieved by observing a number of conditions. The following should be stressed:

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

a communist orientation, party-mindedness, unity of ideological and psychological influence upon the servicemen, and maximum application of scientific achievements in the training and indoctrinational process.

Instructions issued by the 25th CPSU Congress on the need to take a comprehensive approach to the organization of the entire system of indoctrination and to ensure close unity of ideological-political, labor and moral indoctrination, taking the specific characteristics of various groups of workers into account, are of prime importance for improving the effectiveness of moral-political and psychological training for Air Force personnel.[7]

2. The Content, Forms and Methods of Moral-Political Training for Flight Personnel

Moral-political training envisages, first of all, developing in the airmen a communist world outlook, ideological conviction, Soviet patriotism and socialist internationalism, and proper morals of behavior in peacetime and in a combat situation; arming the personnel with an understanding of state interests, the policy of the Communist Party and the Soviet Government, and the nature and objectives of wars fought in defense of the socialist homeland. Moral-political training is carried out as part of the overall system for training and indoctrinating the personnel, mainly in the area of ideological work, but it has its own specific forms and methods.

A scientific, Marxist-Leninist world outlook has an enormous function in the practical work of fighting men in the Soviet Armed Forces, including airmen. It helps them to understand the laws of social development, to orient themselves in questions pertaining to the international situation and to life in our nation, and to gain an understanding of the natural patterns of warfare, trends in the development of military affairs and factors determining the fighting efficiency and combat readiness of the Armed Forces.

A Marxist-Leninist world outlook forms the basis of ideological conviction and of the political awareness of Soviet fighting men. It helps them to correctly appraise and understand the class essence of social development, to thoroughly comprehend the policy of the CPSU and the Soviet Government, to precisely determine their place in the struggle to implement the demands made of the Armed Forces by those bodies, to resist bourgeois ideology, and to successfully combat relics of the past in their thoughts and conduct.

A communist world outlook plays an important role in the accomplishment of specific tasks involved in maintaining combat readiness and in the training and indoctrination. The ideological conviction of airmen is demonstrated in their daily actions and conduct, in the improvement of their combat skill and in the strengthening of discipline, order and organization. It was explained at the 25th CPSU Congress that "communist ideological principles are a combination of knowledge, conviction and practical action."[8]

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

The communist world outlook and the ideological conviction of airmen is developed in the process of personnel training and indoctrination and in the performance of their assigned tasks. The planned political training of officers, shore-based warrant officers, soldiers and sergeants, agitation and propaganda, cultural and educational work, and party education have a leading role. Independent preparation by servicemen constitutes the main method of expanding their ideological-theoretical prospective and giving it a more solid foundation.

The thorough study of decisions coming out of the 25th party congress is the main element in the political training for the personnel at the present time.

Flight personnel study in Marxist-Leninist training groups. These groups are formed around a subject chosen voluntarily by the officers, based on their knowledge and on the sequence for studying the components of Marxism-Leninism.

Subunit and unit commanders or their deputies for political affairs lead the Marxist-Leninist training groups for pilots.

The group leaders conduct seminars and schedule consultations, provide the officers with extensive assistance in the organization of their independent work, and work up and present lectures on topics of current interest. For example, the commanders of many air units lead lectures on the following subjects: "Specific features of the new stage in the development of the Armed Forces of the USSR and the officers' tasks in the training and indoctrination of the personnel"; "Fundamentals and principles of Soviet military organizational development"; and "Modern weapons and their effect on the course and outcome of a war." They relate each lecture to the life of the unit and subunit.

The heightened interest of military cadres in Lenin's ideological and theoretical heritage and in decisions and materials of the 25th CPSU Congress is a distinctive feature of the officers' Marxist-Leninist training at the present time. In the propaganda and study of these, extensive use is made of lectures and reports, theoretical conferences and discussion of written papers on Lenin's works, party congress decisions and current theoretical issues.

"It is the honored duty not only of propagandists, lecturers and those delivering reports, but of all our party activists, to explain the concepts emerging from the congress to each communist, to each Soviet individual," General Secretary of the CPSU Central Committee L. I. Brezhnev stressed in the Accountability Report at the 25th party congress. "We must put all of our knowledge, all of our skills of conviction, all the powers of our minds into this work."[9]

In the air units and subunits a great deal of attention is devoted to the organization of the officers' independent work, to making the study of

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Marxism-Leninism more effective. Commanders, political workers and party organizations create conditions conducive to this work, arrange consultations, help the officers to select the reading material and to develop skills in studying it on their own, summarize and disseminate progressive experience and arrange for monitoring of the studies.

The officer's centers, clubs and libraries are doing a great deal to improve the quality of the independent work. They have set up self-education rooms and methodological centers, which contain literature for Marxist-Leninist training, folders of military newspaper and magazine clippings on specific subjects, and methodological guides for the independent work. The libraries perform a great deal of bibliographic and reference work and help the lecturers, group leaders and students select the required literature.

Of the forms and methods used to monitor the independent work of the officers, the following have proven themselves entirely on the practical level: individual discussions on the subjects studied and on the content of the recommended reading; making assignments to address military scientific conferences and theoretical seminars, to prepare papers on a current topic and to write articles for magazines and newspapers; group discussion of synopses written by individual comrades; and the exchange of experience in working with original sources.

The discussion of these issues at party and Komsomol meetings and at committee and bureau sessions contributes effectively to the vitalization and improvement of the political studies of the airmen.

Many Air Force officers study at the night universities of Marxism-Leninism and party schools, and are correspondence students of higher military educational institutions. Commanders, political workers, party and Komsomol organizations are doing everything possible to see that their studies are productive and have a constructive effect on their service activities.

Agitation and propaganda work, in which many pilots, engineers, commanders and political workers take part, has a large role in the development of a communist world outlook in the airmen. The concepts of Marxism-Leninism, the foreign and domestic policies of the CPSU and the advantages of the socialist system over capitalism are explained to the fighting men in the course of this work, and the social nature and the historical purpose of the Soviet Armed Forces and their missions are clarified.

In the performance of this work, the propagandists and agitators not only bring knowledge to the masses of fighting men but also have a good opportunity to study the moods and requests of the airmen and to enrich themselves from the experience of the latter, without which it would be impossible for them to have an effective indoctrinational influence on the personnel.

The mass media--the press, radio and television--as well as visual agitation, are the reliable assistants of the commanders, political organs, party and Komsomol organizations in the ideological-political indoctrination of the airmen.

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Cultural-educational work has a considerable role in the development of the airman's spiritual being. Officer's centers, officer's clubs, libraries, rooms of combat glory, Leninist rooms, film studios and schools of fine arts (izostudii), literary associations, folk theaters, ensembles, orchestras and amateur art groups take an active part in this work.

By making extensive use of the forms, methods and means of cultural-educational work, commanders, political workers and party organizations are actively contributing to the success of the personnel in their combat and political training, raising their political, military technical and cultural levels, and publicizing the experience of the best airmen and the results of socialist competition. The highly diverse possibilities of cultural-educational work are applied in a manner which promotes the successful performance of combat and political training tasks and the improvement of combat readiness, and making it an effective means of producing a soldier and citizen possessing a well-balanced combination of spiritual richness, moral purity and physical perfection.

Local party, soviet and Komsomol organizations, military patron commissions, creative unions, cultural and educational institutions, scientists and cultural figures provide the air units with active assistance in the conduct of cultural and educational work.

A communist world outlook and ideological conviction are developed in the airmen in the course of their combat training. Each class conducted as part of the ground training and all of the flight training are imbued with the communist ideological spirit and are designed to develop in the fighting men an aware attitude toward their assigned job, pride in the good combat qualities of Soviet aviation equipment and confidence in its dependability and effectiveness for performing combat and training tasks and for combating a powerful enemy.

Commander, political workers, party and Komsomol organizations strive to see that the political, military and moral indoctrination process develops in the military airmen a vigorous outlook on life and an aware attitude toward their social duty, and that unity of word and action becomes the standard for their daily conduct.

A high level of communist awareness is demonstrated by military airmen primarily in their steadfast implementation of requirements set by the party and government with respect to further increasing the combat power of the military aviation in the persistent improvement of combat skill, the strengthening of discipline, order and organization, and in a constant readiness to perform their duty to the homeland of protecting its sacred air borders in an exemplary manner.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Indoctrinating Military Pilots in a Spirit of Soviet Patriotism and Internationalism

The work performed by commanders, political workers and party organizations to indoctrinate the airmen in a spirit of Soviet patriotism and socialist internationalism has specific, closely interlinked focuses, and constitutes a single process of developing social and patriotic feelings in the personnel. The patriotism and internationalism of the fighting men is based on a high level of political awareness and a profound certainty of invincibility for the great cause of communism. The stronger the individual's ideological conditioning, the more powerful are his patriotic feelings and the greater his activeness in the performance of his military duty.

As stressed at the 25th CPSU Congress, the entrenchment in the minds of the workers, especially the younger generation, of the concepts of Soviet patriotism and socialist internationalism, pride in the Soviet Nation, in our homeland, and a readiness to come to the defense of socialism's accomplishments has been and remains one of our most important tasks.[10]

Propaganda of the advantages of the socialist system, of the great conquests of the Soviet people and its achievements in the building of communism has a large role in the patriotic indoctrination of the airmen. The importance of the five-year plans in the building of socialism and communism in our nation is explained to the personnel; the Communist Party's role in the accomplishment of social and political, economic and cultural reforms is demonstrated to them; and they are told about the successes achieved by the Soviet people in the implementation of plans, and the achievements of Union republics in the development of their economies and culture.

Diverse forms and methods are employed in this work: lectures, reports, talks, evenings of discussion, the showing and discussion of movies, readers' conferences, trips to factories and plants, kolkhozes and sovkhozes, and meetings with workers in the national economy and with representatives of local party, Komsomol and trade union organizations.

The lecture film series "Know and Love Your Homeland," for example, is highly popular with the men in air unit "X." It includes filmed documentary chronicles on the Union republics and the nation's important economic regions. As a rule, the films are preceded by presentations by propagandists, scientists and cultural figures, representatives of local organizations and outstanding workers in the production sphere. Such activities make a deep impression on the airmen and help to make them patriotic.

As they publicize the successes achieved by the Soviet people in the building of socialism and communism, commanders, political workers, propagandists and agitators stress the international importance of our achievements and their role in the development of the world revolutionary process, which helps the fighting men gain a thorough understanding of their international missions.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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The revolutionary, combat and labor traditions of the Communist Party, the Soviet people and their Armed Forces are extensively employed in the patriotic indoctrination of the military airmen. The courage and selflessness of the communist revolutionaries and the heroism demonstrated by the Soviet people in labor and in battle provide our fighting men with a powerful and inspiring example of sefless service for the homeland, an example of irreproachable fulfillment of their duty to it.

The traditions of the Soviet Armed Forces and of the military aviation are becoming especially important in the indoctrinational work. The most important of these are infinite devotion to the cause of communism, to the Soviet homeland and the people; mass heroism, persistence and selflessness in the fulfillment of military duty; friendship and military comradeship; a persistent effort to improve combat skills; loyalty to international duty and combat fellowship with fighting men of the other socialist armies.

As they publicize combat traditions, the commanders, political workers, party and Komsomol organizations strive to provide each airman with a good knowledge of the history of the Soviet Armed Forces and of the military aviation, the combat history of their unit and the feats performed by those who have served in their unit. This helps to make the airmen proud to be members of the glorious family of armed defenders of the homeland, proud of their unit and subunit.

Meetings of the airmen with Heroes of the Soviet Union, veterans of the Armed Forces and of the aviation, veterans of the Great Patriotic War, and those who have demonstrated courage and heroism in the performance of their military duty in time of peace are a proven means of indoctrination in the fighting traditions. The development of patriotic feelings in the airmen is advanced by military rituals and other ceremonial activities: presentations of government awards, meetings, parades by the personnel with the trooping of the unit fighting colors, the taking of the military oath by the young soldiers and the presentation of aircraft to their flight crews.

Visits to monuments and the fraternal graves of combat heroes, to sites of historic events and heroic battles of the civil war and the Great Patriotic War and to exhibits and museums are also of great indoctrinational value.

The patriotic indoctrination of airmen is organically linked to the development of their sense of socialist internationalism. Its purpose is one of developing a fighting man who can function with assurance in an atmosphere of intricate ideological struggle, in an unforeseen situation, who will steadfastly defend the interests of socialism at all times and wherever he may be. Strengthening our combat fraternity with personnel in the armies of the socialist states is an important integral part of the international indoctrination of Soviet fighting men.

A number of areas can be singled out in the work of providing Soviet fighting men with an international indoctrination. Among the most important are

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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thorough clarification of the essence of proletarian, socialist internationalism and the combat fraternity of the socialist armies in the contemporary situation; publicizing the experience of patriots and internationalists of various nations in conducting joint combat operations against the common enemy; familiarizing the airmen with the lives and the combat work of armies of the socialist nations; indoctrinating the fighting men in a spirit of internationalism in the course of joint exercises with armies of the socialist states; and constant consideration for the conditions under which Soviet fighting men serve in the fraternal nations in the performance of party-political work.

Those units temporarily located in the socialist states or stationed in military districts next to nations of the socialist commonwealth have accumulated a great deal of experience in developing socialist internationalism in the personnel. The work includes extensive use of political information briefings on the achievements of the socialist nations and on the combat histories of their armed forces; meetings of Soviet fighting men with those of the fraternal armies; joint celebrations of revolutionary and national holidays (ceremonial meetings, demonstrations, military parades); joint evening discussions on special subjects and combat fraternity gatherings; trips to plants and goskhozes, visits to museums and exhibits, the sharing of movies and newsreels on the lives and combat training of the soldiers, and so forth.

Joint unit and headquarter exercises conducted under a plan of the Unified Command of the Armed Forces of the Warsaw Pact Nations play an important role in the strengthening of ties of friendship among the fraternal armies. Just before such exercises are conducted our commanders, staffs and the political organs coordinate their plans with the commands of the fraternal armies, work out problems of interaction and discuss common tasks and experience in conducting party-political work in exercises.

Soviet pilots frequently perform shoulder to shoulder with those of the fraternal nations in these exercises.

Cultural and eductional institutions, song and dance ensembles and amateur performing groups work extensively during the exercises, and field friendship clubs function, organizing programs by concert groups for the troops and for the local citizens.

The tactical exercises are followed by critiques, meetings and parades. The critiques are attended by a broad group of commanders and political workers representing the armies of the socialist nations. They help to analyze the joint operations and to publicize demonstrations of combat fraternity.

In the forces located away from home, international indoctrination of the fighting men is promoted by a study of the differences involved in serving under these conditions. There is a tradition in units assigned to groups of forces, for example, whereby personnel arriving to serve in these units are acquainted with the state structure of the socialist nations, with their

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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successes in the building of socialism and with ther national customs and laws. Special attention is devoted to the study of agreements covering the legal status of Soviet troops temporarily located in fraternal nations. Posters, booklets, leaflets and books of graphic aids issued by the political organs of Soviet forces are very useful in this work. Our German, Czechoslovak, Polish and Hungarian comrades address seminars, assemblies and conferences of commanders, political workers, propagandists and secretaries of party and Komsomol organizations, and do a great deal to familiarize our fighting men with the nation in which they are located.

The fervent love of the Soviet people for their socialist homeland prompts another, opposite feeling--a burning hatred for its enemies, the imperialist aggressors. This organic unity of two opposite feelings is well illustrated by the words of the great patriot and humanist A.M.Gor'kiy: "Life is arranged in such a devilishly skillful manner that it is impossible to love sincerely without being able to hate."[11]

Exposure of the reactionary, misanthropic nature of contemporary imperialism is an important part of the work of developing hatred for the enemies of the socialist homeland in the personnel. An understanding of the fact that imperialism cannot exist without exploiting the workers, without appropriating the product of their labor, evokes a politically acute attitude toward oppressors in the fighting men and creates a feeling of solidarity with peoples struggling for liberation.

Demonstrating imperialism's aggressive and plunderous nature and demonstrating the disasters and sufferings which the wars it has unleashed have brought and continue to bring to peoples occupies an important place in the exposure of imperialism. Commanders, political workers, propagandists and agitators devote special attention to exposing the brutal character of the imperialist military, who will resort to anything in order to achieve their criminal goals.

In order to steadily increase the fighting strength of the military aviation and to further improve the process of training and indoctrinating the personnel, it is necessary to continuously improve forms and methods of moral-political training for the airmen and to seek new forms and methods of conducting modern warfare, air battles and engagements. The greater the political awareness and the ideological conviction of the fighting men, the stronger will be their feeling of patriotism and internationalism and the more effective will be the results of their missions in the peacetime training or in a combat situation.

3. Basic Areas of Psychological Training for Flight Personnel

Psychological training envisages the development of psychological qualities in the airmen, which permit them to function successfully in the dangerous and stressful conditions of modern combat, to perform their assigned combat missions in full accordance with their communist convictions and moral behavioral principles.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Psychological training is not a separate kind of training for servicemen but comprises an intrinsic part of the entire system of combat training and troop indoctrination. Such training was conducted in the past to some degree, but it did not have a special name. The role of the moral factor in a war has now grown to such an extent, however, that it has become necessary to separate the concept and to take special steps to strengthen the psychological stability of the personnel. The fact should also be stressed that the effective employment of aviation equipment is now increasingly determined by the individual's psychophysiological capabilities, which fluctuate within a wide range even in the same pilot, depending upon his physical and mental state. Consideration of these states and the mobilization of all the individual's reserves have become an important condition for successful flight work and for ensuring flight safety.

It is for this reason that another psychological training task, the purpose of which is to promote the exemplary performance of flight assignments and to ensure the safety of every flight in peacetime, is being performed in the Soviet aviation, along with that of preparing the personnel to conduct combat operations under the conditions of modern warfare. Naturally, the isolation of these tasks is extremely conditional, for they are closely interrelated and closely linked to the moral-political training. Nonetheless, it contributes to a more accurate understanding of the role of psychological training within the system of training and indoctrination for flight personnel and to the determination of practical measures to be carried out in this area.

The Development of Psychic Functional Reliability in Pilots

The development of psychic functional reliability in flight personnel covers a broad range of tasks. Important among them are the development of self-confidence, a positive attitude toward flights, a good work capacity and other qualities and skills in the pilots, which contribute to the successful performance of the assigned missions.

Air battles which have been fought and the routine flight work have convincingly demonstrated the fact that their effectiveness depends to a considerable degree on the pilots' self-confidence and their ability successfully to cope with any assignment, with any complication of flight conditions. Since this matter will be discussed in detail in the following chapter, we shall limit ourselves at this point to general aspects of the problem.

In order to successfully develop such confidence, it is important that the flight work be thoroughly conceived and scientifically planned. Proper determination of the number of flights and their sequence, a gradual progression from the simple to the complex, and a rational build-up of the workload all contribute to successful flight work and, consequently, create self-confidence in the individual and a desire to attain even more. On the other hand, assigning the pilot work which is beyond his capabilities and which are not commensurate with his experience and abilities retards the improvement of his combat skills, undermines his confidence in his abilities, and may even

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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instill a fear of flying in him. In other words, it may create a so-called psychological barrier, which will then be difficult to overcome.

It is important to utilize both the positive and the negative from the practical flight work for developing confidence. By stressing the positive aspects of a pilot's actions and commending him for his successes, one promotes a growth of confidence, while stressing only the shortcomings may unsettle and confuse the pilot and then cause him to lose confidence in himself, in his abilities. In other words, the development of confidence in flight personnel should be based on positive examples, while the negative aspects of the pilot's actions should be employed as auxiliary material and should be presented with great care and tact.

Naturally, every pilot error should be carefully analyzed to eliminate the possibility of a repetition. At the same time, one should not forget the fact that an unsuccessful flight, an unpleasant situation, causes the pilot to suffer deeply and that at such moments he needs support and sympathy more than at any other time. The best way of mobilizing the pilot's will, his emotions and thoughts for achieving the goal is to reveal the true cause of the error, to indicate ways of correcting it, to give the pilot support and encouragement, to express absolute confidence in the fact that he will cope with the assigned missions.

The pilot's preparedness to withstand the great pressures experienced in the air depends to a great degree upon his psychological state prior to a flight, upon his self-control, his morale and step-up mental activity, that which is referred to in psychology as preflight or combat excitation. A special ritual marking the beginning of the flight day or night contributes to the creation and development of this sort of preparedness: a mustering of personnel and the observance of a formal moment of silence at the airfield; precise commands, a report from the meteorologist, a weather reconnaissance report, instructions from the navigator and the flight operation officer, and the raising of the Air Force flag. This unites and rallies the team for the successful performance of the assigned missions, creates enthusiasm in the personnel and helps them to put negative thoughts out of their minds.

The fact must be emphasized that negative thoughts frequently have a great effect on the course and outcome of a flight. One pilot, for example, told how he continued to think about an unpleasant conversation with his wife during an entire round-robin flight and did not notice a dangerous loss of altitude until he was descending, only with effort forcing himself to concentrate on piloting the aircraft. Another pilot was so engrossed with a misunderstanding which had occurred at work the evening before that he did not notice in time that he was straying off course, did not hear commands issued by the flight operation director and was forced to land at a neighboring airfield.

Unexpected changes in the flight schedule, inadequately organized servicing of the aircraft equipment, crudeness and harsh comments from superiors during

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

the flight day and long waits for takeoff can make airmen less calm and result in deterioration of their psychological readiness for a flight. A great deal depends upon the flying experience and general background of the pilots. The young pilots are ordinarily the more keyed-up and impatient. The individual's specific psychological traits also play a role, a fact which cannot be ignored when the flight schedules are compiled.

Prior to each takeoff a pilot should have time to prepare himself psychologically for the specific upcoming flight, to collect his thoughts and to go over the flight plan and the sequence of the actions involved. A lack of time or acceleration of the usual pace of takeoff preparations can result in the omission of or mistakes in certain operations and to excessive emotional tension.

The successful development of a positive frame of mind for flying depends to a great extent upon how thoroughly the individual psychological qualities of the pilots are taken into account. These qualities may be quite specific for various people. A bad mood or family difficulties may have little effect on the work of some pilots, for example, and they are able to divorce themselves from problems experienced on the ground once they are in the air. Similar situations may markedly affect the efficiency of others and cause them to make mistakes. Some pilots react calmly and correctly to complications in flight; others may become excessively excited, hasty and nervous, while yet a third group may experience a retardation of attention and the thought processes, motoric constraint and sluggishness in making decisions. It should be noted that the manner in which pilots react to complicated situations on the ground and in the air is fairly constant for each individual. It is important to understand this and to take it into account in the training and indoctrination of pilots.

A special study has shown that following a safe outcome of an emergency situation, approximately half of the pilots have increased confidence in their abilities, in the fact that they can always find a way out of any complication, which has sometimes resulted in an exaggerated concept of their capabilities, in overconfidence. Others have begun preparing more thoroughly for flights following such incidents, to study more carefully what is to be done in emergency situations. Yet other pilots have lost confidence in the equipment, in their abilities and capabilities, a loss which can only be restored with great effort.

All of this demonstrates the fact that there are no ready solutions in such cases. Individual traits are called just that because they differ from one individual to another and an individual approach is required in every case. Proper evaluation of these characteristics and the skillful development of personal qualities depend upon the pedagogical skill of the commander and upon his understanding of the psychological essence of the phenomena being studied.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

A pilot's psychological stability and his reserve strengths can be reduced by fatigue during an assignment--a temporary drop in efficiency. It is manifested in a deterioration in the precision with which he maintains the prescribed flight parameters, in errors and in reduced efficiency in the combat employment of the aircraft.

Organizing flights properly--providing a precise daily schedule, observing flight-load standards, scheduling breaks between flights, minimizing the amount of time spent waiting for takeoff, and so forth--is highly important for preventing fatigue. The nature of flight work is such, however, that fatigue may build up even when it is properly organized, which means that additional steps must be taken. For example, it is recommended that the pilots' load be gradually increased over a period of 1 or 2 weeks following a leave, that it then be maintained at a high level for 5 to 6 months and then reduced somewhat, permitting the pilots to rest up at health centers.

In efforts to prevent fatigue it is also important to take into account the positive emotions produced by the flight work itself. The sensation of great speed of flight, for example, the extraordinary beauty of the clouds, the enormity of the heavens and a feeling of satisfaction from subordinating the awesome machine to man's will and satisfaction with a successful assignment, all create vigor, uplift the mood and reduce fatigue. This does not occur on flightless days or when the workday continues after the flights have been completed. Some pilots even say that they become more tired on days when they do not fly than when they do.

There are periods in the life and work of pilots, during which they have greater loads and consequently become very tired (in exercises, for example). A clear understanding of the need for the increased loads, however, and a heightened sense of duty and responsibility motivate a pilot and stimulate his mind to the extent that fatigue does not affect his performance. There have been cases during exercises, however, when this has necessitated a reduction in the number and intensity of flights, a shortening of the workday, and so forth.

Studies have shown that flight personnel fatigue is related to the great nervous and emotional stress and to inadequate physical activity. This means that their strength can best be restored most rapidly with active relaxation: daily calisthenics, walks, tourist excursions and sports.

In addition to increasing the pilots' physical strength and stamina, sports training makes it possible to develop a large number of psychophysiological and psychic qualities: the ability to distribute their attention, the ability to make decisions rapidly and to act with precision, spatial orientation, a preparedness for unexpected events, the ability to work under nervous stress, boldness and decisiveness, determination and self-control, persistence and tenacity.

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The effective development of psychic functional reliability in flight personnel depends not only upon the commanders, political workers and aviation doctors, but also upon the pilots themselves. Constant attention to this matter on the part of all is one of the important conditions for productive flight work.

Improving the Emotional-Volitional Stability of Flight Personnel

The great nervous and emotional stress characteristic of flight work plays a double role. On the one hand, it is necessary to stimulate the psyche and to ensure that all of the individual's reserves and capabilities are applied toward the successful performance of the flight assignment and for the development of stamina and preparedness to tolerate large overloads, which is exceptionally important for preparing a pilot to operate in a combat situation. On the other hand, great nervous and emotional stress can cause errors, contribute to fatigue and sometimes even result in diseases of the nervous system.

From the standpoint of ensuring flight safety, maintaining good efficiency on the part of the flight personnel and prolonging their ability to provide flight work to the maximum, it is therefore important that the mental stress on a flight conform fully to the complexity of the mission being performed and to the crew's capabilities. Good emotional-volitional stability is one of the conditions of such conformity.

The development of good emotional-volitional stability in flight personnel is a complex and painstaking process which requires a certain knowledge of psychology on the part of the commander, the political worker and the aviation doctor. Let us consider a few of the specific features of this process.

As we have previously mentioned, when an individual finds himself in a complicated situation he experiences a state of special psychic tension, which stimulates all of his systems and has a powerful effect on the individual's behavior and efficiency. The dependency between the degree of this tension and the individual's functional efficiency can be depicted in the form of a parabola. As the tension mounts the individual's efficiency and capabilities increase in comparison with a state of calm (his reactions become more rapid and precise) until they reach a peak, and then begin to drop. Individual operations begin to be omitted and there is a tendency to switch to more simple actions, those solidly reinforced in previous practice, the attention span narrows and it becomes more difficult to distribute and switch one's attention, the sense of time is disturbed, errors of perception and lapses of memory occur, there is a feeling of bewilderment, and so forth. Building up emotional-volitional stability makes it possible considerably to increase psychic capabilities and to prevent a drop in efficiency.

A pilot's good emotional-volitional stability is based primarily on his ideological conviction, his world outlook and interests, on the main purpose of his life and his flying. It is also influenced by the individual's personal characteristics (mainly the temperament) and his psychological preparedness to withstand great stresses in flight. The development of this

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

preparedness requires first of all that the decisions and actions required in any possible situation be worked out in advance, before leaving the ground. This is achieved by means of various types of classes and drills, by mentally "running through" the circumstances which could be encountered on a flight, and so forth.

Preparing the pilots to deal with the unexpected is especially important in the development of emotional-volitional stability. No matter how well conceived and thorough are the preparations for a flight, it is impossible to foresee all of the possible situations, especially in a combat situation. A pilot's ability rapidly to appraise an unexpected situation and to find the correct way out of it, that is, his mental alacrity and efficiency, is the decisive factor.

The importance of mental alacrity and efficiency has risen sharply in the flight work of today. This is a result of the increased combat capabilities of the aviation, the continued development of air tactics, the increased complexity of aviation equipment and weapons, the improved control of flights and combat operations, and the increased importance of independence of action and initiative on the part of the crew or group in the performance of combat training missions.

The creation and development of mental alacrity and efficiency in pilots is accomplished through a diversified process of training and indoctrination. The assigning of unexpected problems to the trainees during classes, preliminary and preflight preparation, flight critiques, the extensive employment of hypothetical problems in drills performed with special equipment and in the aircraft cockpit, the assigning of individual assignments to the pilots in the more complicated aspects of the piloting and combat employment of the equipment helps to develop in the pilots flexibility of mind, mental alacrity and efficiency, independence in making decisions and speed of implementation.

It is especially important to provide pilots with the ability to function on the basis of limited or contradictory information and with a shortage of time. Trainers can be of invaluable assistance. They make it possible to simulate a complex flight situation, contradictory instrument readings when one of them breaks down, false emergency signals on the panel from a malfunctioning system or unit, fluctuations of needles and other indicators which may be taken as a breakdown or unstable functioning of indicators, false instructions, loss of contact with the flight operation officer, and so forth. It is especially important to work out in trainers questions arising in actual flights, exercises and combat operations.

As a result of such training during exercises and drills on the ground, the pilot is able to accept a sudden change, an unexpected or critical situation almost as an ordinary, normal development, thereby providing for the activation of additional psychic reserves.

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

It should be pointed out at the same time that extreme care must be taken to the performance of such drills in the air, ensuring absolute flight safety. It is important to protect the pilot in such a way that he is not aware of the fact. In actual practice, however, an instructor will sometimes warn a pilot as to what sort of malfunction is to be simulated, thereby making it easier for him to perform the complex actions. Such a practice creates passivity and does not sharpen the trainee's mental alacrity and efficiency. Along with simulating malfunctions, the experienced commanders and instructors also achieve the same purpose by altering the procedure designated for performing flight patterns, require piloting at an "evolutive" speed, by delaying the removal of the cover from the cockpit hood when coming in for a landing, and so forth.

Gradually increasing the complexity of flight conditions, bringing them into maximum conformity with an actual combat situation, is an effective means of improving the emotional-volitional stability of pilots. Naturally, all of this should be done in a carefully conceived manner, using the proper methods and taking into account flight safety requirements and the individual qualities of the pilots.

Experience has shown that conditions approaching a combat situation to the maximum possible degree, not to speak of actual combat, have a powerful effect on any individual and alter his psychic state. This state is determined to a great degree by the correctness of the individual's perception and thinking, by the degree of volitional stress and by the nature of his actions.

Under certain conditions a complex and dangerous situation will inhibit functioning in the cortex of the large cerebral hemispheres. This can disturb the normal flow of the psychic processes, reduce conscious control over actions and increase the role of biological and physiological factors in the adoption and implementation of decisions in a difficult situation.

I. P. Pavlov stressed the fact that man first experiences reality through direct perception by the sensory organs and only then, with the acquisition of experience, does he become the master of reality. As one remains in a stress situation, the nature of its effect on the psyche gradually changes. One ceases to react to the unusual nature of the situation and the psychophysiological mechanisms readjust, adapting the organism to function under the new conditions. The complex situation changes from an inhibiting to a stimulating factor and creates a state of militant excitation, a surge of strength, mental acuteness and firmness of will.

Some elements of a combat situation, serving as powerful irritants, produce an involuntary orientational reflex in the individual, which inhibits his regular functioning, focusing his attention on the irritant itself (devastation, fires or an atomic blast, for example). The force of the orientational reflex weakens as the individual becomes familiar with them, which permits him to concentrate again on the performance of his assigned task.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Exercises, field firing practice, bombings and missile launchings provide a good opportunity for creating conditions approaching actual combat. Being present in tense situations, the independent adoption of important decisions, continuous alteration of the situation, the employment of real weapons, simulation of the external factors of combat effects, and so forth, provide the best possible psychological conditioning. Routine, simplification and indulgence, on the other hand, do not provide the required psychic conditioning and retard the improvement of combat skills.

It is important to note that computations and actions involved in the performance of combat training missions--camera-gun firing, camera-bombing, a simulated missile launching or the dropping of airborne landing equipment--may be identical to those performed in actual firing, bombing and missile launchings, but are entirely different things from the psychological standpoint. There have been many instances in which a pilot with a good theoretical background and well drilled in training flights has permitted major errors in the performance of a combat training mission. The psychological conditioning of the personnel should therefore be based on many factors and specific features characteristic of flight work and on the individual traits of the pilots.

In conclusion, it should be noted that the above list of general tasks and specific features of moral-political and psychological training does not cover the entire diversity of problems characteristic for this type of training. They only serve as a methodological basis for our review in subsequent chapters of specific problems involved in the development of good moral-political and psychological qualities in the pilots in the process of their combat training.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Chapter III. MORAL-PSYCHOLOGICAL PREPARATION FOR FLIGHTS IN ADVERSE WEATHER AND AT NIGHT

1. The Focus of Attention--On The Instruments

Man In The New Situation

Flights in adverse weather conditions and at night are an important part of the aviation's combat training system. They account for a constantly increasing portion of the flight training. This is a result of the broader range of tasks to be performed, by the growing combat capabilities of the aviation and by the improvements being made in airborne and ground control equipment. Such flights involve considerable difficulties, created in large part by the fact that the human body is functioning in a situation new to it.

We know that under ordinary ground conditions the individual assesses and evaluates his position relative to his surroundings by means of an orientation system based on the earth's gravity and the gravitational field. The functioning of his visual, vestibular and muscular (motor) analyzers makes it possible for him to perceive the position of his body under the effects of the earth's pull and to orient himself in a coordinated manner. On earth man can move, sit, lie, turn and perform simple acts with his eyes closed.

When flying in the clouds or at night, however, it is very difficult and frequently impossible to assess one's position in space without visual contact with the horizon or with instrument readings. When flying "blind" the instrument readings are the main source of information on the aircraft's position in space, its speed and altitude, and so forth.

As altitude increases, the gravitational field is altered, the effect of the earth's gravity is weakened, and new forces begin to affect the individual--acceleration, overload and others. The existing system of coordinated perception of the position of the individual's body in space undergoes certain changes as a result. He has an increased sensation of pressure produced by centripetal and centrifugal forces during the performance of flight maneuvers, when altering linear flight, and so forth. The absence of a solid foundation beneath his feet gives rise to new sensations, unlike those experienced on earth, which affect man's psyche.

Something like a "revaluation of values" occurs--the functioning of the eyes is altered: they become the main analytical agent for determining the body's position in space. Averaging the instrument readings in flight, the individual then turns to data provided by his main source of information, his visual analyzer. As he takes the instrument readings, the pilot not only assesses his position in the air at the exact moment, but also notices a changing trend in flight conditions, especially of the aircraft's position in space. The gyro-horizon still shows the aircraft to be flying in a straight line, but the needle of the rate-of-climb indicator is slowly dropping. And pulling the lever slightly toward himself, the pilot controls the degree of change in flight conditions by the readings on other navigational instruments.

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When a well-trained pilot flies by instrument, his entire body senses any change in the vertical plane, as well as acceleration, overload or turning simultaneously, and he almost instantaneously glances at the rate-of-climb indicator, the altimeter and the gyro-horizon or at the sideslip indicator in order to verify the signals received by his brain. Where do the signals come from? From his muscles. Muscular sensations are extremely perceptible, but they are "blind" and must therefore be continuously checked. As soon as the visual analyzer has confirmed the change in flight conditions, signals from the muscles first grow weaker and then disappear until there is another change in flight conditions.

It has been determined that while a reaction to a light stimulus lasts 1.5-3 seconds, muscular sensations make themselves felt 10 times as rapidly. This does not mean, of course, that man's muscular sensations are the main source of information in "blind" flight. Both muscular signals (they arrive more rapidly) and visual signals should be used for determining the aircraft's position in space rapidly and accurately, with preference given to the latter.

During night flights the pilot can monitor his position in space both visually, by observing the horizon, and by instrument. As a rule, the horizon is clearly visible on a dark night, a fact which considerably simplifies navigation and eliminates a great deal of psychophysiological stress. In order to monitor his position in space the pilot periodically checks his own impressions against the instrument readings. Should an entire night flight be performed by instrument readings alone? Hardly. Prolonged "fixing" of the eyes upon the instruments rapidly produces fatigue. It is best to rely upon both visual observation and instruments for flying at night, when the natural horizon is visible.

On daytime flights, when weather conditions are good, the pilot focuses attention mainly on the functioning of the engine and the different systems, on visual orientation, maintaining his position within the zone, and so forth, only periodically making a visual check on the aircraft's position in space. During instrument flights, on the other hand, it is of prime importance continuously to monitor the aircraft's position in space by rapidly reading the navigational instruments, only infrequently checking on the performance of the engine and the various systems.

The Pilot's Increased Pace of Action

The number of instruments in an aircraft cockpit has increased 30-fold over the past 30 years, and the time available to perform each of the operations involved in controlling the aircraft, the engine and other equipment has been reduced 6- to 7-fold due to the increased flight speeds and to changes occurring in the operation conditions of the equipment. This has complicated the functioning of man's signaling systems for determining his position in space when flying in adverse weather conditions, in the stratosphere and beyond, and has placed greater demands upon him with respect to his knowledge of the equipment design and methods of operating it.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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When piloting an aircraft by instrument one's eyes are constantly fixed upon dials, needles and indicators, the individual's main external signaling devices, while his mental activity is focused upon processing continuously changing information on flight conditions. Even before takeoff the pilot must know hundreds of various parameters--specifically, those pertaining to take off, climb, route, target approach, bombing and interception and the functioning of the engine and other systems--and to remember numerous paragraphs of instructions and manuals, and other information. All of this abundance of data goes into action in flight, interweaving in the individual's mind and, combined with the flow of information from the ground and from other crews, creates considerable stress in the work.

