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AIR DEFENCE IN NORTHERN EUROPE

Heikki Nikunen

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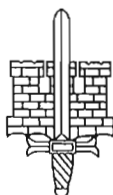
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AIR DEFENCE IN NORTHERN EUROPE

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INTRODUCTION

The historical progress of air power has shown a continuous rising trend. Military applications emerged fairly early in the infancy of aviation, in the form of first trials to establish the superiority of the third dimension over the battlefield. Well-known examples include the balloon reconnaissance efforts made in France even before the birth of the aircraft, and it was not long before the first generation of flimsy, underpowered aircraft were being tested in a military environment. The Italians used aircraft for reconnaissance missions at Tripoli in 1910-1912, and the Americans made their first attempts at taking air power to sea as early as 1910-1911.

Aviation technology was still taking its first steps in those times, however, and progress was hampered by all kinds of prejudices. Thus, when the First World War broke out, none of the combatant nations had any clear air doctrine or material readiness to assume dominance of the air. But once the initial experiences and results had been acquired, the development which had started gradually then accelerated at an astonishing tempo. Reconnaissance missions were again the natural first area of application for the new branch of the military services, and it proved so successful, and on the other hand so annoying, that some kind of anti-aircraft action was needed. The first weapons, personal pistols issued to the pilots or navigators, were soon replaced by heavier weapons, mainly machine guns mounted over the upper wing or shooting backwards from the rear cockpit. The most decisive instrument of airborne warfare, the fighter, had been born.

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The problem with the first fighters was to create an effective and accurate way of shooting forwards from behind the propeller. One solution was a pusher engine, but aircraft of this type seemed to suffer in agility and speed. A French Lieutenant by the name of Garros then introduced a straightforward innovation; he mounted metal wedges on the propeller blades and shot through the rotating propeller. The bullets hitting the blades ricocheted aside, and although the propeller lost some of its efficiency, the first breakthrough in air combat had been made. Soon came Anthony Fokker's synchronized machine gun, air battles became fierce and the first aces emerged. Along with the development of new aircraft types and weaponry, new applications of air power grew up, and by the end of the First World War practically all the contemporary methods of air warfare were already in use. In addition to fighter and reconnaissance missions, bomber and ground attack operations were being carried out, and even the first interceptions from an aircraft carrier were being made. By the final phase of the war, top speeds had risen to about 200 kilometres per hour, maximum altitudes to about 6000 metres and the engine sizes to between 200 and 400 h.p.

The aviation technology had opened up quite new possibilities for military applications of flying by the time the Second World War broke out, but again air doctrines were premature and it was only through the experiences of war that commanders learned the right priorities and were able to develop the right kind of material and equipment. Air superiority proved to be of overwhelming importance, and the need for concentrated, flexible air operations became apparent. By the end of the war the speeds of propeller aeroplanes was about 600 kilometres per hour, they were flying at over 10,000 metres and engine power was in excess of 2000 h.p. Some types of jet aircraft had also become operational, with top speeds of about 900 km/h, and the basic structure of contemporary surveillance and control systems was already in existence.

The Cold War, with its accent on nuclear weapons, directed military aviation technology into a rather narrow planning sector. Strategic nuclear bombers on the offensive side and supersonic interceptors with missile weaponry on the defensive side dominated both operational and technical thinking. High and fast were the keywords of the day, and traditional fighter virtues

such as agility and cannon power were dropped. But once more the doctrine was far removed from the reality. The various wars and conflicts taking place in the real world fairly soon taught people the lessons which had actually been there to be learned all the time. Air superiority had to be won before any other successful operations could be carried out, and it had to be won with fighters. The fighter pilots had to master combat tactics and manoeuvring, and the fighter planes had to be capable of both interception and dogfight.

The Persian Gulf War was the first in which air strategy, training and equipment were on a level with technology (cruise missiles and stealth included) and the objectives of the war,^{2,3} but this applied only to one side, the coalition. This was why the final result and the pace with which it was achieved were so overwhelming.

From its futile start just over eighty years ago, air power has become the dominant factor in warfare,³ and therefore every nation interested in guaranteeing its independence and sovereignty, has to take a hard look at its air defences and make sure that its forces are well trained, modern and ready to take up the challenges of an always insecure future. This overview will be concerned with the air defence status of Northern Europe. It examines first the general role of air power, then its historical development, followed by contemporary solutions and the future expectations of selected countries. For the reasons of scope it is limited, in alphabetical order, to Finland, Norway, the north-western part of Russia and Sweden. Much of the text is based on the author's unofficial files, collected from various public sources.

The Role of Air Power

Like the technical development of aviation itself, the strategic value of the air power has been increasing steadily and continuously. Also, like technology, it has been a target of many suspicions and prejudices. Probably the most widely known case is the court-martial in 1925 of General Mitchell, who forecast the increasing value of air power and arranged a bombing test which was so successful that, ironically, he lost his job and his rank.

Air operations were helpful in the First World War but not decisive. The continuous flow of information acquired by photo and visual reconnaissance flights for the support of intelligence and targeting proved to be invaluable, and air superiority was essential for various operations, but it was not yet a prerequisite for success on land or at sea. The bombing raids were of little military importance, due to the limited payloads, but they had some psychological effect, especially among the civilian population, and the ground attacks used in the latter part of the war lacked any real punch because of the small calibre of the guns and grenade-sized bombs. Nevertheless, air operations had proved their value in battle and no intelligent commander could imagine facing a fully equipped enemy without air assets. On the other hand, most of the high-ranking officers still regarded air actions as hobbies for enthusiasts who were bringing some rather disturbing ideas into the military community.

The Second World War led to a vast transformation in terms of both attitudes and results. The major powers had different philosophies regarding warfare in the about the air. Germany and the Soviet Union maintained their air forces in tactical roles, while the USA and Great Britain started to widen their scope to include strategic missions. One new feature became common everywhere in the course of the war: that air superiority, or the ability to deny one's opponent air superiority in the critical phases of operations, proved to be necessary in order to carry on any land or sea operation. This was true from the standpoint of both defence and offence.

One of the defence examples that has been spoken and written about most is the Battle of Britain. After the rapid capitulation of the Low Countries and France, Germany was ready to conquer Great Britain, whose land defence was in ruins after the hasty evacuation from Dunkirk. However, there was still one obstacle before Operation Seelöwe could be launched. Air superiority over the channel and southern England was deemed necessary for this complicated sea and land effort. Germany regarded this as a fairly easy task after the Luftwaffe's quick victories in Poland, Holland, Belgium and France, but the Royal Air Force had already started its preparations for defence during the French campaign, refusing to commit any more forces to that lost cause and setting about strengthening its fighter

defence. One great advantage, the importance of which the Germans underestimated, was the home chain radar network, which gave the RAF a means of early warning and effective ground control. The number of trained pilots became the critical factor for Great Britain. The margin was extremely narrow, but it survived the test, and the invasion plan was shelved; for ever, in fact. The fighter pilots had saved the country and Churchill pronounced his famous words: "Never in the field of human conflict was so much owed by so many to so few."¹

Famous examples of offensive actions include the Battle of Midway in the Pacific War and the Normandy invasion and subsequent attack on Germany. Once Japan and Germany were no longer able to deny their opponents air superiority, final defeat was only a question of time.

In the course of the Second World War air power consolidated its status as an equal military branch with the others, and in many countries it was only after that that the air force became independent and its leadership could properly apply the methods called for by the special characteristics of air operations. More importantly, it was only then that the political leadership of many countries realized that air power would be a dominant factor in security policy in the future and was prepared to invest in it to any substantial extent. History since that time has shown that these investments were justified, and the countries concerned have come out on top in most subsequent wars and political conflicts.

The conflicts that have occurred since the Second World War have been very variable in scale and nature, and therefore also in the use made of air power. The Korean War was a small-scale extension of the Second World War in a sense, in which jet fighters dominated the sky and the United Nations' troops typically made heavy use of close supporting fire from the air even in the case of pinpoint targets on the front line. Military success in the various short skirmishes in the Middle-East was also closely connected with the ability to maintain air superiority. The Vietnam War was probably the most seriously misinterpreted campaign in military history. The misuse of military power, and especially of air power in this case, was in many circles, including professional ones, wrongly understood as underlining the unsuitability of the equipment and incompetence of the

organizations, which had actually been given a military task without permission to carry it out by sound military methods. Tactically, however, Vietnam opened the eyes of the fighter community throughout the world and caused both training and fighter technology planning to return to the right priorities, which had been somewhat forgotten in the shadow of the Cold War.

The extreme ends of the scale of air operations are guerilla warfare on the one hand and air strikes on the other. The former leave little room for high technology participation in isolated skirmishes fought out with small arms, whereas air strikes are the ultimate display of air power in which the only active combatant unit on the offensive is the air component. The objective usually is to destroy a limited target or to enact some form of political punishment by eliminating a system or function belonging to one's opponent. Air strikes typically involve a high level of training and a sophisticated level of weapons technology.

The Gulf War was a new turning point in military history. Where air superiority had become a prerequisite for carrying out land and sea operations in the Second World War, the continuing upward trend in development had now reached the point where air superiority was a prerequisite for winning the war. The decisiveness of the air operations from the point of the initiative as a whole and the final result of the campaign was proved with exceptional clarity. It should be remembered that the defeated party possessed formidable forces, including a large army with modern equipment and weaponry. What was lacking was the right philosophy of air warfare and an appreciation of the decisiveness of air power. Without knowing it, the Iraqi leadership was doomed to lose the war before they had even started it.

Many of the countries belonging to the coalition were ones that had witnessed the rise of air power from the early days, and neither the manner of operation nor the outcome was any surprise for their leaders and managers, in fact it was to be anticipated on the basis of the pre-war simulations and exercises. The biggest surprise, in effect, was the low casualty rate among friendly forces.

On the other hand, the prompt results achieved by air operations were too much for the conservative officer cadre in some countries, and all manner of "nuts and bolts" explanations were developed to play down the overall effectiveness of the air

component, mainly related to the environment, the landscape, unsatisfactory probabilities of hitting the designated targets, weather and so on. However, there was no avoiding the truth that if a party to a modern conventional war is not capable of fighting successfully in the air, he no longer has fighting units but only target units. No two wars are alike, and the tempo of operations, loss rates, geographical and weather conditions etc. can vary on wide scale, but that one unavoidable truth will remain.

The high value of air power has tempted many into both false expectations and mismanagement. The contemporary conflict in Bosnia is one example of a situation which is difficult in terms of international crisis management. There are so many parties involved, the causes and motives are complicated, and there are no strategic advantages to encourage a commitment from outside. A certain mishandling of the problem of the Vietnam type was discernible in the United Nations' attitude when threatening the Bosnian Serbs with air strikes if they failed to observe the cease-fire agreement. The goal of the operation was obviously unclear, the target priorities were arguable and the will to carry out effective, destructive raids was lacking. The Serbs interpreted it as representing the familiar pattern of tough talk followed by back-peddalling and inaction. As a senior staff member at RAND, Dr. Lambeth, said: "If you want to send a message, use Western Union."⁴

Finally, the more solid NATO commitment brought the use of air power closer to the right principles. The parties in the conflict were given a foretaste of a real determination to use air strikes as military methods for eliminating unyielding elements in the game, by hitting command bunkers, radar and control centres, munitions and ammunition storages and bridges, rather than indefinitely warning the stubborn players. This worked, for the Bosnian Serbs realized through these examples that if NATO was serious and ignored human shields and revenge casualties on the ground, the Serbs would no longer be anything more than sitting targets. This led to conclusion of the most promising peace agreement so far, although the deep wounds already made will still need an indefinite time to heal.⁴⁴

The mismanagement of air power is an old military sin, and astonishingly enough, effort in this direction continue to pop up

time after time in military circles. Perhaps the most colorful description about the desire to control the air power is given by Gregory Boyington, who was one of the American voluntary pilots with the "Flying Tigers" in China in 1942. There was his boss Chennault plus General Stilwell and another general, who both outranked his boss but were still without combat troops of their own. Tells Boyington: "The manner in which these three argued over control of this handful of pilots impressed me much the same as three whores would have - arguing over their virginity. The combined stars upon their own shoulders were as numerous as the combat pilots they happened to be arguing about. And apparently we pilots weren't to be consulted."⁴⁵

The correct concept has been learned by the always reliable try and error method in numerous wars, but peacetime formality often pushes the lessons of the real world into the background. Air Marshall Tedder's words that "the aircraft doesn't know any other boundaries on land or sea than those which are dictated by its radius of action", give a clue to the right principle. Concentrated control of forces, decentralized and flexible operational systems and coordination with other branches are the key to the correct management model. In the dynamic, three-dimensional conflicts of today, and especially those of the future, all branches are important, and good cooperation between their highly specialized leaderships is essential. There are still some officers who are speaking of a "main" branch, implying some permanent priority status. Such statements tell us more about the speaker than about the subject. The role of each branch depends on the situation, and the main role can change many times during a prolonged campaign. The only branch that is able to claim some kind of permanent main role is the air force, for it is the only one capable of purely independent operation. The others will always need air support in any major action.

The strategic value of the control in the air will increase further in the future, and with it the role of air power as a whole, and thus air defence will be crucial to any country's effort to deter violations and avoid crises in its territory and airspace.

AIR POWER BEFORE WORLD WAR II

Finland

The Finnish Air Force was founded on 6 March 1918, and its first aircraft was donated by a Swedish count, Erik von Rosen, and bore his own personal insignia, blue swastikas, painted on its wings. This was the origin of the first official Finnish Air Force markings, which thus have nothing to do with the Nazi swastikas of the 1930s.

There was one exceptional feature in the founding of the FAF, that it was organized right from the start as an independent branch of the armed forces. This foresight on the part of the Supreme Commander, Mannerheim, created a good basis for its development and made it one of the oldest air forces in the world.

The FAF flew its first combat operations in the War of Independence in 1918, its main missions being reconnaissance sorties, with equipment that included a modest total of 19 Thulin Parasol, Albatros, Friedrichshafen, Rumpler, D.F.W.C.V and Nieuport aircraft.⁵

In summer 1918, after the War of Independence was over, the FAF was organized into five air stations, of which three acted as training centres as well. Because of the enormous number of lakes in the country, sea planes were regarded as the most suitable type of aircraft, thus four out of the five air stations were in effect sea plane harbours. All of the stations were located in southern Finland, as their main mission was surveillance and in this way the network served well to cover the Gulf of Finland and Lake Ladoga areas. The total number of aircraft was increased to 31, representing 14 different types.⁶ This variety was to prove a fairly permanent problem in later times, especially for the FAF technicians.

New proposals were made in the early 1920s to organize and strengthen the Finnish Air Force in order to be ready to take up the challenges emerging in international military aviation. The Commander drew up a development plan according to which the FAF should have 15 fighter squadrons, 10 reconnaissance squadrons, 8 ground attack squadrons and 8 bomber squadrons, to a planned total of 315 aircraft. A competing plan devised by

British specialists put greater emphasis on the offensive squadrons, especially sea planes.⁶ The small number of existing air bases, the ubiquitous presence of lakes and the dominance of sea operations in a British context had obviously left their mark. The FAF Commander's plan was much more up to date than the British proposal, but the real arbitrator proved to be the lack of resources, which effectively compromised any development plans.

The next attempt was made around 1930, when a plan for 17 squadrons was proposed, with a total of 221 aircraft.⁶ This had been influenced by the international trend which favoured an offensive role for military air power. The earlier predominance of fighter aircraft in planning had relax to create some room for bombers as well. Air warfare was still too distant a subject for either the military or political leadership to appreciate, however, and yet one more plan was more or less buried. The total complement of the FAF in the early 1930s remained at around 80 aircraft.

When General C.G.E. Mannerheim in 1931 was appointed Chairman of the Defence Committee in Finland, he initiated a thorough investigation into the status of the Finnish Defence Forces. He was one of the military leaders who foresaw the importance of air operations in future wars and therefore set about improving the combat potential of the Air Force. The international fashion for bomber dominance was criticized by a group of fighter pilots, who started to oppose the offensive ideology and to emphasis the importance of air defence in any future war. They were able to achieve positive results in the priorities assigned to the purchase programmes, to the extent that the five-year programme of 1937 included 11 squadrons comprising 81 fighters, 27 bombers, 52 reconnaissance and light ground attack planes for liason with the army and 13 maritime reconnaissance aircraft.⁶ War was about to break out by this time, however, and the armament programme was very much unfinished. Even so, the fighter leaders had developed and practised a Finnish blend of fighter tactics which proved to be justified in the harsh test of air combat.⁷ The use of formation tactics and emphasis on individual precision in air-to-air gunnery were important force multipliers against the superior numbers of the enemy.

The organization of the FAF in 1938 was:⁶

- Air Force Headquarters, Helsinki
- 1 Wing
- Staff, Suur-Merijoki
- 10, 12, 14 and 16 Reconnaissance squadrons, Vyborg and Sortavala
- 2 Wing
- Staff, Utti
- 24 and 26 Fighter squadrons, Utti
- 3 Wing
- Staff, Immola
- 44 and 46 Bomber squadrons, Immola
- 36 Maritime squadron, Santahamina (Helsinki)
- Air Academy, Kauhava
- Technical School, Santahamina (Helsinki)
- Air Depot, Tampere

The State Aircraft Factory in Tampere had planned and manufactured several original aircraft types and was building Fokker DXXI fighters and Blenheim bombers, for example, under licence.

When the Winter War began on 30th November 1939, the FAF had altogether 114 aircraft in its possession, but almost a half of these were obsolescent. Thus the nation was placing its pilots in a most difficult defence position. Their motivation and fighting spirit were high, however, and the training provided in both the FAF and the voluntary Air Defence Association gave a good boost to their morale. Also, the people at large lent both psychological and material support. The various collections of money by students and other groups materialized in the form of donations of aircraft to the Air Force, and a special Academic Air Defence Organization was founded in addition to the existing Air Defence Association to support the Air Force.⁶

Anti-aircraft artillery was first considered by the Finnish Defence Forces in 1921, when an artillery committee considering anti-aircraft defence decided that 21 batteries were needed to protect the front-line troops at the centre of the defence. This proposal did not lead to any action by the general staff, however, and remained in existence on paper only.⁸

The next time that the question of anti-aircraft artillery was

raised was in a meeting of the Defence Rationalization Committee on 26th November 1923. The need to organize this new branch of artillery and acquire the proper weaponry was identified and calculations of the material needed in wartime were made.⁸

AAA training started on 1st July 1924, and the first anti-aircraft battery was founded on 18th June 1926. By 1928 three anti-aircraft batteries were ready, belonging to the coastal and field artillery divisions. This arrangement caused certain discrepancies in cooperation over training methods and development priorities, and thus the three batteries were eventually combined in 1930 to form an anti-aircraft artillery battalion, which then became an anti-aircraft artillery regiment in 1934. Purchases of anti-aircraft weapons were small, however, and lagged behind the development plans.

An additional separate Anti-Aircraft Artillery Battalion was founded at Suomenlinna (Helsinki) in 1938, and all anti-aircraft troops were subordinated to the Air Force. The basis for an integrated air defence system had been created and the principles for its organization had been brought up to date, but for practical reasons, considering the time needed for equipping, training and fine tuning a technologically complex branch of arms, these actions had come too late. The anti-aircraft artillery was still materially in an early phase of its development in the autumn of 1939.⁸ Since aircraft purchases had also been slow on account of the general underdeveloped nature of the defence funding, it was no wonder that the war was to face both the political and military leadership with a rude awakening.

Norway

Military aviation in Norway began in the spring of 1912, when the Stortinget donated funds for Norwegians to participate in flying training in France. The first group included three Army officers and one from the Navy. A group of Norwegians who lived in France donated them a two-seater Farman reconnaissance plane. After two month's training, the officers gained their pilot's licences and returned to Norway. The aircraft, called "Ganger Rolf", was flown to Hedmarken and the flight served as a reconnaissance mission in connection with an autumn military

exercise. The army built its first air station at Kjeller, where two more Farman donations were located.¹²

In April 1912 five Navy officers bought a German single-seater Taube aeroplane. At first it took off from a field, but later it was installed on pontoons and moved to Horten. This sea plane, given the name "Start", was transferred to the state inventory, and marked the beginning of naval aviation.¹²

Aviation attracted increasing interest once the First World War had broken out. The Army and Navy both established their own aircraft factories, and both branches also had their own flying schools.

Both factories manufactured several original Norwegian models of aircraft during the 1920s and 1930s, and many foreign types were also built under licence.¹²

The Army Flying Corps and the Navy Flying Corps lived more or less separate lives in the years between the wars, for it was believed at that time that the Navy and Army had quite different needs. Navy pilots shared responsibility for the defence of the coast, while the Army Flying Corps mainly operated observation planes and a dispatch service for Army units in the interior.¹³

The question of whether there should be one or two flying corps had been discussed during World War I and was brought up repeatedly over the years leading up to World War II without any final decision being made. In the mid-1930s the Army had a total of 72 front line aircraft, including Gloster Gladiator fighters, and the Navy had 64 pontoon planes. When World War II broke out in 1939, the Norwegian Armed Forces had already ordered new, modern fighters, but they had not yet been delivered. The Navy had received six Heinkel 115 torpedo bombers,¹³ and the Army had an organized air defence consisting of over twenty anti-aircraft artillery batteries.¹⁸ The post-World War I trend of international pacifism, which left Europe very vulnerable and became one of the major causes of the Second World War by giving Hitler his initial easy victories, had also had some effect in Norway, in addition to which the separation and subordinate positions of the two flying corps did not provide the best possible basis for considering seriously the special characteristics of air warfare. Thus the air defence system was not tuned to maximum readiness when the Germans mounted their surprise attack on 9th April 1940.

The first military aviation schools in Russia were established at Sevastopol, in the Crimea, and at Gatchina, near St. Petersburg, in 1910, and the branch continued to develop between then and August 1st, 1914, when Germany declared war on Russia, but too slowly to meet the demands of a major war. During the pre-war period Russian military commanders preferred to purchase French aircraft such as Farmans and Nieuports, and they also acquired planes from Britain, Germany and the United States, but in smaller numbers. American Curtiss hydroplanes became popular in the naval air units after 1911, however. Domestic production was limited to foreign types, except for a few designs produced in St. Petersburg. Up to 1913, when Sikorsky demonstrated his four-engined transport plane, "The Grand", weighing 9,000 lbs, the aircraft consisted of single-engine biplanes and monoplanes, for most aviation specialists considered larger models impracticable. By the outbreak of war the Imperial Air Force had acquired two four-engined Sikorsky planes.

The Russian aviation industry grew from a few small factories in 1910 to a total of from ten to sixteen airframe and aircraft engine manufacturers during World War I, employing 10,000 workers and technicians. The foundations of the industry in Russia were laid by French firms and French capital, but most of the factories were hardly more than workshops. The largest comprised the French firm of Duks, founded in Moscow in 1910, the Russian-Baltic plant in St. Petersburg; and the Gnome Rhone engine plant, built by a French company in Moscow in 1912.

Following the outbreak of World War I, the Russian Government made greater efforts to expand and modernize military aviation. One Western European source of information maintains that a total of 1,769 airframes and 660 aircraft engines had been built by 1916, and another reports that Russia produced from 1,500 to 2,000 planes in 1917. One Soviet source has stated that the average output during World War I was from 230 to 380 planes a month, but reports from American observers in Russia at the time suggest a lower approximate figure, indicating that from 800 to 1,000 aircraft were built in 1917. In any case, total wartime production has been estimated at about 4,700 aircraft.

The disintegration of the combat capabilities of the Russian

armed forces, including the Imperial Air Force, began during the early months of 1917. Following the March Revolution, which transferred power to Prince Lvov and later to Kerensky, air operations gradually came to a standstill.

Almost immediately after the overthrow of the Kerensky government, the Bolsheviks determined to establish a military air force to defend their victory in the October Revolution and, wherever possible, to extend its scope. Many of the political and military leaders of the new regime, including Lenin, were apparently impressed with the potential value of air power, not only as a military weapon to be used against both foreign and domestic enemies but also as a political and economic means of consolidating and expanding the Soviet system. Although the obstacles were formidable, circumstances provided later opportunities for political and military expansion, many of which the Soviet leaders exploited.

The first attempts to organize aviation units were made within the disintegrating structure of the Czarist Army and Navy and through local soviets, revolutionary committees and military bureaus. Petrograd and Moscow were the principal centres for the formation of the first Red Air Fleet elements from the beginning, however, and the centralizing authority emanating from Petrograd at first and later, after March 1918, from Moscow, asserted control over the local initiatives and prepared the way for the establishment of a Central Administration of Workers and Peasants Air Fleet.

The principle of collective leadership was retained until 1924. A Field Administration of the Air Fleet was established in September 1918 and attached to the Revolutionary Military Council, but the Air Fleet was not directly represented on the Council for several years. The Field Administration exercised operational command over all air units of the Red Army.

The total number of aircraft in units of the Red Air Fleet increased from about 140 in July 1918 to 350 by the end of 1920, when the Civil War ended in western Russia, although a great many planes were unserviceable by that time. By the time the Japanese left Vladivostok in October 1922 the number had risen to about 400 planes. From December 1920 to the end of 1922, Russian aircraft strength was replenished primarily by imports from Germany, Italy and Holland, and possibly also from Britain,

as well as by the production of Russian models based on foreign types. The aircraft importation programme begun at that time received priority attention during the succeeding NEP (New Economic Policy) period, and by the end of 1922 it was possible to assign several hundred planes that had survived World War I to training schools and units in the interior.

Aircraft imported during 1921 and 1922 included Italian Savoyas, Ansaldo and Balillas, Dutch Fokkers and German Junkers, and possibly some English De Havillands, Avros, Martinsydes and Vickers. About 100 Ansaldo single-seater and two-seater aircraft were delivered to Moscow by Italian pilots at the end of 1922. Fokker F-3 aircraft were used on the Moscow-Königsberg route after 1921 by the newly formed Russian-German civil transport company called Deruluft. German-Soviet military collaboration increased in scope and concentration from 1919 and 1920 onwards, and had greater impact on the development of the Red Army, the Air Fleet and the aviation industry, particularly after the Treaty of Rapallo in 1922. At that time, the German policy of collaboration with Russia, partly camouflaged as unofficial commercial relations and based on Bismarck's old policy of friendship for the East, was viewed by the German Reichswehr and elements of the Foreign Office as a military and political necessity in view of the onerous terms of the Treaty of Versailles. Both Germany and Russia had become outlaws in the community of nations. The Reichswehr established a "base" in Russia for the development of German military power, primarily artillery and aviation and chemical and mechanized warfare, and the military and economic strengthening of Russia as an ally of Germany was a concomitant of this eastward orientation. Red aviation benefited remarkably in organization, training and technology in this way.

During the decade that included the NEP and the first Five Year Plan (1929-33), the Soviet regime strengthened the foundations of the state and thus enabled fundamental improvements to be made in the size and operational capabilities of the military and civil air establishments. The needs of air power received the highest priority in the allocation of human and material resources. Assistance was procured from western Europe, especially Germany, whenever possible, however, and also from the United States. The more advanced "capitalistic"

nations of the West were still superior in air power in 1932, but the Russians were gradually cutting back their advantage. At the same time, they skilfully used the potentialities of aviation to strengthen internal security, increase the prestige of Communism and support the long-term party program of international revolution.

The Red Air Force (former Red Air Fleet) also acquired greater power and influence in military councils under Red Army control. The principal organization directing it was still the Revolutionary Military Council, a collective body through which the Commander-in-Chief of the Armed Forces controlled the Air Force of the Red Army and by which the Red Army General Staff and the military districts and separate armies, with their air force components, were ultimately governed.

Until about 1928, the Red Air Force field organization was subject to frequent experiments, which were usually carried out only in part before being superseded by others. The units first included a mixed variety of new detachments and squadrons, as well as some groups dating from the civil war period. Some were numbered and others bore names, e.g. the "Lenin Squadron".

The Red Air Force squadron became the principal tactical formation with a fixed establishment. There were two or three detachments, or flights, in each squadron, each of which contained two or three sections. Squadron strength varied considerably because of shortages and the variety of types available; the normal numbers were from eighteen to thirty-one. Some squadrons, independent flights of similar composition and groups were subordinate to the naval fleets.

The number of aircraft in Red Air Force units rose from more than 400 to about 1,080 between 1923 and 1928, over 800 having been purchased abroad. Although only 10% of the aircraft were less than three years old in 1923, about 600 could be considered reasonably new by 1928, at which stage the Soviet air force was about equal in strength to that of Great Britain.

Aircraft strength increased to about 1,300 in 1931, rose to 1,500 after Japan occupied Manchuria, and may well have reached 2,200 by the end of 1932, in anticipation of possible conflict. At that time bombers constituted over 30% of the total force, the remainder comprising mainly fighters, including two-seater planes, some attack fighters, numerous other aircraft to be used

in direct support of ground forces, more modern seaplanes, amphibians, transports and trainers. A large bomber was introduced in 1931. Influenced by the doctrines of the Italian General Douhet, who advocated an independent bomber force for strategic air attack, the Red Air Force continued to rely substantially on such aircraft until the political purges of 1936 and 1937.

Aircraft of Soviet design entered production especially during the years 1930-1932. These comprised mostly the reconnaissance or multipurpose aircraft designated R-1, R-3 and R-6, which were used in tactical units, and the I-series single-seater biplane fighters, notably the I-2, I-3, I-4 and I-6.