In order to fly in adverse weather conditions and at night, a pilot must also possess considerable physical stamina, a good visual and motor memory, the ability to perform complex coordinated actions and the ability to maintain his spatial orientation without being able to see the earth or the natural horizon. Wearing pressure suits and airtight helmets for lengthy periods, staying in one position and breathing under the extra pressure, in turn, create additional difficulties. Even the small physical force repeatedly applied to the control elements tires the hands and legs and reduces their sensitivity, which is so necessary for operating a modern high-speed aircraft. The pilot is also affected by accelerations and changing load-factors, powerful vibrations and loud noises, changes in pressure and so forth.

When pilots fly in the clouds at night, they frequently encounter the phenomenon of flashes produced when the cockpit blister, which is made of organic glass, comes into contact with dense, electrically charged clouds. The flashes are sometimes so powerful that they light up the cockpit. Patches of light reflect off the glass covering the instruments, making it difficult to read them. Pilots, especially those encountering the phenomenon for the first time, automatically have the urge to look at the flashes, and a great deal of willpower is required to withstand the temptation and keep one's eyes upon the instruments. A powerful flash can blind a pilot for a moment, and a certain amount of time elapses before his keenness of vision is restored. Any sort of distraction which takes the attention off the instruments can result in erroneous readings and in a breakdown of the sequence for distributing one's attention. As pilots acquire experience in flying in the clouds at night, the flashes do not have the same effect as they do on the first such flights, but this does not eliminate the need for willpower to carry out the assignment successfully and to ensure flight safety.

The peculiarities of flying in the clouds at night, the abundance of various information dealt with and the need to perform numerous complex operations with the control elements for the aircraft, the engine and the special equipment thus force the pilot to operate at a rapid pace and with maximum exertion of effort.

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2. On The Ground And In The Air

Ground preparations for flying in adverse weather conditions and at night include a broad group of measures. The study by flight personnel of the nature of the planned exercises and the specific features involved in performing them and of the requirements contained in regulations, manuals and instructions, training sessions with special equipment and in the cockpit, and discussions with veteran pilots on the peculiarities of flying under such conditions are of primary importance among these measures. From the standpoint of psychology, each of the measures helps to form and develop in the pilots the various qualities and skills essential to the successful accomplishment of the assigned missions.

Experience has shown that it is exceptionally important when studying the nature of the exercises and the required guides and when organizing the exchange of flight experience to instill in the pilots confidence in the fact that they will successfully master the performance of flights in adverse weather conditions and at night, and a readiness persistently to overcome difficulties in the path of acquiring combat proficiency. The experienced commanders also attempt to see that each pilot is capable of objectively evaluating his training results, taking advantage of the experience of others and demonstrating a sense of responsibility in matters both large and small. This, combined with thorough military technical erudition and a desire to understand all of the fine points of aviation work, is precisely what produces combat proficiency and, along with it, confidence that the flight skills will be successfully mastered.

Practical Training in the Use of the Equipment--An Important Phase of Training

Practical training sessions with special equipment and in an aircraft cockpit makes it possible to closely duplicate actual flight conditions for a pilot and to thoroughly study the individual's personal traits, to objectively evaluate his successes and deficiencies and to form and develop in the trainees not only flight proficiency but good psychological qualities as well.

The first instrument "flights" in the cockpit of a trainer ordinarily present no difficulties for the pilots, since they usually involve a horizontal flight, turns with a bank of less than 30 degrees, descents at low vertical speeds, and so forth. Setbacks may occur, however, when the assignments become more complicated: when they involve turns with a bank of 45-60 degrees, for example, zooming maneuvers and descents at angles of 20-30 degrees, turns onto prescribed courses while climbing or gliding, descents and landing approaches. It is the instructor's duty to do everything possible to see that the failures do not discourage but motivate the pilot and make him even more determined.

Proper use of the radio by the instructor for making comments and instructions is one of the means of achieving the proper frame of mind in a pilot working

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in a trainer. It is important for such comments and suggestions to be made in a calm and comforting manner, for them to produce positive reactions in the trainee. Harsh comments, yelling and irritability traumatize the pilot and result in deterioration of his performance. Sometimes, in the process of working out a complex element of flight on a trainer, a situation develops in which an error by the trainee creates a threat to "flight" safety and the desired results are not produced by repeatedly reminding him of his error by radio. In such a case the instructor should issue an order to rectify the error in a more determined manner, in a firm and insistent voice, or break off the "flight." The good thing about working with a trainer is the fact that the assignment can be halted at any minute, the errors thoroughly analyzed and suggestions made for correcting them.

A typical error made by pilots learning to "fly" on a trainer is failure to maintain the required altitude, speed or banking angle. This ordinarily occurs when the trainee is practicing descents and landing approaches in clouds, when exceptionally precise distribution of attention and prompt reactions to the instrument readings are required.

Experience has shown that after "flying" several times in the clouds in a trainer, a pilot requires less time to take the instrument readings, his determination of altitude, speed and descent parameters is more accurate, and he develops and reinforces his ability to distribute his attention and to determine the situation "at a glance," based on readings of navigational and other instruments. As a rule, at the end of the trainer "flight" program, the trainee's actions become more confident, prompt and precise--he has developed a dynamic stereotype, which makes flying in the clouds and at night considerably easier.

Training sessions in the cockpit of an airplane (or helicopter) have a large role in the pilot's professional and psychological training. The arrangement of the instruments, the colors and markings of buttons, levers and signal lights and the play in the controls are exactly the same as those which the trainee will encounter on an actual flight. Performing the exercises once only is not enough to make the trainee comfortable in a cockpit at night. When the electric power is turned on and the cockpit lights up it is sometimes difficult to determine the location of this or that piece of equipment or button or to read the numerous instruments. Practical training in the use of the equipment at night therefore helps to develop precise, cognative, automatic actions in a cockpit, stable skills in distributing one's attention and the ability unerringly to determine the overall situation on an actual night flight.

It is important for the practical training acquired in a cockpit to include only cognative actions with the aircraft and engine control elements and know purely mechanical "turn-on--turn-off" procedures, because the greater the degree of awareness on the part of the trainee in the performance of a certain operation, the greater will be his success.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Training sessions in an aircraft cockpit on a runway illuminated by searchlights and with the nosewheel in landing position have proven themselves to be effective prior to initiatory night flights. This permits the trainees to master more rapidly the technique of landing at night.

Flights In a Dual-Control Trainer

In a dual-control combat training aircraft the pilot can check the level and quality of the skills acquired by the pilot while training on the ground, the most important of which are his ability to operate the cockpit equipment, to take the instrument readings, to maintain the required parameters for gaining altitude, entering the zone and approaching the landing airfield, and can observe the trainee, checking his mental activity in the resolution of hypothetical problems, the stability of his psychological functioning, his reaction time, peculiarities in the coordination of his motor processes, his flight skills and so forth.

Flights in a dual-control trainer with blinds closed, combined with training sessions on the ground, not only improve the psychological functioning of the trainees and increase their speed of response to external stimuli, but also contribute to the formation of new new qualities and skills. Special among them is the ability to coordinate the reading of the various instruments in a relatively dark cockpit and to fly under night conditions, when the aircraft's position in space is monitored by means of instruments and by observing the horizon.

Experience has shown that it is expedient to combine flights in a dual-control trainer in adverse weather conditions and at night with practical training sessions in the continuous and prolonged reading of the instruments under ordinary conditions: en route to the flight training zone or a range, on an air route, when descending at a landing airfield, and so forth. The pilot observes both the instruments and the ground and compares the results of the observations, thereby improving his skills in determining the aircraft's location.

We should stress the fact that the process of developing skills proceeds rapidly and successfully at first, but that it later slows down and the quality deteriorates somewhat. This occurs because the larger deficiencies in piloting techniques and in working with the cockpit equipment are eliminated in the beginning, and then barely perceptible, deeply rooted deficiencies, which can only be eliminated with a considerable amount of work. The length of time required to develop skills and how well they are developed depend to a great degree upon the pilot's personal characteristics: his level of knowledge, personality, reaction speed, degree of physical development, psychological state, and so forth.

Systematic training is required to retain skills already formed. Lengthy breaks in flying, especially in the initial stage, can result in temporary

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deterioration of skills and to a loss of linkage between them. This process occurs more rapidly in young pilots than in the veterans. A breakdown of skills and of the dynamic stereotypes is ordinarily manifested in uncoordinated actions, in reduced acuteness of perception with respect to spatial orientation and instrument reading, in a loss of the "feel of the aircraft," and so forth.

The term "harmful carry-over of habits" is frequently encountered in the work. What does this mean? If a pilot has flown a single type of aircraft for some time, he has developed certain conditional reflexes and formed specific habits in his handling of the control elements, and has acquired muscular adaptation to the specific functional loads. When he undergoes retraining to fly a different type of aircraft or when he advances from a dual-control trainer to a combat aircraft with a somewhat different arrangement of instruments, buttons, toggle switches and signaling devices, the trainee encounters difficulty in reading the instruments and operating the control elements. Habits carried over will influence the pilot for a certain period of time, which sometimes results in errors in determining flight speeds and altitudes, in tardy extension and retraction of flaps, and so forth.

Before beginning solo flights in adverse weather conditions and at night it is important thoroughly to work out all of the complicated actions involved in flying the aircraft, operating the control elements and reading the instruments in trainers, in an aircraft cockpit on the ground and in flights in a dual-control trainer with the blinds drawn, in order to prevent the harmful carry-over of habits.

Under Nighttime Conditions

Piloting by instrument, the specific kind of lighting in the cockpit and the complexities of visual orientation--all of these specific features of flying at night make exceptionally large demands of the pilot's vision. It must successfully perform its functions in reduced illumination and in situations of abrupt change from radiant light to darkness and vice versa.

We know that when an individual remains a long time in a brightly lighted area, his eyes become accustomed to the situation and function in accordance with it. It takes considerable time (20-25 minutes), however, to adapt to sudden darkness. It is important to bear this in mind when preparing for and during the course of night flights. It helps to take one's position in the cockpit 15 to 20 minutes before starting up the engine before a flight, for example, and 5 to 7 minutes before turning on the lights in the cockpit, giving the eyes an opportunity to adjust to the reduced illumination. The eyes also have to adapt when going from darkness into brilliant light. Otherwise, there is a possibility of temporary blindness or even damage to the eyes, since the pupils of the eyes expand (the area of the pupil increasing as much as 16-fold) in dim lighting and visual sensitivity is extremely great.

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Something similar occurs in the case of visual orientation when local objects are poorly illuminated. The pilot strains his eyes in determining his position and seeking out reference points for navigational or bombing purposes and then encounters difficulties when he subsequently goes back to reading the instruments: his eyes require a certain amount of time to adapt to the cockpit lighting.

On a night flight the cockpit lighting greatly affects the pilot's work and his mental and emotional state. Very bright or very dim lighting forces him to strain his eyes, tiring them. The lighting in the cockpit should be adjusted so that it is possible to read the instruments accurately, to see all of the main control elements and to switch from observing the radar screen for aiming to monitoring the instruments, and vice versa, without strain. A pilot will sometimes greatly increase the brightness of the radar sighting screen in order to make out the target blip among the interference or local objects reflected there, which makes it difficult to monitor the instruments. The light filters used in operating the sight on night flights and flights in clouds help the pilot overcome this difficulty.

It sometimes happens that an aircraft will enter the beam from a runway floodlight when starting on the second circle at a low altitude, because of an inaccurate landing computation on the part of the crew, which temporarily blinds the crew members. In such a situation the pilot should look only at the instruments and although it will be difficult to read them for a certain period of time, the flight should be performed in a straight line, without maneuvering and climbing to a higher altitude until full vision has been restored. Only after full restoration of vision should the pilot return to visual observation of the natural horizon and ground orientation lights.

A feeling of aloneness and impotence may develop and a drop in activity may occur on long night flights, when there is a starry sky overhead and blackness and no visible reference points below. Such feelings are experienced not only by the beginners but by veteran pilots as well, individuals who have developed their skills in distributing their attention and orienting themselves to the point of automation and who have developed a "flair" for flying. In such a case, it is advisable to force oneself to increase the pace in monitoring the instruments, to make contact with the flight operation officer or the officer manning the command post and to stretch and relax the arm, leg and stomach muscles several times.

Clouds--A Major Test

When performing assignments in the clouds the pilot's work is performed in a situation which not only requires a high level of proficiency but also involves great physical and emotional stress. His "world" has been reduced to the extreme, limited to the cockpit and the multitude of various instruments by means of which he controls the aircraft. All of his visual links with the earth's surface, the sky and the natural horizon have been broken.

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Like every new type of flight training, training for flying in the clouds begins with training classes, training sessions with special equip[illegible] and in an aircraft cockpit and with check flights and initiatory flig[illegible] a combat training aircraft.

The first difficulty ordinarily encountered by the trainees is delayed reaction to the instrument readings because of imprecise distribution of attention and inability to appraise the overall flight situation instantaneously, "at a glance," so to speak. The pilot's main object of attention is the gyro-horizon, which makes it possible to determine the aircraft's location, which an individual without visual contact with the earth or the natural horizon cannot do on his own. Almost half the time a pilot spends monitoring the instruments his focus is upon precisely this one, leaving little time for the others. This gives rise to errors in the distribution of attention among the instruments and to delays in reacting to their readings.

Approaching for a landing and descending in the clouds presents a certain amount of difficulty in learning to fly in adverse weather conditions. Due to the rapidly changing situation and the nearness to the earth in this phase of a flight, there is a certain deterioration of the aircraft's aerodynamic qualities (the lowering of the landing gear and flaps, and so forth), and the amount of time available to read the instruments and to assess the situation in general is greatly reduced. The pilot's work pace increases. Under these conditions young pilots may experience stress, which is manifested in a deterioration in manipulation of the controls, "suppression of control," an increase in the amount of time required to read the instruments, mental inertia or sluggishness, a breakdown in radio communication, dullness of hearing, general constraint, and so forth.

An overly demanding instructor sometimes demands precise and prompt actions and strict adherence to all flight parameters from a trainee on his second or third flight in adverse weather conditions. But not every individual is capable of rapidly mastering piloting techniques with the natural horizon not visible, and all the more, of demonstrating good psychological stability, stamina and self-control in a situation which seems very complicated to him. Beratement and lack of objectivity in appraising the young pilot's actions are especially harmful in such a situation. Pedagogical tact, respect and a desire to help the trainee learn the causes of his errors and ways to eliminate them--these are far from all of the useful factors for indoctrinating those who have not yet acquired stable skills in piloting aircraft in the clouds, in whom the mental and emotional qualities essential for such flights have not yet fully developed.

The results of man's practical work, of course, depend greatly upon his mental state. When he notices low clouds prior to takeoff, the pilot who is given to worrying, especially who lacks experience, becomes agitated, requests a weather forecast more frequently than the others, is overly cautious and pays too much attention to what others have to say. After takeoff, as a rule, the attention of such a pilot is focused on strictly maintaining each degree of bank and

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

each meter of altitude, and should an instrument malfunction or something happen to the engine at such a time, he may experience stress and then begin committing gross errors.

Over-anxiousness is to some degree an inborn trait, and although it is therefore probably not reasonable to speak of overcoming it completely, we should discuss preventive measures which can cure a depression. It is not desirable to leave the overly anxious pilot alone for a long period of time. It helps to engage him in conversations about subjects of interest to him, to play chess, to involve him in some volunteer activity. In other words, it is important that he always be in the group, that he share its plans and activities. This has a positive effect on his mood and makes him less anxious.

As flying experience is acquired the anxiousness fades somewhat, but this does not mean that the commander, the political worker and the doctor can forget about it entirely. In the process of training in an aircraft cockpit and "flying" on a trainer, it is advisable gradually to increase the complexity of the hypothetical problems, to simulate sudden "breakdowns" of the engine, other systems and instruments more frequently.

One sometimes hears it said that the circumstances of an assignment should become increasingly more complicated as they develop. This ostensibly helps to prepare the pilots mentally and emotionally for more difficult flights. We feel that such an orientation does not stimulate the development of the required mental and emotional qualities but, on the contrary, contributes to the development of a state of tense anticipation of extremely difficult flight elements, which has a negative effect on the pilot's performance. Experience has shown that it is best gradually to complicate the assignments and to arrange for more frequent exchanges of experience among the best crews, taking the individual's personal features into account. It is important to stress the fact that the pilot has all of the abilities necessary to perform the mission successfully. This helps to develop a positive frame of mind in the individual and confidence in his abilities and in the equipment which he operates. It is no less important, of course, to direct attention to the inadmissibility of overestimating one's strengths and abilities and of complacency and self-satisfaction.

Experience has shown that a pilot undergoes extensive psychological stress during the transition from visual flight to flying in clouds, during which time his psyche and his visual analysis mechanism undergo a reorganization process with respect to spatial orientation by instrument. A flight in good weather conditions, in which the horizon is clearly visible and the pilot does not need to "fix" his sight constantly upon it, does not produce complicated psychological situations. When, however, following takeoff or when coming in for a straight-end landing, it is necessary to enter the clouds and to climb for a lengthy period, to come out onto a prescribed course, to set out on an intercept mission or descend for a landing, the pilot undergoes considerable mental and emotional stress. The stress is especially great

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

when descending in clouds immediately above the ground, making course correction turns or altering flight conditions (altitude, forward or vertical speeds), when flying in dense clouds and when it becomes dim inside the cockpit.

We know that good landings are ordinarily preceded by good approaches and that an inaccurate approach, on the other hand, ordinarily results in a poor landing. These two constituents of a flight are closely interlinked, because adjusting an approach involves a change in the course, which, in turn, involves a more complicated maneuver--a descending turn. The pilot focuses attention upon maintaining vertical speed and the prescribed bank on the turn and upon determining the moment for pulling out of the turn, and there is not always enough time or sufficient altitude for him to prepare for and execute the landing. And since the landing is made in sight of the flight operation officer and other personnel, the pilot wants very much to make it an excellent one. By trying too hard, however, he frequently achieves exactly the opposite. This is why veteran instructors frequently remind the trainees of the unwritten rule: "Prepare for a landing on the last turn."

The approach of the earth makes some pilots want to look ahead and spot the airfield as rapidly as possible, which can result in premature loss of altitude and speed. In such a situation it is extremely important for the pilot to have the willpower to keep his eyes on the instruments. A certain degree of relaxation, which ordinarily follows complete emergence from the clouds and sight of the approaches to the airfield and of the runway, is a result of the pilot's complete confidence that the clouds are behind and the airfield is nearby and that he can now switch to visual flight. This is especially typical when the bottom edge of the clouds is not distinctly outlined, when the earth begins to flash by beneath the wings and the pilot experiences an increasingly persistent urge to see it, if only out of the corner of his eye. This is where his willpower, self-discipline and psychological stability are most essential.

Sometimes, when flying in the clouds, the same individual will not be consistent in his piloting technique: on one flight he will perform the assignment precisely, strictly maintaining the required parameters, while allowing the aircraft to list constantly in one direction in the horizontal phase of another flight. The error surprises him: he has apparently done everything correctly, but the instructor has frequently reminded him that the aircraft is listing.

Such deflections of the aircraft are ordinarily caused by the pilot's position in the cockpit, position frequently determining perception. A movement of the body out of its usual position (along the aircraft's axial line and the instrument panel) gives him a feeling of awkwardness and discomfort, and the pilot involuntarily adjusts the control stick in an attempt to align it with his body, thereby causing the aircraft to list. The pilot gradually finds the proper position for his body within the cockpit relative to the longitudinal line of the aircraft and the center of the instrument panel, evolving a certain familiar position, and any changes in that position can lead to piloting errors.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

The first solo flights in clouds create great nervous and emotional tension in pilots. Some of them, especially those with inadequate experience, may have a pulse rate as high as 140-150 after a landing. It is not difficult to imagine the stress to which the heart and the nervous system are subjected the first time a pilot takes off on his own and the first time he flies into clouds. This is why it is important when scheduling flights in adverse weather to carefully observe pilots taking off for the first time and the inexperienced ones, to help them develop immunity to danger, to excessive caution upon encountering clouds, and the ability to control themselves in any situation. It is sometimes best not to react negatively to the fact that a young pilot, upon returning from a flight, shares his impressions excitedly, gestures widly and speaks with an altered, cracked voice--let him get his emotions out of his system. Later, however, when he has "cooled off," it is good to congratulate him on his first solo flight in the clouds, a major victory.

Officer N. Zhukov, military pilot first class, eloquently described what pilots go through in the performance of assignments in adverse conditions: "Pilots are extremely painstaking in their preparations for such flights. They carefully study the makeup of the assignments and the methods to be used in performing them, and the requirements contained in guiding documents, work diligently in a trainer, repeatedly run through what is to be done in special circumstances, and pay close attention to the weather report. They are supercritical about accepting the aircraft from the technicians. All those who have ever flown in extremely adverse conditions vividly picture the danger inherent in such flights. There is apprehension, and perhaps even fear, of the unknown. None of the pilots hides his mental and emotional state, but they are all typically calm on the outside. They are only slightly more taciturn and smoke more frequently. This outward calm is nothing other than the ability to keep their emotions in check, an ability which takes years to develop.

"In their preflight conversations with comrades one frequently hears detailed accounts of flights made in adverse weather, of how they feel in the air. They answer questions with 'Nothing unusual.' Or 'Yes, it was a little on the difficult side.' That is all. And it is only during the critique that everyone learns exactly what those flights were like. Each pilot recalls how he constantly worked to maintain his orientation in the clouds, carefully monitored fuel consumption and the functioning of the engine, carefully maintained the prescribed flight conditions...."

Crews making long flights in clouds are in an especially tense and complicated situation. The constant switching of attention from one object in the cockpit to another, constant monitoring of the navigational instruments to anticipate changes in flight conditions in good time and to maintain flight safety, the monotony and uniformity of the situation all produce fatigue in the crew. It ordinarily takes the form of deteriorated accuracy in reading the instruments, slowed mental processing of information, a feeling of sluggishnes and drowsiness, and so forth.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

I. P. Pavlov pointed out that for man, especially his brain, to function normally, he requires external stimuli, because a constantly uniform, monotonous situation ("sensory starvation") lowers the tone of the cerebral cortex, which can produce undesirable changes in the psychophysiological area. At the appearance of fatigue, sluggishness and drowsiness, it is recommended that the individual move his head smoothly in various directions, tense and relax his muscles, and move his arms and legs, that is, engage in physical exercises for a brief period. Naturally, while he is thus engaged he must continue to monitor the instruments, control the aircraft and strictly maintain the prescribed flight parameters.

Success Demands Confidence

Among other factors affecting the development of positive feelings and the proper frame of mind for a flight in the pilots, it is important to give them confidence in their abilities, in the aircraft equipment and ground flight support systems. Confidence helps to raise the individual's fighting spirit and gives him strength, calmness and persistence. Faith in the reliable functioning of the aircraft equipment in the air and in the ability of personnel manning the command posts, the flight supervision group and the landing and navigational systems to correctly appraise the situation and to guide the aircraft precisely to air and ground targets, and confidence in the fact that the ground service specialists will always come to their assistance in a time of difficulty all have a great deal to do with the pilots' success in the performance of their assignments.

Such confidence is developed in flight personnel by various ways and methods. Important among them are classes conducted with the equipment, meetings and talks with the servicemen who man command posts and landing systems and those of other service subunits, joint practical training sessions with them, other kinds of classes, periods of training for pilots at command posts, tactical and technical conferences, and so forth.

The autosuggestion practiced by many pilots prior to their first flights in adverse weather conditions has proved itself unquestionably. Autosuggestion is a process whereby the individual tells himself things like "I can and will learn to fly in clouds!" And "I must always concentrate on the instruments! The most important things are the aircraft's position, speed and altitude!" Autosuggestion produces a feeling of confidence in one's abilities, unfetters the attention and the muscles and gives the individual a feeling of being in complete control of the aircraft.

When learning to fly by instrument, a pilot frequently experiences setbacks, which are most frequently caused by his inability to control his attention and to concentrate his efforts on that group of tasks which are of prime importance. As a rule, his lagging attention results in a breakdown of the sequence for monitoring the instruments. This occurs most frequently during turns in the clouds, when entering the landing course and when simultaneously descending and changing directions.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

If the individual's instrument piloting skill has not improved after repeated practice on the ground and in the air, then the so-called zigzag is recommended: altering the attention distribution procedure, the height of the cockpit seat, the volume of the radio set and the aircraft intercom system (SPU), and so forth.

Failures encountered in learning to fly in adverse weather conditions sometimes cause a pilot to become inattentive, reserved and lethargic, and he sometimes loses his desire to move forward, to improve himself. In such cases it is the duty of the commander, the political worker and the party organization to come promptly to the individual's assistance, to give him confidence in his abilities.

This is precisely what once happened to officer B. In the beginning, he was training to fly a missile carrier, he proved himself to be a capable, diligent and persistent pilot. It appeared that the officer would successfully complete the retraining program. It was soon revealed, however, that he was making major errors in the interception of air targets: there was no spirit or vigor in his attacks and he would err extensively in "fire" as a result of which he was not completing the operations within the established time limits.

Pilot B. tried to explain that the problems in his intercepts were caused by inconsistent functioning of the radar sight, by errors on the part of the aircraft controller or even by the fact that "the target was not moving as it should have." A detailed analysis of his performance in the air and on the ground and some frank discussions revealed the fact that his failures resulted from a loss of confidence in his abilities and in the reliability of the equipment. The commander, the political worker and the veteran pilots had to work hard to help officer B. acquire the confidence, the qualities and skills essential to productive flight work. Training sessions with special equipment and in an aircraft cockpit, talks with veteran pilots, individual assignments and practical training at the command post and as a member of a landing crew were employed for this purpose. As a result of all this, pilot B. caught up rapidly and achieved considerable success in his combat development.

In the process of instilling confidence in a pilot it is important for the commander and political worker to be especially careful and objective in evaluating the results of the individual's combat training. It is useful for them to praise him and sometimes to express their gratitude for his successes, thereby giving him the inspiration to perform more difficult tasks. When his efforts meet with failure the pilot should be encouraged and helped to correctly analyze the causes of his errors, and should not be permitted to lose his self-confidence. It is not always justifiable from the psychological standpoint to discuss a pilot's performance publicly. When a pilot's errors are mentioned repeatedly in the flight critiques, for example, he may become resentful and withdrawn and may lose confidence in

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

his own strengths and abilities, which frequently entails new errors. It is also dangerous to go to the other extreme--praising a pilot excessively, stressing his natural gift for flight work and his good innate reaction speed, and so forth. This may cause him to become overconfident, which frequently produces conceit and results in poor relationships with his service comrades.

Flights in adverse conditions ordinarily stimulate the individual's volitional capacities, sharpen his ability to focus his attention and heighten his capability for physical activity. That is, they help to place the individual in the highest state of readiness to perform the assigned tasks. In this state the individual is capable of maximum concentration and maximum performance; he does not feel fatigue and his emotional state reaches its highest level. It has been noted that the handshake of pilots preparing for flights in adverse conditions is more forceful and their arm and leg movements more dynamic. This is explained by the fact that the pulses emitted by the central nervous system stimulate the secretion of adrenalin, which intensifies the body's vital processes and heightens the capabilities of the muscles. The external manifestations are a stepped-up hearbeat, a flushing of the face, an unusual brightness of the eyes, increased activity, excessive talkativeness, and so forth. The positive emotions are reflected in improved coordination of movements, in the ability to switch one's attention more rapidly and in quicker reaction to the instrument readings and to ground instructions. That is, it takes considerably less time for impulses to travel from a stimulus and evoke a motor response in the muscles. In other words, the individual's psychic capacity is mobilized to the maximum.

The first flights in adverse weather conditions, with a certain weather minimum and involving interceptions and bombings in the clouds, are highly important for developing good professional and psychological qualities and skills in flight personnel. Sometimes, because of the great tension experienced by pilots on such flights, certain aspects of the flights are not performed with great precision. This should not discourage or unsettle the trainees, however. Such a deficiency results not so much from poor professional training as from inadequate psychological conditioning, the development of which ordinarily lags somewhat behind the former. And we know that a pilot may lose self-confidence when the difficulty of a flight assignment is increased abruptly, when the planning includes considerable skipping from one exercise to another and when the pilot finds himself in a dangerous and unfamiliar situation.

Experience and many years of observation have provided us with the basis for concluding that many factors are responsible for a pilot's confidence. Important among them are a solid knowledge of the aircraft equipment and the theory of flying, careful preparation of the aircraft for flights, continuous improvement of flight skills, without lengthy interruptions, good flight control, the confident functioning of crews manning command posts, control stations, landing systems and so forth, thorough analysis

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

of the weather situation, excellent maintenance of the airborne rescue facilities, a well-organized rescue service, constant concern for the living, rest and recreation conditions for flight personnel, and development of the proper moral and aggressive frame of mind in them.

Confidence is also closely linked with self-control. The latter manifests itself in the ability to appraise the situation calmly, correctly and rapidly and make decisions, to avoid losing one's composure in a difficult situation and to perform boldly, resolutely and vigorously. A pilot needs self-control not only in combat, but in the peacetime training as well, especially during the performance of flights in adverse conditions.

A pilot has to perform a large number of operations per unit of time, for example, on flights involving interceptions, bombing and launching missiles in clouds, and during refuelings. Should the equipment fail or some other unusual situation occur in the performance of such missions, nervous and emotional tension may reach a maximum bordering upon extreme stress. It is not surprising, therefore, that many nations are actively engaged in further automating the aircraft control process, particularly during the performance of assignments in adverse conditions.

It would be incorrect to say that in order to prepare himself for possible complications during flights at night or in clouds he spend his time anticipating them. In the air his attention is occupied mainly with piloting the aircraft, and the expectation of possible complications is not a determining (decisive) factor. The most important thing in a pilot's work, naturally, is to perform the assigned mission successfully, whether it be a flight along a certain route, a bombing or intercept mission, the delivery of an airborne landing group or a refueling.

Does a Pilot Experience Fear?

We have already mentioned the fact that critical situations may develop when flying in adverse conditions, situations requiring that flight personnel exert their maximum effort and mobilize all their capabilities for the successful performance of the assigned mission. Temporary confusion or even fear is not ruled out in such a situation.

This is how the well-known French writer and pilot Saint-Exuperi described his own state when the plane he was flying went into a spin: "I looked down with some amazement at the fields below, onto which I was going to fall and be dashed to pieces. This was something new for me. I could feel myself growing pale and cold from fear, fear which penetrated my very bones. There was nothing humiliating about that fear, however. It was more like some sort of new and inexpressible understanding."[12] Exuperi deliberately stresses the fact that there is nothing humiliating about such feelings in an individual who finds himself in an extremely dangerous situation. It is another matter when an individual is afraid to go from a lighted room into the dark or is frightened by a black cat crossing his path.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Someone once expressed the opinion that a Soviet pilot should not experience fear, no matter how difficult his situation in the air. This opinion is groundless and erroneous, however. Read the testimony of officer V. Agafonov, pilot first-class: "The squadron commander and I were flying as a team for purposes of developing our skill in formation flying. We were to perform a dive and then pull out of it. At the leader's command, I accelerated and took the aircraft into a dive. A few seconds later, I heard the command to pull out of the dive, but just at that point I sensed that the aircraft was no longer responding to the controls. It went into a 'spin.' And not the kind of spin which the instructor had demonstrated for me when I was learning to fly a jet aircraft, but a very real one. 'Is this really the end?' the thought flashed through my mind, but I immediately dispelled it. I had to do something--and immediately. The aircraft was rushing toward the earth at a very steep angle, spinning around a longitudinal axis. I tried to remain calm and did everything required in such situations: I pulled the engine control stick toward me and lowered the flaps. Nothing helped, however. The aircraft continued to spin, and the altitude was melting away with the passage of each fraction of a second.

"Fear was again treacherously overtaking me. I exerted my willpower and dispelled it again, forcing myself to think and act. I decided to lower the landing gear, and a feeling of calmness immediately came over me. My hand moved automatically to the valve. Why hadn't I thought of this before?! A drastic change in the aerodynamic flight conditions might save the situation. As soon as I had lowered the landing gear, I felt a braking force, the speed dropped instantaneously, and I brought the aircraft into horizontal flight."

Officer V. Bogdanovich, military pilot first-class, told us the following: "Once, on a night flight, I was flying through the field of a searchlight when I carelessly shifted my eyes from the instruments to the bright beam of the searchlight, which was inclined toward the horizon. An illusion of banking was immediately created, and I turned the fighter upside down in an attempt to eliminate it. This confused me for an instant. I tried to right the aircraft but was unable to take my eyes off the beam the light. 'Remove the light!' I yelled over the radio, noticing that my aircraft was in a banking dive and that there was little altitude left in which to maneuver. Fear literally petrified my entire body for a certain period of time. It was as though an octopus had enveloped me, gripping my arms and legs. Once more, with an effort of will, I forced myself to pull vigorously on the control stick. In the darkness, it seemed that the aircraft would crash into the earth at any moment, and I automatically closed my eyes in anticipation of the impact, while continuing to pull the fighter out of the dive with both hands. I succeeded in doing so just above the earth."

To be able to overcome fear one must understand the nature of fear and how to combat it.

Fear is that state experienced by an individual who has temporarily lost his self-control in an adverse situation. From the psychological standpoint,

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

this state is not inborn but is acquired as one goes through life and is essentially a natural extension of the body's protective mechanism, which comes out when the individual is scared. There are cases, as an example, in which pilots, primarily the inexperienced ones, having once experienced fear in a difficult situation, are for a long time afraid to perform that specific flight maneuver which they were performing when the fear arose. Having once encountered fear during the performance of a turn in the clouds, which developed into a spiral because of too great a bank, for example, the individual will long feel excessive caution when working on instrument turns in the clouds. As a rule, his attention is automatically focused on strictly maintaining the required bank, an increase which could result in a steep spiral.

It is sometimes said that a person can be taught to fly but that he cannot be taught courage or daring, that these qualities are contained in the individual's genes, in his heredity. Experience in the field of flying has completely disproven such opinions. We could give many examples in which timid and extremely cautious cadets, who are afraid to perform even simple piloting techniques on their first flights, turn into fearless and bold warriors of the air, performing all kinds of assignments in the most difficult conditions.

Fear is not man's normal state, of course. There is an apt folk saying that "Fear magnifies everything." This means that when an individual in a difficult situation loses control of his actions and fails to analyze the circumstances he may make serious errors, errors which it is far from always possible to correct. This is why the development of good moral-political, aggressive and psychological qualities in the young fliers also calls for the formation of such qualities as fearlessness, determination, self-control and the ability to hold out in a difficult situation and to conquer momentary confusion.

There is no person alive who can remain indifferent when his life is endangered. It is just a matter of how the individual reacts to danger: one person will be stimulated to action, overcoming his growing concern with an effort of will and performing the mission, while another individual faced with a difficult situation will try to avoid confronting it, look for assistance from others, waste valuable seconds and suffer failure. The ability to keep oneself in hand, to stave off panic and avoid vacillation and doubts, remaining calm and determined--these are the moral-volitional qualities of a daring and courageous individual, qualities which depend entirely upon the individual himself and which are developed in the process of intense military work. It is never easy to conquer oneself. Victory goes only to those who strive fervently to achieve it, following the dictates of their heart, boldly surmounting barriers and their own hesitations and doubts.

Illusions Must Be Resisted

Illusions, false impressions of the aircraft's position relative to the natural horizon, constitute one of the factors complicating the performance of flight assignments in the clouds and at night. It is not difficult, of course, to

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

determine the aircraft's position when the earth and the horizon are visible. A pilot flying in such conditions and affected by acceleration forces sometimes has a distorted concept of his position. There are illusions of banking and spinning, of flying upside down, illusions of descending and of tail heaviness, and visual illusions. Illusions of banking, descending and tail heaviness are those most frequently encountered.

As a rule, illusions occur during those phases of a flight in which the pilot's attention is diverted from the instruments and there is a lack of information. Under the influence of an illusion, the inexperienced pilot or one who has not flown for a long time will attempt to "return" the aircraft to what his sensations tell him is normal flight. He will bank the aircraft or cause it to descend, and sometimes turn it upside down, frequently creating a complicated situation which can lead to disaster.

Illusions occur most frequently in the case of pilots with insufficient experience in flying in clouds and are not well conditioned psychologically, those who cease to believe the instrument readings and rely exclusively upon their own perceptions. Any delay in a dangerous situation, any hesitation or doubt can exacerbate a difficult situation, and it is therefore important promptly to detect an error and to correct it resolutely. By integrating the readings of the gyro horizon, the rate-of-climb indicator, the altimeter, the compass and other navigational instruments, the pilot must be able to retain a true concept of the aircraft's position at all times when flying in the clouds.

Illusions occurring when flying in the clouds ordinarily last only a few seconds, creating nervous and emotional tension in the pilot. They sometimes last longer, and this can result in total loss of spatial orientation. The illusion in this case is caused by the prolonged diversion of the pilot's attention from the gyrocompass, the altimeter, the rate-of-climb indicator and the resulting lack of conformity between the individual's perceptions and his concepts of the aircraft's location, which are formed by his visual analysis mechanism from the navigational instrument readings.

The discontinuity of visual information has a considerable effect on determination of the aircraft's location. When flying in an uncomplicated situation the pilot receives continuous information on the natural horizon and therefore illusions do not occur. In adverse weather conditions, however, the pilot is sometimes forced to take his attention away from the navigational instruments (when operating a radar sight, adjusting the radiocompass frequency, and so forth), and incoming information on flight parameters is therefore not continuous but segmented. The shorter the intervals between the receipt of information, the stronger will be the continuity within the "instrument-man-control" system.

No matter what the pilot is doing with the control elements, it is important that he concentrate mainly on being precisely aware of flight conditions when flying in clouds. If it becomes necessary to check the position of levers,

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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buttons or toggle switches, he should not take his eyes off the navigational instruments for more than a fraction of a second. All of his actions in the cockpit, including the distribution of his attention, should be performed without needless fuss or excitement but without any pauses between the individual constituents of the actions. In other words, they should be guided by the saying well known in aviation: "Don't rush, but don't delay."

Steps have recently been taken in a number of nations to make it possible to depict instrument information on the cockpit windshield, which helps to reduce pilot fatigue from switching attention while flying in the clouds. The pilot will ordinarily not have to shift the focus of his eyes for observing the situation outside the cockpit and reading the instruments. Only those parameters are depicted on the windshield which are essential in a given phase of the flight, which makes it possible to appraise the overall situation thoroughly and rapidly and to make decisions with respect to altering altitude, vertical speed, course and so forth.