By 1934 and 1935 the collegiate principle of command had been eliminated throughout the entire Soviet military organization, and both the Council of Labour and Defence and the Revolutionary Military Council had been abolished. Although the command and organization of the Red Air Force had improved in the 1930's, the Red Army continued to exercise effective control over air power, which was viewed chiefly as an instrument for supporting the ground forces. This meant that unit quantities were emphasized at the expense of the quality factors needed in air warfare.

The trend towards more conventional patterns of military organization lasted only until the political purges of spring 1937, however, which led to reintroduction of the commissar system and of organs of collective control, including military soviets at high command levels. More than 50% of the highest-ranking Air Force officers, including the commander-in-chief, were removed in the purges later that year.

Air defence, called PVO, received increasing attention during this period, particularly in the late 1930's. Additional PVO fighter squadrons were assigned to defend important cities and industrial centres, in conjunction with anti-aircraft artillery under the High Command, barrage balloons and supporting units. Warnings for the whole air defence system were provided by an organization called VNOS, which was divided into battalions and companies in 1937. The PVO fighter squadrons and anti-aircraft artillery battalions, under the command of either an air defence district chief or the commander of a military district, were attached to military district brigades for support

and training. It was only in later years that a fighter-interceptor command was formed in the Red Air Force.

During the Second Five Year Plan the number of aircraft rose from about 2,000 to more than 5,400, the figure reached in 1938, of which approximately 4,200 were considered first-line planes in 1937. Soviet fighters from 1937 on were primarily of the I-15 and I-16 types, designed by Polikarpov. The medium-sized bombers included the SB-2, SB-2 Bis and DB-3.

The number of squadrons and brigades in the Red Air Force multiplied greatly from 1933 to 1939. The number of brigades rose from more than twenty-two to about fifty between 1933 and 1935, including over two hundred squadrons. Brigade strength in 1938 was approaching sixty, not including seven or eight brigades engaged in naval aviation. The following year the number of brigades theoretically available must have been about eighty.

When the Soviet Union attacked Finland on 30th November 1939 it committed almost half of its total aircraft strength to the offensive. Since bombing operations played a great part in the air campaign plan, the proportion of the total available strength of Soviet bombers engaged over Finland was almost 50%. Each Red Army unit was supported by one or two air units of brigade size.

Sweden

Military aviation in Sweden began in the Navy in 1911 and in the Army in 1912, again through donations of aircraft. In the period from 1911 to 1917 the Army acquired a total of 42 aircraft, of which 12 were donated by individual persons or associations and the Navy obtained 22, of which 14 were donations.¹⁵

Sweden had 8 military aircraft, 4 in the Army and 4 in the Navy, and 20 military pilots at the time when the First World War broke out. The war in Europe with its air operations raised the question of a possible attack on Sweden from the air. The idea of a combined air organization was also raised, but weariness with military matters and a trust in "eternal peace" and the League of Nations buried these initiatives once the war was over.¹⁵

The main concern of the politicians was to cut defence

spendings. They considered organizing an independent Air Force as a mean of rationalizing the Armed Forces.⁴⁸ So, when the question of a united air organization was raised again in 1924, the Riksdagen was ready to act. A positive decision was reached, and the second oldest independent air force in Northern Europe, Flygvapnet, came into being on 1st July 1926. Its initial organizational structure included four air stations, at Uppsala, Hägernäs, Malmen/Karlsborg and Östersund, and one flying school, at Ljungbyhed. The aircraft included types such as Nieuport, Phönix, Albatros and Dront. The Fokker CV-E S 6 became the standard reconnaissance plane for army purposes and the Heinkel He 5 S 5 for the same mission in naval operations. The Avro 504 and Albatros were eventually abandoned in favour of the Heinkel HD 35 Sk 6 as a trainer model at Ljungbyhed. The Air Force's own workshop, CVM, manufactured Fokker aircraft under licence at Malmslätt.¹⁶

The goal for the 'first development phase' in 1926-1936 was a force of 230 combat aircraft, but the necessary resources were not granted, and thus the total number of combat aircraft in 1935 was about 70 and the number of trainers about 10.¹⁶

When the second development phase, for the period 1936-1946, started, threatening signs were already visible in the international security environment. The new defence decision therefore included considerable improvements to Flygvapnet. The total number of wings in the organization was to be increased to seven, with one flying school:

- F 1, bomber, Västerås
- F 4, bomber, Frösön
- F 6, bomber, Karlsborg
- F 7, bomber, Såtenäs
- F 8, fighter, Barkarby
- F 2, naval torpedo and reconnaissance, Hägernäs
- F 3, army reconnaissance, Malmslätt
- F 5, flying school, Ljungbyhed

In addition to the general staff, the wing organization included three divisions, each having 12 aircraft in bomber, army reconnaissance, torpedo and two navy reconnaissance units. One navy reconnaissance division had 8 aircraft, and the three fighter divisions each had 15 airplanes. Altogether the development

plan comprised 257 combat aircraft and about 80 trainer aircraft.¹⁶ The effect of the international preference for bombers can clearly be seen in the very heavy dominance of the bomber wings in the development planning.

The domestic aircraft industry also was considered very important in Sweden, and the Swedish Railway Workshop's Aircraft Division in Linköping and the new Swedish Aircraft Factory at Trollhättan carried out production under licence and eventually also generated some original designs.¹⁶

When the World War II broke out in September 1939, some progress had been made according to the plan, but it was only in its initial phase, of course. The total number of aircraft was about 180, of which there were 40 Junkers Ju 86 B 3 bombers, 30 Hawker Hart B 4 light bombers, 50 Gloster Gladiator J 8 fighters, 25 Fokker CV-E S 6 army reconnaissance aircraft, 25 Heinkel He 5 S 5 maritime reconnaissance aircraft, 10 Heinkel He 115 T 2 torpedo aircraft and about 80 elementary and advanced trainers.¹⁶ The development of a fighter system had started only in that same year.¹⁷

Anti-aircraft artillery was first regarded as a new specialized field artillery weapon system in Sweden in 1928, when an anti-aircraft artillery regiment was established in Karlsborg. In 1937 anti-aircraft artillery planning was strengthened by organizing a specialized department for it at Headquarters. The anti-aircraft artillery in Sweden was permanently organized within the Army.¹⁸

WORLD WAR II

Finland

The Winter War was the first real baptism of fire for the Finnish Air Force. The Soviet Union and Nazi Germany signed the famous Molotov-Ribbentrop pact in 1939, which resulted in the German attack on Poland in September of that year. This was followed on 30th November of the same year by the Soviet Union's attack on Finland.

The scarcity of Finland's material defence resources now became apparent, and there is no doubt that the FAF was ill-prepared for the war from a material standpoint. At the beginning of the war there were only two fighter squadrons, and only one of those had even relatively modern aircraft, 40 Fokker D. XXIs, of which 36 were available to the squadron at the outbreak of war. The other squadron had 15 obsolete Bulldog biplanes, of which 10 could be mobilized.¹⁹ In addition, the two bomber squadrons had 18 Blenheim bombers altogether, and the reconnaissance and liaison units a total of 56 aircraft which would have belonged better in a museum than on a battlefield. The air defence artillery also lacked weaponry, so that only 11 heavy and 7 light batteries could be mobilized. The air defence machine-gun companies should have had 120 light cannons and 120 machine guns, but only 24 cannons, 70 air defence guns and 71 infantry machine guns were available. Only 20 guns were available for protecting the air bases.⁸

Air surveillance was well organized, but the sparse telephone network caused delays which badly hampered ground control for fighter interception and fire control for the air defence artillery.⁸

The level of training and motivation of the troops was high, however, and thus the same may be said of their readiness for combat. The FAF had already adopted up-to-date fighter tactics in 1935, while many other combatant countries, including the Soviet Union and Great Britain, for instance, only learned this approach later in the war. There are three basic things that made the Finnish fighter force successful:²¹

-The philosophy of loose, broad section and finger four formations which had been adopted in 1935.

-The emphasis on individual accuracy in air-to-air gunnery, which was trained for systematically. The Finnish fighter pilots were taught to shoot at certain parts of the target plane and not just at the plane in general.

-The principle of attack regardless of numbers, which always gives one the advantage of initiative.

A supporting factor was the individual freedom of action allowed inside the formation, the principle of "first see, first shoot", which applied to every pilot. This increased the effectiveness of the entire formation, cutting down delays and making every pilot an efficient shooter in a revolutionary way. Also, the small number of fighters had one benefit; before a new pilot was introduced to aerial combat he was tested in the front line squadron and then protected by the veterans through his first critical battles. As a result, the Fokker D.XXIs (FRs) were able to achieve an exchange ratio (kills in air combat versus losses in air combat) of 16:1 against Soviet combat aircraft. This was spectacular considering that the Fokkers had fixed undercarriages, making them slow for bomber interception missions and clumsy against fighters in aerial combat.

The bombers were used to cut the enemy's logistic communication lines and in long range photoreconnaissance missions. Due to the small number of planes, the bombing raids were more disturbing than destructive, but the reconnaissance results were invaluable for intelligence, mapping and artillery targeting.

The obsolete reconnaissance biplanes and dive bombers suffered heavy losses at first, until the change was made to night tactics. They were then able to carry out continuous harassing bomb raids on the enemy logistic centres and transportation lines in addition to their standard reconnaissance missions.

The lack of fighters was quickly realized within the nation at large, and prompt measures were initiated to increase the fighter force. Thus 92 fighters were purchased or received as donations during the Winter War, including Fiat G.50, Gloster Gladiator II and Morane-Saulnier M.S. 406 types. The best fighter acquired during the war, a Brewster B-239, came too late to participate in combat missions, and the same applied to the 10 Hawker Hurricane I fighters.¹⁹

In addition to their normal duties the fighter squadrons, together with bombers, played a decisive role in ground attacks on the advancing enemy on the ice of the Bay of Vyborg in the final phase of the war.

The anti-aircraft artillery was divided fairly evenly into home area and front line troops. As with the fighters, accelerated purchases of anti-aircraft guns started immediately, with the result that 9 Bofors 75 mm cannons from Sweden, 12 Breda 76 mm cannons from Italy and 24 Vickers cannons from Great Britain were received in the course of the war, together with a great number of smaller-calibre cannons and machine guns and the necessary ammunition.⁸

The majority of the field army anti-aircraft units were located in the rear section of the army on the Karelian Isthmus, an area that was consequently fairly well protected. These units also achieved good results in causing losses to the enemy in the air. Many of the home area units, on the other hand, had only small-calibre guns which were unable to reach the flying altitudes of the enemy bombers.⁸

In Lapland there was a Swedish flying unit F 19, an anti-aircraft company and an anti-aircraft artillery battery operating on voluntary basis,^{25,8} and these units played an important role in the defence of the region, for even though enemy operations in the north were minor compared with the main offensive, it would have been impossible to leave these areas totally unprotected. Thanks to the Swedish voluntary units, all the Finnish air defence resources could be concentrated on repelling the main Soviet attack.

The Soviet order of battle in the Winter War enjoyed a ten-fold superiority in numbers over the Finnish Defence Forces, and this meant that Finland was forced to yield ground in Karelia. On the other hand, the Soviet offensive was brought to a stop and heavy casualties were inflicted on the attacker. Germany was hostile at that stage, however, Sweden was officially strictly neutral and the support plans drawn up by France and Great Britain proved inadequate, so that Finland simply did not have the resources to continue the fight alone. A peace treaty was signed on the evening of 12th March 1940 and came into effect the following day. This included a revision of the national border west of Lake Ladoga.

Finland's strategic position became increasingly difficult. The Soviet Union continued its diplomatic pressure and Foreign Minister Molotov, on a trip to Germany in November 1940, demanded that the "Finland problem" must be resolved for good. The country's closest supporters, France and Great Britain, were themselves embroiled in the war and in an ironic twist of fate, the Finns found that the only nearby country with whom they could trade to improve their defence status was the Soviet Union's former ally, Germany, which was at that time prepared its eastern offensive.

From a political point of view Finland did not want to be involved in an alliance with Nazi Germany, but from a military standpoint cooperation seemed to be the only possible solution. But despite numerous requests by Germany to advance their forces beyond the demarcation line drawn through Eastern Karelia, for an attack on Leningrad, the Finns refused to do this.

When Germany began its eastern offensive against the Soviet Union in June 1941, Finland had already given that country permission to stage units through Lapland, and after Soviet bombers had attacked various targets in Finland on 25th June 1941, the Finns officially entered into military cooperation with Germany, marking the beginning of the Continuation War.

At the beginning of the Continuation War the Soviet forces enjoyed only a two-to-one superiority over the Finns, and this permitted the Finns to advance fairly quickly to establish a defensive line in the area where the network of trenches was eventually to be located. The FAF had about 120 fighters in its flying units at that time, including Brewsters (BW), Fiats (FA), Morane-Saulniers (MS), Curtisses (CU) and some Hurricanes (HC), 21 bombers, mainly Blenheims (BL) plus some war booty planes, and 58 reconnaissance and liaison planes of various types, mainly obsolete.²⁴ During this initial phase of the campaign the FAF achieved air superiority, and the Brewsters in particular excelled themselves, achieving a remarkable exchange ratio of 32:1. They added to the Winter War formation tactics and shooting accuracy a vertical energy-speed manoeuvre which was very effective against their main adversaries of that time, the I-153 Chaikas and I-16 Ratas, which were more agile but a little slower.

During the trench war period the most important air operations were carried out in the Gulf of Finland. These were

partly the outcome of naval operations, and gradually the process evolved into the Battle of the Gulf of Finland, which culminated in Soviet air raids on Kotka and Helsinki. Finnish fighter pilots carried the main defensive burden in this battle, and were quite successful in this. The FAF strategy of concentrating on aerial combat instead of attacks on the well-defended enemy bases proved correct. The numbers of enemy aircraft destroyed on the ground didn't mean much because the superpower's own aircraft production plus lend-lease support from Great Britain and the United States meant that there was no shortage of aircraft. The shortage of trained pilots, however, became a problem for the Soviets, as became apparent in the final phase of the Battle of the Gulf of Finland. After the major aerial engagements of May 1944, the People's Commissar for the Navy, Admiral N.G. Kuznetsov, had to withdraw a whole regiment from front line duties because of the lack of pilots.²²

When the tide of war changed and the German forces began to retreat westwards, Soviet pressure on Finland increased. In spring of 1944 the Soviets decided to take Finland before beginning their advance towards Berlin. They amassed a ten-fold superiority in troops and aircraft on the Karelian Isthmus and began their strategic offensive on 9th June 1944. They met with some success initially, forcing the withdrawal of Finnish forces along the Isthmus, but in July 1944 the Finns were able to stabilize the front at the Vuoksi River and further attempts by the Soviet forces to advance beyond this line were repelled. The process seen in the Winter War was repeated.

Despite the Soviet superiority in numbers of aircraft, the FAF was able to concentrate its air forces and continue to achieve good results. The Brewsters, along with the Morane, Fiat and Curtiss fighters, although continuing their operations, became obsolete in terms of performance from 1943 on, and new fighters, Messerschmitt 109 G (MT)s, were received, although once again only in small numbers. When the Soviet offensive began, the units had about 40 Messerschmitts.²⁴ Fortunately, the FAF was able to get 74 more fighters from Germany during the campaign, so that despite the fierce battles, the number of Messerschmitt fighters actually increased during the summer of 1944. The number of bombers in the flying units at the beginning of June 1944 was 66.²⁴

One good example of the ability to achieve local and temporal air superiority was the fact that the FAF bombers and a German support unit known as Kuhlmeier were able to continue their effective air raids, which were vital contributions to the war effort, as the bombings could be concentrated on massed troops just before their preplanned attack times. Warnings of impending troop movements were usually captured by radio intelligence. It is also significant that no bombers in the formations escorted by the Messerschmitts were lost to enemy fighters during this period. The Messerschmitts thus achieved an exchange ratio of 25:1.

The anti-aircraft artillery was in fairly good shape when the Continuation War began as compared with the situation during the Winter War. The army corps and divisions were almost fully equipped, although some units in the rear area organizations still lacked adequate artillery support. The total numbers of guns in the various units were 107 75-76 mm cannons, 314 40 mm cannons, 189 20 mm cannons and 153 7.62-12.7 mm machine guns. The clear emphasis in the disposition of weaponry was on the front line troops.⁸

In the attack phase leading to the trench war line the anti-aircraft artillery units served well to protect the troops, and the only problems were the difficulties in building up a working air surveillance network during the rapid advance. Due to the lack of early warning possibilities, some special light anti-aircraft units were established, and these, being able to move with the infantry, could also protect the spearhead units. During the trench war it was the anti-aircraft artillery in Kotka and Helsinki that was under the heaviest pressure, and a system employing a control centre with target acquisition and a controlled barrage firing technique was developed in both cities. Especially in the big Helsinki raids carried out by the Soviets in February 1944, the anti-aircraft artillery excelled in turning the main bulk of the bombers away with coordinated barrages backed up by special light effects and misleading ground bonfire patterns. The anti-aircraft artillery units on the Isthmus were under very heavy pressure in the final combats during the summer of 1944 and fared extremely well. In addition to the losses caused to the attacker, they attracted a high proportion of the enemy sorties to themselves, lightening the burden on the other troops. Even more anti-aircraft units could and should have been concentrated

in the Isthmus region, for as it was, only one quarter of the field army anti-aircraft resources were located there.⁸

Norway

When Germany attacked Norway on 9th April 1940, the Norwegians began their resistance and the first air combat took place. The main part of the Junkers Ju 52 transport formation carrying the paratroopers with the mission of occupying the Fornebu air base near Oslo had to turn back due to the fog on the route, but the covering formation of eight Messerschmitt 110 long-range fighters was on the spot and was attacked by nine Norwegian Gloster Gladiators. Two of the Messerschmitts were shot down, but the remaining six continued to strafe the defences of the base and finally landed there due to a shortage of fuel. Two of the Gladiators, which had landed earlier, had been set on fire and the rest were given orders not to land at Fornebu. They landed on frozen lakes north and west of Oslo. The Messerschmitt 110 crews were then able to secure the base for the Junkers Ju 52 transports, which eventually began to arrive.²⁰

During the day the Stavanger-Sola air base also was occupied by the Germans and under the pressure of numerous bombardments most of the Norwegian strongpoints had yielded to the German airborne troops by the evening of April 9th.²⁰ The organized air defence eventually lost its infrastructure, and during the next few weeks, when the allied expeditionary force had failed in its attempt at invasion, the occupation spread to cover the entire country.

All the aircraft that had a sufficient range were flown to Britain, and the task of establishing a new Norwegian defence organization was started there while fighting was still going on in Norway. One of the results was the opening of the "Little Norway" camp in Canada in December 1940. This was a joint Army-Navy flight training establishment.¹³

330 Squadron was established in Iceland in May and June of 1941, with Northrop seaplanes which had been ordered before the war. Then followed 331 Squadron, operating Hurricanes from Catterick and later Spitfires from Skeabre on Orkney. Next was 332 Squadron at Catterick, also with Spitfires, and 333 Squadron,

first with three Catalina flying-boats at Woodhaven and later with a flight of six Mosquito fighter-bombers at Leuchars. The Mosquito flight later became 334 Squadron.¹³

At the turn of 1942, No. 132 Norwegian Fighter Wing was established at North Weald outside London. This consisted of 331 and 332 Squadrons, with Spitfires.

By Royal Decree of 28th March 1941 it was determined that the two air forces should be placed under a joint Norwegian command but otherwise retain their independence. The new command was set up in London and called the Joint Air Force Command. This new organization was ordered by the Ministry of Defence in 1943 to consider a full amalgamation of the Navy and Army Air Forces, a measure that was completed in summer 1944, and on 10th November of that same year the Royal Norwegian Air Force was established as an independent service by Royal Decree. All materials and staff from the two former Flying Corps were taken over, and the work of creating a new service began.¹³ 132 Fighter Wing was transferred to France in 1944, and it also flew missions from bases in Holland and Belgium. It later returned to Scotland, and in May 1945 was repatriated to Norway to start the rebuilding process.¹²

The Soviet Union

The Red Air Force concentrated about 3000 aircraft against Finland when it began the Winter War on 30th November 1939. The main thrust was directed at the Karelian Isthmus, with over 1000 planes of the 7th Army Air Force, and also north of Lake Ladoga, on the Isthmus of Olonets, where the 8th Army Air Force was operating with about 500 aircraft. There were also weaker formations operating further north, where the 9th and 14th Army Air Forces each had a couple of hundred planes. The Baltic Navy had about 470 aircraft on the eastern and southern coasts of the Gulf of Finland. In addition, the offensive was supported by 300 planes of the long-range bomber command and 300 from Kravtshenko's Detachment.⁹

The main aircraft types used by the Soviet forces were Polikarpov I-15 Bis, I-153 Chaika, and I-16 Rata fighters, Tupolev SB-2 and Iljushin DB-3 bombers, Polikarpov R-5 and U-2

reconnaissance planes and a Beriev MBR-2 maritime reconnaissance plane.

The Soviets started their air operations with bombing raids on sixteen cities or towns. These came as a surprise to the civilian population, and almost 100 people were killed and over 200 wounded in Helsinki alone. Otherwise the air raids failed to achieve any military effect.⁹

Weather conditions in early December were mainly poor, and this considerably restricted the air operations. Whenever the weather permitted, the bombing campaign was continued. Since the Finns had to concentrate their small fighter force and anti-aircraft artillery units on the most critical areas of defence, the numerous Soviet bomber formations were often able to fly fairly freely over the hinterland of Finland. Thus they tended to fly without any fighter cover in the initial phase of the war. They occasionally suffered rather heavy losses when they did meet defending fighters, however, and often dropped their bomb loads prematurely at random and turned back attacked.²¹ The Soviet Command then changed its tactics and brought in large fighter formations as cover for them.

A largish part of the force was withdrawn from the bombing campaign in the February to provide direct support for the ground force attack on the Karelian Isthmus, but the air raids still continued, and Vyborg experienced exceptionally heavy bombing, for example.¹⁹ At the beginning of March, just before the peace treaty was signed on 13th March, the Soviet fighters carried out a mission to intercept the Finnish fighters which were concentrating on ground attack sorties outside Vyborg.

The air operations undertaken in the Winter War were considered a failure in the Soviet Union. Despite the overwhelming, thirty-fold superiority in numbers, the bombing campaign, with about 44,000 sorties, failed to neutralize the Finnish war effort or to disrupt the country's economy. The morale of the Finnish people actually improved. It is thus understandable that the concept of strategic bombing won few advocates in the Soviet military councils of that period.¹⁴ Also, the Soviet fighter tactics proved to be mistaken. A tight triple formation was developed to increase firepower, on the assumption that the wingmen would follow the leader closely and shoot together with him each time. In practise, such tactics

possessed almost all the drawbacks of fighter aviation. The tight formation was easier for the enemy to see from a distance, the formation lookout doctrine was poor because the wingmen had to watch the movements of the leader carefully all the time, and only the leader had any practical chances of hitting a target in that kind of shooting arrangement.

The main reason for the failure was obviously the complicated command system, which effectively ruined any attempts at concentrated use of the various forces. The supporting factor was the particularly subordinate status of the Air Force to the Red Army which gave no freedom to adjust the training and equipment to the specific demands of air combat. It is significant that although the Soviets had air superiority by virtue of sheer numbers, they were unable to weaken the Finnish fighter force or to prevent the FAF bomber and reconnaissance operations. The FAF fighter force's operational capacity was better at the end of the war than it had been at the beginning. It had been totally engaged all the time and had always been able to carry out its missions.

When Germany opened her eastern attack on the Soviet Union on 22nd June 1941 this came as a surprise to the Soviet leadership. A variety of revealing intelligence information had been delivered to Stalin, but he had obviously planned to let Germany and the western powers tire themselves out in their war efforts before he made any move himself, and now it was hard for him to believe that Hitler had already made his eastern assault.

The German "blix" on the central front demanded almost all of the Soviet attention, but the Air Force still attacked various cities and air bases in Finland on 25th June 1941. Their unescorted bomber formations suffered very heavy losses, however, and the raids were not repeated. After these attacks Finland declared war, announcing military cooperation with Germany, whose troops already were operating in Lapland and in the Gulf of Finland.

The Soviets had about five-fold superiority in numbers in the air on the northern front and about two-fold superiority on the ground, but they were on the defence and had to retreat to the waterline in Eastern Karelia, where the Finns voluntarily stopped their advance and secured their trench positions at the end of 1941.

The FAF enjoyed air superiority over the battle area at this stage, and the Soviet Air Force, caught by a surprise attack in the middle of its renewal and reorganization programme after the experiences of the Winter War, was unable to provide any effective opposition to its air operations in support of the advance of the ground forces. During the trench warfare period at the beginning of 1942 the Soviets gradually improved their air assets and introduced their first new aircraft types, e.g. the MiG-1 and MiG-3 fighters. Western lend-lease support in the form of British Hurricane and Spitfire fighters and American Tomahawks and Airacobras began to arrive in more and more substantial quantities.²⁴

When the German advance was stalled and the retreat westwards began, Soviet pressure on the northern front also started to grow. The main area of operation was the surroundings of Leningrad and the Gulf of Finland, while the main target inside Finland in 1943 was the city of Kotka, an important harbour for naval operations in the Gulf of Finland. The new dive bomber, the Petlyakov Pe-2, and the LaGG-3 and La-5 fighters, and later the Yak-9, together with the lend-lease aircraft, formed the backbone of the air fleet, which operated from bases around Leningrad, the island bases of Lavansaari, Seiskari and Kronstadt, and the Borki air base in the Oranienbaum encirclement.

The Pe-2 dive bomber formations, escorted by fighters, made regular attacks on Kotka, and in addition to strengthening their anti-aircraft artillery system, the Finns had to establish a new fighter air base in Kymi and deploy their new 34th Fighter Squadron, equipped with Messerschmitt 109 G 2 fighters, there to defend Kotka. There were frequent fierce air battles over the Gulf of Finland as the Soviet formations carried out their raids and the FAF fighters attacked them from the Kymi and Suulajärvi air bases. The Soviet Air Force could easily replace the planes lost in these air battles, but the losses of pilots began to become a concern to them.²² By the beginning of 1944 the first contacts were being made about a separate peace agreement between the Soviets and the Finns. The Soviet terms were considered unacceptable in Finland, however, and so, the Soviets tried to make them see reason by sending formations from the Long Range Bomber Command (Aviatsiya Dalnego Destviya - ADD) to the air bases of Levashovo, Kasimovo and Gorskaya near

Leningrad, in close proximity to the front line. These and other formations in the rear, altogether about 500 bombers, started a strategic bombing campaign and carried out three major night air raids on Helsinki in February 1944. The well coordinated barrage fire of the Helsinki anti-aircraft defence was able to repulse and deceive the main thrust of the raids, however, and the damage remained minor relative to the volume of the attacks. Out of a total of about 20,000 bombs dropped during the raids, only about 800 hit the city. Casualties amounted to 146 people killed and 356 wounded.²³

At the beginning of March 1944 three Finnish bomber squadrons were on the alert, while air surveillance and radio intelligence were watching the movements of the ADD formations. When these were returning from Tallinn after an air raid on 9th March, Finnish bomber squadrons joined them over the Gulf of Finland under cover of night and followed them to their bases. When the landing lights were on and the Soviet bombers were in the middle of their landing sequence, the Finnish bombers started their run and dropped their bomb loads on the bases. After this the ADD formations were transferred to rear bases and the Helsinki raids were not repeated.²⁴

A build-up of troops to take Finland was initiated in spring 1944, before the race to Berlin began, and the decisive offensive was planned for 9th June 1944. The troops due to participate in this operation had been in training in the area south-west of Leningrad. It was calculated that a ten-fold superiority in numbers was needed for the campaign. The air component included the 13th Army Air Force, the II Fighter Corps and the Baltic Navy Air Force. The 13th Army Air Force was reinforced by two bomber divisions (where one division contained three regiments, each having 32 bombers) and one ground attack division from the Long-Range Bomber Command. The total number of combat planes was about 1500.

The mission of the 13th Army Air Force was:²⁴

- to destroy Finnish defence positions in the 21st Army's attack sector
- to prevent enemy artillery and mortar barrage fire
- to prevent the transfer of the Finnish troops to their prepared defence positions

- to destroy the Vyborg railway yard, the Raivola and Rautu railway stations and the bridges over the Vuoksi River at Kiviniemi
- to prevent road and railway transportations up to the line Vyborg - Käkisalmi
- to provide cover for troops of the 21st and 23rd Armies, reserves, lines of communication and positions against enemy air attacks.

Air reconnaissance was to be extended to 150 kilometres beyond enemy lines, to the line Hiitola-Lappeenranta-Hamina.

The Baltic Navy Air Force flew several reconnaissance missions, a sea transport cover mission and a special mission to carry out an attack with two Il-2 ground regiments on defence positions at Valkeasaari.

After the initial success of the offensive the Finns were able to stop the Soviet advance at the Vuoksi River in July. The superiority in numbers proved to be inadequate and the race to Berlin was accelerating all the time. The Soviet Union started to remove its troops from the Karelian front to the Central European area. A cease-fire was agreed on with Finland on 4th September 1944, which meant that the summer 1944 offensive against Finland became the only one which the Soviet Union failed to carry through during the latter part of the war.