Sometimes, a pilot just returned from a flight will frankly discuss his experience in the air with his comrades and, unfortunately, frequently becomes a special subject of discussion at the flight critique, sometimes even being temporarily grounded as punishment. Instead of thoroughly analyzing the reason for the illusions, some individuals will be quick to accuse the pilot of not being prepared for the flight, of not getting enough rest or in failing to follow certain instructions. Paradoxically, the pilot is harmed by his frankness. Should he remain silent and conceal his doubts and alarm, however, no one would know about what happened and the pilot might find himself in an even more difficult situation on the next flight. Careful concern for each individual leaving an aircraft cockpit following a flight is an essential condition for creating a good frame of mind, for successful combat development and for strengthening the aviation team. Irritation, faultfinding and attempts to resolve problems arising in the flight training on the spot or taking a suspicious attitude toward an individual who has not been afraid to bring up his illusions can cause serious psychological harm to the pilot, damage which is not easily repaired.

How can one combat illusions? In the past, any pilot who mentioned this unusual sensation was temporarily grounded and subjected to careful medical examination. Experience has shown that such actions do not serve their purpose: they frequently disturb the pilots and harm them emotionally. More effective and objective methods began to be employed after it was discovered that illusions are not a pathological state but a brief disturbance of the individual's vestibular mechanism and of his nervous and emotional system.

What should a pilot do if he begins to experience illusions? In the first place, he should force himself to concentrate on the navigational instruments, especially the gyrocompass, and if he begins to doubt the gyrocompass readings he should compare them with the readings of other instruments (the rate-of-climb indicator, the tachometer, the altimeter, and so forth).

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Avoiding abrupt movements of the control levers, he should bring the aircraft into horizontal flight and keep his body in the same position for a certain period of time. Without taking his attention off the instruments, he should then bend his head with a smooth and even motion, move his legs, tense and relax his arm, back and stomach muscles several times, and inhale and exhale deeply. As soon as he frees himself of the illusion, he should return the aircraft smoothly to the prescribed flight mode.

Sometimes, following takeoff, especially when the bottom edge of the cloud cover is not far above the ground, a pilot who has not prepared himself to navigate by instrument will take the aircraft into a sharp turn onto a new course, only focusing attention upon the instruments after he has entered the clouds. It may suddenly seem to him that the aircraft is banking in the opposite direction, although the gyrocompass indicates a turn onto the required course. The pilot must immediately verify the compass readings, and if they correspond to the gyrocompass readings (right turn--increased heading) he must force himself to believe the instruments and take the aircraft out of the bank.

Many years of experience in flying in clouds and at night, and the observations and impressions of pilots have convincingly shown that after taking off, retracting the landing gear and flaps and setting the prescribed mode for gaining altitude prior to entering clouds, it is important immediately to concentrate on the navigational instruments, thereby preparing oneself mentally and emotionally for flying in clouds. It is advisable to turn onto new courses only after achieving stable navigation by instrument in the clouds.

Ice crystals sometimes form in extreme cold with a high relative humidity, which, at night, create a "screen"--visual illusions, which produce an incorrect perception of the distance to the runway: the approach lights and other illumination facilities of the night landing system appear nearer or farther away than they actually are. This phenomenon occurs most frequently in the northern latitudes. In such cases the pilot should switch immediately to instrument flight, report this to the runway control station and continue the flight by the instrument readings and instructions from the landing system operator or the flight operation officer.

Brilliant stars in the dark background of the heavens are sometimes taken by a pilot as navigation lights (BANO) of a nearby aircraft. A pilot on a nighttime visual intercept mission once noticed such lights directly ahead. Taking them for the target, he began approaching for the attack. Increasing his speed to the maximum, the pilot flew for a long time without approaching to within firing range of the target. Only then did he realize that he was attacking not a target but a distant star.

In order to avoid such errors, one should look a little longer at a lighted object and try to determine its relative speed, which will ordinarily be zero if it is a star ahead of the pilot. When attempting to catch up with the object at a low angle of approach, there will be no noticeable convergence:

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

the object will appear to be constantly retreating instead of approaching. In order to determine the nature of a lighted object when flying in formation, one should contact an adjacent crew by radio and request them to blink their navigation lights. This will dispel once and for all any doubts concerning the origin of the other lights.

Sometimes, when flying at night over bodies of water during a period of high humidity, the reflection of the moon and the stars immediately beneath the aircraft will form what the pilots call a "second" moon. The sky seems to have turned upside down, replacing the surface of the land (or water) in spots. In such a case one should switch immediately to instrument flying and fly for 3 or 5 minutes by the mode set, with attention focused constantly upon the instruments. If, after this, the "lunar apparition" has not disappeared, the flight should be continued strictly by instrument. Such phenomena sometimes last a long time, sometimes even throughout an entire nightshift. Pilots flying under these conditions experience considerable mental and emotional tension and must apply considerable willpower to keep their attention focused upon the instruments and to overcome the desire to look outside the cockpit and see the carpet of stars beneath the wings.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Chapter IV. COMBAT TRAINING FLIGHTS AND THE MORAL-PSYCHOLOGICAL CONDITIONING OF FLIGHT PERSONNEL

1. The Preflight Period

Flights performed for combat training purposes--missile launchings, firing, bombing, interceptions of air targets and other types of training--constitute an exceptionally important phase of the pilot's training and of his development as an air fighter. Such flights provide flight personnel with the best possible opportunity to acquire skills in the employment of weapons in combat and for the development of daring, determination, courage, initiative, psychological stability and other qualities essential to the successful conduct of modern warfare.

The well-organized and quality performance of combat training flights depends primarily upon the preparations made for them, and moral-psychological conditioning is an inseparable part of such preparations. It is begun long before takeoff and from the moment the mission is assigned it acquires concrete focus in conformity with the specific nature of the assignments to be performed.

The emotional state of flight personnel undergoes considerable change when they receive their flight assignments. This is due to the fact that flights involving the employment of weapons (bombs, missiles or shells) increase responsibility with respect to the quality with which the mission is performed and to flight safety. It is one thing for a pilot to err in making calculations for a landing or when piloting in the zone, but it is another matter when firing at ground targets, bombing, intercepting a target, conducting a reconnaissance flight or dropping a landing group or cargo.

An error during a landing could produce the preconditions for a flight incident or even damage to the aircraft. An error during a firing or bombing, however, or during the landing of an airborne group, could have even more serious consequences.

External and internal factors raise the pilot's activity level during preparations for combat training flights. He experiences prebattle excitement and a desire to thoroughly understand the assignment and the procedure for operating the cockpit equipment in the various flight phases. A strong-willed individual will suppress temporary apprehensions, indecision, lack of confidence and other negative developments of his mental and emotional state.

After receiving their bombing, firing, interception or other missions, the pilots compile a flight plan, sketch the target situation and indicating the best sectors for approaching the target without detection, prepare flight maps, enter the frequencies of homing stations and the call signs of alternate

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

airfields on plotting boards, study the probable "enemy," and outline tactical maneuvers for overcoming air defenses along the route, above the target and on the return flight. During this time, some pilots may develop tension due to the increased responsibility for completion of the flight assignment, some lack of confidence and constraint. Some young pilots become fidgety and attempt to perform several tasks at the same time (making notes in their workbook, making diagrams, preparing flight sheets and maps, and so forth), and are excessively talkative. In such cases, more than at any other time, it is appropriate for the commanders, political workers and veteran pilots to give the young pilots comradely advise and assistance.

The pilots' excitement does not always become apparent while they are busy preparing for a flight. As soon as there is a lull in their activities, after they have completed their drawings and maps, and so forth, however, a state of heightened excitement can be observed, especially in those who lack experience in performing the kind of tasks facing them. At this time it is highly beneficial for them to hear experts in the combat employment of the aircraft speak about their experience in operating the control elements of the armament systems, approaching a target undetected and performing the operations directly involved in the bombing, in carrying out attacks, launching missiles, landing airborne forces, and so forth. Talks by veteran pilots and reminders of the need for precise actions in all phases of the flight help to strengthen the pilots' self-confidence.

Training sessions with special equipment and in aircraft cockpits are especially important for developing the qualities of good fighters and a positive frame of mind in the pilots. Along with developing skill in operating the systems, it is important to devote serious attention to instilling confidence in the correctness of their actions in the pilots. This is achieved with a skillful combination of simple and complex operations during practical training sessions in the cockpit pilot or on a trainer and by demonstrating and analyzing errors most frequently encountered on a flight (confusing the toggle switches, failure to switch on individual units of armament systems, and so forth). Strict observance of safety measures is especially important when practicing to use the control elements for the aircraft armaments from the cockpit. Aircraft specially prepared for this type of practical training are carefully inspected and tested.

After a pilot has seated himself in the cockpit of an aircraft readied for takeoff he concentrates on being extremely calm and precise in his actions, in order to avoid accidentally engaging the armament systems. The pilot's psychological state at this time is one of considerable tension, and it is therefore important to be especially attentive and patient with him during the issuing of instructions prior to takeoff and during radio exchanges. Any raising of the voice, any irritability or hastiness can have undesirable consequences.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Those commanders are proceeding correctly, who, during classes in a trainer, work out the steps to be taken in possible situations not covered by regulations (special flight situations) resulting from malfunctions of individual armament units until those actions become automatic. They strive to see that the pilot is capable of responding to each specific situation with prompt and correct actions and is able to correct errors and inaccuracies in his work.

Precise clarification of the flight assignment, familiarity with the experience of senior comrades, a thorough knowledge of the equipment, tactics and the weapons, and focused, independent preparation all help to develop confidence, positive reactions and fighting gusto in the pilots.

In actual practice, active preparations for a mission in an exercise or at a range are followed by a period of waiting for takeoff. If the pilots are not in the aircraft cockpits it is advisable to focus their attention on clarifying the route, rehearsing the procedure of action for the various phases of the flight, checking their knowledge of the main and standby radio frequencies, keeping them in a positive frame of mind for the flight and maintaining a high level of volitional and psychological activity. Any relaxation of their attention or deterioration of their attitude toward the flight can have a negative effect on their reaction time and on the precision of their performance in the air, especially during the first phase of the flight.

2. During the Performance of Flight Assignments

During Missile Launchings, Firing and Bombing Practice

In the phase preceding the beginning of the actual employment of the weapons the crew does not always possess adequate information on the air situation. In this case it is important that the pilot not focus his attention on one or two objects (instruments, the search for the target, and so forth) but that he operate from an overall standpoint, simultaneously performing several of the most important tasks and filling in information previously obtained. When approaching the range, for example, it is advisable to conduct continuous observation in all directions, to search for the target, monitor the readings of the piloting and navigational instruments, to prepare the bombing or missile launching equipment, and so forth.

The actual performance of the live firing, missile launching and bombing is characterized by a further build-up of psychological tension, by the crew's cumulative concentration on destroying the target and by an atmosphere of dynamism both outside the aircraft and in the cockpit. Time is limited, and the pilot must fly the aircraft, engage in observation, continuously follow the target, visually or by means of the airborne radar, precisely determine the approach and monitor the instruments. The extent of rapid change occurring in the situation and the volume of information may reach their maximum at this time, and if the pilot has learned to properly distribute his attention and to

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

control the fire with precise actions developed to the point of automation, and is capable of restraining himself in the face of new and unexpected problems, then the successful performance of the combat mission is ensured.

In his desire to perform the combat mission with excellence, an inexperienced pilot sometimes becomes tense and constrained, concentrates on a narrow sector and is not constantly in control of himself. This complicates the performance of the assignment and sometimes brings the efforts of the entire crew to naught.

On one flight the crew of officer U. was to deliver a strike against an "enemy" airfield. The pilot flew the bomber right to the target. The navigator opened the bomb-bay doors, found the bomb-release button with his hand and bent over the eyepiece of the optical sight. The target should appear any time. The navigator spied "enemy" aircraft on the ground and reported happily to the aircraft commander:

"Target in sight. Two degrees right"!

"Roger. Two degrees right," the pilot turned the aircraft onto the course indicated by the navigator.

The target entered the graticule. The navigator waited the required period of time, pressed the bomb-release button and then reported to the commander that the bombs had been dropped.

It was time to switch off the bomber armament, and the navigator reached for the main switch. His fingers did not find the automatic circuit protection device in the upper position--it was disengaged. "How can that be? I'm sure I did everything right," thought the disturbed navigator. "Did I really forget to switch the main toggle switch?" In order to find out, he pressed the general verification button and saw the silhouette of a bomb on the lighted transparency....

Why had this happened? In order to answer this question, we must trace the crew's actions from the very beginning. Following the long flight along the route, the pilot reached the precalculated point and made a turn. The navigator checked the settings on the sight and the position of the main switches for the last time. The emotional tension of the pilot and navigator reached its apex when they reached the beginning of the bombing run. All of their attention was occupied with maintaining the required flight parameters.

"Engaging the main switch!" the navigator reported and moved his hand to the bomb control panel.

At that moment, the aircraft commander requested the instrument altitude.

"Climb 50 meters," the navigator answered hastily and returned his arm to the armrest without turning on the main switch.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

After that, he operated in accordance with the flight plan.

Both the navigator and the pilot were to blame for what happened. The former was negligent in "forgetting" to turn on the main switch, while the latter decided to check the flight altitude at the wrong time. The flight phase covering the start of the bombing run and the bombing run itself should be strictly regimented for the flight crew, planned in advance down to the tiniest detail and eliminating the need for any sort of clarifications except for those absolutely essential for the bombing.

As a rule, the navigational, piloting and bombing equipment carried by modern aircraft is duplicated, and any crew member can check the instrument readings, the signal lights and the position of the switches. When the crew members work in a well-coordinated manner, it is not greatly difficult for one of them to check the actions of a comrade. The pilot had only to check the signal lights following the navigator's report that the main switch had been turned on, and the bombing would have been successful.

Various forms and methods are used for developing moral-psychological stability in the flight personnel in the performance of combat training flights. Highly effective among them are accounts of their experiences by those who have participated in combat operations, who have a great deal of experience in the employment of weapons under modern conditions. Such accounts help to develop in the aviators the courage, determination, boldness and other moral and militant qualities essential to the victorious conduct of aerial combat.

Following is a description of an actual bombing flight by Hero of the Soviet Union M. Chechneva:

"There was nowhere in the air for the pilot to hide: there was no solid earth to be found. Ahead lay only a savage play of fire.... Piskareva and Rozanova plunged unhesitatingly into the fire, rushing to the aid of their friends. Katya maneuvered the aircraft masterfully. She flew the aircraft in zigzags--now a long leg, now a short one. She gave the antiaircraft gunners no opportunity to take aim, while persistently moving toward the fording point. Rozanova released an illuminating aerial bomb.... Three pale-blue beams of light struck the aircraft.... Fragments drummed upon the skin. Piskareva wove her intricate evasion pattern.... And there was the target: a long column of motor vehicles and numerous moving dots. Rozanova dropped a second aerial illumination bomb.... She instructed the pilot to turn 15 degrees.... 'Maintain bombing course'! Piskareva maintained the flight mode ideally, making it possible for the navigator to drop the bombs accurately.

"During those seconds when the aircraft is on the bombing run, however, it makes a perfect target for enemy antiaircraft gunners. The aircraft shuddered from the impact of fragments--again and again. The aircraft rocked and banked to the side--a direct hit by a shell. Without taking her eyes off the sight, Rozanova instructed the pilot:

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

'Maintain bombing course'!

"With a final effort, Katya Piskareva returned the crippled aircraft to a horizontal position.

"Long and agonizing seconds of sighting.... The navigator pressed the bomb-release lever, and the bombs flew out.

'Ready. Take off!' Rozanova gave the signal to withdraw from the target.

"Piskareva renewed the zigzag flight and maneuvering. The crew was hurrying to get out of firing range. The navigator observed the bomb bursts. They exploded in the very thick of the vehicles. A blast shook the aircraft. Frequent flashes with white and blue tongues of fire flickered on the ground. The firing continued.... Just one flight!

"And Hero of the Soviet Union Larisa Rozanova has 816 to her credit."

Sometimes, the crews perform combat exercises in the same air or range situation for a long time, which helps the pilots to become accustomed to standard flight conditions. And while these flights are permissible in the case of the young pilots lacking experience in the combat employment of the aircraft, such indulgences are harmful for others, since they do not contribute anything to the improvement of their tactical and firing skill, are detrimental to their combat training and do not help them to develop the needed psychological stability.

During a check-out in one of the units, the senior chief ordered a strike against ground targets located at a range with which the pilots were not familiar. Despite what seemed to be good preliminary preparations, during which the flight personnel studied the target situation from diagrams and performed a practice run-through of the mission, the results achieved in the actual mission by some of the pilots, especially the young ones, were not especially good. Those who received low scores attempted to use the strong crosswind, the difficult approach to the range and the fact that the leading pairs of aircraft had not maneuvered entirely correctly as an excuse for their errors.

The main explanation for the low performance, however, was poor preparation on the part of those pilots, who had become accustomed to operating on a range with which they were thoroughly familiar.

In the interest of improving the pilots' combat training, the experienced aviation supervisors endeavor to increase the complexity of assignments from one flight to another and to place the crews in circumstances which contribute to the development of good moral-combat and psychological qualities. The officer in charge of firing in one unit, for example, altered the approach conditions and the direction for approaching the target, the flight pattern

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

after coming out of the dive, flight altitude, and so forth. This forced the pilots to appraise the situation in detail, to demonstrate initiative and to function at their full capacity. Setting up the firing practice in this manner has helped to improve the combat skills of pilots in this unit.

We should stress the fact that in the initial stages of training in the various components of combat employment of the weapons, the pilots should be given the opportunity to attack the target from their usual, "standard" position. In the process, it is important to raise the crews' training to a level giving them confidence in themselves and in the quality and trouble-free performance of the weapons, and permitting them to acquire a feel for the aircraft in all the different flight phases. The conditions and the procedure for performing the missions are made more complicated after the pilots have become familiar with the range and have acquired solid skills in bombing, firing and missile-launching. This promotes steady improvement of the flight personnel's combat proficiency and helps to toughen their moral-psychological makeup.

It is especially difficult for the young pilots to master low-altitude flights to the range, involving employment of the airborne weapons. In their attempt to reach the target and deliver the strike rapidly, some of them are not precise in their actions; they rush preparation of the bombing and missile equipment and do not maintain the prescribed altitudes for beginning the attack. This sometimes results in poor performance of the exercises.

On one flight, young officer M. reached the precalculated point, executed a vertical maneuver, took the aircraft into a dive and immediately opened fire. His actions appeared to have been correct in all respects, and according to the pilot's calculations, the shells should have destroyed the targets. Unfortunately, however, this was not the case. The shells missed because of the pilot's hasty actions and because he opened fire at too great a distance.

It is not an easy matter to practice in the combat employment of the weapons on low-altitude flights. Maximum concentration on piloting and orientation immediately above the earth, the need to maneuver after attacking the target and the limited amount of time available for performing the operations--all of this and many other factors create great psychological stress and make it essential for the pilots to perform with exceptional precision, to be attentive and perform with flexibility and efficiency.

A pilot with an inadequate attention span will sometimes take a long time to adjust the sight precisely and will begin "chasing after" the sight marker, thereby causing the aircraft to wobble in the dive. As the earth approaches the pilot becomes increasingly anxious to complete the fire as rapidly as possible and to take the aircraft out of the dive. This is not fear. It is simply activation of the human protective impulses. A pilot in this situation especially needs a strong will, fortitude and the ability to force himself to cross the frontier of danger.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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In the diving process it is important to determine the proper moment for opening fire (or launching the missiles). Certain parts of this almost instantaneous action can be worked out on a trainer, but the crucial factor will be the pilot's practical perception in the air, when the learned dimensions of the target begin to approximate those of real ones. When the target dimensions are not known, sighting precision is determined by the position of the marker or from other sight data.

Anyone who has ever performed a firing is familiar with the way the heart stops beating and breathing is arrested when one pushes the trigger or launching button. As he waits for the gun burst or the missile launch, the individual seems to be cut off from the rest of the world and sees only the target.

In an attempt to see the firing results, some pilots delay bringing the aircraft out of the dive, and then, when the earth is even closer, whip the aircraft out of the dive literally with a single movement, and this could result in a critical angle of attack or a stall condition.

For firing at ground targets a pilot must withstand prolonged mental exertion and be able to properly distribute and shift his attention and to control the aircraft and himself near the earth, at both low and high speeds. These qualities and skills can only be acquired through persistent training and regular drilling and with a creative approach to the assigned job.

When the Target Is On the Screen

The interception of air targets in modern fighters involves an entire system of complex maneuvers by the interceptor, combined with an active target search with ground and airborne radar, sonic or telemetered target designation, lock-on of the target with the sight and an attack with missiles or guns. This type of aerial combat, especially interceptions in the clouds or at night, is among the most difficult from the standpoint of psychological tension.

Success in searching for the target is greatly determined by the interaction between the aircraft controller and the interceptor pilot. If it is smoothly coordinated, the guidance process occupies only a small interval of time and proceeds smoothly and in an organized manner. The aircraft's ability to determine the distance between the interceptor and the target and the correct course for entering the attack curve from the blips on the ground radar screen and his ability to check his own calculations are frequently the determining factor in an interception.

An aircraft controller sometimes hurries, does not bother to make accurate calculations and rushes to instruct the aircraft to take a new flight course or altitude. There is a continuous stream of commands from him to the air. This sort of flight "control" increases the psychological pressure on the pilot, makes him nervous and prevents him from systematically monitoring the

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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piloting instruments or the situation on the sight screen. This, of course, can result in a breakdown of control and, consequently, in an unsuccessful intercept.

The range of tactical procedures used in interceptions has expanded considerably in recent years. More extensive use is being made of instrument guidance with computers, and the interceptor's capabilities for detecting and destroying targets have grown. All of this has further complicated the pilot's functions and increased the amount of information received by him, especially during the approach to the target, the lock-on and launching. Prior to this phase, the pilot executes commands from ground and can devote a considerable amount of time to piloting by instrument, continuously monitoring the aircraft's position, but when the target blip appears on the screen there are considerably fewer opportunities to do this, since the pilot is now focusing attention on the sight screen. In this phase of an interception the amount of time available for integrating the instrument readings and those on the sight screen is also greatly reduced. The pilot can no longer permit himself to hold his attention on one or two instruments: he glances quickly at the dials and then returns his attention to the sight screen.

In an attempt to destroy the target as rapidly as possible, some pilots prematurely switch the sight to the lock-on mode, which sometimes results in an unsuccessful interception. It is important to wait a certain amount of time, check the distance to the target and only then, press the lock-on button.

After detecting the "enemy" on one flight, officer P. hastily switched the sight to the intercept mode at a range exceeding the prescribed distance. The target blip appeared at the center of the screen for a certain length of time, but the "enemy" only had to perform a vigorous maneuver and the sight was no longer locked on to the target. The pilot appraised the situation and promptly corrected his error. He detected the target again, approached to the required distance and locked on. Continuously tracking the target and monitoring the piloting instruments, he determined that the "enemy" had begun a new maneuver--this time on a vertical plane. The pilot began to climb and performed a zooming maneuver, while pursuing the target relentlessly.

The intensity of the battle grew. While never taking his attention away from the sight screen, the pilot concentrated on his piloting, on determining the distance to the "enemy" and holding the blip in the center of the electronic circle. And when the final launching signal came, he pressed the launch button vigorously, while keeping the target blip at the zero azimuth. The "enemy" was intercepted in this position.

The ability persistently to hold an air target in lock-on position always produces a surge of energy and confidence and a desire to complete the attack

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

successfully. And, no matter how the target maneuvers, the pilot, psychologically attuned to the intercept mission, proceeds boldly to approach the target, pilots confidently and achieves victory.

Naturally, it is practically impossible to maintain a heightened psychological state throughout an entire, sometimes fairly long flight in the clouds, and this state should be alternated with brief periods of partial mental relaxation when the situation becomes somewhat less complicated. The lengthy state of tension existing during the performance of an interception may result in premature fatigue, errors in assessing the situation and faulty actions.

As pilots acquire experience in intercepting targets, they develop psychological stamina and solid skills in piloting in the clouds while simultaneously operating the sight. They monitor the movement of the target blip on the screen, as well as the speed of approach, the distance to the target, changing flight altitude and so forth, with greater confidence. The piloting and operation of the sight becomes somewhat automatic, which reduces the mental load and helps to increase psychological stability.

One of the most complicated types of work performed by pilots is that of piloting in clouds and operating a sight simultaneously. Not every individual is capable of rapidly mastering the entire interception process. This is why it is important to pay exceptionally close attention to those who lack experience in the performance of such flights, to endeavor to eliminate the slightest doubt or vagueness in their minds, and to take advantage of every opportunity to conduct classes, personal discussions and flights in a dual-control trainer to improve their psychological preparedness to fly intercept missions.

Exercises--A Serious Test

Tactical flight exercises constitute a real school of combat proficiency for fliers and a serious test of their preparedness to perform combat missions. An air and ground situation approaching the conditions of an actual air battle is created for the exercises. The professional skill of the airmen and the level of their moral-combat and psychological qualities are judged from the results of tactical flight exercises.

As they perform tasks of varying complexity and scope, interacting with other branches of aviation and with ground forces, the airmen demonstrate the proficiency they have acquired and improved in training flights involving bombing, firing, missile launchings, interceptions, reconnaissance and the dropping of airborne landing forces and cargo.

While the crews ordinarily have advance notice of the mission to be performed on flights covered by combat training plans and have an opportunity to prepare for it, in exercises the combat mission is frequently assigned

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

to the pilots after takeoff. The element of surprise has a considerable effect upon the pilots' mental and emotional state. It is one thing to perform a bombing or firing mission on a familiar range, and another to carry out bombing attacks and missile launchings against unfamiliar targets. The fact of not knowing the air or ground situation may have a negative effect upon the individual's mental and emotional state and may lower his volitional action level.

When preparing for tactical flight exercises steps are therefore taken to reduce the effects of vagueness in the situation by conducting additional reconnaissance, by studying available mosaics of the area of impending operations, and so forth. A thorough understanding of the procedure for handling the sight and the bombing, missile and artillery, navigational and other equipment helps to create solid internal psychological links and, consequently, to develop confidence in the crews that the missions will be successfully accomplished.

The performance of two pilots in one exercise is worthy of mention in connection with this. They were performing identical missions of firing at a ground target. And they were performing under adverse conditions: a low cloud cover, poor visibility and a strong crosswind. The first pilot was not able to appraise the unfamiliar situation swiftly and efficiently or to determine the target's location or the proper procedure for approaching it. As a result, his attack was aborted. He had to start all over from the beginning. The second pilot analyzed the conditions rapidly and correctly and determined what sort of maneuver was required on the basis of his analysis. He then performed a vigorous zooming maneuver, took the plane into a dive out of a turn and opened fire at the right moment. The target was destroyed.

The commander derived the correct conclusion from his analysis of the performance of the two pilots, who had approximately the same training background, that they were not psychologically prepared to the same degree for the exercise. The first pilot was not able to rapidly appraise the complex situation and make the right decision with his limited information. That is, he was not able to fully activate his capabilities. The second pilot was able to concentrate in the complex situation, determining his sequence of action rapidly and correctly, which ensured his successful performance of the mission.

When performing exercise missions an individual will frequently take an intuitive approach in appraising the constantly changing situation. His success depends greatly upon his ability to analyze, his flight experience and the thoroughness of his knowledge and skills. The more a pilot learns about the ground and air situation, about weather conditions and other peculiarities of the specific flights, the more effective is his intuition.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Mental flexibility and efficiency on the part of flight personnel is highly important to successful performance in exercises. In a situation of rapidly changing circumstances and limited time, this helps them to evaluate events correctly and, consequently, to make intelligent decisions. Mental flexibility and efficiency require the activation of all psychological elements, first and foremost, attention, willpower, persistence and determination.

Subunits are frequently assigned new missions in the air during tactical flight exercises. Such refocusing of groups, especially for the subsequent performance of complex assignments in an unfamiliar area of combat operations, when there is a lengthy period of psychological stress, can result in the intensification of retardation processes in the nerve centers of the brain. In many cases this leads to negative emotions, deterioration of concentration and a slowing of response, and consequently, to deterioration in the performance of flight assignments.

Such negative phenomena can be forestalled by running through the refocusing of a group during the daily flight training, by conducting the combat training without indulgences or simplifcations, and by persistently seeking the most effective possible actions in a situation which changes rapidly and drastically.

There are things to be learned in this respect from the experience acquired in the squadron commanded by officer N. Tyutyunnikov. In that squadron, combat training plans are carefully compiled, strict sequence is observed for working on the combat training tasks, and a persistent campaign is waged against routine, indulgences and simplifications and against all violations of the requirements contained in flight service regulations. The training and indoctrination process is geared to the future and the performance of more difficult tasks. All of this makes it possible for the squadron to achieve good results in combat development and to perform successfully in tactical flight exercises.

In one exercise the squadron was assigned the mission of covering a route without detection, penetrating the "enemy's" air defenses and delivering a strike against a target. The time allocated for preparations was curtailed, and it was decided to carry out the attack from various directions, based on a detailed study of the situation and the target area. After takeoff, the squadron commander received additional information and altered his decision, deciding to approach the target at minimum altitude and to maneuver for the attack before coming within visible range.

The squadron arrived at the designated point precisely at the time specified and flying at great speed, performed the maneuver briskly, performed bombing, missile and gun attacks against the target and, after taking evasive action, departed the attack with the same speed. The performance by squadron flight personnel was given a good rating. The exercise director noted, along with the tactical and fire training of the pilots, their good psychological conditioning, determination, resourcefulness and boldness.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Preparations for and the organization of tactical flight exercises is highly important in the contemporary situation. Success in exercises conducted without simplifications or indulgences is ensured primarily by thoroughly planning the kind of preparations to be made and the methods to be employed, by elaborating the various components of the combat operations in great detail, by thoroughly appraising the combat training level of the personnel and their psychological preparedness for engaging in modern aerial combat and by creating a highly militant frame of mind in the airmen.

The commanders and political workers in the outstanding units boldly complicate the situation after the exercises are under way, in order to develop psychological stability in the pilots. The unexpected appearance of "enemy" air defense fighters, temporary cessation of radio contact (radio silence), the jamming of ground and airborne radio equipment and the retargeting of crews in the air for strikes against new objectives--all of this helps to develop in the airmen the determination, initiative, independence and other qualities essential to victory in modern combat.

Combat training flights and the personnel's participation in exercises are thus the most complex and important elements of combat training for fliers and of the process of improving their psychological conditioning. The proper organization and conduct of flight critiques, the summing up of exercises and evaluation of the missions performed have an important role. A correct and objective evaluation is an important factor in the indoctrination of flight personnel. It is absolutely inadmissible to give ratings higher than those actually earned, because this disorients the pilots and frequently brings on serious problems. The aviation commander is required to participate in the evaluation of the flight performance of each pilot, crew, flight, detachment and squadron, and to ensure that their combat training is evaluated from a strictly objective standpoint.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Chapter V. MORAL-PSYCHOLOGICAL TRAINING AS A FLIGHT SAFETY FACTOR

1. Flight Service Regulations--A Law

Regulations, manuals, instructions and other documents governing flight work reflect the experience of many years of conducting flights and training and indoctrinating airmen and in operating and maintaining aircraft with the latest achievements of science and technology, and the practical experience of outstanding units and subunits. A thorough knowledge and precise fulfillment of the requirements contained in these documents give the personnel a high level of discipline and create the kind of positive frame of mind which contributes to the confident performance of flight assignments, to the maintenance of strict order at the airfield and to the competent operation of the equipment on the ground and in the air.

The personal examples set by commanders and chiefs in the study and fulfillment of requirements contained in guiding documents is highly important. Continuous work to improve themselves and strict adherence to regulations, manuals and instructions help them to organize the training and indoctrination of subordinates purposively and correctly from the methodological standpoint, to mobilize them for exemplary performance of the assigned tasks and to steadily strengthen military discipline and order. Flight work makes no allowances for anyone, especially for supervisory personnel, for lack of knowledge, inadequate skill, a low level of demandingness or inadequate preparation for flights, and severely punishes those who rely totally upon skills and knowledge already acquired and who do not try to improve.

As they organize the study of documents governing flight work, the experienced commanders and chiefs constantly attempt to see that every flier acquires a thorough knowledge of regulations, manuals and instructions, understands every paragraph and takes a conscientious attitude toward the classes, one reflecting a sense of great responsibility. They devote special attention to the study of documents defining the organization of flight service, first and foremost, the performance of flights and the navigation and aviation engineer services. The objective of such classes is only achieved when they are conducted at a high methodological level and take the training and the individual psychological traits of the students into account.

Commanders and chiefs consider it their duty to look after the independent work of the airmen, which focuses on the thorough study of guiding documents. They set up consultations, help their subordinates select the proper literature and strive to see that the greatest possible results are obtained from the self-instruction. When the airmen are highly demanding of themselves and focus their willpower on the study of regulations, manuals and instructions and on their practical implementation, their knowledge is expanded and strengthened and become a powerful motivating factor.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Well-organized monitoring of the fulfillment of requirements contained in documents governing flight work is an inseparable part of the campaign for flight safety. It helps to indoctrinate the airmen in a spirit of good organization and discipline and helps to promptly correct deficiencies and errors in the combat training and in the performance of flights. The main purpose of this control is to step up efforts to prevent the development of situations which could give rise to flight accidents and to increase the feeling of responsibility in each individual who participates in the flights or in their support. Verification of the implementation of requirements contained in regulations, manuals and instructions and in flight training courses calls for being highly demanding of those performing the work, providing them with on-the-spot assistance and conducting a determined campaign against the slightest deviations from flight service regulations.

The flight plan is, of course, the basic document for a flight day (or night). It defines the course exercises, the takeoff sequence, the amount of time the crews are to remain in the air, flight zones, ranges, routes and so forth, on the agenda for flight personnel. The flight plan is an order, which, when received by the airmen, stimulates emotional and volitional processes focusing on the quality performance of each flight assignment. Naturally, all of this takes place in a background of goal-oriented work by commanders, political workers, party and Komsomol organizations and of persistent efforts on their part to mobilize the men.

Supervisory personnel of units and subunits do everything possible to instill in the airmen a feeling of special respect for the flight plan and a desire to perform all of the exercises well and within the time allocated for the purpose. This makes the flight work proceed smoothly and evenly and ensures stable order on the ground and in the air and ultimately, flight safety as well.

The airmen receive all-round support and encouragement from command for demonstrating intelligent initiative in the performance of the flight schedule and a creative attitude toward the assigned job, and for endeavoring to focus their knowledge and experience on the performance of the assigned missions. Manifestations of formalism, lethargy and inertia, on the other hand, create alarm and concern and require that proper steps be taken to correct the situation.

The political-indoctrinational work conducted during flights is designed to ensure that every airman considers himself to be an active fighter for implementation of the flight plan and responsible for the safety of each flight, from the time the aircraft taxis out until the engine has been switched off after landing. A great deal depends upon the emotional state of the men, upon their relationships and upon the emotional atmosphere created in the collective, both on the days preceding flights and while they are under way. The elimination of haste, a situation of mutual demandingness and responsibility for the combat readiness of the unit and for flight safety, and

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

mutual aid and assistance in the work create that spirit of fraternity and comradeship which contributes greatly to the successful performance of the assigned tasks and to the insurance of accident-free flight work.

A high level of discipline and organization and the precise implementation of each paragraph of regulations, instructions and manuals by everyone involved in organizing flights is a guarantee of success, both in the professional development of the pilots and in the observance of safety measures. Special importance is also attached to the self-discipline of each airman, which ensures a high level of organization and precision of action in any situation, no matter how complicated. Commanders and political workers, therefore, demonstrate special concern for indoctrinating the airmen with an inner need for efficiency, internal discipline and personal conviction as to the need for strict observance of flight regulations.

2. Psychological Analysis of Errors Committed by Flight Personnel on Flights

What Is "Human Error"?

We know from experience that psychological factors and not deficient control of the aircraft constitute the main cause of errors committed in the performance of flight assignments. They include incorrect appraisal of the situation, violation of the procedure for distributing attention, and so forth. These factors are ordinarily referred to as "human error."

Errors are frequently defined and recorded (in flight logs and reports) as deviations of the aircraft, however: leveling-out too high, landing at too high a speed, insufficient gliding angle or failure to maintain the assigned flight altitude, or the general "error in piloting techniques." From the psychological standpoint it cannot be the ultimate goal to simply state an incident in this manner, to establish only the external cause of the error. This is only the starting point for an analysis to establish the dependency of the external, immediate cause of the error upon more remote circumstances, which can be acted upon with preventive measures. Nor is it beneficial to attempt to classify the causes of errors by type, to place them into an existing pattern, a general group of errors. This, in turn, leads to a situation in which preventive measures are reduced to general demands for improvement of training methods, piloting techniques and the organization of flights.

The psychological analysis requires identifying that which is characteristic of the specific incident in each concrete case of erroneous action, thoroughly considering everything pertaining to the pilot, and in each of his errors, looking not only at the deviation of the aircraft or even, let us say, at the improper distribution of attention, but at the human error in that state and under those conditions which existed in the given instance. This method makes it possible to reveal the true causes of errors, to eliminate deficiencies and to improve flight safety and the combat readiness of the pilot. Let us reinforce this idea with examples.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Returning from a flight on a designated route, pilot Z. was ready to lower the landing gear prior to the third turn. At that moment the flight operation officer asked how much fuel was left. The pilot answered: "Everything normal; landing gear down; green lights on...," and he attempted to make a landing with the landing gear retracted. This incident, which could have caused a flight accident, was attributed to carelessness resulting from inadequate skills in using the equipment.

On his first solo flight, a circular flight at night on a MiG-17, one cadet at a flight school reported the landing gear down on the "T" traverse. He was actually flying with the landing gear retracted, however. The flight operation officer concluded that the error was due to the cadet's carelessness in operating the equipment in the aircraft cockpit.

As he was returning from the range, pilot S. witnessed an incident involving a comrade. At the proper location, he made the routine statement that he was lowering the landing gear but did not perform the action. The flight operation officer did not notice the pilot's failure to do so. As a result, he landed with the landing gear retracted. Fortunately, the pilot emerged safe from the incident. The error was attributed to lack of discipline and inadequate skills in using the cockpit equipment.

These were three externally similar errors, and three identical conclusions were drawn as to their causes. Did they reveal the true causes of each incident and make it possible to take specific steps to prevent such errors in the future? Obviously, they did not.

It should be pointed out that attributing attempts to perform landings with the landing gear retracted to lack of discipline or inadequate training does not reflect the psychological nature of the causes. Even the most irresponsible pilot clearly understands the consequences of such a landing, including the consequences for his own life, and does not make such a landing out of negligence. Consequently, the explanation in this case lay in the psychophysiological mechanisms underlying flight skills.

A flight may be an unbroken chain of activity, consisting of numerous, separate acts following one after the other. It has been calculated, for example, that a circular flight involves around 200 separate actions. As flight skills develop, these initially separate actions are combined into larger actions, comprising a single integrated act serving the overall task. The end of one act or movement automatically prompts the beginning of the next act. The shifting or elimination of one of the links in the chain can result in serious complication of the flight.

A system of neural links (conditioned reflexes) between the cells of the cerebral cortex, which is developed and strengthened in the process of flying, forms the physiological basis of flight habits. Excitation in a nerve cell or a group of cells is transmitted to a second cell or group,

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

the termination of excitation in the second initiating excitation in a third, and so forth. The complex of interrelated conditioned reflexes is called a dynamic stereotype.

This sequence of habitual actions, automatically activated, as it were, and which constitutes a developed flight habit, is an essential condition for the performance of flight assignments. It eliminates the need for continuously monitoring the aircraft control movements themselves and makes it possible to focus attention on searching for the target, performing the necessary computations and making decisions, conducting radio exchanges, and so forth. At the same time, however, if for any reason one of the actions is omitted and the mind is greatly occupied at that particular moment, this link leaves the consciousness and is not restored in subsequent activity.

This is precisely what happened to pilot Z. Preparing to lower the landing gear, he substituted his exchange with the flight operation officer for the action, as it were. As he subsequently performed the landing approach and, naturally, was concentrating on this, he performed all of the next successive actions one after another in accordance with the dynamic stereotype, in which there was no place for lowering the landing gear.

The actual origin of the error thus lay in external circumstances: a radio request at an inopportune time in the pilot's work and the structure of the flight habit itself. The most effective possible preventive measures in this case might not have been additional practice in lowering the landing gears, which would have reinforced the stereotype of actions, but practice on trainers, with special distractions inserted into the situation, and clarification for the pilots and flight control personnel of the psychological nature of such errors and of the need to choose a better time for radio exchanges or to exercise extra control in a given situation. Incidents like the one we have just analyzed occur when an unusual situation develops, when external complicating factors arise during a phase of the flight which has not been completely mastered, factors which wedge into the accustomed stereotype and make it necessary to restructure, to transform previously acquired habits and their sequence and to include new or unforeseen actions in the structure. Such factors might be the appearance of another aircraft alongside, straying off the fixed route, the performance of one action instead of another or a deterioration of weather conditions. A proper understanding of such circumstances forces a pilot to be more vigilant and to monitor his actions more closely.

The same sort of mechanism, this one defined by internal circumstances, underlies the student pilot's actions in coming in for a landing with the landing gear retracted. After taking off and retracting the landing gear, he failed to return the valve to the neutral position. Performing a movement of the arm on the "T" traverse and not checking it visually, he moved the valve from the "retracted" to the "neutral" position, believing that he had lowered the landing gear. All of his subsequent actions, including his radio report, were

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

performed according to the stereotype. Tension, which is natural, on a first night solo flight and which considerably reduces the pilot's ability to switch his attention, also contributed to the error. Once more, proper preventive measures could have been defined by establishing the true cause of the erroneous action: In this case, they would have involved training methods.

The theory of the formation of habits tells us that emotional experiences have a considerable effect upon the correctness, precision and sequence of actions. They produce a deterioration of coordination among the nervous system connections, weakening some links and activating others, which sometimes results in disorderly, chaotic movements and actions. Such experiences were the main cause of the error committed by pilot S. Consequently, preventive measures must also focus on strengthening the emotional stability and the psychological conditioning of a given pilot and on explaining to flight operation officers how emotions affect flight work.

A habit becomes more crude and less perfect under emotional stress. Elements of past phases in the development of a habit are sometimes manifested in the developed habit. It is as though the habit goes back to its beginning or even revives an old, past habit. This negative transfer of habits ordinarily occurs in a state of stress produced by various factors, most frequently, emotional experiences or a rigid time limitation. In the preparations for combat training flights--involving firing, bombing or missile launchings--a great deal of attention is therefore devoted to familiarizing the pilot with differences between the arrangements of cockpit equipment on combat and training aircraft, to the development of motor skills and to the operation of the levers, buttons and toggle switches which must be used on a flight. The practice movements are always performed at the tempo required on an actual flight.

Breaks in flight work weaken habits considerably. We know that the more complex a skill is, the more rapidly it is lost. The main focus is therefore placed upon the most difficult flight components following breaks in flying. Such an interruption not only affects the quality of piloting techniques, but also, to a certain degree, results in a breakdown of the sequence for inclusion of the separate actions into the work. After such a break, the pilot devotes a great deal of attention to the immediate process of piloting, which reduces his possibilities for observing the space beyond the cockpit and for monitoring the instruments and signals not directly involved in the piloting. A skill weakened by breaks in the flight work is most susceptible to the negative influence of external and internal factors.

Training In Focusing the Attention

We know from experience that 75 percent of all pilot errors are the result of a breakdown of concentration. Proper evaluation of man's concentration abilities helps to thoroughly analyze such occurrences.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Attention is the focusing and concentration of the mind upon a specific object. There is an inverse relationship between these facets of attention: the broader the focus at a specific moment, the weaker is the concentration. And conversely, the stronger the concentration of attention, the narrower will be its focus.

Broad focus and precise distribution of attention involves the simultaneous concentration of attention on two or several objects or actions. It is only possible if one of the actions is very familiar and is performed automatically, and if all of the activity is taking place in a calm and familiar atmosphere. If the activity becomes more complicated or if an unfamiliar, nonstandard situation arises, the field of efficient functioning of the attention is greatly reduced. One's attention is concentrated on individual objects and cognitive control, time and active volitional effort are required to switch it from one object to another.

When a pilot concentrates on the performance of some specific task and focusing upon a single instrument, he may not notice the readings of another instrument, even an adjacent one: As he performs one action, he may overlook another. As he glided in for a daytime landing in good weather, for example, one pilot once dropped below the prescribed glide path and did not stop the descent until he was reminded to do so by the flight operation officer. It was later revealed that he was attempting to correct a malfunction of a flap at that moment. Extreme concentration on searching for, tracking and attacking the target has in some cases resulted in loss of altitude and speed and to increased banking.

When complications arise on a flight, the pilot concentrates on determining the causes of the problem, on finding the proper solution and on taking vigorous action to get himself out of the situation. In such a situation he is sometimes simply not in a position to engage in radio exchanges or to answer the questions of the flight operation officer, and sometimes, he does not even hear or does not understand ground instructions. It is precisely for this reason that pilots sometimes fail to report their actions in a difficult situation.

A landing approach glide in adverse weather conditions is one of the most difficult flight components. It is characterized by great pressure on the pilot's attention, produced by the process of controlling the aicraft and holding it strictly on course and on the glide path; by a rigid time limitation, which becomes a shortage of time when even flight complications occur; by increased emotional and functional tension resulting from the great degree of responsibility for the performance of each action, as well as by the complexity of the sensomotor activities; and by increased concentration on the group of actions immediately involved in piloting the aircraft, with a resulting drop in the ability to transfer attention from one object to another. Sometimes, a pilot must concentrate so greatly on correcting a deviation from the landing pattern that he may fail to notice changes in the readings of the altimeter, the rate-of-climb indicator, the tachometer and other instruments.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

An incident involving pilot S. demonstrates the level which concentration can reach in such situations. He failed to lower the landing gear during a landing approach. He was concentrating so greatly on the landing pattern that he was not aware when the navigator reminded him to lower the landing gear and did not hear the flight operation officer instruct him to make a second circle, and he made the landing with the landing gear retracted.

The individual involved in this unusual incident was, of course, an inexperienced and emotionally unstable pilot. The complexity of the landing approach glide, the limited possibilities for concentration and the inadequacy of attention mentioned above are real, however. This is why a large percentage of errors recorded on flights--up to 65 percent--occur in this phase of a flight. A psychological analysis of the spcific characteristics of piloting, taking concentration possibilities into account, makes it possible to train flight personnel in a more purposive manner and to foresee likely errors on a flight.

Semiautomatic landing approach systems make the pilot's work a great deal easier by relieving of control tasks and permitting him to focus attention entirely on monitoring the performance of the system. In this case, errors may occur in the case of any sort of system failures if the pilot is not prepared for them. Special drills in the prompt recognition of such failures and in the selection of the right decisions and actions are therefore conducted as preventive measures.

Errors of perception are fairly widespread in flight work. Man's sensory organs are well adapted to ground conditions, but their capabilities are limited in the air. Man does not have a perfect sense of speed (he assesses only acceleration) and he encounters difficulties in determining flight altitudes and directions, in estimating time intervals and distinguishing the details of an object. Visual illusions, which we have already discussed, are a graphic example of errors of perception.

Considerably less is heard about errors of perception related to a specific situation, to the expectation of seeing something and to taking an anticipated phenomenon for a reality.

Forecasting, predicting developments for a certain period into the future, is a feature of the pilot's work. When he performs a certain action, he knows in advance what will follow, how the plane's position, the flight mode and the instrument readings will change (or that they will remain the same). The pilot therefore does not look at the entire instrument but only at that part or segment of the dial where the arrow should be, at that section of the instrument panel where the anticipated signal should appear, knowing in advance, as an example, that the flight altitude is 600 meters and that the green light indicating that the landing gear is down is on or will light up at any moment.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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This foreseeing of events considerably reduces perception time, frees the attention and serves to prevent such negative developments as a shortage of time, fatigue, and others. At the same time, attunement of the mind to the anticipated can lead to errors of perception, when the individual sees not the reality but that which he is expecting.

In a radio exchange, for example, a pilot ordinarily knows in advance what will come next in a given situation. There have been cases in which pilots have requested permission to take off but have heard only the first word of the answer, "Takeoff forbidden." And have taken off. There have also been cases in which the fact that the flight operation officer has changed the number of the zone has not registered in the minds of the pilots, and they have performed their assignments at the previously designated site.

It is perfectly natural for man to make errors of this nature, and they result from a preparedness to perceive the mostly likely occurrence, which is developed in the practical training process. Therein lies the possibility for taking steps to prevent such errors. A command forbidding an act, for example, should begin with the word "forbid," and the zone number, especially when it differs from the anticipated one, should be reported at a moment of least tension--after the takeoff has been completed and the landing gear retracted, for example.

Specific errors may have a connection with the peculiarities of time perception. Man does not have a special organ for perceiving time. He learns to depict and estimate the duration of processes from a number of external (the passage of day and night, the periodicity of phases of the work, and hours) and internal (hunger, thirst, and sleepiness) signals.

Time is an enormously important factor in flight work, and a proper understanding of the ramifications of time is of great importance with respect to preventing errors and ensuring flight safety. We know, for example, that it takes 0.2 seconds to respond to a visual signal under laboratory conditions. During a flight, however, one must first assess the incoming information and make a decision and only then, implement it. Deliberation and precision are as important as speed, since an error in control can have more serious consequences than a few seconds of delay in performing the proper action. It has been established, for example, that it takes approximately 2.5 seconds to appraise the situation and make a decision as to the aircraft's location, and 3.5 seconds to take an aircraft out of a bank, while a total of 15 seconds is required to return an aircraft to horizontal flight from a difficult position.

A pilot must correctly estimate the amount of time available as an important condition for emerging safely from an emergency situation. The skill needed for estimating time, including the distribution of attention, which envisages, first, determination of flight altitude and then, actions dependent upon that altitude, is developed in advance, during ground training.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Various factors may produce a distorted perception of the duration of events, a temporal illusion. Emotional experiences have the greatest distortion effect. Positive emotions cause the individual to underestimate the amount of time elapsing (it seems that the time flies), while negative emotions result in underestimation of the passage of time (time crawls). The individual has an unconscious desire to accelerate events to compensate for what appears to be a dragging of time. This may cause errors. There have been cases in which pilots with a shortage of fuel have failed to maintain the prescribed intervals in the flight patterns and the landing approach, believing that they were allowing sufficient time to pass.

As a result of overstimating the time, a pilot sometimes takes too long to adjust the landing pattern, to the detriment of altitude control, and sometimes descends from the clouds prematurely in an attempt to spot the runway as rapidly as possible. Landing speed is sometimes increased, the result of a tendency to accelerate events.

It is highly possible to develop a good sense of time through practical drills. Special experiments have shown that one can learn to estimate time to within tenths or even hundredths of a second and that experienced parachutists in a highly emotional state (during freefall) determine the passage of time with greater precision than on the ground, in a state of calm.

Calmness Is Always Necessary

It is an established fact that the capabilities of one and the same person fluctuate within a broad range, depending upon his mental and physical state. An analysis of errors committed by flight personnel during flight should therefore take into account, in addition to all other factors, the state of the individual when the error was made. That state itself is sometimes the main cause of errors, other circumstances being only contributory factors.

This tenet is made quite clear by an analysis of the performance of pilots in adverse, emergency situations. At the same time, errors are frequently made under exactly the opposite flight conditions--in relatively easy flight phases, in a calm and familiar situation, when the pilot relaxes and does not anticipate any sort of complications.

A crew is unusually composed when flying in adverse weather conditions. It carefully maintains all of the flight parameters, monitors the airwaves closely and follows the air situation and the positions of other aircraft. In good weather, especially when there is good visibility, some pilots, especially the experienced ones, will sometimes take liberties in piloting, maintaining the flight mode and observation. This is a result of a specific, natural psychological pattern. It has been established that vigilance drops when performing simple work, that all people, even the most conscientious, make errors in a calm situation. As a rule, however, such errors are not encountered in tense, dangerous situations.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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A relaxation of psychic tone and a drop in criticality of thought and concentration sometimes occur as a sort of discharging process following an extremely tension-filled and responsible period of activity. A student at one of the flight schools, for example, who had passed his flying exam with an "excellent" rating, was to perform one more flight according to the flight plan. He was so excited and so overjoyed that he forgot about vigilance and committed a gross error, which almost resulted in a serious flight accident. A veteran pilot may experience this sort of relaxation after the successful completion of a difficult assignment. After a target interception, for example, a low-altitude flight, and so forth, when the final phase of the flight, especially one performed in good weather, would appear to present no great difficulty.

Experience has shown that the repeated performance of the same flight component leads to deterioration of control and, consequently, to deterioration in the performance, even to the point of errors. In many cases, as an example, when a pilot practices diving at a target over and over, he determines the moment for pulling out of the dive less and less precisely.

It goes without saying that none of these psychological patterns or explanations in any way justify the commission of errors. They simply attest the need for cognitive self-discipline on the part of every pilot, based on a correct understanding of the peculiarities of their work, for careful psychological preparation for every flight and for unremitting control over their actions throughout the entire flight.

Fatigue may be the cause of errors. In this case, there is a reduced will to work, which can manifest itself in carelessness or in the deterioration of precision in maintaining the prescribed flight parameters. Fatigue results first of all in a loss of mental flexibility: it becomes difficult to switch one's attention, there is a desire to perform in a routine manner, and one becomes irritable and impatient. There have been cases in which a pilot, after making several unsuccessful attempts to approach for a landing, has even tried to land the aircraft from an incorrect approach.

Depression, emotional suffering or inadequate rest prior to flights can act as factors temporarily lowering mental tonus. It should be borne in mind that negative emotions, no matter what the cause--service problems, family difficulties, and so forth--build up, as it were, combine with the nervous and emotional tension of a flight and can lead to overstress, to a nervous "breakdown."

It is especially important in such cases for the individual to be frank and open, to be able to overcome his feeling of false shame. It is no secret that pilots do not always report errors made in flying techniques or in operating the equipment, loss of orientation on the terrain, a lack of confidence prior to takeoff that the flight will be successful, and positional illusions. This is caused by their fear that being open about their errors might damage their service career, might lower their personal prestige, cause them to be laughed at or accused of weakness; that the error

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will officially be considered a precondition for a flight accident; or that the pilot will be grounded or penalized in some other way. Obviously, what is needed in such situations is not only and not so much orders (and they exist for all such incidents) as much as we need to create a psychological, comradely atmosphere in the subunit or unit, in which openness will further, and not hinder, success in the flight service. This is not an easy task, and commanders and political workers must possess a good knowledge of psychology and pedagogics, sensitivity and a high level of prestige in order to accomplish it.

In the interest of our work, we must thoroughly analyze every flight error and take steps to see that it is not repeated. Naturally, it would be difficult to perform such an analysis for each pilot at the general unit flight critique. It would obviously be more effective to conduct an initial postflight critique on the flight or group level. Self-analysis and self-critique are also effective. They make it possible to thoroughly reveal shortcomings pertaining to personal traits, the mental state, physical health and other factors which might not be known to the commander conducting the flight critique.

In the vast majority of cases there are several causes of errors or factors contributing to them. It is important to bring out the main cause in the analysis, to analyze it thoroughly and to plan essential preventive measures.

Errors are ordinarily separated into two groups when they are analyzed: professional errors related to inadequacies in flight proficiency (incomplete training, loss of or incomplete restoration of skills, lack of knowledge, or inadequate preparations for a specific flight), and "human" errors, which depend upon the personal psychological characteristics of the pilot. The latter are far more common and it is far more difficult to reveal them, since they require in-depth analysis. They may also include a lack of conformity between the pilot's psychophysiological capabilities and those requirements made of him in a given situation; a poor mental or physical state on the part of pilot; and lack of discipline, carelessness, complacency and inadequate vigilance on the part of the crew. Naturally, the preventive measures should differ for each specific case.

3. Flight Supervision and Psychology

Flight Supervision--Personnel Supervision

As a result of the expanded range of tasks performed by the aviation, the continued development of technology and the drastic increase in the amount of information arriving over numerous channels, flight supervision has become considerably more complicated in the contemporary situation. The need for reliable, precise and continuous control of the crews in the air and on the ground and for flight safety places special responsibility upon the flightline crew. This, in turn, increases the emotional tension of each member, especially the flight operation officer. Flight supervision

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is primarily a matter of supervising people, taking into account their training level, their efficiency and discipline and their specific psychological traits.

Appraising weather conditions is, of course, one of the most important duties of the flight operation officer. A correct analysis of the weather contributes to the successful accomplishment of flight assignments and helps to maintain good organization in the flight work and to ensure flight safety. Failure to consider a possible change in the weather or an unexpected deterioration of weather conditions frequently not only necessitates adjustment of the tasks being performed by the pilots, but also considerably complicates control of the crews and has a negative effect on the psychological atmosphere in the team providing flight support.

Weather conditions in the airfield area sometimes unexpectedly fall below the established weather minimum. There is perhaps no more difficult a situation for a flight control officer: On the one hand, he wants to land the crews at their own airfield (There is no place like home!), while on the other hand, the situation makes it necessary to send the pilots to an alternate airfield. Doubts begin to develop as to whether all of the crews will be able to cope with an approach and landing at an unfamiliar airfield.

The crews are ordinarily sent to the alternate airfield if weather conditions there are satisfactory and if they have adequate fuel. When the weather deteriorates at the alternate airfield and the tanks contain a minimum of fuel, the flight operation officer is in an extremely difficult situation, and his nervous and emotional condition becomes extremely tense. For whom are such moments most difficult--for the pilots awaiting a decision from ground or for the flight operation officer? Each pilot answers for himself, while the flight operation officer is responsible for everyone in the air.

The documents covering such situations recommend that every possible step be taken to ensure a safe landing at the home airfield, taking the situation and the level of training of the crews into account. The flight operation officer may permit the crews to descend to the altitude for passing over the inner marker beacon after crossing the distant beacon, in order to emerge from the clouds. What if the pilots cannot see the runway lights even after passing over the inner beacon? Once again, the flight operation officer is troubled by alarming indecision as to the proper course of action, and time is not standing still.

After weighing all of the factors, the flight operation officer decides to land the aircraft at their own airfield. And the decision is carried out precisely and promptly through the joint efforts of the flightline crew and the pilots.

The above example and the actual flight work demonstrate the fact that the psychological stablility of crews in the air depends to a great degree upon

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

the nervous and emotional state of the flight operation officer, upon his tone of voice when he issues instructions and his ability to support the pilots at the right time with both words and deeds, while the calmness and self-control of the flight operation officer is, in turn, produced by the moral-psychological condition of the crews performing the flight assignments. In other words, all aspects of interaction on the ground and in the air should be regarded as parts of a dialectical whole, but the determining role in the psychological pilot-flight operation officer duo goes to the latter.

A pilot who finds himself in difficult circumstances will sometimes become nervous, make frequent radio requests and divert the personnel away from their flight supervision work. Naturally, this evokes a certain corresponding response. No matter how difficult the situation, however, a flight operation officer is required to remain calm and sensible, to provide competent and prompt assistance to anyone in need of it, anyone who has not withstood the extreme pressure.

A flight operation officer is under special tension when it is necessary to help a pilot in trouble, without delay and with an acute shortage of time. At such moments the flight operation officer is under such great mental and emotional pressure that he can temporarily lose his self-control and become confused, a situation containing the seeds of numerous problems in the air and on the ground.

Once, during a night takeoff, young officer B. strayed off the runway axis. He noticed it too late, however, and knocked over a runway light with an under-wing tank. Continuing his takeoff run, the right wheel of the aircraft went over the edge of the runway onto the ground and raised a cloud of dust. Officer Yu. Alekseyev, flight operation officer, noticed the dust and asked the pilot what had happened, but he received no answer. It is not difficult to imagine the state of the flight operation officer in that alarming and totally unclear situation. Later, Officer Alekseyev had this to say about what happened: "I was watching the takeoff run of the aircraft when I noticed that the afterburner flame had suddenly disappeared. I attempted to contact the pilot but there was no answer. Judging from the amount of time which had passed, I felt that the aircraft should lift off the ground at any moment. What should I do? What sort of command should I give? If the afterburner had been disengaged, the pilot would have to continue the takeoff. If the aircraft had lost speed, I would have to give immediate instructions for the pilot to cut off the engine, maintain direction, apply emergency brakes and let out the brake parachute, for there was a mountain ridge ahead. This is what I did, and it turned out to be the right thing."

In this case the pilot was under great nervous and emotional tension, but the flight operation officer was under equal psychological stress. He was able to grasp the difficult and contradictory situation within a matter of seconds and to arrive at the only correct decision. The slightest delay on

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

his part could have resulted in a flight accident. The reaction speed of the flight operation officer, his ability instantaneously to put aside all other kinds of information and external stimuli of the psyche, his resoluteness, calmness and self-control made it possible for him to save a crew and an aircraft in a situation with an acute shortage of time.

Certain flight operation officers, ordinarily inexperienced ones, sometimes get in a hurry, become nervous, raise their voices and issue unclear instructions. This inevitably weakens the psychological stability of the pilot, who is already in a difficult situation.

Once, as he was climbing in the clouds, one pilot noticed that the hydraulic system manometers were giving inaccurate readings. He immediately reported this to officer B., flight operation officer. Making no effort to determine the cause, the latter ordered the pilot to break off the assignment and land. There was, incidentally, no acute need for the pilot to land.

In this case the flight operation officer did not demonstrate a high level of technical competence or persistence: he did not take into account the fact that the supersonic fighter was being flown a young pilot lacking solid volitional habits. There was no acute need in this situation for the decision to land an aircraft with a large amount of fuel remaining in the tanks. The flight operation officer should have instilled confidence in the pilot and helped him to overcome his fear of a possible loss of control. Instead of this, the flight operation officer was hasty and placed the inexperienced pilot into a difficult situation.

Sometimes, instead of a clear and concise command, a flight operation officer will only inform the pilot: "I think you have an undershoot" (naturally, the pilot revs up the turbine and pulls up), and then--"Now you have clearly overshot." This sort of information does not help the pilot, does not focus his attention or discipline him, but only makes the error worse.

It is important to preserve conciseness, precision and an atmosphere of special trust and respect in relations between flight operation officers and pilots. A calm and kindly voice from ground inspires and disciplines the crew, and a flight operation officer can, in turn, derive information on the pilot's psychological state and on flight conditions from the pilot's tone of voice. The pilot sees in the flight operation officer a senior and experienced comrade, from whom he has nothing to hide and to whom he is required to frankly report all of his difficulties and doubts, knowing that he will receive assistance without fail when he needs it.

In some cases an inexperienced flight operation officer will attempt to explain to the pilot everything pertaining to a landing just before the landing. The fliers joke about this: "Here we go with the preliminary preparations." Verbosity on the part of the flight operation officer in such a case can only be detrimental. When the communication channels are

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loaded down, the pilots cannot report completion of important phases of their flight or contact ground control in general, cannot ask for advice or assistance when needed. This is just a step away, so to speak, from a violation of safety measures.

One of the important qualities for a flight operation officer is the ability to consider the psychological traits of the pilots under his control. It contributes to the quality performance of flight assignments, to the improvement of the airmen's combat proficiency and the insurance of flight safety.

Officer Ye. and his crew were once sent up to intercept an air target in adverse weather conditions. In his haste, the pilot forgot to don his oxygen mask and pressurize the cockpit, noticing this only after he had already reached a high altitude. Turning over control of the aircraft to officer P., the other member of the crew, he began to put on the oxygen mask but lost consciousness just at that moment. A taciturn individual by nature, pilot P. did not ask the aircraft commander how he felt and continued climbing. It was not until a few minutes later that he directed a question to the commander. Naturally, he received no answer. The pilot immediately reported the incident to ground. The report greatly alarmed the flight operation officer. The weather was very bad, and officer P. had little experience in flying under such conditions.

Officer G. Gerasimov, the flight operation officer, was in an extremely difficult psychological state and he had to decided whether to trust officer P. to continue piloting the combat aircraft. Familiar with the pilot's good volitional qualities, he permitted officer P. to make the landing. His anxiety remained, however. Would the pilot be able to break through the 10-kilometer-thick mass of clouds? Could his psyche withstand such a test? The flight operation officer knew how tense were the pilot's nerves and he therefore did not bother him with unessential questions or instructions. He supported the pilot's decision to make a second circle and gave him confidence with his calmness. Considering the psychological makeup of officer P., his unhurried actions and taciturnity, the flight operation officer gave him only two commands while he was descending and making the landing. The landing was normal. Had the flight operation officer lost his head, even temporarily, raised his voice or talked excessively, it is difficult to say how the flight would have ended.

A flight operation officer under great stress will sometimes speak abruptly to the pilots. Naturally, it is not an easy matter to create smooth and calm relations with each airman at the airfield and in the air, especially since some of them with their lack of efficiency force the flight operation officer to be highly demanding. This certainly does not mean that the demandingness can be combined with rudeness, however. If efficiency, modesty and discipline are persistently instilled in the personnel, then, naturally there is no need to repeat instructions, to raise one's voice or speak abruptly. It is the duty of flight operation officers, along with commanders, political workers and party organizations, to take an active part in the indoctrination of all categories of aviators.

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The Flight Operation Officer's Responsibility

Officers manning the command post, the landing control officer and the assistant flight control officer, together with the flight control officer, help direct airborne crews. The landing system operators are also authorized to radio information on the aircraft's position and bearing and on the presence of other aircraft in the flight area. Zones of responsibility are assigned in order to achieve better organization of flight control. The flight operation officer or his assistant, for example, direct aircraft within visible range in the takeoff and landing zone. The landing control officer directs aircraft in the near zone, approaching for a landing from a fixed point, a straight-end landing, a landing with two 180 degree turns or a "box" landing, as well as on circular flights. Aircraft in the far zone are directed and controlled by the command post team.

The great responsibility and the specific location of the flight operation officer make it necessary for him to be the director of aircraft both on the ground and in the air, to see and hear everything which goes on, to exercise continuous control over both the crews and the flight control team and, when necessary, to intercede resolutely in the control process. Receiving and processing a large volume of information, he sometimes intuitively knows where each of the crews is located and mentally compiles an aicraft flight plan over the airfield, a plan which must be implemented by officers manning the command post, by landing system personnel and by the flight operation officer himself.

Frequently, especially in a complicated situation, the flight operation officer is inundated by an enormous flow of information arriving from the screens of outlying radar sets and over telephone and radio lines. And when his physical and mental systems are not properly adapted for handling the sharply fluctuating external stimuli (stress factors) the alarm reaction as the first stage of stress may develop into the second stage--the resistance stage--and from it, if the system's ability to adapt is weaker than the stress force, into the third stage--that of exhaustion--that is, into a loss of control over his emotions and his sensory organs.

In some cases, a desire to land the crews as rapidly as possible (when the weather is deteriorating, when another group is ready to take off, and so forth) results in an accumulation of aircraft in the airfield zone, with some of them in a radar dead zone. This deprives the flight operation officer of the opportunity of picturing the entire air situation on radar screens and plotting boards and keeps him in a state of psychological tension for a lengthy period.

No matter who is participating in the flight control process, the main responsibility for flight safety falls upon the flight operation officer, who can take over control of the aircraft in any zone when necessary. The airways frequently become crowded in such situations, and if the aircraft crews, the officers manning the command post and the landing system operators have not

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

been properly trained to handle radio traffic, the flight operation officer may find himself in an extremely difficult situation. Precise delimitation of duties within the flight control group, a high level of demandingness on the part of the flight operation officer, mutual trust and a sense of responsibility on the part of each individual manning a microphone all help to establish a good psychological working environment on the airways and to create a normal situation for performing and controlling flights.

A pilot performing a flight in a complicated situation sometimes receives so much information from the instruments and from ground that only an individual with a solid moral-psychological foundation is capable of receiving and "digesting" it and accomplishing the assignment successfully. An overabundance of instructions from the command post, the vectoring station or the flight operation officer sometimes becomes the cause of a mission failure, development of the preconditions for a flight accident or a breakdown of flight safety.

A pilot performing a combat training assignment once came dangerously close to the target and returned to the airfield with the missiles still on board. After landing, he explained what had happened in the following manner: "Everything was normal when I detected the target. I effected the 'lock-on' and moved the aiming marker up to the electronic circle. The command post requested a report just before I pressed the launching button. I complied. I cannot understand why the missiles did not fire. I did everything according to instruction."

There was no reason not to believe the veteran pilot, and the engineers therefore began looking for a malfunction in the equipment. There was nothing wrong with the equipment or the armament, however. Just why, then, was there no characteristic "pip" on the oscillogram? What had happened in the air? Why had the missiles remained beneath the aircraft wings? In order to answer these questions, the commander had to move into another area--the area of the human senses....

The air situation was complicated during those minutes, especially during the vectoring phase. Flying by instruments, it took the pilot a long time to detect the target, and he became excited and frequently requested information from the command post on the target's location and range. Ground reported that the target was already within detection range of the airborne sight, but the screen in front of the pilot remained blank. Soon, another, internal stimulus was added to the external stimuli affecting the pilot's psyche: "What if I ruin the missile launching? I certainly won't get a pat on the back for that...."

When the target blip appeared on the screen, the aircraft was already approaching it at considerable speed. This produced yet another stimulus--a fear of colliding with the target. This increased the pilot's concern even more. At this point the sight "locked onto" the target, but the target blip was not centered. The pilot began to hurry. He attempted to bring the

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blip back into the electronic ring as rapidly as possible, because the thought of his rapid approach to the target was increasing his alarm. Now he had the target inside the electronic ring. The pilot removed the firing button from the safety device, but just at that moment the aircraft controller came over the air and inopportunely requested a report on the pilot's actions. The latter reported that he was attacking. The aircraft controller did not hear the report and asked for a repeat. Ground did not receive the answer, however: the dangerous approach light came on, and the pilot turned the interceptor vigorously to take it away from the target.

Why had this happened? Who was to blame for the mission failure? Upon receiving the total group of internal and external stimuli (stress factors), the pilot found himself in a difficult situation, with a shortage of time and a possible violation of safety measures--a dangerous approach to the target. In this stress situation, he forgot to press the firing button. The aircraft controller also acted improperly. There was no need to go on the air and request a report from the pilot at that moment when he was in the firing position.

Sometimes, when the tacit agreement of the flight operation officer, an aircraft will receive dozens of instructions, commands and requests from the command post, the landing system and the vectoring station. The pilot is not capable of processing such a volume of information within a short time and sometimes draws hasty conclusions from it and makes baseless decisions. It is therefore important for the flight operation officer constantly to monitor the radio traffic and to combat the slightest infractions with determination.

Experience and strong-willed commanders are appointed as flight operation officers, but there are limits even to their physical and psychological capabilities. This is especially applicable to the memory, which frequently has to bear a heavy load. Many crews are frequently in the air at the same time, and the flight operation officers must know a great deal about them: where they are located on the routes, their points of interception, their sequence for arriving at the marker beacon and for entering the descent glide path, and so forth. It is not an easy matter to remember all of this. In such cases, the use of automation equipment considerably expands the possibility for controlling flights and for improving their dependability and safety. Even then, however, the flight operation officer still has the final word.

We know from observation that when the air situation becomes complicated, some flight operation officers become very tense, make errors and are inaccurate in transmitting instructions to the aircraft, and manifest nervousness and a lack of objectivity in appraising the actions of the pilots. Others mobilize all of their spiritual and physical strengths in similar situations, perform competently, boldly and resolutely, and transmit useful advice and effective instructions to the crews efficiently and promptly.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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The reasons for this lie not only in the specific psychological qualities of the flight operation officers, but in their professional training level as well.

Practical training sessions play a large role in the training and improvement of flight operation officers by helping to expand their knowledge, strengthen their skills, speed-up their reactions and reduce errors in directing the crews.

Group exercises which model the components of flight supervision occupy an important place among the various kinds of practical training sessions. Pilots and officers from the command post and the landing system are drawn upon to conduct them. This makes it possible to create a situation approaching actual flight conditions to the maximum degree possible. The modeling of a pressure situation with an acute shortage of time heightens the emotional load on the flight operation officers, thereby helping to develop essential professional skills and psychological qualities in them.

An officer's interrelations with his superiors and his service comrades, his family relationships, his rest and eating habits and his emotional surroundings are of considerable importance with respect to the officer's preparedness to direct flights. Any disturbance of his preflight regimen--inadequate rest, a change in eating habits, quarrels, loud discussions, and so forth--have a negative effect upon his flight control performance and increase the number of errors made while directing the aircraft, even in simple situations. The situation becomes even more complicated when there is a rigid time limitation and a greatly increased volume of information, and the flight operation officer may not be able to cope with the duties assigned him.

The factor of fatigue on the part of the flight operation officer is sometimes not taken into account when a flight day (or night) is planned. In such cases the most difficult and responsible assignments are scheduled for the second half of the flight shift. It would obviously be more practical to schedule a minimum of flights and less complicated exercises for the last hour of flying, taking into account the lowered psychological tonus of all those participating in flight control.

It should be noted in conclusion that the flight operation officer's great responsibilities and the specific nature of modern flight control work demand that he continuously improve his proficiency, persistently seek more effective ways and means of performing the job and further develop his psychological qualities.

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

4. When A Special Situation Arises

The Effect of an Emergency Situation Upon the Pilot

In recent years a great deal of attention has been devoted to the study of a pilot's behavior in emergency, extreme situation, or, in special flight situations, as they are commonly referred to in the aviation. Under such circumstances a pilot's behavior is determined not only by the level of his professional training but by his psychophysiological qualities as well: the degree of his nervous and emotional stability, his capability for directing his attention and volitional actions according to the force of external stimuli, and so forth.

Any complication of the air situation produces psychological tension in an individual. It mobilizes the will, increases the psychological capabilities and improves the efficiency of some, while it has the opposite effect upon others, producing constraint, depression, confusion and functional discoordination or even fear. In other words, a pilot with a strong nervous system performs boldly, resolutely and intelligently and manifests a high level of volitional activeness and self-control in a special situation, while another individual, one with an unstable psyche and with a weak nervous system, will be slow in appraising the situation, take a long time to make decisions and make errors in operating the aircraft control elements and the engine.

Numerous studies have demonstrated the fact that such psychophysiological features of man as his speed of reaction to an external stimulus, his capability for receiving and processing information within a unit of time, and others, have their limitations, but, at the same time, there are practically unlimited possibilities for developing skills in operating the aircraft, the engine and the radar sight, skills which have a considerable effect upon the individual's behavior in an emergency situation. The individual's nervous and emotional constitution have a substantial effect upon the development of skills, either accelerating or retarding the process. The limits to man's capability for operating the complex combat equipment have expanded as the technical and tactical characteristics (speed, flight ceiling, range, complexity of airborne equipment, and so forth) have increased.

Because of the flexibility and resilience of the psyche, man adapts to his circumstances, developing a complex system which compensates for temporary deficiencies in his ability to react, his attention span, and so forth, to the point that they are eliminated by means of new functional capabilities of psyche and through the conditioning of personal psychological qualities of the individual in complicated situations. By intensifying the conditioning and the automated skills developed in the process, it is possible not only to attain the basic reaction time, information processing capacity, and so forth, under ordinary conditions, but even to exceed them

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

considerably. This important feature of the human organism is especially important for preparing a pilot to fly under complicated conditions and to perform in special cases, with little fuel remaining, with a drastic deterioration of weather conditions in the landing pattern, and so forth.

A pilot in a critical situation not only controls the aircraft but also retains hundreds of bits of information and figures in his memory and selects from among numerous recommendations contained in manuals and instructions those which will help him out of the difficult situation. When an engine fails at a medium altitude, for example, the pilot must make numerous decisions, both large and small, with respect to determining the mode of descent, the altitude and time for starting the engine in the air, working out steps to take in case of a forced landing at the airfield, and so forth, along with controlling the aircraft. In addition, he must demonstrate exceptional self-control, perform swiftly and precisely, and adopt and implement the only right decision. Any delay, the slightest degree of confusion or a temporary loss of his volitional capacities can have irreparable consequences.