The situation in terms of numbers was very much the same at the end of the Continuation War as it had been in the Winter War. The Soviet Union had clear numerical superiority in the air and carried out massive bombings and continuous close support operations with its effective Il-2 ground attack planes. It also had a very dense, effective anti-aircraft artillery in its ground troops and its air bases were well protected with anti-aircraft weapons, but as in the Winter War, they were unable to weaken the FAF fighter force, so that the capacity of the FAF fighter force actually increased during the hectic air battles of summer 1944, mostly because of minimal pilot losses combined with the delivery of new fighters from Germany. Almost all the Finnish top aces were fighting at the end of the war just as they had been at the beginning. Thus they were able to achieve local and temporal air superiority, while the bomber and reconnaissance units were similarly able to carry on their missions throughout.

Sweden

When Germany attacked Poland in September 1939, the Swedish Flygvapnet increased its state of readiness, and after a few weeks this was adjusted to permit an accelerated effort to improve air combat capacity.¹⁵

A new warning of changes in the security policy environment came when the Soviet Union attacked Finland on 30th November of the same year. Sweden as a nation took a strictly neutral position, but voluntary help was given to Finland at an individual level. A voluntary flying unit, F 19, was established at the end of 1939 and started to operate from temporary air bases at Veitsiluoto, Olkkavaara, Märkäjärvi, Oulu, Vaala and Posio at the beginning of 1940 with 12 Gloster Gladiators and 4 Hawker Harts. Although the unit was small, it represented a major part of the Swedish fighter force of that time, and the support it provided was very important to Finland because it made possible to concentrate the entire Finnish fighter force on repelling the main Soviet attack.²⁵

Some voluntary anti-aircraft artillery units also supported Finland in the Winter War. There was one anti-aircraft company and one anti-aircraft artillery battery operating in Lapland and one anti-aircraft artillery battalion and a naval anti-aircraft detachment in Turku.⁸

The next major military operation to occur nearby was the occupation of Denmark and Norway by the Germans in April 1940, which meant that Sweden was now surrounded by conflict areas. Even though the country's advantageous position behind the "frontline" states had kept it away from the action, the nearness of the danger was not comforting.

The examples of Finland in the Winter War and Great Britain in the Battle of Britain left their mark on the Swedish development plan. Two more fighter wings, F9 at Säve and F10 at Bulltofta at first and then at Ängelholm, were added to the programme. Also, a long-range reconnaissance wing was to be established at Nyköping under a decision taken in 1940, and the next year a decision was made for a bomber wing, F12, at Kalmar and a base organization, F21, at Luleå.

The five-year programme approved in 1941 laid down that:¹⁶

- further flying groups (flygeskadrar) should be established
- the entire country should be divided into air base areas
- the force of fighters and torpedo planes should be strengthened
- new wings should be established
- the number of reserve aircraft should be increased markedly
- a workshop organization should be built up
- the aircraft industry should receive increased support.

The development plan was continued during the next few years, and by the time World War II ended Sweden had built almost a ten-fold air force compared with that of 1936. The 46 divisions comprised about 550 combat aircraft, of which the majority were Swedish-built, and the total number of planes was over 800. There were 15 fighter divisions, 15 bomber divisions, 2 torpedo divisions, 3 long-range reconnaissance divisions, 5 army reconnaissance divisions and 6 maritime reconnaissance divisions.¹⁶

AIR POWER AFTER WORLD WAR II

Finland

The most important combat lesson to emerge from the war for FAF was that quality is all-important, and that the most important quality factor is personnel. The world record number of ace fighter pilots relative to population¹⁰ proved to be such an asset that the FAF could always fight successfully regardless of enemy numbers. The national investment in the fighter force had been too small, but anywhere where this team was it remained unbeaten. Supported by technicians with a readiness for the necessary technical improvisation, this force caused heavy losses to the enemy and, perhaps even more important, suffered so few losses itself that it was able to maintain its combat readiness through the two wars. Although the number one quality factor was human resources, the level of technology must also be at least at the same category as that of the adversary. This became evident in the use of obsolete reconnaissance aircraft, for while the pilots in this branch carried out perhaps the most brilliant feats of airmanship of all, they were compelled to take advantage of the weather and night conditions in a very carefully preplanned manner.

The bombers played a very decisive role in the battles of summer 1944, and were also used successfully for long-range photoreconnaissance and mapping, but the maintaining of a large enough attack force proved to be beyond the limits of a small nation.

After the war a reorganization to a peace-time level of deployment took place throughout the defence forces. The FAF changed its wing organization for an air command organization with regional air defence responsibilities. The fierce fighting of summer 1944, which had demanded all the resources that the force could muster, had taught the FAF the right principle of organization. Centralized control allows the commander to use the force flexibly on a national scale, while a decentralized operational system gives each commander the ability to defend his respective airspace with the fighter wing, air surveillance network, control centres and a system of air bases. A force that is

evenly distributed in peace-time can quickly be redeployed, so that one air command can at a certain phase have the entire fighter force in its disposal, for example.

The new air surveillance and control system was built up around control centres equipped with British Marconi long-range radar systems and a network of Finnish-made middle-range VRRVI and VRRVY radar devices. The wartime equipment continued to dominate the arsenal of the fighters up to the 1950s, when the transfer to the jet age was made with the help of Vampire fighters. After this such planes as the Gnat, Fouga Magister, MiG-21 F and Bis, Draken and Hawk have preserved the line up to the present fighter system. The total number of aircraft has traditionally been small, but there are two key factors which have boosted the effectiveness of the force. Firstly, the entire force is concentrated on the most important task: air superiority, with both training and equipment devoted to air combat. Secondly, the professionalism inherited from the war has proceeded without interruption breaks through all the technical generations, building up a continuity of readiness to adopt new applications of aviation technology.

One of the biggest changes in air defence after the war was implemented in 1952, when the anti-aircraft artillery was subordinated to the Army. The leadership of the AAA opposed the transfer, suspecting that the air defence system would suffer,⁸ but the transfer was made for reasons rationalization in the years of stringent economy that accompanied the rebuilding after the war. One reason was, of course, that the majority of the anti-aircraft artillery units had been deployed to protect army troops in the field in the final phase of the war.

Although the transfer decision was a step backwards as far as systems development was concerned, the AAA and Air Force actually turned it into a step forward. Both of these major components of the air defence system were highly specialized and their weapon systems and personnel training used different technological applications and methods. The AAA was predominantly a reserve training organization, like the Army, with wartime complement achieved by mobilization, whereas the Air Force was a professional branch with its fighting capacity maintained continuously even in peace-time. The major factor that they had in common was the air surveillance system and the

air defence fire control system. By combining this area of action, each could achieve the best possible effectiveness by specializing in its own mission and coordinating the net result.

The Commander of Air Force is responsible for the total air defence fire control of the country, and accordingly, the Air Force is responsible for the air surveillance system. Conversely, all air defence units except for the anti-aircraft units earmarked for the Air Force and Navy belong to the Army. These are connected to the Air Force surveillance system and are able to receive the overall air surveillance picture. The Army has full tactical freedom to place its air defence units according to its own plans and situations, and at the same time their air defence fire is controlled by the Air Force control centres in full coordination with fighter ground control. In this way fighter interception and surface-to-air missiles, for instance, can be used effectively and in a coordinated manner in the same airspace. Thus, despite early misgivings, the basic arrangement has worked well by virtue of the key factors of high specialization and keen cooperation.

The material development of the country's anti-aircraft defence has advanced through steps which are very much universal in nature. The dominance of radar for fire control purposes, special armoured anti-aircraft vehicles, automatic cannons, fire control wagons and replacement of the heaviest calibers with cannons which have higher fire rates and smaller calibers are typical examples. The surface-to-air missile era was ushered in with the British Bloodhound system, followed by the Russian SA-3 and the French Crotale and Mistral systems. The small Russian shoulder-launched IR missile weapons Strela and Iгла were also introduced into Army units.¹⁸

Norway

The post-war RCAF consisted of seven squadrons, of which three were fighter squadrons, two light bomber squadrons and two reconnaissance squadrons. It received its four first jets, De Havilland Vampire F 3s, in the spring of 1948, and eventually acquired 62 of these altogether. The aircraft had a short service life, however, and the last of the country's original jets was grounded for good in 1956.¹³

Norway became a founder member of NATO when it was established in 1949, and as a representative of the organization's northern flank, the country was to possess eight fighter squadrons of 25 planes each.¹² The American military aid and assistance programme contributed in all to the procurement of 206 Thunderjet F-84 E/G fighter aircraft.¹³

During the 1950s one type of aircraft after another made its appearance at short intervals. Pilots became familiar with the jet trainers T-33 or T-bird, the Sabre F-85 F was introduced in 1955, and later a new version, the F-86 K. After a little less than a decade with Thunderjets and Sabres, F-104 Starfighter aircraft were purchased in the early 1960s, representing the high technology of the era. After a couple of years yet another new fighter, the F-5 Freedom Fighter, was added to the RCAF inventory.¹³

In June 1975 Belgium, Denmark, Holland and Norway concluded an agreement to purchase and assemble a new fighter, the F-16 A/B. The RCAF received its first F-16 in January 1980 and the last of the total batch of 72 aircraft was delivered in June 1984. One special item of equipment supplied for the Norwegian F-16 fighters was a drag chute to combat the occasionally slippery runways in Norway.¹²

The F-16 fighters are deployed in four squadrons at two air bases, Rygge and Bodö. Together with the F-5 Freedom fighters, of which 15 have been selected to be modernized continue in service up to 2000, the F-16s form the backbone of the Norwegian fighter defence. This can be strengthened by NATO additions if the situation so demands. The F-16s are being subjected to a Mid-Life Update (MLU) during this decade, with the aim of making this originally clear weather fighter capable of all weather interception.¹²

In addition to their air defence task, the F-16s also are earmarked for use on the anti-shipping missions, armed with Norwegian Penguin Mk.3 anti-ship missiles.

The long coastline of Norway emphasizes the importance of maritime surveillance and the wartime operations Catalina and Sunderland have been succeeded by maritime patrols carried out by 7 Lockheed P-3B Orion aircraft. These operate from Andoya and cooperate with other NATO surveillance aircraft over the northern sea areas.

The anti-aircraft troops in Norway are organized under the Inspector of Air Defence. They received their first weapons from the arsenal which the Germans left behind, after which they acquired five British AMES 21 stations in 1946, including surveillance radar, height measuring radar, a control wagon and power supply. Three categories of control centre, Control and Reporting Centre, Control and Reporting Post and Reporting Post, were established in the late 1940s. The purchasing of long-range radar was initiated in 1953, when four British NT-960 stations were acquired. In the same year American aid brought TPS-1D surveillance radar devices and TPS-10D height measuring radars,¹⁸ and in the mid-1950s American support provided FPS-8 surveillance radar systems, which were modified in 1964 to the FPS-88 standard. FPS-6 height measuring radars were also supplied.

A new era began in 1961, when Norway's radar network was integrated into the NATO Early Warning System. After that developments took place at the same rate as in other NATO countries. The NADGE system, reaching from Nordkap to Turkey, was completed in 1972, and new SINDRE radar stations were built in the 1980s.¹⁸

Norway received its first new guns in 1950, again as American aid. These 90 mm M1A2 models with modern central computers replaced the old heavy guns. Other material was also purchased at that time, so that by 1953 the RNAS had 45 heavy and 40 light anti-aircraft artillery batteries, in addition to the 21 batteries operated by Home Defence. The light batteries were equipped with Swedish Bofors 40 mm guns, but new 40 mm L/70 guns were purchased in 1958 to replace the older weapons. A central radar computer system, RSS-40 SkyGuard, was acquired in the 1980s for fire control in connection with these guns.¹⁸

The short-range anti-aircraft weaponry was renewed in the 1960s with the purchase of four 12.7 mm barrel machine guns and two 20 mm barrel FK20-2 cannons. Commissioning of the Nike missile batteries, purchase of which had been decided on in 1957, began in 1959, and operative readiness was reached in 1960. The missiles used were of two kinds at first, Ajax and Hercules, but from 1969 on only one type, the Nike Hercules, was used. The system was modified in 1971 to conform to the Nike Improved level, which meant better accuracy, thrust and

electronic jamming resistance. A new modification project to improve the interception of fast, low flying targets, known as the SAMCAP level, was accomplished in 1975. The last modification was carried out in 1983 by installing new microprocessors in the system according to the NATO Nike Support Plan.

In the early 1980s Norway was studying alternative middle-range anti-aircraft missile systems. The candidates were Roland I and II, Rapier and Hawk. When the USA rejected the Roland II system, Norway had to recommence its evaluation. The eventual choice was the Hawk, which had been developed to the level of the Improved Hawk. This was further modified to NOAH, or Norwegian Adapted Hawk. From the late 1980s onwards Norway has been buying more Swedish RB-70 missiles, which were already in use in the 1970s, to replace its L-40 artillery guns.¹⁸

The Soviet Union/Russia

The strategic situation around the Soviet Union had altered radically as a result of World War II. The occupied countries in eastern Central Europe offered a wide deployment area, and among the reduced number of superpowers the Soviet Union ranked second only to the United States.

Strenuous efforts had to be directed to providing the Soviet military establishment with means of waging an intercontinental nuclear war in the rapidly approaching jet and missile age and of defending the Soviet homeland against modern long-range offensive weapon systems. Tactical air power was no longer sufficient: the age of strategic air power had dawned.¹⁴

Soviet planners considered the position of the Soviet Union vis-à-vis the United States in terms of air power at the end of World War II far from satisfactory, in spite of the progress made in the aviation industry and air force during the preceding decades. Soviet Union was behind the West in many fields that would determine the comparative strength and capabilities of the Soviet Air Force in the immediate post-war world. Future prospects were nevertheless promising.

The first project launched by Soviet air-power planners after World War II was to establish a modern air defence system to protect the homeland against possible air attack by the United

States. This priority was dictated by the fact that the United States alone already had both an intercontinental bomber force and an atomic bomb. Concurrently, there was an increasingly important requirement to furnish the Soviet armed forces with their own long-range, intercontinental bombers that could deliver nuclear weapons effectively at great distances. The development of nuclear weapons had already become a programme of the highest priority in the Soviet Union. Furthermore, great importance was attached to guided missiles, particularly surface-to-surface ballistic missiles. The Russians looked on the German rocket advances at first as providing new and more effective means of executing the role of artillery forces, but in time they came to regard them as the backbone of an intercontinental warfare system.¹⁴

In accordance with high-level decisions reached in 1946, about the same time as the initiation of the first post-war Five Year Plan, the State Committee for Defence was abolished and its affairs were transferred to the Council of People's Commissars, and People's Commissariat (now Ministry) for the Armed Forces was established. As a result, all military air power was placed under the direction of a single administrative authority. This centralization at the ministerial level continued until 1950, when separate war and navy ministries were again set up. The latter step was taken at a time when the jet equipment programmes were well under way and the build-up of naval capabilities was being given higher priority. It lasted only three years, however.

Under the new Ministry of the Armed Forces, the Air Force was elevated to the same level as the Navy and the Army Ground Forces, thus becoming one of the three basic branches. The autonomous status of Soviet Long Range Aviation within the Soviet Air Force was restored, and a new leadership was provided for the Air Force and for the aviation industry.