Experience has shown that in a complicated situation, external stimuli are considerably weaker when the required skills have been automated, which makes it easier to concentrate one's attention and volitional efforts for eliminating the special situation. For example, certain power-consuming units such as the automatic radio compass, the sight, and so forth, must be turned off in case of generator failure on a night flight in adverse conditions. Switching off the radio compass in such conditions, however, poses the danger of complicating the flight even more, since there is danger involved in approaching the airfield and coming in for a landing without this instrument. The well-trained pilot is capable of making a landing approach with the radio compass turned off, although he will experience tension, and the task may prove too great for an inexperienced pilot.

Studies have shown that dozens or even hundreds of special training sessions with special equipment, in a cockpit or during the performance of flight assignments are required in order to develop a stable automatic habit. Furthermore, it is best to develop automatic habits for functioning in special situations little by little, gradually increasing their complexity and number. Such training drills increase the speed of simple reactions by 40-50 percent, that of complex reactions requiring multifaceted actions, by 30-35 percent.

Experienced commanders and instructors adhere to the following sequence for conducting practical training drills to develop proper habits for functioning in a complex situation: they first organize the study of instructions and then work out the procedure for practical training in an aircraft cockpit or in a trainer. Finally, they create emergency situations without giving advance warning to the pilot. The situations introduced are varied with respect to time and place and to flight phase in order to give the trainees an opportunity to practice what they are to do in the same sort of special

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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situation at different flight altitudes, at different distances from the airfield, in different weather conditions, and so forth.

They sometimes simulate a breakdown which does not require immediate action but which must be dealt with after a certain amount of time has elapsed. A breakdown of the hydraulic system, for example, is simulated after takeoff and after the landing gear has been retracted, in order to force the pilot throughout the flight to consider the possibility of an emergency lowering of the landing gear and the flaps. Such drills considerably heighten the pilots' interest in such situations, which steps up their mental activity and improves their grasp of the problems involved.

The practice of assigning priority to the development of action to be taken in case of those failures which are most likely to occur is not entirely correct. If such a breakdown does not produce emotional tension and is easily remedied, it is sufficient to explain and run through the situation once or twice. If, however, an emergency situation, even one which is rarely encountered and which may not occur for a long time, produces a high level of nervous and emotional tension and creates major difficulties with respect to making a decision and in the subsequent piloting, it should be run through frequently and repeated.

The initiative demonstrated in unit "X" is worthy of study in this connection. Supplementary devices for use with the standard trainer have been prepared there under the supervision of officer I. Lazarev, which make it possible to simulate complex failures which are rarely encountered on actual flights and which create tension, constraint of action and sometimes even a prestress condition in many pilots. A trainee in that unit does not learn about a failure by radio, as is ordinarily the case in training practices, but from the readings of the instruments and signaling devices and from external signs (a sudden vibration, a tug of the control lever, and so forth), that is, as it occurs on an actual flight.

The following describes one exercise conducted in this sort of trainer. A signal light indicating generator failure came on during the climb in a "departure" on an intercept mission. The young pilot undergoing training switched off part of the electric power consumers, reported the incident to the command post and turned toward the landing airfield. There was a sudden jerk of the control stick--a malfunction in the hydraulic system. The complexity of the situation had increased, and the psychological strain on the pilot as well. He would have to function precisely and rapidly to control the aircraft in a situation of an increasing flow of information on external stimuli. As he eliminated the malfunctions or reacted to them with a severe shortage of time, the pilot began reporting his actions less frequently and to make more frequent errors in his determination of the aircraft's location. When the "fire" light on the instrument panel came on, he lost his composure for a certain period of time: The first stage of stress (a reaction of alarm) was followed by the second (the stage of resistance)--the organism's adaptation to a stress situation.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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After conquering his confusion, the pilot switched off the engine and activated the fire-fighting equipment. At that moment, however, he felt a jerk and the control stick went dead--the rudders wedged in the glide position. There was only one thing left to do--eject. He then made a hasty report to the instructor and performed the necessary operations prior to abandoning the aircraft. The pilot pressed the catch forcefully, there was a sound like a shot, and the seat, together with the pilot, hung from the edge of the cockpit, thrown there by a special device. Opening his eyes, the pilot had an embarrassed grin on his face: "That was a good drill! Almost like a real flight. My heart is even beating fast."

In the course of such practical training the instructor has the opportunity to monitor many actions of the trainee by means of signal lights mounted on the control panel of the trainer.

The trainer, which is extensively employed in unit "X," helps the flight personnel to develop stable habits of reacting in a comprehensive manner to the instrument readings and to audio and light signals, to considerably increase their speed of reaction to external stimuli in special flight situations and to develop a capacity for foresight, which has a positive effect upon the individual's psychological preparedness for possible complications in the air.

Training sessions in an aicraft cockpit are also highly important in training the pilots to function in an emergency situation. The systematic run-through of many flight situations, the actions performed in the process, the concept acquired of the tasks being performed and the simultaneous sensation of living through the actual situation leave a deep mark in the individual's memory and reinforce the standard decisions and the skills acquired. After completing such practical training sessions in an aircraft cockpit, the development of a similar situation on an actual flight, seems familiar, like an event one has already experienced and survived. This does a great deal to reduce and sometimes, even to eliminate, the main adverse factor in any emergency situation--unexpectedness.

The sight, hydraulic systems and radio equipment are frequently switched on during practical training sessions in an aircraft cockpit, which makes the flight conditions more realistic.

Flights in a dual-control trainer, with one or several instruments turned off during the performance of the assignment, have a considerable effect upon the pilot's psyche in his training to handle special situations. It is not an easy task to fly an aircraft with the piloting instruments switched off. It creates considerable nervous and emotional tension, forces the pilot to perform as though on an actual flight, making an all-out effort, and consequently, reinforces his psychological conditioning.

One of the engines is sometimes switched off during training flights in a dual-control trainer. This is what one such training session was like, as

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an example. In the practice zone, at the instructor's command, the trainee (one of the authors of this book) reduced the speed of one of the engines, fixed it at the required speed and, without taking his eyes off the revolution counter and the other instruments, moved the engine control lever to "Stop." He felt himself involuntarily squeezing the stick and the control lever of the working engine and pressing heavily upon the pedals. He glanced at the oxygen indicator: his "throat" began to open and close more frequently than usual--his breathing had become more rapid. All of his attention was upon the instrument and control panels.

Radio traffic between the other crews and the runway control point became barely audible for a certain period of time, as though the volume of the radio set had been turned down. The instructor's voice was unusually loud over the intercom system. The trainee was made aware that the engine had been switched off by a jerk of the rudder pedal--the automatic course control had been activated. It was only after this that he noticed the drop in rpm on the tachometer.

Flying on one engine was not a great deal different from flying with two engines, but because of the extreme caution exercised by the trainee, the piloting operations were overly smooth and drawn-out. A certain calmness set in, and radio traffic became audible again. The trainee did not respond immediately to a request from the flight operation officer--some time was spent thinking over the content of the report to ground on the performance of the equipment.

The trainee started the engine at once, with a single motion developed to the point of automation, as though he had been waiting a long time for the command to switch it on. The turn pedal leveled out, and a movement of the control stick aligned the needles indicating the rpm's of the two engines. The trainee took his pulse. It was 178, two and a half times the normal. He got his bearings and began preparing to switch off the second engine....

After landing and taxiing onto the parking area, the trainee did not want to leave the cockpit. He removed his oxygen mask. He felt tired from the tension experienced during this not entirely ordinary flight. He felt as though he had been performing physical labor all day.

The above example illustrates the fact that the pilot experiences increased psychophysiological pressure even on a training flight with the simulation of a controlled special situation. This pressure increases even more in the case of a sudden failure of an engine, the hydraulic system, the boosters or the generator when flying at night or in the clouds, and may increase to the limits of man's psychophysiological capacity and result in a stress condition.

It is, therefore, in the best interest of flight work to conduct various types of practical training drills systematically, in conditions approaching an actual flight situation to the maximum possible degree.

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Extensive use is now being made of an automatic prompting device for pilots in emergency situations. This piece of equipment helps them to focus their attention properly upon priority objects and reduces the load upon their psyche, thereby contributing to flight safety. It is important that every pilot learn how to make proper use of this equipment.

The Development of Psychological Stability

A special situation usually disturbs the stereotype which the individual has developed. When he functions in the new situation, the pilot frequently employs different methods of controlling the aircraft and the equipment. That is, he alters not only his habits but also his attitude toward the situation, his emotions. A stereotype developed on ordinary flights may have a constraining effect in special situations, especially at that moment when emergency measures must be taken. The situation forces him to alter his established stereotype, and this, naturally, demands certain volitional acts.

As a rule, the disturbance of the stereotype lasts for some time, and a pilot in the air sometimes has only a limited number of seconds to take steps to extract himself from the critical situation. It is therefore important for him to prepare himself in advance for possible unexpected developments in the air, to work persistently on his methods of eliminating the special situation and to condition his psyche.

Highly active and excitable people have a more dynamic and pliable stereotype. They rapidly develop a temporary pattern of action and therefore get their bearings more rapidly in a complicated situation, make decisions more efficiently and swiftly, and operate the control elements smoothly. People who perceive developments around them more slowly take a long time to make up their mind in complicated circumstances, and the breakdown of their stereotype is more difficult and takes more time.

The opinion is sometimes voiced that man's inherited traits ("He was born that way and nothing can be done about it.") are dominant in his actions and that it is therefore hardly practical to devote a great deal of attention to developing in some pilots precision in operating the control elements or the ability to orient themselves rapidly in a complicated situation, since, it is presumed, they will develop these abilities naturally with experience and the accumulation of flying time. One cannot agree with this opinion: It has been refuted by our experience in flight work.

The personality of the trainee, as well as everything which actually affects the human psyche and creates the temporary pattern of action, forming new dynamic stereotypes, constitute the crucial factor in the development of psychological stability and solid skills for handling special situations in flight personnel. By repeatedly performing exercises focusing upon the development of such skills, a pilot can develop qualitatively new skills, which supplement his inherited skills, and form new nervous and emotional patterns.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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With special classes and drills a slow-functioning, lethargic and inefficient individual can achieve the required speed and flexibility and learn to react promptly to abrupt changes in the situation. The resilience of the human psyche makes it possible to "mold" character and affect the temperament, making them serve the demands of flight work. This process is not a brief one, however, and it requires great effort and application on the part of both the student and the instructors. Single drills and special classes, even lengthy ones, have little effect. The skills and neoformations produced in the psyche survive longer when the training sessions, exercises and classes are conducted systematically, when they are focused and are conducted under circumstances approaching actual flight conditions.

An unexpected complication in the air situation, a sudden failure of the aircraft equipment, sluggishness or inefficiency on the part of the pilot can erode his psychological stability. The difficulty lies in the fact that it is practically impossible to determine the maximum psychological load which can prompt an acute, sometimes spasmodic, deterioration of the volitional processes, which is ordinarily followed by a loss of self-control, confusion and uncoordinated actions--that is, stress. If one fails to focus his will and attention upon the most powerful external stimulus, if he delays or is diverted to secondary signals, the result may be further intensification of the emergency situation, muscular sluggishness and, finally, stress, making it impossible to take steps to extricate oneself from the critical situation.

As a rule, emergency air situations set in unexpectedly. The first reaction is one of alarm, whereby the individual, while attempting to understand the nature of the new development (equipment failure, a lowering of the cloud cover, deterioration of visibility, and so forth), takes responsive action (the resistance stage). If the individual's reaction has been prompt and accurate, the prestress situation is gradually restored and the origin of the alarm is pinpointed: The pilot switches on the duplicate systems or begins a second circle or, in case of a deterioration of weather conditions, departs for an alternate airfield. The stage of exhaustion may set in if the individual's capacity for temporarily rearranging his psyche and eliminating the source of alarm have not measured up to the stress level (the time for responding with action has been permitted to elapse, constraint and lack of coordination have developed or it is technically impossible to take responsive steps to restore the functional efficiency of the equipment).

By breaking down a pilot's actions in special situations into separate temporal segments and stages, it is possible to identify those hidden elements of his psychic reactions, which have had a positive or a negative effect upon his struggle with himself or with the equipment, to establish the effect of pressure upon the individual's behavior and, finally, to perform a psychological analysis of his actions.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Sometimes, when inexperienced pilots detect an equipment failure signal, they engage in so-called impulse activity. That is, they take steps to eliminate the effects of the failure without thinking over their action or analyzing the situation--from their first impression or, at first glance, as they say--and this can have disastrous consequences. Haste in responding to a powerful external stimulus, inability to control oneself and failure to consider other flight factors are usually the result of poor training and an unstable psyche. The ability thoroughly to size up an emergency situation, to grasp the physical process of the failure and to determine specific steps to complete the assignment safely are primarily produced by a good knowledge of the aircraft equipment, automation of the basic skills required for operating the control elements of the aircraft and the engine, by restraint and self-control.

Another type of pilot action is volitional, based on deliberate and intelligent actions in special flight situations. As a rule, a pilot's volitional activity is performed with awareness and contains a certain mental focus.

Sometimes, in a critical and frequently conflicting situation, when there is no time to report to the flight operation officer or to obtain needed instructions from him, or to consult officers manning the command post, a pilot finds himself alone to handle malfunctioning equipment, and the flight's progression and outcome depend totally upon his determined and accurate actions. Deliberateness and accuracy are therefore no less important than speed when there is a severe shortage of time.

The fact that there is ordinarily a shortage of information on what has occurred makes it difficult to determine the nature of a failure in the limited time available. In an attempt to supplement this information, the pilot is forced to generalize and analyze the available information, to intuitively determine the possible side effects and, on this basis, to work out his decision and outline his sequence of action.

In both cases, when an avalanche of various types of information (radio, signal lights, instruuments and so forth) descends upon the pilot, he extracts from it the most important, the crucial. Naturally, the abundance of external stimuli can negatively affect control of the aircraft, the engine and the various systems.

The abundance of information in a complex situation sometimes places the pilot into a position bringing him close to the limits of his psychophysiological capabilities, and this can result in loss of spatial orientation in clouds, have a ruinuous effect upon the situation and, frequently, place the crew into an extremely dangerous situation. Anyone who finds himself in such a situation and has the opportunity to transmit by radio should bear in mind that the first alarm signal transmitted from the aircraft should be followed by radio silence, with only the flight operation officer maintaining stable contact with the individual experiencing the emergency to assist him with recommendations and advice.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

The increased flight speeds deprive the pilot of any extra time. A failure of one unit in the air frequently entails the failure of another, and this demands an immediate decision on the part of the pilot. Within a matter of a few moments he must grasp what has happened and, without disrupting his control over the flight, be capable of monitoring the instruments and switching this or that unit on or off unerringly. An error in such a situation can have drastic consequences.

The pilot's ability to utilize the time is especially important in special situations occurring in adverse weather conditions. While in good weather conditions there is ordinarily extra time for determining what has happened, an inadequately trained pilot flying in the clouds, whose attention is sometimes occupied almost to maximum capacity with monitoring the instruments, cannot react to some types of outside stimuli, being too occupied and incapable of "embracing" new focuses of attention. In such a situation, any stress factor may overload his attention capacity, and then the pilot's entire psyche, thereby destroying the unity of the "man-aircraft" system. This results in a drastic reduction in his psychophysiological capability for reacting promptly to unexpected changes in the functioning of the engine or of the aircraft sytems or in the mission performance conditions. Prior to flying in clouds, it is therefore important carefully to prepare pilots from the psychophysiological standpoint, expanding the range of their capabilities by means of practical training sessions, special exercises, flights in a dual-control trainer, and so forth.

Overcoming difficulties in the air and conquering his own weaknesses give a pilot satisfaction, create a positive frame of mind and expel feelings of apprehension and fear. Experienced commanders and political workers never let positive emotions go unnoticed and make thorough use of them in the indoctrinational work. This helps to develop self-confidence in the airmen, contributes to their sense of personal dignity and contributes to their successful mastery of the flight training components and, consequently, to the development of qualities and skills essential for performing efficiently in special flight situations.

There are cases, however, in which an emergency situation experienced by an individual causes psychological damage from which he takes a long time to recover. As a result, some pilots experience traumatic neuroses, which have a negative effect upon them and cause them to experience psychological tension and to anticipate danger even before takeoff.

Once, pilot K. and his instructor were coming in for a landing after their fourth flight of the day. A strong crosswind carried the dual-control trainer to the edge of the concrete runway. The pilots attempted to correct the situation, but without success. A feeling of helplessness overcame them, and they became flustered for a moment: The extreme stage of stress set in, the stage at which the individual cannot overcome his confusion, loses motive power and becomes passive. The engine had to be switched off immediately and the landing gear retracted in order to prevent a collision with

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other parked aircraft (the dual-control trainer was headed straight for them). This is what the instructions called for and what the emergency situation demanded. The pilots were not able to accomplish this, however. And only good fortune prevented a serious flight accident.

A few days later, pilot K. took off again in a combat trainer. He piloted the plane confidently and efficiently in the zone. As he neared the earth in the landing approach glide, however, he experienced a state of shock--the recent psychological trauma paralyzed his muscles, obscured his mind and deprived him of willpower and the pilot was not able to continue controlling the aircraft. The instructor made the landing.

Successful actions in a special flight situation depend greatly upon the coordinated and precise actions of each crew member. The exchange of prompt and accurate information among them on the operation of the control elements helps to keep the crew members informed and, consequently, increases their confidence in themselves and their actions. A change in the position of most of the toggle switches, valves and levers is ordinarily indicated by a system of lights designed to keep the crew informed. Other equipment in the cockpit, however, does not have signaling devices, and this can produce psychological pressure or even confusion when the crew members are not performing with coordination.

While gaining altitude on one flight, the instructor left the landing gear valve in the retracted position, which prevented pilot B. from lowering the front wheels as he approached for a landing in clouds. The pilot took the failure of the landing gear to drop as a malfunctioning of the hydraulic system and, intent upon switching the valve back and forth, he inadvertently reduced speed and strayed off course. When the instructor told him to maintain the flight mode precisely, he reacted only by moving the engine control lever sharply to increase speed, and continued to descend as he endeavored to eliminate the malfunction. The nearer they came to the airfield, the more frantic became the actions of the crew, which were in a difficult situation because of their uncoordinated actions.

Forgetting that he had placed the valve in the retracted position following takeoff ("I was forced to help the pilot because he was not operating the cockpit equipment fast enough."), the instructor did not check the instrument readings for the hydraulic system or the positions of the levers and valves and did not remind the pilot of the procedure for checking the performance of the units making up the hydraulic system. And the pilot misled the flight operation officer by hastily reporting a nonfunctioning landing gear to ground.

It was only after they had departed on a second circle that the crew of the dual-control trainer figured out what had happened by following instructions from the flight control officer and the duty engineer. A lack of coordination on the part of the instructor and the pilot thus complicated the situation not only onboard the aircraft but throughout the entire flight control and support system.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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The training received by pilots to permit them to function in special flight situations focuses on memorizing the procedure to be followed in a complicated situation, on developing a system of automatic habits and understanding them. A highly effective method of accomplishing this task, among other forms and methods, is that based on the use of algorithms, that is, diagrams (graphs) depicting the pilot's actions in special situations in a definite time and logic sequence. The use of algorithms in the training helps the pilots to form automatic habits, to develop the ability to foresee a possible complication of the air situation and to work out timely preventive measures to ensure flight safety. Their knowledge of the algorithms for their actions is reinforced with special exercises in trainers and in aircraft cockpits.

Combat training performed without indulgences or simplifications, a gradual buildup of the complexity of flight assignments, the development of restraint, boldness and determination in the flight personnel, and a conscious stress upon surmounting all difficulties all contribute to the all-around preparation of man's nervous and emotional capacities for functioning in special flight situations. The more frequently a pilot deals with various simulated elements of special situations, overcomes complicated air situations and received advice and recommendations from veteran airmen, the stronger becomes his will and the greater is his confidence that an emergency situation will be successfully surmounted.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Chapter VI. THE MORAL-PSYCHOLOGICAL CONDITIONING OF FLIGHT PERSONNEL DURING THEIR TRAINING IN THE OPERATION OF NEW EQUIPMENT

1. Retraining to Operate New Equipment--An Important Job

Motivating the Airmen to Master New Equipment

In the contemporary stage of development of the military aviation, units and subunits are constantly receiving new models of combat equipment and weapons, and the personnel are continuously undergoing training in their operation. The process of retraining personnel in the operation of the new equipment has therefore developed from a periodic undertaking into a permanent part of the overall combat training system for aviation personnel. This has necessitated a qualitatively new approach to the problem of mastering the equipment and, in many cases, a basic restructuring of the training and indoctrinational process, the extensive summarization of the advanced experience of units and VUZ's, adoption of the achievements of the military pedagogical and psychological sciences in the retraining process, taking into account the specific conditions of their employment in the aviation, and a quest for more effective forms and methods for studying problems related to the mastery of new equipment.

The development of realistic combat situations constitutes an important factor lending urgency to the need to perfect forms and methods of mastering the aviation equipment. At such a time it will be necessary immediately to bring a large quantity of aviation equipment and a large number of servicing specialists into combat action. The reduced periods of time available for activating personnel and equipment will make it necessary to alter the methods used for retraining personnel and for preparing them morally and psychologically for the rapid and thorough mastery and the combat employment of this equipment in a wartime situation.

Retraining for new aviation equipment consists of a complex organizational-methodological system, which includes an extensive group of measures, forms and methods of training and indoctrinational work. They are determined by the nature of the specific section of the combat training tasks being performed, by the type of aircraft involved, the level of training of the personnel, the quality of the training materials base, the availability of experienced instructors to instruct on the new equipment, the climatic conditions and the handling capacity of the airfield at which the given unit is based, and other factors.

The process of retraining for new aviation equipment is ordinarily broken down into two phases: a theoretical program and the practical retraining. The main tasks of the theoretical retraining are to provide the personnel with a solid knowledge of the design and the aerodynamics of the aircraft involved and of its combat employment and servicing methods, and to familiarize themselves with documents governing the flight work. The main

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

tasks of the practical retraining are to provide the personnel with stable skills in the combat employment and servicing of the aviation equipment.

In order to make it convenient to consider retraining problems, each of these phases can, in turn, be divided into two periods: the theoretical phase--into a preparatory period and a period during which the personnel master the scientific principles of the operation and design of the equipment and the rules for operating it, and the practical phase--a period for conducting the first flights for mastering the piloting techniques and a period of training in the combat employment of the new aircraft. Specific organizational and training tasks are performed in each period.

Work is performed to motivate the personnel to successfully complete the tasks involved in the retraining for the new equipment in all of the phases, and each phase has its own specific features. Commanders, political workers, engineers, party and Komsomol organizations and a broad section of the aktiv take part in this work.

During the preparatory and the theoretical periods of mastering the new equipment, the main effort is focused upon explaining the retraining tasks to the personnel and instilling in them a feeling of great responsibility for the completion of these tasks, and on preparation of the training base and purposive organization of the training and indoctrinational process. During these and subsequent periods, a great deal of attention is devoted to indoctrinating the personnel in a spirit of great vigilance. This matter is discussed at party and Komsomol meetings. Commanders and political workers present reports and conduct talks with the military personnel and their families and explain to them the importance of guarding military and state secrets.

Candidates for retraining are thoroughly instructed. During the process of selecting the trainees and sending them for retraining, party and Komsomol organizers are appointed in the groups, and under their supervision the activists perform various kinds of work to ensure a high level of organization and discipline in the personnel and efficient use of training time, and that there will be comradely mutual assistance among the trainees.

As they mobilize the personnel for exemplary training on the new equipment, commanders, political workers, engineers, party and Komsomol organizations see that good training conditions are created for the airmen. The training base and instructional methods are improved for these purposes, an exchange of experience in the study of new equipment is arranged, and talks, consultations, evening discussions on specific subjects, technical quizzes and other activities are conducted to expand the military-technical perspective of the airmen.

Meetings of party and Komsomol organizations, committees and bureaus discuss issues pertaining to the retraining, to ensuring that communist and Komsomol activists have an avant garde role in the training, to improving the training

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and indoctrinational process and to the placement of the aktiv. Essential steps are taken to see that the main political-indoctrinational work is concentrated in the subunits, that it be flexible, timely and concrete and that it provide the personnel with maximum assistance in the performance of the assigned tasks.

As the pilots begin their training to fly the new type of aircraft, commanders, political workers, party and Komsomol organizations focus their main effort upon ensuring that thorough preparation is made for the first solo flight and that the requirements contained in regulations, manuals and instructions are strictly followed by each airman. This work takes into account the nature of the forthcoming flight day, the pilots' level of training and the specific nature of the scheduled exercises.

During the practical retraining prime importance is attached to the exchange of expertise in the performance of flight assignments and in the operation and servicing of the equipment. (Startovki), operational news sheets, express-reports and stands displaying appeals and excerpts from instructions, radio- and photo-newspapers play a large mobilizational role during this period.

Commanders, political workers, party and Komsomol organizations devote a great deal of attention to the development of socialist competition, and effective means of ensuring successful mastery of the new aviation equipment. They sum up the results of competition in a timely manner and see that competition is given publicity, and do everything necessary to ensure that the commitments accepted are fulfilled well and on time.

Any defect, not to speak of the preconditions for flight accidents, are analyzed in detail and are brought to the attention of all personnel, and essential steps are taken to improve discipline, order and organization.

General Psychological and Pedagogical Peculiarities of the Retraining Process

On the psychological and pedagogical level the process of retraining for new aviation equipment is a complex one. Training and retraining are not identical concepts. What makes retraining different is the fact that it involves the transformation of previous expertise, taking the general and special training level into account, into a qualitatively new pattern of knowledge and skills essential to the operation and servicing and to the combat employment of new equipment. Furthermore, the retraining process involves more than the simple accretion of knowledge and skills: it is a complex process of transforming the old expertise and knowledge previously acquired into a solid basis for the formation of a new system of skills and abilities. In other words, it involves not quantitative but qualitative growth, the end result of which is the development of technical and tactical thought in the airmen and improvement of their professional skills.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

On a psychological plane, retraining is nothing other than a complex process of developing new structures of psychic elements providing for the subtle, differentiated and multifaceted assimilation by the personnel of new conditions involved in the operation of equipment, and also embracing the transformation and adaptation of structures previously formed and their successful application in these new conditions. The process of forming new structures of psychic elements during the retraining takes place in conjunction with the development of other psychic processes, taking personal characteristics into account. The development and manifestation of such psychic processes as perception, concentration, memory, conception, imagination and thought in the retraining process have a number of distinguishing features.

On the physiological plane, the formation of new structures of psychic elements is based upon a complex process of development in the cerebral cortex of specific conditioned-reflex patterns and systems of dynamic stereotypes to meet the new operational conditions, by means of a certain transformation and of interaction with patterns and dynamic stereotypes previously established.

Since the retraining process involves more complicated aviation equipment, both the newly-formed patterns and their interconnections are on a new and higher stage of development. The former conditioned-reflex patterns and established dynamic stereotypes, throughout this entire system of complex stereotype elements, do not simply "sprout" quantitatively new links, "connecting up" with the enew elements, but are themselves transformed and actively interact with the new patterns, comprising an integral and active link in the chain of the new elements formed. This is the approach to the revelation of the physiological mechanisms involved in the transformation and application of former expertise which makes it possible correctly to explain and take into account the manifestation of psychological mechanisms involved in the positive or negative carryover of habits and to make more efficient use of the forms and methods of psychological conditioning in the process of mastering the new equipment.

It is important to note the fact that in the retraining process previous knowledge, skills and experience (and on the physiological plane, previous conditioned-reflex patterns and dynamic stereotypes) do not have simply a passive effect upon the development of new structures of psychic elements (new patterns and dynamic stereotypes) but are a major factor raising the physiological activity of the trainees during the course of their retraining for new equipment. The mastery of new equipment is accompanied by a continuous process of comparison of everything learned with previously acquired experience and knowledge, and there is continuous adjustment of the specialist's work based on that comparison.

Consideration of the inhibitory and interference effects of previous know-how is a characteristic of its use in the formation of new skills during the retraining process. Under certain conditions this know-how may inhibit progress in combat improvement and serve as the physiological basis for a negative carryover of habits into the new situation.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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Experience has shown that it becomes more difficult to detect and prevent the negative carryover of habits as the aviation equipment becomes more complex. This is due to the fact that in the past, when less complex equipment was being learned there was a comparatively small number of simple reactions corresponding to the simple stimuli, whereas the new equipment of today involves a larger number of combined and correlated effects of stimuli responded to with a more extensive correlation of reactions as they occur.

Not only is there a change in the degree of influence of previous know-how as a factor of physiological activity, but the flow of psychomotor processes itself is altered. The nature and the degree of the change occurring in the individual psychomotor processes during retraining are determined by the quantity and complexity of changes occurring in the sensory and motor areas and by the level of previously formed habits and abilities. These changes are especially typical of the complex sensomotor reactions and the realization of sensomotor coordination in flight personnel at the beginning of their training on the new equipment. They are reflected in quantitative and qualitative shifts in the main parameters of the processes indicated.

To be specific, there may be an increase in the duration of the central and motor elements of complex reactions in complex sensomotor reactions. This is due to the fact that when a pilot is retraining, especially during the first flights, he has to process a large quantity of new information not previously encountered. The time required to recognize, evaluate and select incoming signals therefore increases in the perception process. In addition, there is ordinarily a process of subconscious comparison of what is perceived with former experience with an aircraft previously operated, as a result of which there is an inevitable increase in the duration of the central element in most complex reations.

The increased duration of the motor element of reactions in retraining is brought about by the increase in the amount of time determining the beginning of motion, due to the pilot's extra, cognitive verification of the correctness of his selection and determination of control objects (buttons, toggle switches, levers, instruments, and so forth) on the new aircraft. The extent of temporary changes in the motor element of complex reactions in this case depends on how greatly the equipment arrangement in the cockpit of the new aircraft differs from that of the aircraft previously flown, upon the quality of the preliminary preparation performed during the retraining period, the level of the pilot's overall training and his individual psychic peculiarities.

The influence of the factors listed above, which produce temporary changes in the main parameters of complex sensomotor reactions during retraining, are especially vividly manifested in the process of sensomotor coordination when piloting the new aircraft on the first flights, since both perception and motion are continuously occurring, and the motion is regulated by the perception of its effects. Errors and shifts related both to perception

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and motor processes are possible in this case, ordinarily reflected in an increase in the time of reaction to a starter signal (a command from ground, instrument readings, and so forth), general reaction time and reaction accuracy. It is very important to consider the above psychological peculiarities involved in the formation and manifestation of new skills, but most importantly, to foresee them in the retraining process.

In preparing the personnel for their first flights on new aircraft, it is important to see that all operations and actions involving the cockpit equipment have been thoroughly worked out and to actively monitor the actions of each pilot prior to flights. Hero of the Soviet Union M. A. Gallay, test pilot, has made some valuable statements pertaining to this. In an analysis of preparations for the first flights in a new aircraft, he notes "that it was not enough (for the pilot) to know what this or that instrument indicated or what effect was produced by moving a certain lever. He had to learn to use them automatically. A pilot should control an aircraft the way an individual uses his arm, as an example, without thinking about what muscles should be tensed or relaxed and in what sequence.

"It is an interesting fact that on any flight, if a pilot does not have a special assignment to register the readings of any of the instruments, he remembers only those which he considers to be abnormal. Everything else (and do not forget that he has dozens of instruments in front of him) merges in his mind into a general, summarizing sensation--normal. This is due to the fact that the pilot's attention seems to slide over the instrument panel with efficient semiautomation, filtering everything he sees and passing on to his consciousness only that which requires certain steps, or cognitive activity.

"Without this valuable automation, not a single pilot would be able freely to handle the complex works inside the cockpits of modern aircraft, not to speak of the other work for which he is responsible. He would certainly have no attention to devote to it.

"The fact that a pilot can correctly describe the function and the location of any instrument or lever--the landing gear retraction valve, for example--does not mean that he has learned all he needs to know about his work position. When the order 'Retract landing gear!' is given, however, and his hand moves to the proper valve on its own, before the idea has formed in the pilot's mind, only then can it be considered that he has mastered the cockpit."[13]

A general analysis of the retraining process shows that on the psychological and pedagogical plane it has its own qualitative and quantitative definition. Cognitive and indoctrinational tasks and tasks involved in the psychological conditioning of personnel for the new conditions are performed during the course of the training, each of which has specific objectives. The general training task, for example, covers the study, based on knowledge previously

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acquired, of the design and the functioning of the new aircraft, its engine and all the equipment, followed by the formation of new skills and abilities in the operation, control and servicing of the equipment in the altered circumstances of its combat employment by transforming and adapting previous know-how. The development of techniques, methods, ways and forms for efficiently utilizing and transforming experience and knowledge previously acquired is therefore the most important element in the development of a new system of retraining methods.

At the same time, it is important in the retraining process not simply to study and master a given type of aircraft, thereby raising the pilot's level of personal development, but to develop special methodological techniques and forms and to make special plans and select training material which will develop his skills in summarizing and abstracting, his ability to apply his knowledge and habits for performing despite any changes in his work conditions and teach the personnel methods of working on their own and the sequence for studying the new equipment and the rules for operating it, that is, successfully accomplish the task of preparing them for subsequent retraining within a shorter period of time and on a higher level.

The indoctrinational and phsychological conditioning tasks have the objective of developing in the personnel good morale and aggressive qualities, a love for and confidence in the new equipment, a readiness to make full use of its combat capabilities and the desire to thoroughly master its servicing and combat employment, and to develop in the airmen the psychological stability and self-control for overcoming negative psychic conditions which may arise in the process of learning the new equipment.

2. In the Course of the Theoretical Training

The Increased Role of Theoretical Training

In the recent past, as we know, the theoretical training of personnel had a subordinate role in the mastery of new types of aircraft. It was not a determining element in the development of skills and abilities for operating and servicing the aircraft involved, but was basically designed to improve the study of its design and, to some degree, the functional peculiarities of the individual systems. Today, however, a knowledge of the scientific principles underlying the arrangement and the functioning of the equipment is essential not only in order to study its design but also in order to utilize and service it correctly and competently on the ground and in the air.

As a result of this, the dependency of maximum employment of the combat capabilities of new aviation equipment upon a knowledge of the scientific principles underlying its arrangement and operation has become a specific law. Experience has shown that all skills and abilities acquired today have an intellectual orientation. That is, most of the actions and operations

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

performed during the operation and servicing of an aircraft require thorough theoretical insight. If this is not taken into account on the practical level, then deficiencies or even failures will inevitably occur in the combat employment and the servicing of equipment.

A special study, for example, has shown that more than half of the preconditions for flight accidents, failures of aircraft equipment and errors committed by the personnel, which are listed under incompetent performance, are not due to a superficial knowledge of the design of the assemblies and instruments but to improper actions resulting from insufficient knowledge of the physical nature of the processes occurring in the functioning of the equipment or to an incomplete understanding of the consequences of this or that action.

One of the reasons for this situation is the erroneous view of some pilots and even some flight instructors, who assume that the development of skills and abilities is mainly a mechanical (motor) process, that theoretical knowledge has a small role in the development of these skills. This sometimes has a negative effect upon the pilots, especially the young ones. Some of them demonstrate disregard for theoretical knowledge and a lack of desire thoroughly to understand the complex aerodynamic aspects of an aircraft, the thermodynamics of the engine, ballistics, and so forth, and a desire simply to enter the cockpit and begin flying as soon as possible.

This underestimation of the role of knowledge in the development of skills and abilities even results in errors in the organization of retraining. Such errors are manifested in the fact that the practical and theoretical courses are separated in the retraining programs and are covered independently of each other.

In some cases, for example, only two or three visits to the airfield are scheduled to familiarize the trainees with the new equipment during the entire period covered by the theoretical retraining programs. This leads to separation of the theoretical training from the performance of the practical tasks involved in developing flight skills and abilities, creates an unnecessary psychological barrier in the minds of the flight personnel and gives them the psychological illusion that theoretical knowledge has nothing to do with the development of flight proficiency.

Furthermore, a negative psychological premise complicates assimilation of the theoretical knowledge itself, since the knowledge acquired is of a contemplative nature, so to speak, if the theoretical portion of the retraining program does not have a practical orientation, and this complicates its practical application.

The gap separating the theoretical and the practical training complicates the retraining process as a whole and makes their mergence a special problem for the future. Observation of a group of pilots undergoing

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

retraining in one unit during the first 5 or 6 days of their practical work at the airfield following theoretical retraining, for example, showed that during preparation for their first flights the majority of them were forced to return to some extent and with a different approach to the theoretical material already covered. As a result, it became necessary to conduct additional classes on many of the subjects during the preliminary preparation. And to expend considerable effort upon the psychological readjustment of the flight personnel.

The gap between the theoretical and the practical retraining courses sometimes creates the preconditions for flight accidents. After a group had separated for the landing during flights in unit "X," for example, one of the pilots abruptly approached the aircraft flying ahead of him and failed to keep an eye on the speed and altitude of his own fighter after the fourth turn, because he was concentrating on the aircraft ahead. His speed of advance dropped as a result and his vertical speed increased, and the aircraft fell considerably below the normal glide path. In an attempt to correct the situation, the pilot first increased engine thrust and then reduced vertical speed but did not achieve the desired effect. The landing almost had serious consequences.

An analysis of the causes of this precondition for a flight accident revealed that all of the landing phases had been discussed in detail with the flight personnel the day before the flights: movement on the flight path, leveling-out, holding, the landing run and action to be taken in each phase. The pilot demonstrated a good knowledge of all these questions. When he noticed that his aircraft was descending on the flight, however, he acted without considering the effect of the surrounding temperature upon the landing. This was a result of the fact that the pilot's knowledge was only superficially related to the practical requirements for this specific landing.

This example clearly reveals another psychological aspect of the matter: The theoretical knowledge acquired by the pilot in the retraining process must have a certain degree of strength and emotional stability and must manifest itself under any flight conditions, even the most difficult. In this case, they lacked psychological stability, which resulted in imprecise action.

The theoretical training now has an increasingly polytechnic orientation as a result of the highly technical equipment of the modern aviation, the increased complexity of the design of modern aircraft and of the rules for operating them, and the increased requirements made of the training of the personnel. That is, the number of disciplines studied is growing, it is becoming necessary to coordinate their interaction and conditionality with a number of other sciences, the content of the subjects studied is becoming more complicated, and so forth.

The objective premise for the polytechnic orientation of the retraining process lies in the fact that the same basic patterns revealed by aerodynamics, thermodynamics, physics and other sciences comprise the scientific basis for

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

the structural arrangement of various types of aircraft and engines, as well as for the methods applied in their combat employment and servicing. The laws of these sciences comprise the psychological basis for providing the training with a polytechnic orientation, primarily those laws pertaining to the carry-over of previous knowledge and skills into the new situation.

Implementation of the requirements made by the polytechnic orientation of retraining on the psychological level consists in creating conditions which contribute to the successful carry over of previous knowledge and skills into the new situation, that is, creating methods of organizing and conducting the theoretical retraining, which make it possible to find the correct point of contact between the old and the new knowledge, skills and abilities and which ensure that the carry-over is a positive one. This accounts for the increased importance of methodological techniques which contribute to the intelligent application of previous know-how as an essential condition for the achievement of results in the retraining process.

In order to operate an aircraft successfully the personnel must also acquire new knowledge, and highly diverse knowledge at that. Consequently, it is essential strictly to coordinate the extent and the nature of this knowledge, to perfect the structure and the content of retraining programs, the training base and the forms and methods used in the training and indoctrination.

An important requirement put forth by the polytechnic orientation of the theoretical retraining is based upon the need to study first the general principles underlying the design and functioning of the aircraft systems and assemblies, and then the peculiarities of the equipment involved, taking into account experience in the operation and servicing of the type of aircraft previously operated. This method is effective because it is easier for the trainees to grasp specific and concrete questions pertaining to the specific model of equipment after they have mastered the general laws and principles of this or that phenomenon.

The polytechnic orientation of the theoretical retraining helps to develop in the personnel creative initiative, the ability to think on their own and the ability correctly to estimate the place of the aircraft involved within the long-range development of the military aviation as a whole and to draw the proper practical conclusions for themselves. This is especially important during the preparatory period, when, in anticipation of the start of retraining, lectures and reports of a general nature are presented in the units as part of the system of commander and technical training, and the personnel involved in the retraining have not yet seen the new aircraft and do not have a concrete concept of it.

The polytechnic orientation of the theoretical retraining makes it possible to establish not only specific links and connections between the various branches of science studied but also the quantitative and qualitative characteristics of those links and their mutual conditionality. This means that it is important for the training and indoctrinational work to take into

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

account the specific nature of the work performed by various categories of personnel and their training level. Therein lies the need for strict differentiation of the trainees when making up the groups, planning the training process and selecting the forms, means and methods of presenting the training material.

The polytechnic orientation of the training process is of practical importance only when the theoretical material presented comprises not a disconnected assemblage of premises and conclusions drawn from various sciences, but an integrated and complete system or cycle based on the training level of the specialists. The purpose is best served by planning the cycles of study for each category of personnel separately.

The realization of requirements set by the polytechnic orientation of retraining achieves its goal only when, in the course of the training, the airmen develop a psychological preparedness to apply the knowledge acquired under various flight conditions. This kind of readiness requires that the personnel develop a positive attitude toward the new equipment and confidence in its good combat qualities and reliability, and emotional and volitional stability for overcoming difficulties.

Pedagogics and Psychology Must Be Closely Linked

Diverse training and indoctrinational work is performed in the theoretical retraining process. Its effectiveness depends to a great degree upon how fully it meets the requirements set by military pedagogics and psychology and upon the degree to which the forms and methods recommended by them are organically combined in the training and indoctrination of the personnel. Let us consider these questions from the standpoint of the specific periods of theoretical retraining.

During the preparatory period, when the unit has still not received the new equipment and the personnel only have a general concept of it, lectures and reports are scheduled for the airmen as part of the commander and technical training system, at flight methods assemblies and at universities for the improvement of technical standards. They discuss the basic laws of aerodynamics and thermodynamics, the general principles underlying the functioning of the aircraft systems and the engine and the nature of their functional processes, the fundamentals of combat employment of the equipment and other more general aspects of the operation and servicing of the aircraft involved. This makes it important for the personnel to form an integrated concept of the new aircraft and of its aeronautical, tactical and operational characteristics, which, from the psychological standpoint, helps the airmen to develop a positive frame of mind and the proper attitude toward the study of the new equipment and the mastery of its combat capabilities.

The lectures and reports delivered during the main period of theoretical retraining have a concrete focus. They devote a great deal of attention to explanation of the arrangement and functioning of the aircraft systems and

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

mechanisms and of the engine, and to the presentation of practical conclusions and generalizations on the operation, servicing and combat employment of the given type of aircraft. Extensive use is made of visual aids: posters, diagrams, assemblies and mechanisms.

When they explain the design and the functioning of the aircraft systems or the engine, veteran instructors direct the attention of the trainees to the general, basic similarity between the given system and that previously studied, and then to its perculiarities and their importance in the operation of the new aircraft. This method of presenting the material helps to heighten the thinking process of the trainees and promotes more rapid and intelligent carry-over of expertise previously acquired into the new situation.

In this case, the previous know-how becomes the external and internal frame of reference for the successful and thorough mastery of the new knowledge, skills and abilities. From the psychological standpoint the employment of previous know-how in the retraining process helps to create a positive frame of mind in the personnel and confidence that the new aircraft will be successfully mastered, and develops their technical and creative mental process. If, on the other hand, the previous experience is not utilized and the trainees concentrate only on the new material, they develop the opinion that it is overly voluminous and complicated and as a result, lose confidence in the fact that they can assimilate the new knowledge within the set period.

As they present the training material the veteran instructors make skillful use of possible elements of negative carry-over of previous knowledge and skills. The most effective method of accomplishing this is the so-called inverse-proof method, whereby the explanation is begun by describing possible errors or instances of negative carry-over of previous know-how. In classes on practical aerodynamics, for example, when the instructor explains the aerodynamic peculiarities of behavior of the MiG-21 on the landing run, he calls the attention of the trainees to the possibility of a rise in longitudinal wobble. He stresses the fact that when they flew the MiG-17 many of the pilots, in an attempt to eliminate this undesirable condition, would begin braking impulsively, that is, they would press and release the brake lever repeatedly, which produced certain results. On the MiG-21, however, this action has the opposite effect, intensifying aircraft wobble, and can produce undesirable consequences. It is therefore better to brake this type of aircraft with a gradual, single braking action.

The inverse proof method is extremely effective in the psychological-pedagogical respect. Its skillful employment helps to prevent the negative carry-over of previous knowledge and skills into the new situation, increases the practical impact of recommendations as to the proper kinds of action, creates a positive psychological premise for giving the personnel confidence that they can master the new equipment, stimulates the concentration and cognitive activity of the trainees and heightens their interest in the material studied.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

The theoretical retraining in some units and subunits contains shortcomings resulting from underestimation of the psychological factors determining the most practical system for organizing the cognitive activity of the trainees. This deficiency essentially arises from the fact that the retraining programs and the specific methods employed in the theoretical disciplines devote an unjustifiable amount of attention to the inductive method of presenting and assimilating the training material. In other words, despite the fact that most of the personnel have a general understanding of the issues covered and have considerable experience in operating and servicing various types of aircraft, the training process proceeds from the specific to the general, which is not rational and which takes a great deal of time.

Furthermore, the same phenomena are interpreted in a contradictory manner or are duplicated in the study of related disciplines, which waste training time. Along with this, the disconnected facts and phenomena presented do not reflect the full picture of the aircraft's behavior in the individual flight modes or of the actions required to operate the equipment. As a result, the trainees acquire separate facts, bits of information and concepts but are not able to link them together and comprehend them for purposes of practical employment.

An analysis of answers given on exams in one of the units undergoing retraining and errors committed in the control and operation of the new aircraft on the first flights, for example, showed that some of the pilots had a clear understanding of the characteristics of the new aircraft and know what might occur if certain parameters were altered, but when several parameters were altered and it became necessary to derive generalized conclusions and to react in a comprehensive manner to the changes, they were lost and committed errors.

Experience has shown that the mastery of general tenets, basic concepts and principles by the personnel ensures a good mastery of a large number of interrelated phenomena and contributes to the intelligent carry over of techniques and methods into the training on the new aircraft. At the same time, the assmiliation of separate facts and data and the specific peculiarities of the equipment, closely linked with basic principles, concepts and general laws, and based upon previous expertise, heightens the cognitive activity of the personnel, since it opens up broad possibilities for independent analysis, for summarization of the materials studied and for the performance of specific tasks involved in the operation and servicing of the new type of aircraft. Consequently, the job demands that in the presentation of the new training material the attention of the trainees be focused on the basic key problems and that the presentation of the other training subjects for that section of the course center around them.

Oral presentation of the training material in the theoretical retraining process is ordinarily closely combined with a demonstration of models of combat equipment and with diagrams, drawings, tables and training films, and sometimes with a demonstration of techniques in the aircraft itself and with training equipment.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

The demonstration method has been expanded today, and its role and importance have grown greatly. This is due to the fact that in order to master new equipment the personnel must possess a knowledge of the physical and the technological nature of the complex processes occurring in the functioning of the equipment and thorough understanding of the principles underlying the structural arrangement, the functioning and interaction of the aircraft's complex assemblies and mechanisms and its engine in various flight modes. And this cannot be accomplished without using various types of training aids.

The situation today differs from that of the past in that the drawings, posters, graphs and diagrams are more than simple visual aids: they are the actual objects of study. They make it possible visually to follow the physical phenomena clarifying the operating principles of the units, assemblies and systems, to break down this or that process and demonstrate its separate phases, and to trace the interdependencies in the functioning of the aircraft's individual mechanisms and its engine.

This is why experienced instructor-methodologists use a large number of drawings, graphs, diagrams and posters for teaching theoretical topics. And this is justified from the psychological standpoint, because an extremely effective memory reserve--visual memory--is involved in the training process. Studies have shown that its capabilities greatly exceed those of the motor and audial memories. Furthermore, a skillful combination of explanation and demonstration with visual aids makes the classes lively and interesting.

Various types of diagrams have come into extensive use in the theoretical retraining process. General and component layouts and block diagrams, and sometimes simple layouts of the separate systems and mechanisms, for example, are used during the preparatory period, when the unit has not yet received the new equipment and general lectures are being presented for the personnel. They help to stimulate the cognitive activity of the personnel and help provide them with a thorough understanding of the nature of the physical processes and the principles underlying the arrangement and functioning of the new aviation equipment, and help the students form a graphic concept of the prospects for the development of new equipment, thereby exerting an active influence upon the development of their technical thinking.

During the theoretical retraining it becomes necessary thoroughly to master the dynamic processes occurring in the functioning of the separate systems, the specific nature of the interaction occurring among the mechanisms and assemblies, and the kinematics of automatic and remote control. It is also frequently necessary to clarify the physical essence of this or that phenomenon or process, which it is difficult or impossible to explain and demonstrate on the equipment or by means of layouts. Combination functional, electrified diagrams, trainer diagrams, unit diagrams and so forth are used in those cases. The movement of liquid during the functioning of one system or another or the order in which the various mechanisms are activated can be demonstrated by means of electric lights installed on them, which light up in sequence. Some layouts have the controls for a system installed upon

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

a cockpit mock-up with an instrument board, which makes it possible to relate the study of the system's design and functioning with man's work under realistic operating and servicing conditions for the aircraft involved.

Experience has shown that in order for the theoretical retraining to be effective the diagrams must be properly employed, taking into account the psychological peculiarities of the organization of the cognitive activity of the trainees.

Something can be learned in this respect from the work of Officer V. Solov'yev, an instructor. When he prepares for classes, he selects the diagrams ahead of time and plans how they are to be used. As he explains the arrangement and functional principles of an aircraft system, which has a great deal in common with the analogous system in an aircraft previously flown, the officer shows diagrams of the systems of both the former and the new aircraft and points out their differences for the students. This method helps make active use of the students' experience, reduce the time required to study a given system and creates in the trainees a positive frame of mind for mastering the material presented.

As he shows and explains complex functional and combination diagrams, the instructor advises the students as to which elements and cycles in the functioning of a system should be given special attention. He frequently poses problematic or attention-focusing questions and recalls analogous moments in the occurrence of individual processes in the functioning of systems previously studied. When a diagram has complicated parts, he explains the physical nature of the phenomena and makes drawings on the board, and sometimes asks the students what might occur in case of a malfunction or a breakdown of some certain assembly in the system studied.

When, during the explanation of questions pertaining to the overall diagram, it becomes necessary to go into greater detail about the design and functioning of certain assemblies or mechanisms, using other diagrams, Officer Solov'yev always stresses the role, the purpose and place of the assembly or mechanism within the overall scheme of the given system. This method gives the students an integrated concept of the system studied, and the explanation of the design of individual assemblies and units fits logically into the overall sequence of study of the system as a whole.

Training films, the results of flight observations and demonstrations of techniques for operating the cockpit equipment by experienced pilots are extensively used in many units and subunits for organizing the study of the theoretical disciplines.

Observations of flights, for example, are of great practical importance. They are set up in the following manner. The instructor prepares a special assignment plan for the students in advance, which indicates what phases and elements of the takeoff, landing and flight they should observe, what

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

specific features in the aircraft control should receive their special attention and what they should review and study prior to leaving for the airfield.

During the flight observations, the instructor asks the trainees what errors and deviations they have noticed in the performance of the pilots and how they should be eliminated, what the instrument readings should be during one flight phase or another, and so forth. Hypothetical special flight situations requiring a concrete decision are also posed for the trainees.

Various visual aids are used during the flight observations: aircraft mock-ups, charts for making landing computations according to the aircraft's flying weight and weather conditions, diagrams of the glide path, charts showing the aerodynamic forces in effect during takeoff and landing, and characteristic maneuvers (in a bank, on a turn, and so forth), as well as a mock-up or diagram of the aircraft cockpit, by means of which the trainees verbally duplicate the actions of the pilot of the aircraft being observed.

At the end of the flight day the trainees attend a critique of the flights, during which the results of their observations are compared with the opinions of the commanders and the pilots performing the missions.

Experience has shown that the well-conceived employment of flight observations helps to combine theoretical knowledge with practical flight requirements and to improve the quality of psychological conditioning of the personnel for upcoming flights on the new equipment, that is, their psychological adaptation.

In conclusion, we should point out that serious consideration of the peculiarities of theoretical training makes it possible to use the training time more efficiently and to help the personnel thoroughly master the new aviation equipment and the rules for its combat employment, operation and servicing.

3. In the Practical Retraining Process

The New Equipment Is Necessitating Adjustments

The final phase of retraining for new equipment consists of the flight program. It involves the practical application of the knowledge acquired during the theoretical training and the development on this basis of skills and abilities for operating and servicing the aircraft.

Practical retraining is an important and responsible period for every airman. In the course of practical training, a qualitatively new foundation is laid for the further development of skills and abilities, the moral-combat and psychological qualities of the personnel are actively improved, and they form a definite attitude toward the new equipment, acquire experience and build up confidence in themselves and in their ability to master a new and higher stage of combat proficiency.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

While in the past, in the course of practical retraining, flight and technical personnel mastered the operation and servicing of aircraft which differed little in design, operation and combat employment, and flight skills and the technical servicing of the aircraft were basically simply improved when a transition was made from one aircraft to another, now, when the aviation has been reoutfitted with supersonic aircraft carrying powerful nuclear missiles, it has become necessary, along with the transfer of previous know-how, to develop basically new skills and abilities or to thoroughly re-form or destroy skills previously developed.

This specific aspect of modern practical retraining is due to the peculiarities inherent in the development of skills and abilities, peculiarities related, in the first place, to structural engineering improvements made in the new aviation equipment and, in the second place, to the aerodynamic characteristics of modern supersonic aircraft. We shall discuss these peculiarities in detail.

The personnel today are mainly dealing with complex automatic or semiautomatic systems, which alters the nature of their work considerably: they function primarily as operators. This has resulted in a reduced role for muscular activity and an increase in the load borne by the higher divisions of the central nervous system and the sensory organs. While the objective of retraining in the past was that of developing new motor skills out of the pilot's old ones, the task of forming mental and sensory skills and complex skills for performing the various tasks involved in the operation and combat employment of new aircraft has now moved to the fore.

The substantial differences distinguishing the control of modern aircraft from that of the older ones have made it necessary primarily to develop skills in instrument flying, even for uncomplicated flights. While in the past a number of flight parameters and the aircraft's position were mainly determined by the gyro-compass and from ground reference points, as flight altitudes and speeds increased and as more advanced piloting and navigational instruments came into being, instruments came to be used more and more extensively for orientation purposes. Today, a pilot can obtain correct information on the aircraft's position only from instruments. As a result, it has become very important to instill in the flight personnel confidence in the veracity of instrument information, even when it conflicts with their own feelings.

Modern aviation equipment also embodies considerable changes in aerodynamic characteristics, which have a considerable effect upon the process of flight skills development. This is primarily due to the specific nature of the supersonic flow of the aerodynamic shapes of modern aircraft, which reflects the essence of all the aerodynamic effects during a flight.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

The separate changes frequently require not only a dynamic restructuring of flight skills, but a thoroughly conceived psychological preparedness for perceiving these changes as well. Modern turbojet engines, for example, and their air intake devices have a complicated automatic control system. Activation of the automatic system at certain engine speeds produces characteristic noises. In the retraining process, especially during the first solo flights, these noises evoke caution in the pilots and distract their attention. It is therefore beneficial to permit the pilots to become accustomed to the noises on the ground, prior to the first flight, and to direct attention to them on subsequent flights. Failure to do so may complicate flight conditions.

Once, while flying at night in good weather, pilot K. heard a loud knock in the engine compartment while executing a turn at a 60 degree bank. He reduced rpm and, after seeing them drop, reported to ground that the engine had failed. At the specific altitude, at a command from the flight operation officer, the pilot restarted the engine and immediately discovered that the front landing gear strut was in the lowered position.

An analysis of the pilot's actions and a special check flight in the aircraft confirmed that the pilot had taken the spontaneous dropping of the forward strut on the turn and the sound it made as it locked in place as a disturbance in the engine. The pilot took the sharp drop in rpm, for which he himself was responsible, as engine failure.

Sometimes, immediately after liftoff in a supersonic aircraft, there will be distorted readings on certain piloting instruments (the gyrocompass, the altimeter and the rate-of-climb indicator), which complicates piloting, especially at night and in adverse weather conditions, and creates additional psychological tension in the pilot. With this in mind, veteran flight instructors develop additional methods to be used in the retraining for monitoring the aircraft's position and direct the pilot's attention immediately prior to takeoff to the importance of operating with precision. For this purpose they place the aircraft in the takeoff or landing position and show the pilot how to select the best scanning sector and the best sequence of surveillance, explain possible errors in visual observation according to the height of the pilot's seat, direct his attention to characteristic lines of sight along the aircraft hood or other parts of the cockpit relative to the horizon, and so forth.

Vigorous and extensive movements of the control lever can produce a longitudinal wobble in modern supersonic aircraft during takeoff and during the second half of the takeoff run, when the nose wheel is off the ground. This makes it difficult to maintain a constant takeoff angle during the second half of the takeoff run. It is therefore necessary in the retraining carefully to develop skill in maintaining the aircraft's longitudinal balance in the takeoff position, according to the speed of the aircraft, its flying weight and temperature conditions.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

On the psychological plane it is important specially to prepare flight personnel to detect and accept calmly these and many other characteristic piloting peculiarities of the new types of aircraft. This helps considerably to relieve psychological pressure and emotional overstress, especially on the first solo flights.

Experience in the retraining of outstanding units and subunits has shown that when the peculiarities of the new equipment are thoroughly considered, the process of mastering it proceeds successfully, fewer errors are committed on the first flights and the flight personnel develop more rapidly the necessary skills and abilities and confidence in the reliability of the new equipment.

Take the Individual's Psychological Peculiarities Into Account

An important element of the overall system of practical retraining for new equipment is the preparation of flight personnel for the first solo flight. It consists of general ground preparation for flights on the new type of aircraft and immediate preparations for the first solo flight.

The general ground preparation is ordinarily begun by acquainting the commander (or the flight instructor) with the pilots assigned to him. He carefully studies each of the pilots, the positive and negative aspects of his flight training and his personal psychological qualities in order to ensure successful fulfillment of the retraining program.

The experience of Officer B. Voronkov is instructive in this respect. As he studies the pilots whom he will be retraining on the new equipment, he gradually records information on them in a special notebook. He gives special attention to the following questions: total flight time, number of hours flown during the past year, class rating, reports of the flight-surgeon's commission, types of aircraft flown, certifications for flight work, disruptions in flight work, checks on piloting techniques, training in ejection on the ground, flight training courses, instances of psychological breakdowns, data on any forced landings he has made, and so forth. This information is later checked in personal talks with the pilots and while observing them in the training process.

In the talks with the trainees Officer Voronkov inquires about each pilot's instrument training and his attitude toward the retraining on a new type of aircraft, and clarifies any questions he might have. If it becomes necessary, he requests assistance from those who have taught the pilot and flown with him in the past.

All of this helps the officer to plan and conduct the pilot's preparation for the first solo flight, correctly and with a good pedagogical and psychological foundation, and to perfect his skills during the flights, taking his individual characteristics into account.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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As an example, let us describe the methods used by Officer Voronkov to train young pilot K. and veteran pilot P. The following data was collected on pilot K.: third-class rating, previously flown three types of aircraft, medium total number of flying hours (note: poor in instrument training); no restrictions for reasons of health, but suffered injury to right elbow joint prior to retraining as a result of which he was grounded for 35 days; total of 2 hours 40 minutes of flying following checkout flights, after which he did not fly for 32 days while undergoing theoretical retraining (note: check number of practical instrument training sessions); two preconditions for a flight accident--overshoot during a landing, and once rolled off the end of the runway (note: determined causes of preconditions); landing most difficult element of piloting techniques (note: devotes special attention to development of landing skills).

The following notations were made following the first talk with the pilot: good-natured, excessively talkative, demonstrates some carelessness (note: step up control over classes and practical training sessions); expressed apprehension about training sessions to develop skills in breathing under excessive pressure: since childhood, afraid to sleep with his head covered up; almost drowned at the age of 8 years.

After considering the personal characteristics of pilot K., Officer Voronkov compiled the following recommendations:
1. Conduct his drills in breathing under excessive pressure last to make it possible for the pilot to observe the training of his comrades. Begin the sessions at the minimum acceptable excessive pressure, after personally demonstrating how to breathe properly under excessive pressure;
2. Pay special attention to the development of actions to be taken in special situations involving depressurization of cockpit in the air;
3. Conduct exchange of experience in given type of training within the group;
4. Speak with doctor about working out special psychological training measures for pilot and step up control during his training sessions and during the performance of his first flights;
5. Assign an experienced pilot from the group to pilot K. for the entire practical retraining period.

All of this helped the young pilot to correct the deficiencies and to retrain successfully for the new type of aircraft.

Officer Voronkov made the following notes after getting to know pilot R.: squadron commander, first-class rating, flown seven types of aircraft, extensive total flying time; flies under all conditions, flight instructor, no limitations for reasons of health, twice involved in emergency situations, no residual traumatic effects observed.

The overall picture was good: This was an experienced and determined pilot. During the talk with the pilot, however, it was revealed that Officer R. felt that those in charge of the retraining placed too much emphasis on theoretical matters and that more attention should be devoted to the practical

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

flight training. This attitude alerted the instructor, and he decided to check the pilot's knowledge of the theoretical principles underlying practical aerodynamics and to assign him to classes in the group studying "Aerodynamic Peculiarities of Takeoffs and Landings with Aircraft Involved in Retraining" and "Peculiarities of Aircraft Stability and Controllability on Takeoff Run and at Flight Ceiling."

In addition, the instructor noticed in his talk with the pilot what he considered to be overconfidence. As a result of this, he tactfully told the pilot about several preconditions for flight accidents resulting from poor knowledge of theoretical matters and from certain developments occurring in flight. At the same time, the instructor stressed the fact that in the interest of achieving the very best results in the retraining the same high demands were made of all pilots, regardless of their rank or position.

The instructor informed the commander of his doubts about the theoretical preparedness of Pilot R. The commander spoke with the pilot and revealed a number of gaps in his knowledge of aircraft aerodynamics and the operation of the engine and aircraft equipment. The pilot admitted that he had devoted little attention in recent years to improving his theoretical level and that he had not understood everything in the theoretical retraining but, as senior member of the group, had been embarrassed to ask questions. Pilot R. received the assistance he needed, made up his theoretical training deficiency and successfully completed the practical retraining.

The pilot's study of piloting technique instructions and other documents governing flight work on the given type of aircraft constitutes an inseparable part of the overall solo flight preparation. It is closely tied in with other training activities of the practical retraining phase.

Learning the Aircraft Cockpit

As we have already pointed out, the cockpit of a modern aircraft contains a complex system of instruments, equipment for controlling flight mode, control levers, communication equipment, and so forth. Flight safety and the successful perfection of flight skills as a whole depend upon how thoroughly the flight personnel master this system.

Experience has shown that the effective development of skills in operating the cockpit equipment depends primarily upon the employment of sound training methods and upon a knowledge of and consideration for a number of important psychological factors.

Let us describe an example taken from retraining experience in order to present a graphic concept of the psychological peculiarities linked to learning the cockpit.

The squadron commander in one of the subunits undergoing retraining checked out young pilot U. for solo flight certification. The checkout flight was

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

far from comforting: The pilot was constrained, operated the cockpit equipment without confidence, demonstrated nervousness and was slow in reacting to commands from ground and from the tester.

The squadron commander concluded that the pilot had not mastered the aircraft cockpit satisfactorily and that he had not developed the required functional automatism. The flight commander threw up his hands in amazement and asserted that he had personally checked the pilot several times in a trainer cockpit. Each time the pilot had unerringly named and pointed out the instruments, levers and control sticks and had accurately described the sequence for distributing his attention among the instruments during the most important flight phases.

What had happened? A knowledge of psychology helped to clarify the situation.

An analysis of the pilot's actions and his methods of preparing for flights demonstrated the fact that there had been psychological gaps in his training. They essentially involved the actual methodological system developed by certain commanders and flight instructors for teaching the aircraft cockpit.

We know, of course, that despite the great multiplicity of techniques and methods employed in flight training practices, a number of systems of methods have been developed for developing skills in working with the cockpit equipment on modern aircraft.

All of the groups of methods can be differentiated by content into three main categories, each of which has a strictly defined psychological basis:
1. The study and development of actions involved in operating the cockpit aircraft by area of location in the cockpit (that is, the equipment on the left panel is studied first, followed by that on the right hand panel, the instrument board, and so forth);
2. The study and development of operations involving cockpit equipment by separate control items (the study of the radio equipment control panel, for example, that of the equipment pertaining to the landing gear, the flaps, the sight and the separate systems and so forth);
3. The study and development of skills in working with the cockpit aircraft according to basic operations and flight phases (take off, landing, circular flights, flights on a route, piloting during the performance of various piloting maneuvers and the performance of general, solidly established combat employment techniques, and so forth).

On the psychological plane, these groups of methods are used for performing such tasks as memorization of the location of this or that instrument, lever or toggle switch in the cockpit, rapid registration of their readings and the development of skills in operating the quipment in an efficient sequence, and, finally, the establishment of a logically-based relationship between the instrument readings or the positions of the control levers and the state of functioning of the control objects in accordance with the prescribed flight modes.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Each group of methods has its positive and negative sides. The study of the cockpit and the development of skills in operating it according to basic operations and flight phases, for example, contributes to the rapid development of a skillful sequence of action approaching that followed on actual flights. This method of instruction recreates the essential set of actions most completely and precisely, that is, it forms a specific system of actions. Under this system, however, less stress is laid upon remembering the locations of the instruments, the control levers and toggle switches, and upon their relationship to the aircraft and engine systems and assemblies.

The study of the equipment and the development of skills in operating the cockpit equipment by areas of surveillance, on the other hand, contributes to the rapid memorization of the positions of equipment in the cockpit but is not effective for developing the sequence of actions. Furthermore, this system of methods does not orient the pilot toward establishing a connection between the instrument control or the control lever with the state of the object which they affect. This deficiency is best eliminated in the second group of methods, whereby the study of the equipment and the development of skill in operating the cockpit equipment are conducted from the beginning by individual objects of control.

Psychological studies have shown that the use of one or another group of methods in isolation for mastering the cockpit in all of the training phases is not sufficiently effective. The best results are obtained when they are used in conjunction, accordin to the theoretical and practical tasks being performed.

From the very beginning of the theoretical training, in their explanation of the design of the separate systems and mechanisms, veteran teachers, flight instructors and engineers simultaneously direct the trainees' attention to the principles underlying remote control of a given system or mechanism and the positions of instruments, tumblers and control levers for the system, explain the basic operating parameters and demonstrate the specific manner of manipulating the control levers in various flight modes. That is, they successfully use the system of studying and mastering the aircraft cockpit by separate control objects at a given phase of training.

In many cases in this phase of training, however, when the flight personnel does not yet have a clear concept of the aircraft involved, some instructors give additional explanations of the peculiarities of control over the system or mechanism studied in ints dynamic setting, that is, as applicable to a certain complex or operation involved in the aircraft control as a whole. As a result, the study of the cockpit is not as effective.

In the above case there is a stratification of logically baseless information, the trainees' attention is overextended, and the value of the practical recommendations presented is reduced. During this period, the training purpose is best served by employing the method of mastering the cockpit by individual objects controlled and regulated directly from the aircraft cockpit.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

The study of the cockpit of a new aircraft during the theoretical retraining period is thus a sort of preparatory stage for the further improvement and development of skills in aircraft control.

All of the groups of methods can be used, both in combination and separately, during preparations for the first solo flights on the new equipment. To be specific, many veteran flight instructors use the second and third groups of methods during the first days for checking the trainees' knowledge and for reviewing and reinforcing the material covered in the course of the theoretical retraining. From the cockpit itself, they check the pilots' knowledge of the separate aircraft systems and mechanisms and methods of regulating and controlling their functioning, direct the attention of the flight personnel to the peculiarities involved in operating the various control levers, valves and toggle switches, demonstrate the proper speed of action, explain possible errors in the process, and demonstrate the sequence for distributing attention in the control and automatic control processes and during the performance of specific functions.

In other words, if in the theoretical retraining process, the instructor has mainly explained the positions and the structure of this or that item of cockpit equipment, then at this stage the flight instructor concentrates mainly on teaching the pilots to use the equipment efficiently. The development of specific skills in controlling and operating the new aircraft are thus formed, along with the performance of cognitive tasks.

During this period some flight instructors make successful use of the first group of methods, that is, the study and mastery of the cockpit by areas of cockpit equipment. Experience has shown that the final checkout is most effective when the flight instructor need only verify how well the trainees have learned the positions of the instruments and control levers. This is due to the fact that the given method makes it possible to focus upon the location of the instrument and equipment in isolation from the operations and from the control of the separate systems, that is, it makes it possible to heighten the students' attention and draw it to the positions of the instruments in the cockpit.

In some units a more complicated version of this method is sometimes used--the so-called blind checkout, whereby the flight personnel's knowledge of the cockpit equipment on the aircraft for which they are retraining is tested with their eyes closed. It is important to consider the specific nature of the flight personnel's perception and activity when this method is used. That is, the assignments should be geared to their capabilities and should focus mainly upon the development of automatism in determining the arrangement of the cockpit equipment and upon the development of the structure of the skill as a whole. It is furthermore advisable to employ the system of learning the cockpit by areas of equipment distribution as the main method, since the study of instruments and equipment in isolation from the operations required in the different flight phases or without relating them to regulation or control over the individual systems and assemblies can result

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

in the mechanical memorization only of their locations and of separate and disconnected operations performed with them. Furthermore, it frequently has a negative effect upon, and interferes with the development of, certain complex skills required by the pilot for controlling the aircraft in the various flight modes.

Experience has shown that employment of the third group of methods is more effective for the development of complex skills and of a dynamic stereotype for controlling and operating the new aircraft, that is, the system whereby the study and development of operations involving the cockpit equipment are performed in a coordinated manner, by individual complex operations and according to the main flight phases or the cycles of operations involved in controlling and monitoring the performance of the systems and mechanisms. This is the main and concluding phase in the pilot's mastery of the cockpit, and all of the preparatory work is brought together in it.

On the psychological level, it is important in this phase to adhere constantly to strict sequence and graduated buildup of complexity in developing skills in operating the cockpit equipment, both in special classes and the practical training sessions conducted as part of the ground training process and when working on each flight assignment during the practical flight training period.

When they employ this method for teaching the cockpit, veteran flight instructors first review and reinforce the pilots' knowledge of the total group of instruments and control elements in the cockpit, their structure and arrangement, by individual systems and mechanisms, work out sets of actions to be performed with this equipment and then perfect the cycles of operations already completed, in a specific sequence corresponding to the flight phases covered by the program for mastering the piloting equipment.

Furthermore, experience has shown that in the first stages the mastery of the cockpit equipment and its operation proceeds more successfully when the more complex cycles of actions or operations are broken down into more simple components or algorithms of action (the pilot's cycle of actions during the first half of the takeoff run, for example, during the second half, at the moment of liftoff, during the climb, and so forth). It is important, however, that the performance of the operation first be explained as a whole, that is, that the flight instructor explain the general takeoff peculiarities for the given type of aircraft and possible errors, demonstrate the group of pilot actions for all the phases, from the beginning of the takeoff run to the attainment of the assigned altitude, and then discuss in greater detail and go through the operation of the cockpit equipment for each phase.

From the psychological standpoint, the effectiveness of this system lies in the fact that it gives the general purpose of the performance of the entire program of actions as a whole. The pilot grasps the integrated structure of the operations studied, and the performance of its separate elements seem to logically fit into the structure without destroying its unity. Another

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

positive factor in this case is the fact that in the process of comprehending what he has perceived the pilot is relieved of the necessity of making an additional mental effort to combine the separate algorithms of action into a total operation.

At the same time, some teachers and flight instructors sometimes commit major errors in this area. In an attempt to provide the best and most complete information possible on the equipment in the cockpit of a new aircraft, they forget to adhere to the sequence established for presenting the material. When they explain the peculiarities of operating this or that instrument or control lever, before the pilots have a complete picture of the complex operations and the patterns of actions involved in the various flight phases and before they have covered the fundamentals of the systems, these instructors attempt to explain the peculiarities involved in operating an instrument or a control lever in various flight situations or in connection with the operation of other systems not yet covered. The result is an unwieldy buildup of information and a disorderly accumulation of disconnected facts, which has a negative effect upon the study of the cockpit instruments.

What we have discussed here, naturally, does not reflect the entire highly diverse employment of methods of learning an aircraft cockpit. It is only one of the possible versions of a structure and sequence for developing the methods to be used in this important and complex process.

Caution! Negative Carryover of Habits

An aircraft failure occurred in one of the air units, during the first solo flights on the new equipment. For 8 years, Pilot K. had successfully flown the MiG-17 and had earned a first-class rating 4 years in a row. As one of the best pilots, he was among the first to be permitted to train for the new aircraft. Following intense study and practical training, it came time for his first solo flight. The instructor had no doubts as to the pilot's readiness. The unforeseen occurred, however. As he was approaching for a landing the pilot discovered that the landing gear would not descend. He reported this to the flight operation officer, who directed him to begin a second circle and to effect an emergency lowering of the landing gear.

Naturally, the fact that this was the first solo flight on the new aircraft created a certain constraint and tenseness in the pilot, and added to that--a malfunction.... The flight operation officer understood this and issued instructions calmly and precisely. Following his instructions, the pilot began to move the valve from neutral to the "lowering" position, that is, downward, to effect the emergency lowering of the landing gear. The valve would not move. The pilot made another strong effort, and the valve broke. This complicated landing conditions drastically. What had happened? Was it equipment failure, happenstance or simply a pilot error? An analysis of the incident showed that the pilot was basically to blame. It was not a simple error, however, or a result of carelessness. In order to move the

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

valve to the "lowering" position on this type of aircraft, the valve lock had to be moved toward the pilot and the valve moved downward. It was just the opposite on the MiG-17. After many years of flying the pilot had developed firmly established habits in operating the cockpit equipment, specifically the landing gear valve. This habit had apparently not been completely broken or precisely altered in the process of retraining on the new aircraft. Under ordinary circumstances, or even, perhaps, during training flights, the pilot would have functioned confidently and correctly in the cockpit, but when conditions changed and became more complicated, and time was running out, he experienced a so-called spontaneous loss of individual habits not solidly established.

The physiological mechanism of this development of the psyche was based on a solidly established dynamic stereotype of conditioned reflexes in response to certain signals on a flight, which had developed in the pilot's cerebral cortex in the process of many years of flying. In this case, the instruction to effect an emergency lowering of the landing gear served as the signal. In his preparatory training for the flight, in the analysis of action to be taken in special situations, the pilot had undoubtedly operated the emergency valve for lowering the landing gear. In a calm situation, with time to think, constant self-control had permitted him to function properly. This newly-developed habit had not been practiced to the point of automatism, however. More than that, it had not even become a part of his conscious actions. The pilot's error was not a result of confusion or of hasty instructions from the flight operation officer. The real cause of the pilot's incorrect operation of the cockpit equipment was something different.

In the complicated situation, when the pilot had to focus his attention properly in order to perform a specific type of function within an extremely short time, the flight operation officer's command should have stimulated him even more. Since the pilot had still not developed a dynamic stereotype for operating the new equipment, however, he received the command subconsciously, perfunctorily. It acted as a sort of stimulus abruptly activating the previous stereotype, and this, in turn, led to an erroneous reaction to the command. Instead of removing the lock from the valve and moving it to the "lowering" position, the pilot pressed the valve lock and broke it by moving it too far.

Aviation equipment is constantly undergoing renewal at the present stage of development. Not only do fundamentally new aircraft come into being each year, but existing aircraft are also undergoing constant improvement. Flight personnel not only have to undergo systematic retraining as a result, but also have to undergo additional training for the old equipment, making certain adjustments in their habits and skills.

Changes brought about in the pilot's work as a result of improvements in the aviation equipment create certain conditions for the negative carryover of former skills into the new situation. How does one account for the development

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

of these conditions? The most likely causes are the following: structural changes in the control elements for the mechanisms and systems; the relocation of levers, buttons, toggle switches and instruments in the cockpit; changes in the pilot's attention distribution pattern in the important flight phases due to changes made in the sequence of operations performed for controlling the aircraft; and the breakdown of previously developed temporal intervals in the performance of certain actions. This can be illustrated using the following example.