The manpower of the Soviet Air Force was markedly reduced at first after World War II, under a partial demobilization order, and the number of combat planes decreased to about 14,000 or 15,000. These changes were accompanied by a considerable regrouping and consolidating of forces, which nevertheless still remained very numerous as compared with those of the United States Air Force after demobilization.¹⁴

By 1948 an increase in strength was again apparent,

probably mainly because the new jet fighters and long-range conventional bombers were becoming available and the light jet bomber replacements for the Tu-2 and Pe-2 in the tactical air fleets were expected to arrive by 1951. The complement of the force also increased during the period 1948-50, in response to the requirements of Soviet foreign policy, which was becoming more and more evident to the West. The country's aircraft strength was about 18,000 to 19,000 planes in from fifteen to eighteen armies. These included about 1,000 jet fighters.¹⁴

Within the first two years after the war the Russians were producing two interim jet fighters based on two captured German turbojet engines, the Junkers JUMO-004 and BMW-003. Both of these engines were leaving the Soviet factories in 1946. The first jet fighter was the MiG-9, which used two BMW-003s, now known as RD-20. This was an original design that had been started by the team of Mikoyan and Gurevich even before the end of the war. Next came the Yak-15, which was an adaptation of the basic airframe of the Yak-9 powered by a single JUMO-004B turbojet engine called the RD-10. This fighter project had also begun before the end of the war. It was later modified as the Yak-17, Yak-19 and Yak-23.

As a result of the successful testing of the MiG-15 late in 1947, the initial work of other designers in the jet fighter field was passed over. This was the fate of the Sukhoi Su-9, which resembled the Messerschmitt Me-262A, and the Lavochkin La-160, reportedly the first Soviet jet fighter embodying wing sweep-back. The Russians were more concerned at first with building up a nucleus of trained jet fighter pilots and establishing a ground organization, a base structure and early warning radar networks to support a sizeable jet force than with attempts to develop a variety of jet fighter models with marginally better performance than their Western counterparts.¹⁴

Thanks to the importation from the United Kingdom of 25 Rolls-Royce Nene I centrifugal-flow turbojet engines and thirty of the low-powered Derwent Vs in 1947 and 1948, the Soviet Union was able to take a tremendous step forward in its engine industry. These engines were considerably better than the 4,400 lbs engine based on a German design which had originally been selected to power the MiG-15. Both of the British engines were copied, improved and put into mass production in the Soviet

Union within a remarkably short time. The MiG fighters were developed through types MiG-17, MiG-19 and MiG-21 in the course of the 1950s and 1960s, and a very similar family of Sukhoi fighters was also produced.

In the bomber field, the first major work was carried out by the Tupolev organization in copying the United States B-29 four-engine conventional medium bomber within a space of only two years. This aircraft, called Tu-4, was in mass production by 1948, and the first individuals had been delivered to Long Range Aviation units to become the carriers of the Soviet Union's first atomic bombs. The Russians recognized the necessity of developing a turbojet bomber to supersede the Tu-4, however, and in 1948 Ilyushin came up with a four-engined prototype, the Il-16, but this was under-powered, as it depended on the JUMO-004 for its power. Limited production of a later tactical jet bomber designed by Tupolev for the Soviet Navy, the two-engine Tu-14, began in 1952. By then Ilyushin's two-engine light jet bomber, the Il-28, was being produced in quantity as a successor to their prototype Il-26, and from then on Tupolev concentrated more on longer range bombers and transport aircraft.

The introduction of the MiG-23, Su-24 and Su-17 series of tactical aircraft, replacing the previous generation which had dominated Soviet deployments in the 1960s, improved the range/payload characteristics of major Soviet tactical aircraft in the 1970s and meant that air strikes against mobile targets could be accomplished throughout the depth of the theatre. At the same time, the development of mobile surface-to-air missiles and high performance radar-guided AAA which were organic to the Soviet defence had the effect of reducing the demands placed upon Frontal Aviation for the air defence of Soviet divisions when manoeuvring, at rest, or in second echelon holding areas.¹⁴

Bombers such as the Tu-95 Bear, Tu-22 Blinder and Tu-22M Backfire are examples of the offensive equipment of 1960s and 1970s. A major reorganization of Soviet Air and Air Defence Forces took place between 1978 and 1980, including Frontal Aviation, Long-Range Aviation, interceptor aircraft of the National Air Defence (IA-PVO) and Ground Force Troops of the Anti-Aircraft Defence (PVO Voysk). Prior to the reorganization, Frontal Aviation was organized into sixteen tactical armies, each subordinate to the local commander of a military district in the

Soviet Union or the commander of the Group of Soviet Forces deployed outside the Soviet Union. These numbered armies were disbanded and the majority of their assets became Air Forces subordinated directly to the Military Districts and Groups of Soviet Forces or Fronts in wartime. Some of these assets, together with bombers of Long-Range Aviation, also went to make up what is known as the Air Armies of the Supreme High Command. The overall purpose of the reorganization was to create a strategic and operational structure to provide integrated air support in the Theatre of Military Operations (TVD).²⁶

Each Air Force of a Military District or Group of Soviet Forces included tactical bombers, fighter-bombers, fighters, reconnaissance planes and army planes. The Theatres of Military Operations were designated as North-Western, Western, South-Western, Near Eastern and Far Eastern. In addition to these there was the National Reserve. The Military District in the north was that of Leningrad.²⁷

An Air Force subordinated to a front in wartime could be as large as 300 aircraft, as had been the case with the old 16th Air Army assigned to the Group of Soviet Forces in Germany. One hundred and twenty-six aircraft were normally assigned to each fighter/ground attack division. Each regiment in turn was usually composed of three squadrons, depending upon type. Three flights were assigned per squadron. Air logistic functions were provided by the Aviation Technical Unit attached to each air force.²⁶

Not surprisingly, the bulk of Soviet air assets were deployed against NATO, including those assigned to the Group of Soviet Forces in Germany, the Group of Soviet Forces in Poland, and to the Carpathian, Baltic and Belorussian Military Districts in the USSR. As the NATO area represented the major diplomatic and military interest of the Soviet Union, it had deployed forces there to support that commitment.

The total number of tactical combat aircraft in the various Theatres of Military Operations in the late 1980s was about 8,000, the total air assets of the various military organizations being deployed as follows:²⁷

Air Defence

- 1,210 interceptors: MiG-23 Flogger 420, MiG-25 Foxbat 305, Su-15 Flagon 240, Su-27 Flanker 5, Tu-28/-128 Fiddler 80,

- Yak-28 Firebar 65, MiG-31 Foxhound 95
- 8 airborne warning and control aircraft: Tu-126 Moss 7, Il-76 Mainstay 1

Air Forces

- 165 long-range strategic bombers: Tu-95 Bear 150, Mya-4 Bison 15, Tu-160 Blackjack in development
- 550 medium-range bombers: Tu-22M Backfire 155, Tu-16 Badger 260, Tu-22 Blinder 135
- 2,780 tactical counter-air interceptors: MiG-21 Fishbed 490, MiG-23 Flogger 1,570, MiG-25 Foxbat 105, Su-15 Flagon 260, Tu-128 Fiddler 20, Yak-28 Firebar 20, MiG-29 Fulcrum 275, MiG-31 Foxhound 30, Su-37 Flanker 10
- 2,835 ground attack aircraft: MiG-21 Fishbed 130, MiG-27 Flogger 830, Su-7/-17 Fitter 895, Su-24 Fencer 770, Su-25 Frogfoot 210
- 50 tanker aircraft: Mya-4 Bison 30, Tu-16 Badger 20
- 685 tactical reconnaissance and electronic countermeasures aircraft: MiG-21 Fishbed 65, MiG-25 Foxbat 195, Su-17 Fitter 165, Su-24 Fencer 65, Yak-28 Brewer 195
- 260 strategic reconnaissance and ECM aircraft: Tu-16 Badger 115, Tu-22 Blinder 15, Tu-95 Bear 4, Yak-28 Brewer 102, MiG-25 Foxbat 24
- 3,050 attack assault helicopters, including Mi-8 Hip and Mi-24 Hind
- 1,500 training aircraft, including 800 fixed-wing and 700 rotary-wing aircraft
- 575 military air transports assigned to Transport Aviation (VTA): An-22 Cock 55, An-12 Cup 210, Il-76 Candid 310
- 1,300 transports in other elements of the armed forces, 1,635 civil aviation transports assigned to Aeroflot

Naval Aviation

- 340 strike and bomber aircraft: Tu-22M Backfire 120, Tu-16 Badger 190, Tu-22 Blinder 30
- 145 fighter and fighter-bomber aircraft: Su-17 Fitter 75, Yak-38 Forger 70
- 70 tankers: Tu-16 Badger
- 200 reconnaissance and electronic warfare aircraft, including Tu-16 Badgers, Tu-95 Bear Ds, Tu-22 Blinders, An-12 Cups, and others

- 480 anti-submarine aircraft: Tu-142 Bear F 60, Mi-14 Haxe A 100, Ka-27 Helix 60, Ka-25 Hormone A 115, Be-12 Mail 95, Il-38 May 50
- 465 transport and training aircraft

Ground Forces

- 4,260 combat and support helicopters: Mi-2 Hoplite 675, Mi-4 Hound 20, Mi-6 Hook 450, Mi-8 Hip 1,950, Mi-24 Hind 1,100, Mi-26 Halo 50, Mi-10 Harke 15, Mi-28 Havoc and Ka-50 Hokum in development

The Air Defence Air Force (PVO Strany) became an independent branch in the area of air defence and anti-aircraft systems in 1948. Its organization was:²⁸

Command System

- Headquarters in Moscow
- Air Defence Districts
- Radio Technical Troops
- Fighter Regiments
- Anti-Aircraft Troops

The anti-aircraft units belonging to the army made up the Army Air Defence Troops (PVO-SV) and were not integrated into the national air defence system. The Army Air Defence Troops were subordinate to the Military Districts and Groups of Forces in peace-time and to the Front and Army Staffs in wartime.

PVO Strany was reorganized in 1981 and its name was changed to Voyska PVO (Air Defence Troops), but it maintained its status as an independent branch, and the main body of army air defence troops, including the military schools, were annexed to it. The anti-aircraft aspect of the army was organized as a subordinate branch called the Air Defence of Troops (Voyskovaya PVO). Although the Soviet Army anti-aircraft troops seem to be subordinated to Voyska PVO, the dependence is probably more administrative, logistic and technical than operative. The Voyska PVO lost its separate command and control system in the reorganization, and about half of the fighters and the majority of the flying training system was transferred to the Air Force.

Voyska PVO consists of:²⁸

- Anti-Ballistic Missile Troops, Voyska PVO PRO
- Space Defence Troops, Voyska PVO PKO
- Air Defence Air Force, Aviatsia PVO
- Air Defence of Troops, voyskovaya PVO
- Air Defence Districts

The first two of these report via Air Force Headquarters to the General Staff. Their equipment in the late 1980s consisted of:²⁷

- 9,000 strategic surface-to-air missile launchers: SA-1 2,300, SA-2 2,675, SA-3 1,135, SA-5 2,030, SA-10 860
- 4,445 tactical SAM launchers: SA-4 1,350, SA-6 850, SA-8 765, SA-9 500, SA-11 180, SA-13 800, SA-X-12 in development
- 100 anti-ballistic missile launchers ABM-1B Galosh
- 7000 warning systems, including early warning and ground control intercept radars and satellites.

The next major phase of change in the Russian air system occurred in the early 1990s, when the Soviet Union disintegrated and various limitations imposed by international agreements began to come into effect, at the same time as the country's faltering economy started to have its effect on the modernization plans.

Sweden

After the massive build-up during World War II, Flygvapnet started its modernization programme fairly soon, with the aim of moving into the jet age. Its first jet aircraft, a De Havilland Vampire J 28, was purchased in 1946, and the first Swedish-built jet plane, the SAAB J 29 Tunnan, was tested in autumn 1948 and later became a standard aircraft for fighter, attack and reconnaissance units in the 1950s.¹⁶

In 1951 the service comprised 11 fighter wings with aircraft such as the J 30 Mosquito, J 22, J 26 Mustang, J 28A and B Vampire, J 21A-2 and R types, 4 attack wings with A 21, B 18B and T 18B, and two reconnaissance wings equipped with S 18A, S 31 Spitfire and J 26 Mustang.¹⁷

A new jet attack plane, the A 32 Lansen, was introduced in 1952, and three years later a jet fighter, the J 35 A Draken. The number of wings was the same in 1955 as in 1951, but the J 29 Tunnan was already well represented in the units. Development of the air surveillance and control system was extended in the 1950s via tests with PJ-21, PS-14 and PH-13 radar installations to reach the Stril-50 system, which has formed the basis for later modernizations. The base system, including the road bases also started to be extended in the 1950s.¹⁶

Six fighter wings were equipped with J 29 Tunnan aircraft by 1960, two with J 32B Lansen, two with J 34 Hawker Hunter, 120 of which had been purchased from Great Britain, and one with J 35A Draken. All four attack wings were equipped with the A 32 Lansen type. The two reconnaissance wings had S 29C Tunnans and S 32C Lansens.¹⁷ New long range radar systems, PS-08, had already been bought from Great Britain in the mid-1950s, and the Stril-50 was modified to the Stril-60, with increased automatization, in the 1960s.²⁹

The first signs of a need to reduce the organization for reasons of economy appeared in the late 1960s. Thus F9 at Säve was closed down on 30 June 1969, and the same happened to F2, F3 and F8 in 1974. Next followed F11 and F12, while F14 together with F18 were reorganized as a non-combat unit.¹⁶

A new aircraft type, the 37 Viggen, was introduced by SAAB on 8 February 1967 and eventually made its way into the units during the 1970s.¹⁷ A new combined light attack and trainer aircraft, the B3LA, was in the development plans in the 1970s but the project was later abandoned.

By the 1980s the number of wings had dropped to a half of that of the early sixties. F21 in Luleå had JA 37 and S37 Viggens, F4 in Östersund JA37 Viggens, F13 in Linköping JA37 and S37 Viggens, F16 in Uppsala JA37 Viggens and J35F Drakens, F10 in Ängelholm J35F Drakens, F17 Ronneby JA37 Viggens, F6 in Karlsborg AJ37 Viggens, F7 in Sätenäs AJ37 Viggens and F15 in Söderhamn AJ37 and SK37 Viggens. There were about 220 fighters; about 150 attack aircraft, including the light attack aircraft SK60, and about 50 reconnaissance planes.²⁹ A decision to build a new aircraft, the Saab JAS 39 Gripen, was made in the early 1980s, to be introduced in the early 1990s.³⁶

The question of the position of the anti-aircraft artillery in

the defence forces was taken up immediately after the war. There were four main objects of debate:³⁰

- the position of anti-aircraft artillery as a type of arms in the army
- transfer of the anti-aircraft artillery to the air force
- transfer of air surveillance from the army to the air force
- transfer of the coast artillery's anti-aircraft artillery to army units.

In 1947 an air defence committee pointed to a number of weaknesses in air defence and suggested that fighter units, army anti-aircraft artillery and air surveillance should be united as an independent air defence branch. The Chief of Flygvapnet wanted to transfer the anti-aircraft artillery to the air force, and the Chief of the Army wanted it to stay in the army. The idea of a new branch was abandoned, as were changes in the basic organizational structure, but air surveillance was transferred from the army anti-aircraft artillery to the air force in 1948.³⁰

The peace-time organization of the anti-aircraft artillery in 1949 comprised three regiments and four other anti-aircraft groups. Lv (Luftvärn) 2 in Linköping was closed down in 1958 and Lv1 in Karlsborg the next year. The number of wartime units remained at about 300.³⁰

The anti-aircraft artillery in the late 1940s had 26 fire control radars, 158 central calculators of the Papello, Gamma and Haze type, and 172 searchlights. The new radar systems, PE-07/R and PS-23/R, had been bought from Great Britain, and the next steps were Stril-50 and Stril-60.¹⁸

A new 40 mm gun with central calculator and radar was introduced in 1948, and a new 57 mm automatic cannon was taken into use in 1954. An anti-aircraft tank with two 40 mm guns and fire control radar was developed in 1960s. The missile era started in 1961 with the British Bloodhound II, called the Rb 68. The American Hawk system, called the Rb 367 at first and later the Rb 67 was supplied in 1962.

The Hawk system was modernized in 1977 and the name changed to Rb 77. The close range missile question was solved by purchasing Redeye shoulder missiles in 1969.

Work was started in 1967 on a Swedish design, the Rbs 70, and the first test units were delivered in 1974. A target acquisition radar PS-70/R was part of the development of this system.¹⁸

THE CURRENT SITUATION AND FUTURE EXPECTATIONS

Finland

The current peace-time organization of the FAF is as follows (Figure 1):

Headquarters,	Tikkakoski
Lapland Air Command,	Rovaniemi
- 11 Fighter Wing	
Satakunta Air Command,	Tampere
- 21 Fighter Wing	
Karelia Air Command,	Kuopio
- 31 Fighter Wing	

All three Air Commands are identical in their organization, consisting of a headquarters, a control centre with radar and air surveillance network, an aircraft repair shop, a signal repair shop, a logistics centre and a staff company in addition to the fighter wing itself. The base system consists of main bases and alternative standby bases, including road bases.

- Support Squadron	Tikkakoski
- Air Force Academy	Kauhava
- Air Force Signal School	Tikkakoski
- Air Force Technical School	Halli
- Aircraft Depot	Tampere
- Test Flight Centre	Halli
- Signal Depot	Tikkakoski
- Signal Test Centre	Tikkakoski

The peace-time complement is about 4500 persons, and the total number of aircraft is about 200, including 60 fighters and 54 BAe HAWK fighter trainers. The wartime strength is about 30 000 persons. The majority of the reservists belong to the optical air surveillance and air base systems, both covering the entire country, or to the anti-aircraft units. The latest equipment modernization cycle has been concentrated on the air surveillance and control system and the fighter fleet.

A renewal of the long-range radar equipment has just been completed, in which the old Marconi system was replaced with the new French Thomson CSF 3-D long-range system. The Finnish-made middle-range radar devices of the late 1970s are now experiencing their first update modification cycle, and the first new gap-filler radar devices, Swedish Ericsson Giraffes, have been purchased. The air base approach radar systems, which are part of the air surveillance and control system, are now of the new British Plessey Watchman design.¹¹

The modification cycle of the control centres is almost completed, so that these are now based on network-type data transfer, allowing a fighter to be intercepted in northern Finland under control from a centre in the south, for instance.

The largest modernization project to come to the public eye has been the renewal of the fighter fleet of Draken and MiG-21 Bis aircraft, which are reaching the end of their technical service life and are also becoming operationally obsolete in a rapidly developing international technological environment.

This had been part of the FAF's long-range planning from the early 1980s, and the programme commenced officially in 1989, when the first replacement candidates were named. A very comprehensive specification was drawn up and the first contacts were made with possible suppliers, Saab for the JAS 39 Gripen, Dassault for the Mirage 2000-5 and General Dynamics for their F-16. Since the bilateral trading agreement between Finland and the Soviet Union was still in force at that time, one further candidate, the MiG-29, was considered for purchase under that arrangement.

During the evaluation period McDonnell Douglas and US Navy informed the Finnish authorities about a possible fifth candidate, the F/A-18 Hornet, which had originally been regarded as too expensive. This additional information placed it in the same category as the others in terms of total cost structure, and once the parliamentary defence policy committee had recommended that, for reasons of economy, the new fighters should all be of the same type and the entire purchase should be made as a one deal, the Hornet was included in the competition and a quotation was requested from the McDonnell Douglas Company. The evaluation was carried out in two phases: flight performance and controllability test flights on the manufacturer's

premises and radar and weapons system test flights in Finland in winter with identical FAF target patterns. Maintainability, availability and other cost calculations, together with negotiations over industrial participation, were carried out alongside the tests by the various specialized groups. The request was made for 100% offset purchases, and every candidate supplier was ready to accede to this.

The eventual decision was made in the late spring of 1992, and the final formula for determining the outcome, after a massive data processing operation, was quite a simple one:

PERFORMANCE/TOTAL COST (including
both purchase price and the life-cycle costs).

Performance was evaluated in the context of a typical mission: in winter, at night, a scramble take-off from a road runway, air surveillance and target acquisition, interception beyond the visual range, a dogfight, break-off, navigation to base, landing, rearming and refuelling. The various parts of the mission were weighted differently, of course, with beyond visual range (BVR) interception ability by far the dominating factor.

The clear winner in the competition proved to be the F/A-18 Hornet, which was successful in all areas, its BVR capability and firepower with an AMRAAM AIM-120 missile load being especially impressive. Cost factors were also favourable, since economy of scale had proved its worth, given high production figures and a large user family.

A Letter of Intent was signed on 6th May 1992 and the offset agreement on 19th May 1992. The government made its purchase decision on 4th June of the same year, and the Letter of Acceptance was signed on 5th June. Thus the massive evaluation and negotiation task had been carried through in three years. There were two things in particular which gained respect in the international feedback: adherence to the preplanned schedule, and completion of the type selection process without any media leaks. The key to success lay in the detailed, comprehensive specification, which had demanded a great deal of effort at the time but subsequently effectively eliminated any loose ends or extra iteration cycles.

The total package included 7 two-seater F/A-18 Ds and 57 single-seater F/A-18 Cs with the new AN/APG-73 radar, new

and more powerful F404-GE-402 engines, plus AMRAAM AIM-120 radar missile and Sidewinder AIM-9M infra-red missile armament. The two-seaters were delivered directly from McDonnell Douglas and were flown from St. Louis to Finland in November 1995 and February 1996, while the F/A-18 C fighters and their engines are being assembled in Finland by Finavitec Ltd, formerly Valmet Aviation Ltd. The first delivery was made in summer 1996, and they will continue in the same pace as the older fighters are withdrawn from service, so that the entire fighter fleet will have been renewed by the year 2000.

The doctrine of the FAF has been streamlined by both its war experiences and its peace-time resource limitations. Air superiority, or rather the ability to deny the adversary air superiority, was put forward as the most important factor for the protection of strategic targets and for front line operations, and thus air combat capability is priority number one among the various alternative mission areas.

On the other hand, Finland has never invested in defence at the expense of other governmental responsibilities, in fact the contrary has tended to be the rule, so that the resources available for defence have traditionally been modest. There is one benefit that has arisen out of this; that the limited resources have allowed no margin for political speculations and have created a long-range stability which has enabled continuous upward progress to be made. This in turn has been an important contributor to the morale and motivation of the personnel. In any case, any attempt to build up a miniature superpower air force with such resources would have led to ineffective assortments of aircraft types and mission priorities, whereas by concentrating the system entirely on the most important mission it has been possible to build up a force which also has some quantity effect in that specialized field. This simplifies both training and material administration and development, and dictates certain clear-cut priorities for recruiting. The pilot selection system recruits a new pilot group each year, on a ratio of one to every 40 - 50 applicants. They all are selected and trained as fighter pilots, backed up by a small supporting cadre of former fighter pilots. Individuals with a background as a fighter pilot also make up a considerable proportion of the ground controllers.

One fairly original feature of the FAF are the fact that the

fighter wings operate two aircraft types. This both improves pilot training and reduces the overall costs. Every fighter wing also has a Hawk squadron, which gives new pilots full air combat manoeuvre training after their basic and advanced training at the Air Academy and before they move on to the fighters. At the same time, this arrangement permits continuous air combat training with different types of aircraft, the "Red Flag" being carried on the wings on a daily basis within the fighter squadrons. The instructors in the Hawk squadrons, being qualified fighter pilots themselves, can quickly show the newcomers the correct air combat principles and alternatives.

The Finnish anti-aircraft organization for the peace-time training of reserves and the systems development is as follows:

- Anti-aircraft Department, HQ for Defence Forces
Helsinki
- Helsinki Anti-aircraft Regiment Tuusula
- Varsinais-Suomi Anti-aircraft Regiment Turku
- Kymi Anti-aircraft Regiment Hamina
- Lapland Anti-aircraft Regiment Rovaniemi
- Armoured Anti-aircraft Battery Parola
- Anti-aircraft School Tuusula
- Anti-aircraft Battery, Reserve Officers' School Hamina

The organizational anti-aircraft units in the Army, Air Force and Navy are equipped with the following surveillance, control and weapon systems:¹⁸

- Target Acquisition Radar m-95 Giraffe 100
- Target Acquisition Radar m-87 Giraffe 75
- Regiment Control Centre m-90
- Battalion Target Acquisition Centre m-87
- Battery and Platoon Air Situation Display System
- NVS 12.7 mm machine gun
- 23 ItK 61 23 mm cannon
- 30 ItK 62 30 mm cannon
- 35 ItK 88 45 mm cannon
- 40 ItK 36-59 40 mm cannon
- 57 ItK 60 57 mm cannon
- Tank ItPsv SU-57 57 mm cannon
- Tank ItPsv 90 Marksman 35 mm cannon
- Shoulder Missile ItO-78 (Strela)

- Shoulder Missile ItO-86 (Igla)
- Missile System ItO-91 Mistral
- Missile System ItO-90 Crotale
- Missile System ItO-79 Pechora

The Finnish Anti-aircraft System can be divided into two components: the control system and the weapons system. The control system is integrated nationwide, and information passes to and fro between the air force control centres and posts and the anti-aircraft control and weapon units. Fire control on a resource and safety basis is the responsibility of the air force within the air defence fire control system, and basic shooting techniques and tactics that of the regimental control centres in the strategic target areas and the battalion control centres in the army units. The key functional components are the air surveillance system, the air situation display system and the communications or signals system. Tactical management follows the operational order of battle.¹⁸ The weaponry consists of gun and missile systems, which are categorized into close-range, medium-range, or target protection, and long-range, or area protection systems. The anti-aircraft system comprises all of these components at present, and most of them are modern.¹⁸

The Commander of the Air Force is responsible for the air defence of Finland. In effect, he wears two hats:

- In the Defence Staff he is the Air Defence Commander and the Commander-in-Chief's air specialist, who handles the deployment of air defence and anti-aircraft assets nationwide within the strategic target structure, the air commands and the military commands.

- As the Commander of the FAF he has his headquarters, operations centre, air commands and the rest of the organization to maintain peace-time operational readiness, training and material functions and to execute the Air Force's mission in wartime.

The commanders of the air commands work in cooperation with those of the military command to coordinate air, ground and naval assets and use them at the right time and in the right place according to mutually and jointly prepared plans. The Inspector of Anti-aircraft Defence at the Defence Staff is responsible for the materials development and the training of anti-aircraft troops

in all branches. He is an assistant to the Air Defence Commander at the Defence Staff.

There have been no radical changes in expectations regarding air defence in Finland. The majority of the air surveillance and control system has been modernized, and the programme will continue by building up redundancy in the sensor and data transfer systems.

The new fighter fleet will remain in service for many decades after the turn of the century. One of the benefits of the new Hornet system is the user family's common philosophy of continuous updating of the fighter. The two-year cycle of new operational computer programmes guarantees continuous availability of the latest weapons, electronics and other systems. The look-down shoot-down capability and the BVR fire-and-forget firepower, able to handle the cruise-missile and multi-target environment, are, of course, the main assets of the new fighter. But the overall multi-role versatility of the aircraft also is most important.

The post-war Achilles' heel of Finnish air defence has been the lack of systems for offensive counter air operations. Even now, for economy reasons, only air defence weaponry was purchased. From the systems standpoint, however, the situation is now entirely different. Extensive, time-consuming modifications would have been needed earlier in order to install new weapon systems in fighters, but now the Hornet system is immediately ready to use a wide variety of specified stand-off missiles ideally suited for offensive counter air operations. Thus the achievement of a rapid, marked improvement in the overall effectiveness of the fighter system is now only a question of money and not of systems capability.

The Hawk fighter trainer will obviously be fitted with a new, more durable "combat wing" in the early 2000s, and some kind of mid-life cockpit update is possible after another twenty years or so, but before that a small number of support planes of various kinds and about 30 elementary trainers will be replaced with new aircraft types.

The organization is rationalized by transferring the fixed wing aircraft of the transport squadron from Utti to Tikkakoski, and will be combined with the reconnaissance squadron to form the support wing. The helicopter squadron stayed in Utti, and became an army unit.

In the anti-aircraft sector the ItO-79 area protection missiles are becoming obsolescent, and a preliminary survey of potential replacements has been carried out, showing that appropriate alternatives could be found from several sources. There was one financial advantage, combined with system performance, which tipped the balance in the direction of the Russian BUK-M1 system, namely Russia's debt to Finland, inherited from the era of bilateral trading, which amounts to about 8 billion marks, a certain small proportion of which has been earmarked for offsetting against arms supplies. Russia has a long tradition as a developer of a multitude of anti-aircraft missile systems, so that this system in any case represented the best choice for the defence forces. Also, the above funding solution allowed the old system to be replaced ahead of schedule, delivery taking place at present.