Night flights in adverse weather conditions were ending in one air unit. The flight commander, an experienced pilot, was in the air. Having completed the flight assignment, he had received permission to make a straight-end landing. The lights of the approaching aircraft came into view in the sky. But why were there so few of them? "Your outside landing gear lights are not on." reported the flight operation officer. There was no doubt that the pilot was coming in for a landing with the landing gear retracted. The flight operation officer ordered the pilot to begin a second circle. The lights came on just at that moment, indicating that the pilot had only then lowered the landing gear. It was soon learned that the pilot had forgotten to perform this operation at the right time.

How could this have happened? After all, this was an experienced pilot in the sky, a pilot who had performed hundreds of landings.... Let us run through his actions. Upon receiving permission to approaching for a straight-end landing, the pilot began performing the required maneuver. On the 30-second horizontal stretch, he slowed the aircraft to the prescribed speed by means of the brake flaps. We would point out that the pilot reduced speed not by lowering engine rpm as the instructions indicate, but by lowering the brake flaps. A new action involved in pressing the air brake button was introduced into the habitual, developed set of actions. In the pilot's words, this somehow filled a subconscious quantitative and temporal gap in the established dynamic stereotype and somehow took the place of the omitted action with the toggle switch controlling the valve for lowering the landing gear. After performing the operation with the button controlling the air brake flaps, he somehow automatically began lowering the wing flaps into the landing gear position. Upon noticing that the aircraft speed was increasing at the given rpm, however, he began to doubt the speed indicator. In order to check the speed indicator, he took the aircraft into a temporary climb. The speed indicator correctly indicated the reduction in speed.

The conditions for a negative carryover of a habit were created in the above case by introducing an additional operation into the developed sequence of operations.

A negative carryover of habits can also take the form of a so-called carryover by association. This can be caused either by sets of skills and habits of operating in a strictly defined manner, which have developed in the process of flight work on aircraft previously flown or, in part, by skills and habits

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

produced by the individual's daily life-style or by his temperament. In other words, carryover by association consists of spontaneous actions on the part of the pilot by analogy with the manner in which he was accustomed to performing previously. This sort of carryover of habits may be negative or positive. The negative carryover in this case is one which has a harmful effect upon the pilot's work, especially when learning to fly a new aircraft.

The nature of a negative carryover of habits can be illustrated in the following manner. We know that when piloting subsonic aircraft the pilot's manipulations of the rudders and ailerons have greater amplitude and there are shorter intervals between movements of the control lever, whereas the carryover of analogous actions to the control of supersonic aircraft can have dangerous consequences. This is especially clearly manifested during takeoff. Physically, this is due to the fact that there is less contrast between changes in speed and the effectiveness of the rudders on subsonic aircraft than on supersonic ones. As a result of the smaller area of the rudders during the first half of the takeoff run, their effectiveness increased more slowly, increasing sharply during the second half as a result of the rapid buildup of speed. Because of this, a differentiated approach must be taken to developing skills in operating the rudders when learning to fly supersonic aircraft. During the second half of the takeoff run these actions should be smooth and should be performed somewhat in advance of the need. Experience has shown, however, that due to the increased psychological tension in this phase, many pilots who previously flew subsonic aircraft skillfully subconsciously carry over the more abrupt movements. This frequently produces a dangerous longitudinal wobble in the aircraft during takeoff. Special studies indicate that pilots with a good theoretical knowledge of the use of the rudder during takeoff beging to function in the presence of slight complications in the manner in which they were accustomed to performing previously. That is, they have a carryover of skills by association.

In many cases, the pilot's temperament, or his psychic reactivity, as they say, influences the pilot's actions. For example, when flight conditions become complicated the actions of pilots with a choleric temperament may become quicker and more abrupt, which has a negative effect upon aircraft control and sometimes results in the development of preconditions for flight accidents. Pilots who are phlegmatic by nature, on the other hand, become more sluggish in their actions in such cases, and there is an intensification of inhibitory processes in the cerebral cortex and as a result, poor receptivity to ground commands, a slowing of sensomotor reactions and delayed response to deviations of the aircraft in flight. Therefore, when flight preparations are made and when the pilots are working on actions they are to take in adverse conditions, it is important carefully to differentiate the forecasting of their behavior and to work out special steps and recommendations in advance for the flight operation officer. This, in turn, requires a special study of each pilot's personality and a knowledge of the psychological peculiarities of behavior of the flight personnel on the part of everyone taking part in the flight control work.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Speaking of the problem of negative carryover of habits, we should mention yet another variation of carryover by association, which pertains mainly to skills used in actions related to a specific pace of movement. This mainly applies to motor reactions and operations performed with the cockpit equipment, in which the beginning and the end of the motion to be asynchronous. Opening a valve rapidly but closing it slowly, for example, making an abrupt and rapid motion with the hands and a simultaneous smooth movement of the feet and so forth.

It is important to take into account the possibility of negative carryover of habits in flight work during the organization and conduct of all types of training of the personnel and to extensively apply special psychological and pedagogical methods of preventing these developments. A considerable body of experience in this area has been accumulated in the forces.

In the process of mastering new equipment, for example, or when converting to modifications of aircraft already mastered, commanders, political workers and instructors in the outstanding units analyze and determine in advance possible points of contiguity between previously acquired skills and those newly developed in the control and operation of the new equipment, taking each pilot's personal characteristics and training level into account. They also take into account the possibility of a negative carryover of skills, depending upon the type of aircraft which the pilot has previously flown and the type on which he is presently training.

In many units, flight methods committees and specialists from the various services together thoroughly analyze instances of pilot errors caused by a negative carryover of habits and then work out a system of measures to prevent such occurrences in the process of mastering the new equipment.

During the preparations for flights, in the course of each class and practical training session, veteran commanders and flight instructors foresee possible instances of erroneous actions and conditions conducive to the negative carryover of previous habits in the specific flight conditions. They draw the pilots' attention especially to such situations, explain and demonstrate the typical causes of erroneous actions and explain their consequences.

When the flight instructors in one of the units were retraining on a new combat training aircraft, the pilots frequently overshot on the landings during the first flights. The initial analysis of their actions did not produce positive results. The overshoots continued to occur. Only a detailed study of each action performed by a pilot during a landing made it possible to detect the element of negative carryover of a previous habit. It turned out that the nose section of the new aircraft had a larger angle of rake than the one previously flown. The pilots were fixing the horizon sighting line on the edge of hood just as they had done on the types of aircraft previously flown, and were creating a considerably greater angle of pitch when landing the new aircraft. As a result, they were overshooting on the landings. This fact was pointed out to all of the pilots, and proper adjustments were made in the computations. All of this helped to eliminate piloting errors during landings.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

When they organize training and methodological work to prevent negative carryover of habits, veteran commanders and flight instructors schedule special classes and practical training sessions to reinforce new skills and break down old ones. The following techniques and methods are employed: explanation and demonstration of what should and should not be done; description of possible indications of erroneous actions and of their consequences; inverse explanation and demonstration, whereby the trainer or instructor first explains the process involved in the performance of an erroneous action and the consequences, and then tells how to perform this or that operation or action properly. All of this helps to prevent the negative carryover of previous habits into the new situation and accelerates the process of their attenuation and breakdown.

The following are effective means of preventing negative carryover of habits: the posing of various problematic questions and hypothetical problems; focusing the attention of the trainees upon the incorrect actions of their comrades while observing flights and other practical training exercises; reviewing specially important incidents in the course of training on the new type of aircraft; analyzing the correct actions of pilots during flight critiques, and so forth.

What Goes Into a Successful Solo Flight

Today, practical training of the personnel on trainers and in the aircraft themselves are exceptionally important for retraining on new equipment. The content of this training has grown considerably more complicated and the range of training subjects has expanded. This is due to the fact that for piloting a modern aircraft the crews must process an enormous volume of information on the aircraft's position and the functioning of the engines and equipment, convert this information by a logical thought process, make decisions and manipulate the control elements correspondingly.

It is important to consider a number of peculiarities of this training method in the retraining process, when using trainers to develop essential skills and abilities in flight personnel. A trainer is not simply an external replica of a weapon, mechanism or system but a complex technical device making it possible to simulate the situation in which the pilot operates while controlling the aircraft and to take into account the psychological factors contributing to the development of essential skills in the trainees.

It is therefore important when using training equipment to devote attention not only to the recreation of a specific sequence and technology for the performance of the technique or action being studied, but also to create realistic conditions and the various operational-tactical situations in which the newly formed skills and abilities will be demonstrated in the future.

In the practical retraining, it is not always possible to create with training equipment a completely authentic combat situation. When trainers are used

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

which lack the equipment for visually simulating the conditions under which the skills and abilities should be developed, the instructor must verbally describe those conditions, constantly readjust them during the course of a practical training session and explain the causes of erroneous actions and ways of eliminating them.

Movies, television and film slides can be used simultaneously to present a more graphic picture of the conditions and the tactical background, as well as the sequence and pace for performing the action or operation being learned. When working on landings in a trainer, for example, it is important first to show all of the components of a landing specially filmed for training purposes (the commentary can be written or verbal). And it is desirable to show not only the aircraft's maneuvering as a result of the proper performance of certain actions but also, when possible, the actions of the pilot in the cockpit and the positions of the indicators on piloting and other instruments. A demonstration of possible errors of action and their consequences also contributes to the proper development of skills.

One important requirement of training conducted in a trainer is that the psychological structures underlying the development of habits conform totally to those of the actual skills. That is, the actions practiced may be taken out of a complex work situation, but they must remain the same as when they are performed in the real situations.

Training with the use of trainers must also be set up so as to exclude to the fullest possible degree all conditions which would result in interference of habits. That is, the carryover of habits formed by means of trainers should be positive and should not entail any sort of psychological readjustment in the actual situation. This means that the sequence and the pace for performing the actions, the positions of the instruments and control levers and the working conditions (degree of restriction, lighting, coloration, temperature, and so forth) in exercises performed in a trainer should conform to the actual conditions for operating the combat equipment. This makes it important to develop standards for all exercises conducted on trainers and to justify them psychologically, taking the structural features of the trainer into account.

It is important to combine exercises on trainers with exercises on the new equipment in the retraining process in order to achieve good development of the required skills and abilities in the flight personnel. And this combining of exercises must be accomplished, whenever possible, after each logically complete cycle of actions or operations has been worked out.

Initiation flights constitute the final phase in the practical training for the first solo flight. They are conducted on a combat training aircraft and are subdivided into familiarization, demonstration and checkout flights.

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During the course of advance, preliminary and preflight training, along with making a detailed study of the pilot's actions as specified by the retraining program, commanders and flight instructors direct the trainees' attention specially to the peculiarities of each flight, to the specific techniques for piloting the new type of aircraft as compared with those previously flown, and to possible errors and deviations in piloting techniques resulting from negative carryover of previous habits.

The advance, preliminary and preflight training is more effective when it is conducted not in the form of simple instruction, whereby the instructions on piloting techniques are simply repeated, as is sometimes done, but when problematic questions are posed and special hypothetical problems are assigned in the classes, and when the trainees themselves are involved in analyzing the questions and answers and the instructor only directs the training and summarizes the answers, when visual aids such as miniature takeoff strips, aircraft models, diagrams of airfields, cockpit mock-ups, and so forth, are actively used.

The flight instructor ordinarily employs several different methodological techniques when training the pilots on a flight. The basic techniques employed on initiation flights are demonstrations of aircraft control actions, joint control, observation and suggestions made over the aircraft intercom. Before a flight the veteran flight instructors remind the pilot as to which elements he should give special attention and what difficulties may be encountered in piloting the new aircraft, compared with the aircraft previously flown.

The instructor performs the first two or three flights as demonstration flights, depending upon the pilot's training level. On these flights the pilot participates in the control and observes the instructor's procedures. On subsequent flights the pilot is given greater independence, and the instructor's actions basically consist in observing and instructing the trainee.

On any flight it is important to teach the pilot to concentrate on the main peculiarities of each flight element. On the takeoff, for example, the instructor directs the pilot's attention to maintaining course on the first half of the takeoff run by means of the brakes, to the instant of liftoff of the nose wheel, separation of the aircraft from the earth, operation of the controls after leaving the earth and the raising of the landing gear, as well as the procedure for distributing his attention in the takeoff phases. The development of skills in piloting techniques is far more effective when the instructor not only indicates a certain reference point for an action but links it with the action itself, that is, when he demonstrates the pace of a movement and its amplitude, the sequence for switching attention, and so forth.

After the instructor has assumed control during a landing, for example, and after he has arrived at the precise computation and achieved leveling-off altitude, he directs the pilot's attention with instructions such as the

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

following: "Altitude 7 meters; leveling off; reducing rpm." and "Altitude 1 meter; rpm reduced." In this manner the instructor develops the conditional links between altitudes and the required actions on the part of the pilot. That is, this training method contributes to the trainee's understanding of what he must do and at the same time helps develop a stereotype of the motor reaction required upon receiving the orientation signal.

An analysis of actual flight retraining has shown that when they are training pilots some instructors demonstrate excessive nervousness and raise their voices when conversing and giving instructions, which creates tension in the trainees and impairs their mastery of the flight elements. Other instructors, on the other hand, allow talking during a flight, which detracts the pilot's attention away from the work of piloting the aircraft.

Without making fully certain that the pilots undergoing retraining are adequately prepared, some instructors entrust them with such important elements as takeoffs and landings on the first flights, which frequently leads to gross deviations in pilotage, creates great tension in the pilots and produces a lack of confidence on subsequent flights. The opposite is also sometimes true, whereby the instructors underestimate the experience of a trainee and do not trust him to pilot the aircraft during the initiation flights and are overly protective, thereby creating a lack of confidence in the pilot and instilling doubts as to his ability to master the new aircraft successfully. A typical failure of some instructors lies in the fact that when they are teaching certain flight elements they tell the trainee what should be done but do not instruct him as to how to perform this or that operation or action, or how to check to see that it has been properly performed and by what means.

Some instructors do not accustom the trainee to analyzing a flight after it has been completed but limit themselves to pointing out and enumerating errors and deficiencies. And when they do conduct a critique of errors, some of them perform it only superficially, that is, they simply indicate how they occurred on the flight and their possible consequences, but do not reveal or analyze their real causes. And this greatly hampers the conscious and thorough development of skills in a pilot, necessitates an increase in the number of initiation flights and prolongs the retraining period.

It is even more important to consider these matters when organizing and conducting the first solo flights on a new aircraft. The pilot's psychological conditioning for the first solo flight and the psychological peculiarities involved in directing the flights and conducting the flight critiques are especially important here.

The preliminary and preflight preparation of flight personnel for the first solo flights on a new aircraft is conducted in the usual manner. Veteran instructors, however, devote greater attention to in-depth and thorough control over each pilot's actions, taking into account his personal characteristics as revealed during the performance of the initiation flight program.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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They direct the attention of the flight personnel to possible equipment failure and changes in weather conditions, which could complicate the flight situation, and thoroughly clarify the separate aspects of the pilot's interaction with the flight operation officer. During the run-through of the flight each pilot works out all of the actions and operations involved in the impending initial solo flight.

Observations of preparations for the first solo flight and questionnaires filled out by pilots and talks with them immediately following the first solo flight show that the flight personnel develop certain psychological conditions during this period, including tension, constraint, nervousness, retardation of sensomotor reactions, and so forth. They are especially clearly manifested when the flight personnel is forced to learn to fly new types of aircraft without dual-control trainers, that is, without training on a combat training aircraft with aerodynamic and tactical characteristics similar to those of the new aircraft. In this situation the flight personnel experience most intensely the newness of the aircraft's behavior on a flight and are forced to master a number of new elements of piloting techniques on their own and to make independent decisions in an unforeseen situation.

Numerous examples taken from our experience in conducting initial solo flights demonstrate the fact that, as a rule, the pilots perform under maximum pressure precisely on these flights. The pressure is manifested in abrupt and extreme movements of the controls, in constraint of control actions, in slow reactions to commands, in poor switching of attention, in failure to observe the proper sequence of actions when operating the cockpit equipment, and so forth. The pilot's tension sometimes causes a retardation of individual habits or even various types of illusions. We have mentioned before, for example, the fact that pilots experiencing tension on their solo flights have failed to lower the landing gear and confused the toggle switches during a landing, that during takeoff some of them have experienced the illusion that the control stick has become wedged, that the aircraft is departing from the axial line of the runway and so forth.

Various factors can create tension on a flight. In one case, it may be a lack of confidence in the functional reliability of the new equipment, in another--inadequate knowledge of the aircraft structure and the rules for operating it, and in a third case--a negative emotional situation created the evening before the flights.

Out of 50 pilots surveyed as to their impressions during the first two or three flights on a new aircraft, for example, 42 stated that the main condition underlying their psychological preparedness for the first flight and for its successful accomplishment was the possession of a solid and deeply cognizant knowledge of the design of the new aircraft, of the methods of operating it and of its aerodynamic features. Some pilots say that they would prefer that such flights be conducted like ordinary flights, without ceremony, that a great deal of advise and instructions not be given by various individuals prior to the flight and that only one individual, the

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

commander or the instructor, be involved in instructing them. Some pilots have even indicated a desire to have the instructor continue helping them to ready the aircraft up to the point of closing the cockpit canopy.

Many pilots even state that they are more calm when the instructor or commander, who has flown the new aircraft repeatedly, does not specially stress the negative aspects of piloting the aircraft but simply explain its characteristics and its advantages over the aircraft previously flown.

We know from experience that during the first solo flights on a new aircraft flight personnel are favorably affected psychologically by the fact that veteran pilots, the unit and subunit commanders, have flown the new aircraft ahead of them, that other pilots involved in the retraining are to observe their flights from the ground. Frank talks with commanders and veteran pilots and thorough answers to questions help to raise the trainees' confidence in the reliability of the new aircraft and their confidence that the flight missions will be successfully accomplished.

The flight operation officer has a responsible role in the organization and conduct of solo flights on new aircraft. Experienced commander-methodologists, individuals who fly the given type of aircraft skillfully and are familiar with all of the fine points of flying it, are therefore drawn upon to direct the flights.

During the first solo flights, veteran flight operation officers attempt to issue all of the commands and instructions to pilots in the air precisely and calmly and to give the pilot the opportunity and time to comprehend each command. At the same time, they try to avoid disturbing a pilot in the air with insignificant explanations or detracting his attention away from the performance of the main flight elements. When a flight operation officer concludes from certain signs (a delayed response to an instruction, a comparison of information received from the pilot with the results of his own flight observations, and so forth) that a pilot is experiencing great tension on a flight, he calmly reminds the pilot of the sequence for performing the basic actions and of the procedure for exercising self-control over his actions, thereby calming the pilot and giving him confidence that the flight assignment will be successfully accomplished.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Chapter VII. THE MORAL-PSYCHOLOGICAL PRINCIPLES UNDERLYING THE FORMATION AND THE WORK OF AVIATION TEAMS

1. Problems Involved in the Group Training of Crews Under Modern Conditions

The combat employment, operation and servicing of modern aircraft requires a coordinated effort on the part of a large number of specialists and military teams and the development of teamwork in the personnel for their joint work with the equipment. There are two aspects to the accomplishment of these tasks. In the first place, if the job is to be performed well these qualities and skills must be developed within the aircrews, teams and equivalent subunits themselves, and in the second place, their development is necessitated by the need for interaction between the aircraft crews and the flight support services.

The problem of developing teamwork in the personnel has become especially important in the contemporary situation. This is a result of the increased complexity of the tasks performed by the aviation, by the intensity of flight training and the increase in the number of specialists servicing the aircraft and readying them for flight. It has become a practical necessity to develop a definite system of interaction among the specialists and to develop their skills in working together.

The Crew Must Be United

The work performed by an aircrew (or team) today is extremely difficult with respect to the physical and the moral-psychological pressure involved. The crew has a special responsibility for the successful performance of the combat training tasks. The solidarity, smooth functioning and efficiency of a crew or team determines to a great extent the success of its assigned job.

The practical combat training work in the forces has shown that a specialist will sometimes demonstrate an excellent knowledge of his duties with respect to the combat employment, operation and servicing of the equipment and weapons on tests and exams, and then make errors and exhibit deficiencies when it comes to the performance of complex, joint tasks. This is due to a lack of proper teamwork training in the personnel and to the unsatisfactory application of scientifically-based forms and methods of training and indoctrinating the servicemen and the military teams.

Because of this, one of our prime tasks is presently that of working out a large number of new and more effective psychological and pedagogical techniques in the methods used in the joint training of crews and teams for combat actions; selecting the training material intelligently; coordinating the sequence for conducting the individual and group training of crew members and other servicing specialists; improving the system of comprehensive training exercises to develop their teamwork skills; and further improving the development of teamwork abilities in the members of teams and crews, especially for working in the complex conditions of combat training.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

In other words, training and indoctrinational tasks are combined on the psychological and pedagogical level in the process of training a crew or team. The main tasks are those of developing teamwork skills in the members of a crew or team and teamwork between the crew members and the specialists of servicing subunits, of instilling teamwork qualities in the members of a crew or team, and developing in them a feeling of friendship, comradeship, mutual trust, and respect for the commander.

The accomplishment of these tasks is influenced by a number of peculiarities, which can be differentiated into two main categories: peculiarities involved in the training and indoctrination of the members of crews and teams, resulting from changes occurring in their work as a result of improvements in the equipment and weapons; and peculiarities in the training and indoctrination of the members of teams and crews, related to changes occurring in methods used in the combat employment of the equipment and weapons and in the tactics of combat operations. These special factors are given full consideration when the training of the crews and teams is organized in outstanding air units and subunits.

For example, special programs and methods aids are worked out for the training process, which, together with the individual training of the servicemen, cover the training of the crew or team as a whole, a system of special training classes is outlined covering different aspects of interaction among crew members, and methods assemblies are scheduled for instructors and for crew and team commanders. Many units employ special plans for preparing the crew and team members psychologically for the various conditions of their work. These plans devote special attention to the makeup of the crews, taking the psychological compatibility of the servicemen into account, to the development of skills in the performance of complicated joint operations and to the development of such moral-combat and psychological qualities as boldness, determination, personal responsibility for the performance of the combat mission and the ability to stand up under prolonged nervous and psychological pressure and under maximum physical loads.

In the interest of solidly uniting crews and teams, the commanders, political workers, party and Komsomol organizations of units and subunits perform a great deal of work to strengthen the primary party and Komsomol collectives and to indoctrinate the fighting men in a spirit of friendship and comradeship, and personal responsibility for the success of the entire team on the part of each specialist, raise the effectiveness of socialist competition among the fighting men, crews and teams, and summarize progressive experience. They thereby effectively influence the process of developing in the airmen good teamwork qualities and a desire to master related specialties and to help a comrade on the crew.

The Comprehensive Approach--A Dictate of the Times

We have discovered from experience that some people are still of the opinion that the group training of the fighting men should not be initiated until significant progress has been made in the individual training. In other

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words, the development of teamwork habits and skills in the specialists should be accomplished in the last phase of the training: It should not be performed from the beginning of training on the new aircraft but when the entire crew begins practical training on the equipment. This has produced a situation in which the training programs, various types of classes and checkout tests and exams focus upon the individual training of the specialists.

As a result, despite the fact that the crew and team members have a fair understanding of their duties, incorrect actions and errors in the operation of the combat equipment and weapons occur at the beginning of the cooperative work. Certain specialists demonstrate constraint and tension in their work, and sometimes fail to complete their assignments when the combat training work becomes complicated.

Consequently, this approach to the development of teamwork skills in the crew and team members produces a situation in which the level of their preparedness to perform together lags behind their abilities to work individually. Along with this, the servicemen experience increased nervous-psychological and emotional tension, it is more difficult to establish comradely relationships within the crew or team, and additional difficulties arise in the development of team behavior patterns.

On the other hand, good results are achieved in combat improvement when the individual and collective training of teams and crews is performed together. On a practical level this is accomplished in the following manner. Individual and collective training of the servicemen is conducted simultaneously from the moment the crew or team is formed. As a result, the specialists gradually understand their place and role within the crew or team and the functions of their service comrades, learn the personal traits and capabilities of each, and so forth. As a result, by the time the joint practical work is begun in the crew or team, they are fully prepared and perform their collective duties better.

We would especially like to stress the importance of solidarity, friendship and mutual understanding in the crews, which are made up of flight, engineering and technical personnel. It is their joint efforts, after all, which primarily account for the successful performance of flight assignments. It is with good reason, therefore, that commanders, political workers, party and Komsomol organizations devote so much attention to the formation, training and indoctrination of this sort of aviation team.

2. Ways to Strengthen the Aviation Team

It is a difficult and important task to develop united, efficient and amicable aviation teams and to train and indoctrinate them. Success depends primarily upon how much thought is given to their formation from the standpoint of selecting the men and upon the degree to which their training and indoctrination is conducted in a purposive and objective manner.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

What is Psychological Compatibility?

Due to the increased complexity of the work performed by aviation personnel today, it is becoming increasingly necessary to consider so-called psychological compatibility in the teams, that is, to deal with matters of interrelationships among people performing a common task and their ability to work harmoniously. And this is not surprising. The modern aviation complexes, as we have already pointed out, are complex systems made up of many interrelated objects and linkages. Diverse control processes, strictly delimited by task and time, occur in them, and they occupy a large number of people differing in training, experience and character.

We encounter instances of incompatibility of components within a system, including psychological incompatibility of people, more frequently than before. What is the nature of this phenomenon and what causes it? This can be determined from the following example.

A new crew had been formed in one of the air units. The pilot and navigator had a solid flying background, and both were specialists first-class. There appeared to be every reason to expect the crew to be successful. It turned out otherwise, however: The training of the crew never shaped up, and the flight assignment results were frequently low. The pilot and navigator demonstrated antipathy for each other. What was the cause?

The answer was discovered unexpectedly. It was decided to listen to the radio exchange among the crew during important flights. The interchanges between the crew members indicated irritability. Because of his dynamic personality, the commander did not entirely trust the phlegmatic navigator, hurried him when there was no special need and frequently requested the flight parameters. The navigator would not have time to make the required computations and would go to pieces, finally becoming angry or simply throwing up his hands.

The psychological incompatibility of the two men with different personalities was apparent. This gave rise to a dislike for each other, to irritability and other negative developments in their relations. It was clear that the situation could not be corrected, neither with an order, nor with punishment or any other means. One of them had to be transferred to another crew.

Psychological incompatibility can be produced by a large number of factors in any kind of work. Two people or a team of workers may not be able to work together because their views on certain matters do not coincide, for example. Another individual or group of specialists may not be capable of servicing this or that system well, because they do not possess the required physical attributes. In the above case it was a matter of incompatibility of the personalities of two men. We would point out, in passing, that inadequately trained comrades consider this to be the main cause of incompatibility. In fact, however, this is far from true. Other traits of the psyche also produce psychological incompatibility of people. Dislike or distrust for one of the

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members of a flight crew, for example, may arise becau- he is always morose and silent, even though he may cope with his duties w

Man's inner world, as we know, is extraordinarily complex and diverse. It is determined by traits of personality and temperament and the abilities of the individual, and by his knowledge, skills, habits and convictions. We also know that the nature of man's actions is also very complex and sometimes difficult to explain. This is what gives rise to the various factors influencing the work of a crew or team and of each member, factors which a commander must understand in order to avoid taking the wrong steps.

The following examples are worth reviewing in this respect. In one air unit, pilot K. had been transferred from one flight to another several times because he had not been able to get along with the team and had committed acts of impropriety. In another unit it became necessary to relieve Officer N. of his post and transfer him to another job. The reason was psychic instability. As soon as the officer took over the microphone to begin his duties as a flight operation officer he would become nervous and raise his voice, and would become unsettled in a complicated situation, although he was a good pilot himself.

Here, we have two different situations. Pilot K. is not accepted by the collective, while Officer N. cannot work with others because he frequently becomes nervous and resorts to yelling and rudeness. The decision would appear to be obvious in both cases--transfer each officer to another collective. And this is what was done. There was apparently nothing else to do with Officer N. But what about Pilot K.? One could hardly agree that moving him from one flight to another was the thing to do. Since it was entirely a matter of the individual's personal qualities, which did not depend upon his psychic makeup, but specific flaws in his indoctrination, the pilot should be helped to rid himself of those personal mannerisms which were discrediting him. And it should be done in his present subunit, without transferring him anywhere.

The issue of interrelations among people within a "closed" collective is a subtle and delicate one. One must not derive hasty conclusions or take ill-conceived steps in the matter. Unfortunately, this rule is not always followed. Frequently, only administrative measures are taken in the training and indoctrination of the airmen, and no attempt is made to delve into the psychological aspects of the problem. Not all commanders, political workers and aviation doctors thoroughly study the conditions giving rise to psychological conflicts, clarify their objective causes or analyze the motivating factors behind people's behavior in detail. Sometimes, only the formal characteristics (education and experience) are taken into account when the crews are made up, while the ideological-political and moral qualities of the people are not considered. An in-depth analysis of the relations among people forming a team and preventive work in this area are not a once-only measure but a complex and multi-level process.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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What are the basic ways and means of ensuring psychological compatibility in the aviation teams?

First of all, a thorough study must be made of the specialists, their individual traits must be taken into account and the people who will be working together should be selected in a rational manner. Furthermore, a comprehensive and creative approach is required in these matters. For example, one must not evaluate the emotional and volitional qualities of every pilot in the same manner. Sometimes, two individuals will possess the very same trait--emotional instability and a quick temper--but one of them will be able to restrain himself when necessary, to suppress his emotional tension with an effort of will and force himself to function calmly, while the other, on the contrary, will lose self-control, become hysterical and so forth, in the same situations.

When making up a crew it is important for the pilot and navigator to compliment each other, to prevent a situation in which the makeup of the crews do not change at the beginning of each training year. After all, it takes time for the crew members to learn to function together smoothly. And the smooth functioning and solidarity of a crew have a great deal to do with its moral-psychological preparedness and its success in combat improvement.

Secondly, a systematic effort to develop teamwork behavior in the fighting men and the development of special methods for forming skills in working together in the combat employment and servicing of the aviation equipment and weapons are an effective means of ensuring psychological compatibility of the members of a team.

Thirdly, certain types of physical training and sports can be used, and types of activities selected which involve either a rapid change in the situation or a smooth and even process for purposes of preventing psychological incompatibility due to differences in temperament among the specialists. For example, it is good to recommend that specialists of phlegmatic temperament engage in such sports as soccer, basketball, tennis, volleyball, driving automobiles and training activities on special equipment with constantly changing hypothetical problems. It is best for servicemen with dynamic personality features and a highly active nervous system to engage in smooth and rhythmic types of sports--swimming, skiing, rowing and heavy athletics. It is also beneficial for them to train on trainers and on combat equipment, resolving hypothetical problems involving carefuly preliminary thought as to the actions ahead of them.

In the fourth place, the prevention of psychological incompatibility based on social-psychological factors (a breakdown in the chain of command, in interrelations among various categories of specialists and moral-domestic relations, and departures from duty) requires indoctrinational work to raise the political awareness of the airmen and to develop in them a communist outlook on life, ideological strength and conviction, patriotism and a desire to perform their military duty irreproachably.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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A fifth important area of the work performed to create strong and battle worthy collectives involves purposive and systematic indoctrinational work with the commanders of crews and teams. The achievement of a positive psychological frame of mind in their subordinates in the collectives and the achievement of success in combat improvement depend greatly upon them. Pedagogical tact, self-control and proper relations between the commander and his subordinates have a great deal to do with the accomplishment of these tasks. Fussiness, lack of restraint and lack of confidence for adopting decisions hamper the indoctrination and training of the airmen and the creation of a lively and energetic mood in the collective.

Naturally, what we have covered does not exhaust the entire arsenal of means and methods of preventing psychological incompatibility. Army reality is extremely diverse and can give rise to new developments of a psychological nature requiring a new approach to the resolution of the problems arising.

The Development of a Sense of Collectivity Among the Fighting Men

The development of collective qualities in the fighting men and of teamwork skills in the personnel constitute an important means of strengthening the aviation collective. A specific system of performing this work has developed in the air units and subunits, which produces positive results.

The following are the primary forms and methods used to develop teamwork skills in the members of crews and teams:
1. the development of skills in working together in trainers and on the combat equipment itself;
2. practical training on other crews (or teams) and observation of their combat training work;
3. the conduct of special measures to prepare the servicemen psychologically for functioning as part of a team;
4. the study of the functions of other members of the crew (or team);
5. summarization and adoption of progressive experience in the training of crews;
6. discussion during flight critiques of matters pertaining to intra-collective relations and the functional harmony and organization of the work within each crew or team;
7. employment of the applied types of physical training and sports, which help to develop teamwork skills.

As they apply these forms and methods, many instructors, commanders and engineers employ a number of effective psychological and pedagogical techniques which stimulate the attention of the servicemen and help them assimilate the material studied. A description of the duties of a certain crew member, for example, is combined with an explanation of the actions performed by the other crew members with whom he will come into contact most frequently in the joint work. Special attention is devoted to analyzing the causes of errors on the part of other crew members. The instructors demonstrate techniques and methods of control and self-control, which is also highly beneficial.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

All of this not only improves the study of the material covered by the fighting men but also helps to develop such qualities as responsibility to the collective for their actions, readiness to help each other out, determination and boldness for functioning in a difficult or dangerous situation.

Veteran instructors and subunit commanders begin developing teamwork skills in the crew as soon as the members begin studying the arrangement of the aviation equipment and weapons and the principles underlying their combat employment. Special attention is devoted to the need for absolute observance of the requirements contained in documents governing flight work and to the inadmissibility of errors and carelessness in the operation and servicing of the equipment. This sort of focus in the training and indoctrination helps each airman develop a deep awareness of his personal responsibility for the performance of his service duty and for the insurance of flight-work safety.

The work performed to prevent deficiencies in the operation and servicing of equipment and weapons typically includes classes which cover the most typical kinds of failures of aircraft assemblies and instruments through the fault of the personnel, and cases of improper interaction among the specialists in the performance of a certain operation. Special training sessions are scheduled in some cases, which include hypothetical problems covering various types of equipment failures in flight. In this training sessions, the instructors point out possible failures of the aviation assemblies and instruments and the trainees describe the causes and what they are to do in such complicated situations. This is an effective method not only from the standpoint of improving the trainees' knowledge of the equipment design and the rules for operating it, but also from the point of view of developing collective thinking habits and skills in working together in various situations.

Experience has shown that the process of developing teamwork skills produces greater results when complex matters are broken down into more simple ones, into so-called algorithms of action. When an air interception is being covered, for example, attention should be given mainly to the following components: the search for the target, the approach to the target and the attack. It is important that the problem of interception first be analyzed as a whole, and then by parts, taking the peculiarities of each flight phase into account.

The results of observations of the crews and teams in the dynamics of flight work have an important role in their training. It is important carefully to plan the observation methods, to prepare for them and to analyze their results.

Having the crew members observe the specialists whose work is closely related to their own, as well as the crew and team commanders, is a proven observation method. On the psychological plane, this technique makes it possible for the trainees to form a complete and comprehensive picture of the work performed by the crew as a whole, to identify the specific techniques employed by their comrades and to compare those with their own capabilities in one

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complex situation or another, and to determine the best way to coordinate their own actions with those of other crew members in changing situations. Observation of the crew or team commander makes it possible to watch him work and to evaluate his performance, to adopt his expertise and to determine one's own place in the work of the team as a whole.

Such observations have a positive influence not only upon the effectiveness of the training process but also upon the development of teamwork behavior in the crew and team members. In the course of the observations the specialists accumulate a certain body of experience in teamwork, which provides the basis for developing confidence in themselves and in their comrades in the crew, and responsibility for the performance of their service duties, as well as emotional-volitional stability for working together.

Training sessions on special equipment and on the combat equipment itself have a large role in the development of teamwork skills in the airmen. The effectiveness of this training depends in the first place, upon the methods employed for conducting them, and, in the second place, upon how effectively the working conditions of crew or team members are modeled.

When they conduct this sort of practical training the veteran methods experts assign the crew or team hypothetical problems, even before the classes begin, and describe or reproduce training conditions approaching those of actual combat. In order to stimulate the trainees, each crew member is told the main moments in his joint work with the other crew members and techniques for personally controlling the performance of the operations, and specific periods are set for the performance of the exercises and are gradually reduced. The following methodological device has justified itself entirely from the psychological standpoint: During the practical training sessions the instructors have trainees with similar jobs replace each other and assign them hypothetical problems designed to encourage interaction among the crew members. This helps enliven the training process, on the one hand, and to develop the tactical thinking of the fighting men, on the other.

When teamwork skills are being developed on training equipment or on the combat equipment itself, the veteran commanders and instructors devote attention to the quality of the individual training, as well as to the correctness of the actions performed by the crew members, from the point of view of teamwork.

The fighting men also develop teamwork skills in the process of physical training and sports. These help the crew or team members to achieve a mutual understanding and to develop various types of sensomotor reactions, and the prolonged physical exertion helps them develop stamina.

The conduct of various types of exercises is an important stage in the development of teamwork skills and collective action in the airmen. They achieve their purpose only when they are carefully planned and conducted in a situation approaching actual combat to the maximum possible degree, when the fighting men perform at their full capacity and demonstrate initiative and persistence in the performance of the assigned tasks.

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Party-political work plays an effective role in the development of teamwork in the airmen. As they organize and conduct this work, commanders, political workers, party and Komsomol organizations keep the solidarity and efficiency of the crews and teams constantly in mind, help develop competition within and among them, summarize and publicize the experience of the best, and indoctrinate the fighting men in a spirit of friendship, mutual assistance and rescue.

In the outstanding units and subunits great important is attached to special measures to prepare the airmen psychologically to work together in difficult situations. Special stress is laid upon the thorough mastery by crew and team members of the rules for operating the equipment and weapons, the physical nature and the reliability of the protective equipment and precautionary measures to be taken when working with the equipment, and upon giving the crew and team members confidence in their knowledge and in the proficiency of each specialist.

The results of a survey of 50 pilots following their first flights on a new fighter are worth noting in this respect. The vast majority of them stated that during the period of preparing for the first flight they had been greatly concerned about the navigator's ability to perform his job successfully. This concern only began to abate after they had gone through joint training sessions on special equipment and in the aircraft cockpit, based upon the forthcoming assignment.

In conclusion, we should point out the fact that only a comprehensive approach to the training and indoctrination of airmen and consideration for their individual characteristics ensure the successful development of collective attitudes and teamwork skills in them.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Chapter VIII. CERTAIN ASPECTS OF MORAL-PSYCHOLOGICAL TRAINING OF FLIGHT SCHOOL CADETS

1. Training and Indoctrination—A Single Process

The training and indoctrination of the future air fighters begins the day the cadets arrive at the school. These are youth between 18 and 22 years of age. They have the psychological characteristics typical for that age, characteristics which cannot be ignored in the training and indoctrinational work.

The individual's transition from youth to maturity begins and the development of his nervous system is completed during this period of his life. The functional physiological processes occurring in the cerebral cortex at this age are very intensive, and interaction between the excitation and inhibitory processes is developing into a definite individual system. All of this produces a complex psychic personality structure in the cadet, primarily with respect to his active thoughts, emotional and volitional functioning. Together with this, we should stress the fact that at this age, due to the intensity of the biochemical and physiological processes occurring in the individual and to the fact that he lacks experience, the excitation processes still prevail over the inhibitory processes. This is sometimes precisely the reason for inconsistency of behavior, lack of restraint, emotional breakdowns and frustrations occur, even in highly disciplined and well-trained cadets.

The functional intellectual processes are well developed in the cadets at this age: they have good concentration and can switch it easily; they have good memory capabilities with respect to speed and retention; their imagination is distinguished by a rich diversity of combinations, vividness of images and sufficient realism; their thought process clearly reflects a tendency toward in-depth analysis and synthesis, abstraction and generalizations; and their speech is highly expressive and emotional. They only have to develop these qualities and skill as applicable to the specific nature of flight work. This applies, first of all, to the training of the memory for receiving and accumulating technical information, to the development of their ability to think in technical and tactical flight terms, the improvement of their capacity for combinatorial analysis for the multifaceted evaluation of the performance of complex aircraft systems and of the physical nature of the phenomena and processes underlying their functioning.

An important area of the cadet's training involves actively influencing the development and conditioning of sensomotor reactions and the formation of systems of logical structures for his intellectual activity (systems of technical categories and concepts, skills in the cognitive reading of blueprints, graphs, tables and diagrams, and the ability to utilize reference and technical literature intelligently) and of a qualitatively new basis for space-and-time orientation.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

On the social and political plane, air school cadets, like all Soviet youth, are oriented toward the future, have a desire to be among the front ranks in the building of the communist society and to fulfill their duty to the homeland with honor, and are highly active in public affairs. They have a correct concept of the world, as a rule, and are prepared to serve communist ideals. The public activeness of cadets is reflected in a demonstrated interest in problems pertaining to political life and in events occurring within the nation and abroad, in broad participation in the life and affairs of the subunit Komsomol organizations and in a responsible attitude toward the performance of their public assignments.

Air school cadets also have good morals. They not only correctly perceive the requirements made of them by communist morals, but also attempt to establish socialist communal standards in their practical affairs. Their high values and moral purity give the cadets a feeling of valid pride in the Soviet socialist way of life, and revulsion and contempt for perverse manifestations of bourgeois morals: servile accommodation, cowardliness, obsequiousness, egotistical endeavor and individualism.

The views and concepts of the cadets are not always adequately systematized, however, and not always completely cognitive. Because of this, it is sometimes difficult for some of them to understand the complex developments of life, to evaluate certain events correctly or to understand the prospects for their development. They frequently find it difficult to defend their views and convictions, to evaluate negative phenomena correctly.

Within a certain segment of the cadets one encounters individuals with inadequate moral upbringing. Their behavior reflects a lack of discipline, disrespect for work and training and disrespect for their comrades.

The existence of conflicts, uncontrolled spontaneity and deficiencies in the moral upbringing of a certain segment of the cadets makes it necessary for commanders and political workers to devote greater attention to the development of the young cadet's outlook, to provide them with political knowledge and a familiarity with the modern natural sciences, to guide the development of their interests and to promptly detect standards of behavior alien to our communist morals and help to overcome them.

Loyalty to military comradeship is a characteristic moral feature of most cadets. When a young man enrolls in a military school, it marks the beginning of his independent life. He lacks self-confidence, however, and only feels his independence in the society of peers. In addition, the newness of the military way of life and the enormous flow of training information to which he is exposed makes it necessary for him to unload psychologically, to share his impressions with someone and to convince himself as to the correctness of his behavior and his plans. In the military collective the cadets are united by common interests and emotional experiences, and the ties of friendship developed there are therefore especially strong ones.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Their youthful compulsion for friendship and their need to be a member of a collective form a psychological base conducive to the indoctrination of the cadets in a spirit of friendship and military comradeship and for the formation of solidly united military collectives. Relying upon such a collective, the commander and political worker campaign successfully against instances of egotism, mutual covering-up, individualism and other amoral developments.

The cadets have a highly developed sense of personal dignity and a desire to be independent. They are energetic and have a great deal of enthusiasm, many noble intentions and a desire to find their place in life as rapidly as possible, to make a favorable impression, to demonstrate their full capabilities. In order to convert these aspirations and this enthusiasm into stable personality features, however, it is important for the indoctrinational work to encourage in every way prudent daring and innovation on the part of the cadets, and they must be assigned responsible tasks, rejecting petty patronage. While respecting the self-esteem of the cadets and giving them scope to exercise their energy and initiative, however, we must not forget the fact that a feeling of personal dignity and a desire for independence can turn into conceit and vanity. In order to prevent this, it is necessary to be highly demanding of all cadets at all times, to teach them to analyze their actions and behavior self-critically.

The cadets' feeling of personal dignity and their desire for independence are inseparably linked with a clearly defined unyieldingness in their opinions. As a rule, their statements are categorical, and their opinions absolute. They always express their thoughts frankly. It is important to keep this always in mind, especially when the matter of erroneous views is discussed. One should show them their errors and refute their incorrect opinions convincingly and using concrete facts. In no case should crude pressure be used or one's authority brought to bear.

The cadet's psychic makeup may embody inconsistencies in the evaluation of facts and phenomena of reality and of their actions. Because of their limited experience the young cadets are not yet able to recognize their own capabilities sufficiently or to evaluate them objectively. They frequently evaluate their personal capabilities not from the results of their practical work but on the basis of superficial ideas about reality and about their capabilities.

It is extremely important to take this fact into account in the indoctrinational work. It makes it necessary for commanders and political workers to conduct explanatory work systematically and painstakingly, and with well-reasoned arguments. It is important to develop and improve the cadets' feeling of independence and personal dignity in the indoctrinational process. And from the standpoint of the cadets--future pilots--it is important that the development of these qualities be closely interwoven with the development of honor, integrity and sincerity.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Because of the age-group characteristics of their physiological and psychological development, young people are acutely perceptive, highly impressionable and emotional. They rapidly perceive and remember everything happening around them. Each failure or error leaves a large impression in their consciousness. A remark by an instructor or a commander frequently becomes a determining factor lasting months or even years. The cadets feel the pulse of life with extraordinary sensitivity and notice everything vivid, unusual or new. This is precisely what interests them in classes which are conducted in a lively and interesting manner and which provide them with new impressions and new knowledge.

The feel for the new and the heightened emotional perceptiveness of the cadets are linked to romantic aspirations. For the most part, the youth are bold and brave. Their feeling for the romantic provides the motivating force behind the creative activeness, bold plans, deeds and interests of Soviet youth. The flying profession has always attracted and continues to attract the youth with its romanticism and novelty and because of the great intellectual and physical demands it makes.

Cadets, who have dedicated themselves to service in the aviation, persistently develop such qualities as honor, nobility and valor, and they do not fear the difficulties and dangers involved in flight work. Many of them have a desire to test their strengths and abilities, to do something unusual, something heroic. This is frequently a source of inner preparedness to perform outstanding feats. This inner preparedness sometimes takes over the cadet's consciousness and helps him to function in complicated situations, resolutely, courageously and resourcefully, gives him confidence that he can achieve the planned objective and mobilizes his physical and spiritual strengths.

The cadet's romantic orientation only becomes a valuable quality, however, when it is combined with a correct understanding of the nature of heroism, bravery and valor, and with an awareness of the necessity of working persistently to achieve the goal he has set for himself. Otherwise, a desire for boldness may develop into a show of dashing behavior and braggadocio. Furthermore, a romantic inclination in cadets with inadequate upbringing and their daily sensation of continuously growing creative strengths and capabilities sometimes give birth to neolistic views on past experience and the merits of predecessors, indifference toward superiors and the emphasizing of their imaginary superiority over the latter. After becoming accustomed to flying the complex modern supersonic aircraft, for example, certain pilots sometimes develop contempt for everything pertaining to the piston-driven subsonic aircraft and to training on it.

Since an incorrect understanding of the romantic can give rise to incorrect behavior in some cadets, this phenomenon should receive close attention from all categories of indoctrinators at the school. It is important to channel the cadets' romantic inclinations into selfless service to the homeland, the responsible performance of their military duty, the overcoming of routine difficulties in the service and training, and a thorough and solid mastery of the knowledge and skills involved in flight work.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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An important area of indoctrinational work with air school cadets involves developing in them a love for the flying profession, for the combat equipment and weapons.

Many cadets have derived their ideas about the flying profession, the romantic nature of flight service and the modern combat equipment and weapons from books and movies and from stories told by their parents and their peers. These concepts are sometimes incomplete, artificially embellished or distorted, and the cadets may not expect the difficulties which they will encounter immediately after arriving at the school. This makes it possible to break down the cadets' psychological framework and permits them to reassess their life goals and reconsider decisions previously made. On the psychological plane, it is therefore extremely important to actively build in the future fliers a complete and objective concept of the nature and substance of flight work in the contemporary situation and a feeling of great responsibility for the exemplary mastery of the profession of a military pilot.

One effective means of accomplishing this involves the vivid and purposive publicizing of the combat traditions of military aviators, their courage and combat valor demonstrated during the years of peacetime construction and their combat trials on the battlefields, and explanation of the good combat capabilities of our Soviet-produced aviation equipment and weapons. For this purpose the schools schedule open-door days, exhibits of aviation equipment and demonstration flights at airfields for the young cadets. In many schools the cadets begin their acquaintanceship with the school by visiting museums of combat glory.

The method whereby, during the course of the training, the instructors introduce the cadets to the history of the development of aviation equipment and weapons, along the humanities and the technical disciplines, and tell about the heroic past of the aviation, has proven itself entirely. Such activities as readers' conferences on books about aviation, discussions on the subject "The Pilot--A Heroic Profession," evening competitions in knowledge of the aviation equipment, discussions on films about the lives and the combat service of aviators, and so forth, have proven to be an effective extracurricular means. All of these activities help to develop in the cadets a feeling of pride in the achievements of Soviet aviation and in being a member of the glorious family of winged defenders of the Soviet homeland.

2. Psychological Aspects of the Cadets' Training

The Instructor's Personality--An Important Factor in the Training and Indoctrination

The flight instructor has an exceptionally important role in the training and indoctrination of air school cadets. He is involved, more than anyone else, in the ground training of the cadets, their training in the air and the flight critiques, and constantly exerts an indoctrinational influence upon his students.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Astronaut and flight instructor G. S. Titov speaks of his instructor with great warmth and respect: "Captain Stanislav Ivanovich Korotkov was my instructor when I learned to fly the MiG's. He was considered one of the best methods experts at the school. He never judged people hastily, but studied them with great interest and tact. He thought deeply, was capable of subtle perception and knew how to talk with us cadets, who had still not experienced life, as equals. We loved and trusted him as someone very close. I owe a great deal to Stanislav Ivanovich Korotkov...."[14]

When he first joins a flight group, the cadet is especially interested in the instructor: his personality, his flying experience, his rating and a great deal more, because he is now linked with the instructor by invisible bonds of intimacy, collectivism and common tasks. And the success in the training and indoctrination of the entire flight group and the fate of each cadet depend to a great extent upon what kind of relationship the instructor establishes with the cadets. A cadet views the instructor not only as a senior chief but also as an individual in a position to issue him a ticket to the skies and to help him achieve the main goal of his life--to become a pilot.

Certain instructors do not always attach proper importance to the impression the cadet retains after his first meetings with his teacher in the ground training process, in the familiarization and first initiation flights, and make no attempt to put their best foot forward with respect to uniform, civilian clothing, manners and conversation. Naturally, this has a negative effect upon the training and indoctrination of the future airman and reduces the instructor's prestige.

In everyday life the instructor does more than just impart to the cadets his experience and knowledge and concerns himself for their all-round training, their intellectual, physical and aesthetic development and the development of psychological stability in them. He also strives to see that his students are fervent patriots, bold and courageous fighters of the air, kind and concerned people, demanding of themselves and those around them. The political-moral state of the cadets in the group depends to a great extent upon the instructor's political awareness and ideological conditioning.

It is an interesting fact that many cadets try to be like the instructor, to walk and talk like him and even to wear the service cap in his manner and adopt his interests. His every move is noticed by the cadets and the behavior of the cadets can be predicted from the instructor's behavior in various situations. This fully applies to the instructor's psychological traits and his emotional-volitional stability.

All of the cadets study aerodynamics, aviation engineering and piloting under a single program, they are equally fit medically and go through the ground training for flying together, but their piloting is not identical and they make various errors and master the various flight elements differently.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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This depends both upon the degree of the general development and training of the cadets and upon the focus, level and depth of their nervous and emotional stability, as well as upon the psychological and pedagogical training of the instructor and his ability to find a personal approach to each cadet and to achieve the best results in his training and indoctrination.

It is difficult, apparently even impossible, to develop a cadet into a real pilot if one does not know his character and temperament, the level of his knowledge, his psychological traits and the reliability of his volitional qualities, and if one does not find the one and only way to reach the individual's feelings and emotions, the only one which leads to success. The instructor studies the cadet's personality throughout the training period, from the first meeting to the final exam. He carefully observe the cadet's behavior in the classroom, during the ground training, in the air, on the athletic field and in his daily life. These observations make it possible to determine the merits and the shortcomings in the cadet's personality, to explain certain of his actions and the degree to which he is influenced by his comrades and the collective, the accuracy of his reactions to external stimuli, his ability to concentrate on the main thing, and so forth.

As he talks with a cadet, the instructor reveals not only the level of his knowledge and his general development, but also his psychological peculiarities, his activeness, the range of his attention and his ability rapidly to switch from one object to another or to external stimuli. The experimental method can be used in the work performed on a trainer and on the familiarization and initiation flights to determine the cadet's ability promptly to react to instrument readings and to various hypothetical problems, and to determine the degree to which he is capable of orienting himself in space, determining the earth's approach, and so forth. An analysis of the observations permits the instructor to work out methods and techniques for training the cadet and to make full application of his emotional-volitional qualities for the lasting mastery of flight elements and actions taken in complex situations and for increasing his interest in the pilot's profession.

The future pilot's moral-psychological qualities, as we know, are formed in the family, at school and in the collective, and the instructor should learn about his life and training before entering the air school. In other words, he should know the level of development of the cadet's psyche and his positive and negative sides from the standpoint of their influence upon the flight training and the indoctrination.

On Initiation and Checkout Flights

The first flights with an instructor, which give the trainer an opportunity to observe the trainee's control of the aircraft after this or that flight element has been demonstrated, are especially important for studying the cadet's psyche. The instructor takes into account the fact that a cadet may not notice everything happening around him on the first flights, and he therefore instills elements of organizational principles in the trainee's

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

perception capacity by focusing his attention upon the main and determining elements (upon the aircraft's position relative to the horizon in horizontal flight, upon coordinated manipulation of the controls on a turn, and so forth).

Errors committed at this stage should not bring an immediate reaction from the instructor and he should especially not react sharply to them. Errors are sometimes repeated flight after flight, and the cadet does not eliminate them even though the instructor has pointed them out. This can irritate the instructor, naturally, but he should try to restrain himself from raising his voice over the intercom, from jerking the control stick, and so forth, because it is not impossible that this will destroy the psychological rapport previously established between the instructor and the cadet. An emotional and easily offended cadet may withdraw, lose his interest in flying or his confidence in his own strengths and abilities, or even regret having chosen the profession of a pilot.

The instructor's every word and every action should be kind and comradely and should focus upon helping the cadet master the art of piloting an aircraft as rapidly as possible. It is important for him to notice all of the aircraft's deviations and point out the cadet's errors, but he should not bring them up over and over and should steel himself with patience and give the trainee the opportunity to notice his own errors and time to remedy them himself. Naturally, his tolerance of the cadet's errors should not go beyond the limits of flight safety.

On a flight, unlike the ground training, the instructor does not have the opportunity to explain everything in detail, and his speech is concise while saying a great deal, and forceful, which cannot help having an effect upon the cadet. Each word uttered by the instructor focuses the trainee's attention upon a specific object and then switches it to other instruments or control elements or to maintaining the flight parameters. At the highest point in a wingover, for example, the instructor focuses the cadet's attention upon the need to move the stick smoothly, reinforcing his words a demonstration of the proper actions, and later, after the maneuver has been completed, he has the opportunity to discuss in detail any error made by the cadet. The thorough analysis of the entire flight and the critique of the trainee's errors, however, are not conducted until the aircraft has landed and taxied onto the parking area. In this process, it is advisable also to stress the positive elements in the cadet's actions, which makes him feel better and increases his desire to learn to fly even better and more confidently. During the flight critique it is important to have the trainee mentally run through the performance of the assignment, which permits the instructor to analyze the flight phases in sequence and to determine the degree to which the trainee has mastered what has been covered.

Experience has shown that the majority of cadets master the flight elements rapidly in the beginning, and then the flight training process slows somewhat. This is perfectly natural, because in the beginning the trainee does not have

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to deal with the worst type of errors and masters the relatively simple flight elements without any special difficulty. Subsequently, he performs increasingly difficult missions, which require precise coordination and strict observance of flight parameters, that is, the application of complex skills. This frequently gives rise to constraint, awkwardness, uncoordinated actions, excessive concentration on one object, fussiness and a reduced memory scope, that is, to tension.

Tension is characterized by reduced efficiency and deterioration of the trainee's psychological functions, and by reduced reliability of aircraft and engine control. It is most frequently manifested on the first flights, when mastering new piloting and combat employment techniques, when retraining on new types of aircraft and on missions performed following lengthy breaks in flight work.

We should stress the fact that a purely mechanical approach to the training can result in a cadet's removal from the school for failing to progress in the flight training, due mainly to tension. This sometimes causes the concept "tension" to be surrounded by various conjectures, which distort the concept itself and create alarm, or even fear, in some young pilots. Experience has shown that tension is experienced in one degree or another by many airmen, including veteran pilots, but that it gradually disappears with subsequent practical training and flights, although it may remain with some pilots for a long time.

The following are the most typical causes of tension: the newness of the situation and the fact that the cadet's skills may not match the exercise being performed; peculiarities of the trainee's nervous and psychological makeup, specifically, the presence of a persistent state of heightened emotional excitability; a breakdown in the training methods, primarily involving premature complication of the exercise; inadequate consideration of the individual's psychological characteristics, an incorrect pedagogical approach to the trainee and lack of restraint on the instructor's part in their interrelations; a lack of confidence on the part of the cadet in his strengths and his ability to master the given type of aircraft, and a fear of washing out of the school for lack of progress.

It is important to consider all of these causes of tension in the training and indoctrinatin of cadets, and to endeavor to overcome the tension by means of additional exercises on a trainer, in the aircraft cockpit and during flights. It is crucial in the battle with tension to give the cadets confidence that they can successfully master the aviation equipment and to develop in them stable skills in controlling the aircraft in the air.

Veteran instructors do everything possible to make the cadets aware of the positive results of their work and to build up their confidence from flight to flight, from one training session to another. When flying together with the cadets, they help the trainees to distribute their attention properly, attempt not to mention the need strictly to maintain flight parameters too

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

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frequently, and avoid interfering in the control in the case of slight deviations of the aircraft. Those instructors are acting properly, who create a goal-oriented situation for the cadet on each flight, a situation helping him concentrate on individual flight elements ("Try to maintain precise angular speed on the bank," or "Do not bank more than required when executing a chandelle," for example). Special physical exercises with exercise equipment and fast-moving sports such as volleyball, basketball and soccer are also helpful for overcoming tension.

Encouraging a cadet promptly for any initiative demonstrated, providing him with the opportunity to convince himself as to the reliability of the equipment and its good controllability and gradually complicating the flight assignment conditions--these and other measures contribute a great deal to the rapid reduction, and then complete elimination, of tension in the trainees. In the case of temporary failures and lack of confidence on the part of the cadet while mastering the complex flight elements, the instructor carefully analyzes the causes and persistently seeks ways and means of making the training more effective and of stimulating the trainee himself to greater activity. In one case this may involve a new series of initiation flights, in another case--praise from the instructor, and in yet a third case--joint flights and talks with the flight commander or some other chief.

The tone of the discussion between the instructor and the certifying officer during the critique and evaluation of a joint flight is very important. Even if the cadet is adequately prepared for his solo flight, one must not blow up the psychological situation or exaggerate. It is best to conduct the critique of checkout flights so as not to cause the cadet to lose confidence that the solo flight will be a success. The certifying officer can give a cadet so much spirit and confidence, even after not entirely successful checkout flights, by saying "You will be flying!" and then telling the instructor "Let him make five or six more flights to polish up his landings."

When Working on Complex Flight Elements

Flight training experience has shown that it is fairly common for cadets to master fairly well takeoffs, turns, landing approaches and route flights, and then, as soon as he begins performing the actual landings, piloting maneuvers and other complex flight elements, he will display extreme caution, heightened excitability and, sometimes, even fear. The flight proficiency and attentiveness of the flight instructor, and his ability correctly to demonstrate one flight element or another are especially important in such cases. This determines to a great extent the cadet's first impression, which frequently becomes a determining factor in his subsequent training.

Each demonstration, followed by the cadet's own performance of the flight element, develops a skill in the cadet, and his mastery of the specific operation depends greatly upon the quality of the demonstration. The instructor's proficiency and his flight "style" are literally absorbed by the trainee and subsequently manifest themselves in his ability to pilot the aircraft on

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

his own. The skill is gradually reinforced and perfected. If, on the other hand, the instructor performs the demonstration with extensive deviations from standards, the development of the skill is drawn out or the skill developed is incorrect. Any change in a habit, any inclusion of new and influential elements into the established flight system creates additional difficulties for the trainee.

Any error or lack of consistency on the part of the instructor during the training period considerably complicates the cadet's mastery of the aircraft. This is especially intolerable when the cadet is learning such an important flight element as the landing. The complexity involved in mastering landings on a modern, high-speed aircraft is due in great part to the extreme effectiveness of the rudder and elevator. Even the slightest exaggerated movement of the control stick toward the pilot immediately results in a ballooning effect or a high leveling-off. This frequently creates emotional tension, excessive caution or even fear of landing in the trainee.

The complexity of landing training is also a result of the fact that it takes place so rapidly. There is a passage of only 8-12 seconds between the beginning of the leveling-off phase and the landing of a training aircraft. Consequently, there is a total of only 5-6 minutes for landing training during 40 initiation flights. At the same time, the total length of flights involving 40 takeoffs is approximately only 80 minutes. We can see that the ratio does not favor landing training. Landing time on a modern high-speed aircraft is even less than on a training aircraft, which makes it even more difficult to learn this flight element.

During the performance of landing training the instructor finds himself in a very complex psychological situation: He simultaneously determines the distance to the ground and the direction of the aircraft's movement relative to the landing strip, reduces engine rpm and the glide angle, observes the performance of the trainee and establishes the aircraft's landing position--all of this while communicating by radio and over the aircraft intercom system. Instructors lacking experience in this flight phase either perform the landing accurately but fall behind in their explanation of their actions over the intercom system, or, on the contrary, give good explanations but commit piloting errors.

An entire flight group of cadets will frequently execute the leveling-off for a landing too high or will overshoot. An analysis of the causes of these errors reveals that the instructor himself levels off too high and that the cadets in the group have adopted this error during their training. It is very difficult to alter an established dynamic stereotype, and any change made in it, as a rule, is a difficult emotional experience for the cadets.

Any instructor error ordinarily has a negative effect upon the cadet's psyche which is still not solidly formed, and complicates his formation of an accurate concept of this or that piloting or combat employment technique. It is sometimes difficult for him to form a mental picture of all of the elements

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involved in a piloting maneuver or a landing, since he has not seen them and has not experienced them as an integrated whole, within the dynamics of their performance.

It would be timely, at this point, to refer to an example given in an article by Major General of Aviation V. Filimonov.[15]

Instructor Klimov was once sent on an urgent assignment, and he hastily turned his flight group over to instructor B. When he made the transfer, he made the following statement: "All of the cadets are skilled fliers, but Litvinov is not quite as good as the rest." The new instructor had little time to acquaint himself with the cadets, and the very next day he began flights under the initiation program. It turned out that cadet Litvinov did, in fact, commit extensive deviations in the performance of certain flight elements and had not developed stable skills in making landing computations and performing the landing itself.

During a flight critique the instructor told the cadet: "If you continue to make such errors, you will never become a good pilot." This categorical judgment on the part of the instructor shocked the cadet and wounded his ego. A state of depression began to dominate over him. He lost interest in his chosen career. The quality of his flights deteriorated, and the cadet was on the verge of washing out at the flight school.

By this time instructor Klimov had returned from his assignment. He carefully analyzed all of the circumstances, revealed the real cause of the cadet's failures and resolved to achieve success. The instructor began giving the cadet special attention and performing extra work with him. He mainly focused upon the psychological conditioning of the cadet, however, and did everything possible in order to reverse his attitude and to develop optimism and confidence in him. The instructor's actions and discussions were kindly and demonstrated an interest in helping the cadet. During the training in the air the instructor was patient and commended his trainee for even slight success, but he gave instructions over the aircraft intercom system in a firm manner. The instructor's confidence spread to the trainee--the cadet overcame the psychological barrier and his flight training success began to improve noticeably. Most importantly, however, he became convinced that he could master even the most complex flight elements. Litvinov soon began to fly confidently on his own, gradually caught up with his comrades in the training and graduated from the school. Subsequently, good reports on the pilot began to come in from the line units.

The pedagogical error made by instructor B. had a harmful effect upon the cadet's flight training, and failure to take his personal traits and emotional instability into account almost resulted in the cadet's removal from the school. This example also illustrates the fact that a skillful instructor--and Officer Klimov is unquestionably such an instructor--highly skilled in working with the trainees on an individual basis, can localize and reduce the influence of a trainee's psychological deficiencies, and then gradually eliminate them.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

During the Solo Flight

The cadet's solo flight period, especially the first solo flights, is perhaps the most difficult in the psychological respect for any instructor. One can frequently see an instructor at the airfield, observing a landing by one of his cadets after a solo flight, whispering the words: "Reduce speed! Move the stick, move the stick! Hold it there! That's the way! Good going!" What does this mean? Is it an unhealthy thing? No, it is the instructor's natural psychological reaction, his emotional excitement produced, as they say, by the first test of strength by one of his cadets.

In each element of a flight, especially in a landing, the instructor witnesses the results of his work and sees with his own eyes how well he has prepared the trainee to perform on his own, how successful he has been in developing the cadet's emotional stability and volitional qualities.

It should be pointed out that the proper organization of the cadets' moral-psychological training is one of the most important conditions for successful solo flights and for success in all of the trainees' subsequent flight training.

The simple fact that there is no instructor on board and no one to advise the pilot or correct his errors in the air creates emotional tension in a cadet, tension which may fluctuate, now increasing, now decreasing, in intensity. This is a natural mental and emotional state in an individual who feels his increased responsibility for flight safety and for the quality of the flight.

Experience has shown that emotional tension can have a positive effect upon an individual's psyche, producing all-round stimulation of his volitional qualities. If on the other hand, as the flight continues, tension increases sharply and is accompanied by extreme anxiety on the part of the cadet, it can produce a sharp deterioration in the trainee's emotional stability and in his flying proficiency.

A cadet's psychological preparation for flying is begun long before the solo flight takes place. When the cadets are being taught piloting techniques, prime importance is attached to developing their confidence in the reliability of the equipment, in their own abilities and in the fact that the forthcoming solo flight will be a success. This is done by conducting demonstration flights and talks and by giving the cadet the opportunity to participate in the control of the aircraft and the engine. As the trainee masters the separate flight elements, the instructor periodically permits him to fly the aircraft himself. This helps him to develop certain positive reactions and the required level of volitional activity. As the cadet is permitted to fly longer and longer without interference on the part of the instructor, he gradually becomes accustomed to the feeling that he is capable of performing the flight elements, including the complex ones.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

As they talk with the cadets, the veteran instructors do not stress the exceptional status or the difficulty of the solo flight, although it does involve extensive emotional pressure and requires a certain level of piloting skill. They attempt to see that the cadets come to regard the solo flight as a routine flight, the only difference being that there is no instructor on board. Naturally, this is not an easy thing to achieve: No matter how he attempt to protect his psyche against external stimuli, the cadet will still become excited. It is desirable to reduce the emotional tension to the minimum, however.

As he prepares a cadet for a solo flight, the instructor takes careful note of his behavior, his mood and activity level and his interrelations with comrades. If he notices excessive nervousness, excitability or extreme concentration or distraction in the trainee, he has an obligation to postpone the solo flight, because the cadet is not prepared for it emotionally. The instructor must tactfully inform the trainee of his decision and provide good reasons, in order to avoid hurting him pscyhologically.

The cadet's personal confidence, based on actual readiness is an important factor in the overall system of psychological preparation to ready a cadet for his first solo flights. When asked, a trainee will sometimes tell his instructor: "I am not ready yet." Such an admission is convincing proof of the fact that an atmosphere of benevolence and frankness has been created within the flight group.

Cases of premature, false confidence also sometimes occur. This ordinarily happens when most of the trainees in a group are already flying by themselves, but one of them is still not adequately prepared for solo flights. His desire to solo as rapidly as possible begins to dominate his mind, and the cadet announces that he is ready to solo. In such cases the instructor should be especially attentive and should provide the cadet with practical proof that his declaration is premature--that is, on a joint flight. If the leveling-off altitude for a landing changes from flight to flight, for example, the instructor can tell the cadet something like the following: "You can see for yourself that your leveling-off altitude for landings is not constant. In my opinion, you are not ready for a solo flight. If you really want to solo, you can, after you have polished up your landings." An instructor's decision to forbid a solo flight, which is not backed up with proof, does nothing to stimulate the trainee's volitional and emotional qualities and does not motivate him to overcome the temporary difficulties as rapidly as possible and to master the most complex element of a flight, and sometimes, even destroys a cadet's positive frame of mind, gives him doubts and puts him into an asthenic state.

Astute instructors devote special attention to the creation of good psychological conditions when setting up the solo flight assignment. The instructor's every word and every gesture and the expression on his face should be filled with calmness, benevolence and confidence in the success of the assignment. Such behavior on the part of the instructor inspires the cadet, heightens his volitional activity and efficiency and puts him into a brisk and joyful mood.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

After the cadet has performed his solo flight, the instructor, naturally, wants to make comments and give advice. Experience has shown, however, that this must be done tactfully and precisely and must be backed up with solid reasoning. Such instructions as "Don't raise the nose wheel too soon," "Level off somewhat lower," and "Don't reduce speed too soon" can result in new errors, since the terms "somewhat lower" and "somewhat higher" pertain to the specific flight, and the cadet is accustomed to normal takeoff and landing parameters, to a routine altitude. If the flight deserves an overall positive rating, then it is best to refrain from making comments, because the focusing of the cadet's attention upon errors, given the considerable emotional tension which he is experiencing, can have a reverse effect. That is, it can produce other errors. If, on the other hand, the cadet himself points out his errors, then the instructor may make his own comments and give advice. Subsequently, as the cadet acquires skill and as his dynamic stereotype becomes formed, his errors should be discussed more openly and boldly, without fear of overloading the trainee's psyche. Naturally, however, this must be done tactfully, with good reasoning and without caustic comments.

A cadet's solo circular flights, flights to the zone and along a route, and then flights involving combat employment will become more complicated. This, given the proper performance of the program and a high level of demandingness on the part of superiors, helps to develop in the young airmen proper emotional stability and such qualities as determination, boldness, goal-orientation, discipline, initiative and independence.

As it sometimes happens, a cadet will pilot the aircraft well when performing a circular flight or when flying in the zone, precisely maintain the prescribed parameters on a route flight and confidently perform firing and bomging missions, but will lose his head and commit gross errors when the situation becomes complicated. What is the cause of this? It lies in the cadet's inability to control himself in such a situation.

The modern equipment is very complex, and it is not easy to operate. It is even more difficult for the pilot to control himself, however, especially in circumstances never before encountered by the individual. Self-control is based primarily upon will, that is, the "practical side of the consciousness," which implements the individual's plans and his determination to withstand an unexpected complication of the situation. In other words, the will is based upon aware control of one's actions and of behavior involved in the overcoming of barriers standing in the way of achieving the goal.

Volitional qualities are formed and developed in the training and indoctrinational process. Their development calls for political awareness and ideological conviction on the part of the airmen, a thorough understanding of their military duty and a desire to develop these qualities in themselves.

On every flight a cadet is affected by a large number of stimuli, which he is forced to synthesize in order to gain a picture of the overall situation.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

Because of the time limitation, an inexperienced airman is not always capable of coping successfully with this task. For example, he may not always be capable of mentally encompassing all of the objects in the cockpit, of reacting to the instrument readings, and so forth.

Training on the ground and in the air, designed to reduce the time required to perceive signals and respond in the required manner, gradually expands the cadet's attention range, and the stronger are his volitional efforts, the more rapidly will occur the "acclimatization" of the trainee's nervous and emotional capacity for functioning with a time shortage. Any deliberate acceleration of this process by increasing the duration and frequency of the training sessions can complicate the development of the required skills and qualities in the trainee. A planned and intelligent increasing of the duration and frequency of the training sessions will help to develop the cadet's concentration and thinking and to form the required conditioned reflexes and improve his volitional qualities.

The cadets experience especially great psychological tension when they perform combat employment exercises: aerial combat, firing at ground targets, and bombings. The volume of incoming information increases sharply in such situations, flight speeds and altitudes change rapidly, and responsibility for flight safety increases due to the existence of ammunition on board the aircraft. While, as a rule, the cadet has previously dealt with optimal flight conditions, now, as he trains in the combat employment of the aircraft, he may encounter extreme flight conditions. And the young airman experiences great emotional tension when firing at ground targets or performing bombing practice involving complex maneuvering, with the rapidly approaching earth visible through the windshield.

The psychological tension experienced by cadets when training in the combat employment of the aircraft can sometimes approach maximum or even a prestress condition. It is therefore exceptionally important for the instructor to have a close psychological rapport with each cadet in his group during this phase of the flight training. If a climate of openness and benevolence has been created within the group, then an airman returning from a flight is not embarrassed to talk about what he has encountered, felt and experienced in the air. He knows that his frankness will not bring a reproach or a "dressing down" from the instructor, that his senior comrade will help him and his comrades. The instructor only has to forget tact or to condemn a cadet, and the latter will withdraw, and invisible wall of alienation will spring up between them, a wall which can only be broken down with a great deal of effort and time.

As the cadets' solo time builds up, they begin to demonstrate individual piloting techniques--their own "style," as it is referred to. Certain of them will take the aircraft into a turn with a considerable bank, for example, while others will keep the target within the sight not just by means of the foot controls, but with the levers as well, during a dive when firing at ground targets. This is only natural, and each individual should

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

not be required to copy the instructor's flight style precisely. Naturally, the manifestation of individuality in piloting techniques should not be permitted to go beyond the bounds of flight safety.

The instructor is not simply an observer of all this. He tactfully and insistently directs the cadet's work and his increased activeness and confidence, points out and encourages diligence and initiative on the part of the trainee, and makes increasing demands of him. In doing so, the instructor helps to stimulate the cadets' professional activity and their desire to accomplish the flight training tasks successfully.

In the process of training on a new aircraft the trainees encounter both successes and failures. The joy derived from a flight well performed can give way to disappointment following an unsuccessful landing. Each individual experiences both success and failure in his own way. The more emotional an individual, the more vividly is manifested his attitude toward the rating of his work. An indifferent individual rarely becomes excited, he barely shows his feelings, and they are superficial and quick to pass. It is the instructor's duty to concern himself constantly to see that each cadet begins the day in a good mood and with a desire to perform any flight assignment in the best possible manner. Joking, a brisk word or a word of comfort, a voice reflecting confidence and firmness and joy at the prospect of meeting the sky, the romanticism of flying, a feeling of closeness and oneness with the machine, and a spirited mood on the part of the instructor himself always have a positive effect upon the emotional state of the cadets, heighten their activeness and stimulate the application of their volitional qualities.

FOOTNOTES

1. "Materialy XXV s"yezda KPSS" [Materials of the 25th CPSU Congress], Moscow, Politizdat, 1976, p 83.

2. A. Yakovlev, "Tsel' zhizni" [The Goal of a Lifetime], Moscow, Politizdat, 1966, p 431.

3. AVIATSIYA I KOSMONAVTIKA, No 2, 1971, p 14.

4. AVIATSIYA I KOSMONAVTIKA, No 1, 1971, p 12.

5. V. I. Lenin, "Poln. sobr. soch." [Complete Collected Works], vol 41, p 121.

6. Ibid.

7. "Materialy XXV s"yezda KPSS" [Materials of the 25th CPSU Congress], Moscow, Politizdat, 1976, p 74.

8. Ibid., p 76.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100026-1

9. Ibid., pp 74-75.

10. Ibid., p 75.

11. A. M. Gor'kiy, "Sobr. soch." [Collected Works], vol 18, Gosudarstvennoye izdatel'stvo khudozhestvennoy literatury, 1955, p 267.

12. A. Saint-Exuperi, Selected Works, Moscow, izd-vo "Khudozhestvennaya literatura," 1964, p 590.

13. M. L. Gallay, "Cherez nevidimyye bar'yery. Ispytano v nebe" [Through Invisible Barriers--Tested in the Sky], Moscow, "Molodaya gvardiya," 1965, p 107.

14. G. Titov, "700,000 kilometrov kosmose" [700,000 Kilometers in Space], Moscow, izd-vo "Pravda," 1961, p 34.

15. AVIATSIYA I KOSMONAVTIKA, No 8, 1973, p 18.

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