Norway

The peace-time organization of the RCAF is as follows (Figure 2):³¹

- Headquarters, Huseby, Oslo
- Northern Norway Air Command
 - Helicopter Squadron 330, A Flight, Bodö, B Flight, Banak
 - Helicopter Squadron 337, Bardufoss
 - Helicopter Squadron 339, Bardufoss
 - Fighter Squadron 331, Bodö
 - Fighter Squadron 334, Bodö
 - Maritime Squadron 333, Andoya
 - Liaison Squadron 719, Bodö
- Southern Norway Air Command
 - Helicopter Squadron 330, C Flight, Örland, D Flight, Stavanger-Sola
 - Fighter Squadron 332, Rygge
 - Transport Squadron 335, Oslo-Gardemoen
 - Fighter Squadron 336, Rygge
 - Fighter Squadron 338, Örland
 - Helicopter Squadron 720, Rygge
 - Primary Flying School and Cadet School, Trondheim-Värnes
 - Technical School, Kjevik

The peace-time strength of the RCAF is about 9,500 persons, and the total number of aircraft about 150, including 59 F-16 A/B fighters and 15 F-5 A/Bs. Its war time strength is about 34,000, supplemented by an Air Force Home Guard of 2,500 men organized into ten air defence batteries.¹²

Nato has already been working for several years on building up a new early warning, surveillance and control system to replace the NADGE system, but due to the changing international situation the budget has been cut back markedly. This means that work on Norway's network of 14 stations has also slowed down. The majority of the infrastructure has in any case been completed. Ten new 3-D HADR middle-range radar systems have been purchased to replace the older equipment, and these have been located mainly on the coast, so that they also participate in marine surveillance. The long-range radars from the 1960s are to be replaced with the new Nato system at the turn of the century.

The Norwegian air surveillance and control system works in close cooperation with Nato, USAF and British AWACS planes flying over the Norwegian Sea, although the intensity of flights has decreased since the USA closed down the AWACS unit at Keflavik. Nowadays mainly Nato and British aircraft are continuing the operations, with Örland as their Forward Operating Location (FOL) in Norway. Renewal of the fighter fleet is now entering the planning stage. The mid-life update (MLU) of the F-16 A/B fighters scheduled for 1996-2000 has just begun, and this should prolong their service life to about 2020. The lifetime of the modified F-5 aircraft will obviously come to an end before that, and so they will inevitably be a part of the renewal process.

The evaluation work started with the Rafale, Eurofighter 2000, JAS, F-16 C/D block 50 plus, F-18 C/D and F-18 E/F fighters as the preliminary candidates. The original plan is to acquire 48 aircraft to replace the old F-5 A/B force and the F-16 A/B fighters that have been lost. Deliveries should take place in 2003 or 2004. The current F-16 A/B squadrons are to be replaced with new aircraft in the period from 2015 to 2018.

The main weapon of the RCAF F-16s is the AIM-9L Sidewinder, and without the AIM-7 Sparrow, the aircraft are basically clear weather fighters. The MLU program will give them an all-weather capability, with missiles such as the AIM-120 AMRAAM or MICA.

The anti-ship weapon currently deployed is the Norwegian Penguin P-3 missile, but the longer-range P-4 is under development. The main ground attack weapon is the AGM-65 Maverick and the anti-radar arsenal consists of AGM-45 Shrike and AGM-88 HARM missiles.

The main mission of the RCAF is air defence, to secure the arrival and deployment of specific Nato units in Norway in order to begin operations. A secondary mission for the fighters is anti-ship warfare with the Penguin missiles. The long coastline and vast, open sea area introduce maritime and transportation obligations, which are reflected in the number of anti-submarine Orion P-3Cs and helicopters.

About 40 trainee pilots are accepted each year, and after primary training in Norway, they receive their advanced training in the USA. The trainees are divided into four categories: fighter pilots, transport pilots, helicopter pilots and navigators. After the training in the USA, which takes from 11 to 16 months depending on the category, a period of 3-5 months of tactical training is provided at Rygge. After this the pilots are stationed in their squadrons for possible type courses followed by normal service training.¹²

The Nike Hercules anti-aircraft area protection missile batteries around Oslo have been taken out of commission lately, and some of the Norwegian Adapted Hawk (NOAH) target protection missile batteries are obviously being used to replace them. Norway carried out the NOAH modification by combining the Improved Hawk system with the Acquisition Radar and Control System (ARCS) fire control centre by Kongsberg. The main mission of the present six NOAH battalions is to protect air bases such as Andoya, Bardufoss, Bodö, Evenes, Värnes and Örand.³² Norway was the first country to adopt an active anti-aircraft missile system. This is based on AMRAAM missiles, and two of the first units have already been delivered. The remaining four units are expected to be in operational use by 1997. One battery consists of three platoons, each having 3 launchers with 6 missiles, so that the battery has a total of 54 missiles. These Norwegian Advanced Surface-to-Air Missile System (NASAMS) batteries will use mobile Hughes AN/TPQ-36A target acquisition and fire control radar devices combined with ARCS fire control centres. Their main mission will obviously be to protect the air bases.

The short-range anti-aircraft units were equipped during 1991-1994 with the Swedish RBS-70, which replaced the Bofors L/60 40 mm anti-aircraft guns. These units now form the main bulk of the army anti-aircraft system, although light cannons and machine guns are also used as short range anti-aircraft weapons in the army units. There are anti-aircraft battalions in Rygge, Gardemoen, Lista, Sola, Örand, Värnes, Bodö, Bardufoss and Andoya, anti-aircraft batteries in Langenes, Evenes and Torp, reserve battalions in Fornebu and Flesland, and reserve batteries in Kjevik and Bodö.¹²

The Chief Inspector of Air Defence is the head of the Air Force and is responsible for organization, tactical and material development, flight safety and personnel administration. Operational responsibility extends through the military commands, and the air commands are subordinated to these. The same holds good for anti-aircraft defence, the Chief Inspector of Air Defence being the head of the anti-aircraft troops, with the similar responsibilities as for the Air Force. The structure of operational responsibility is also similar.¹²

The role of Nato plays a major part in Norwegian thinking and expectations for the future. The overall decrease in military spending within the Nato organization will place more of a burden on the national defence contribution. One example is the formidable system of bases, which will need substantial resources if it is to be maintained at its original planned size.

On the other hand, the extensive and highly important Russian military concentration in the Kola region will mean that the northern flank of Nato will never fall out of focus in the planning of air assets. The types of aircraft which Nato plans to deploy in Norway in times of crisis include:

- Tornado and Jaguar reconnaissance aircraft
- A-10 close support and anti-tank aircraft
- F-16 and F/A-18 multirole fighters
- F-15 and Tornado ADV interceptors
- Tornado IDS attack aircraft
- AV-8B and Harrier close support aircraft
- EA-6B electronic warfare planes
- C-130 transports
- C-135 tankers.

The total amount of Nato support amounted earlier to about 300 planes but the expected number is now somewhere around 200 or less.

If a carrier force group were deployed in the Norwegian Sea it would bring 80 or 160 more aircraft onto the scene, depending on the number of carriers. These would include:

- E-2C Hawkeye AWACS aircraft
- S-3A Viking surveillance and anti submarine aircraft
- F-14 Tomcat interceptors
- F/A-18 Hornet multi-role fighters
- A-6E and A-7E attack aircraft
- KA-6D tankers
- EA-6B electronic warfare aircraft

The carrier force can be supported by P-3 Orion surveillance and anti-submarine aircraft flying from Great Britain and Iceland.

Other aircraft such as the F-117, F-111F, F-15E, B-1B, B-2 and B-52 can occasionally be used on the northern flank as well, without being based in Norway. The anti-aircraft weapons possessed by the Nato support forces include the TPS-59/HAWK Anti-Tactical Ballistic Missile system, Rapier, Chaparral-Vulcan, possibly Patriot, and also Shorts Javelin shoulder-launched missiles.

Norwegian Army anti-aircraft defence will be in the hands of air defence battalions equipped with RBS-70 short-range missiles and 20 mm cannons, controlled by Mobilradar control centres and Siemens weapon terminals. These belong to the Norwegian Army Low Level Air Defence System (NALLADS).¹⁸

The anti-aircraft defence of air bases will be divided into three categories. The first will comprise a NASAMS battery, L70 batteries and a RBS-70 battery combined with four ARCS centres, the second a NASAMS battery and a RBS-70 battery combined with four ARCS centres, and the third one RBS-70 battery and two ARCS centres.¹⁸

Russia

The peace-time air force and air defence organizations in the north-western area of Russia are as follows.³¹

76 Air Army (Figure 3)

- Headquarters, St. Petersburg
- 239 Fighter Division, Viitana
 - 159 Fighter Regiment, Viitana
 - 28 Fighter Regiment, Andreapol
- 149 Bomber Division, Gdov
 - 722 Bomber Regiment, Gdov
 - 67 Bomber Regiment, Siverski
- 98 Reconnaissance Regiment, Monchegorsk
- 277 Helicopter Squadron, Taibola
- 138 Support Regiment, Levashovo

The aircraft types include Su-27, MiG-29, Su-24, MiG-25, Su-17, Mi-8, Mi-6, An-12, An-26 and An-30, and amount in total to about 90 fighters, 80 bombers and 60 reconnaissance aircraft, altogether about 230 aircraft and 35 helicopters.

6th Air Defence Army (Figure 4)

- Headquarters, St. Petersburg
- Air Defence Corps, St. Petersburg
 - 180 Fighter Regiment, Sakkola
 - 177 Fighter Regiment, Lotinapelto
- Air Defence Corps, Murmansk
 - 174 Fighter Regiment, Monchegorsk
 - 941 Fighter Regiment, Murmansk
 - 470 Fighter Regiment, Afrikanda
- Air Defence Corps, Arkangelsk
 - 518 Fighter Regiment, Talagi
 - 548 Fighter Regiment, Kotlas

The aircraft types include MiG-31, Su-27 and MiG-25, the total number of fighters being about 200.

Army Air Force of the Northern Military District (Figure 5)

- Headquarters, St. Petersburg
- 6th Army
 - Attack Helicopter Regiment, Alakurtti
 - Transport Helicopter Regiment, Alakurtti
- Helicopter Squadron, Taibola
- Heavy Transport Helicopter Squadron, Römpötti

- 30 Army Corps
- Attack Helicopter Regiment, Kasimovo

The helicopter types include Mi-8, Mi-24 and Mi-6, a total of about 200 helicopters.

Northern Navy Air Force (Figure 6)

- Headquarters, Murmansk
- Carrier Division, Kuznetsov
 - Fighter Regiment
 - Attack Regiment
 - Helicopter Regiment
 - Training Regiment, Murmansk
 - Support Helicopter Squadron, Support Ships
- Anti-Ship Attack Division, Olenia
 - Anti-Ship Attack Regiment, Olenia
 - Anti-Ship Attack Regiment, Arkangelsk
- Attack Regiment, Olenia
- Reconnaissance Squadron, Severomorsk
- Transport Regiment, Pechenga
- Maritime Surveillance and Anti-Submarine Division
 - MSAS Regiment, Severomorsk
 - MSAS Regiment, Kipelovo
 - AS Helicopter Regiment, Murmansk NE

The aircraft types include Su-33, Su-25K, Su-27, Su-25, Tu-26, MiG-27, Su-24E, An-12, An-26, Il-38, Be-12, Tu-95D, Tu-142F, Ka-27 and Ka-25. The total number of aircraft is about 250 and that of helicopters about 50.

Baltic Navy Air Force (Figure 7)

- Headquarters, Kaliningrad
- Transport Squadron, Krabrovo
- Bomber Regiment, Chkalovsk
- Bomber Regiment, Chernyakhovsk
- Fighter Regiment, Nivenskoye
- Maritime Surveillance and Anti-Submarine Regiment

The aircraft types include Su-24, Su-27, An-12, Il-38, Be-12, Ka-25/27, Ka-32 and Mi-14, numbering about 130 aircraft and about 30 helicopters in all.

The Northern Military District can be supported by the Transport Division in Novgorod, with Il-76 transports, and by the Long-Range Air Force with its Tu-26, Tu-160, Tu-16 and Tu-95H planes. More support can be arranged from the 16th Air Army in the Moscow Military District and the Moscow Air Defence Army.

In the immediate wake of the collapse of the Soviet Union in December 1991, the Soviet Air Force relatively quickly reverted from a system with some 20,000 pilots and 13,000 aircraft to a new organization of 13,000 pilots and 5000 aircraft.³⁵ Under the Conventional Forces in Europe (CFE) Treaty, Russia is authorized to maintain 3,450 fixed-wing combat aircraft, 890 armed helicopters and 300 naval aircraft west of the Ural Mountains.³¹

The disintegration of the Soviet Union meant major changes in the country's air defence. The transfer of enormous masses of equipment from the former Warsaw Pact countries and Baltic nations, combined with the scrapping of old material and relocation of newer material in the various depots, required a considerable logistic effort. These arrangements for the redeployment of troops and material were mainly carried out in 1994.

At this same time efforts have been going on to modernize and automate the air surveillance and control system. There is still much work to be done, but the programme is aimed at creating a new computer-based display and data transfer system.

The air defence district is divided into sectors with their own air defence corps. These are responsible for air surveillance and intelligence, fighter defence and anti-aircraft defence in their respective areas.

The radio brigades are responsible for air surveillance and intelligence in each air defence sector. Each air defence corps has two or three brigades of this kind, and each brigade has from three to five radio battalions, each normally with two to four radar companies. The radar equipment is mostly modern, the majority of it having been introduced in the 1980s or 1990s. The most difficult part will probably be modernization of the signals network, and the building up of a hand-operated digital transfer network of the necessary magnitude will take many years and a large amount of resources.

The AWACS Mainstay aircraft forms the mobile part of the

air surveillance and control system, and is connected to the air defence corps network through its data transfer system. The Ilyushin A-50 Mainstay has undergone a continuous cycle of modifications and probably about 20 planes are currently in use. The production line may be discontinued, but no information on a possible successor has yet been released.

The composition of the Russian air forces is tending to follow the international trend for a decrease in both the total number of aircraft and the range of types. Almost all the older types such as the Su-15, Tu-126, MiG-27, MiG-23, Su-17, Tu-16 and Tu-22 were in the process of being phased out in the early 1990s, and the main categories of combat aircraft are now:³¹

Fighters

- Su-27, MiG-31 and MiG-29

Attack aircraft

- Su-24D and Su-25

Bombers

- Tu-26/Tu-22M, Tu-95 and Tu-160

Reconnaissance aircraft

- Su-24F/E and Tu-26

Only 23 new aircraft were purchased altogether in 1993 - 1994 and only one type of combat aircraft, the Su-27, was evidently in production in 1995. None were budgeted for 1996.⁴⁶ Frontal Aviation has shrunk from a high of over 5000 combat aircraft in 1989 to less than half that number today. Of these, around a third are fourth-generation MiG-29s and Su-27s. If current budget trends continue, Frontal Aviation's holdings, by its own estimate, will decline from 2280 to 1440 combat aircraft in 2000. The Air Force leaders have stated that because of cash shortages, the first priority in fighter force enhancement would be Su-27 modifications, including the Su-35 air superiority fighter and Su-32/34 two-seat all-weather strike aircraft, as well as a reconnaissance variant and a much needed ECM/EW version.⁴⁶

The Air Defence Force has experienced a rate of decline much like that of the other combat air arms since the late 1980's. From a high of some 2300 interceptors it is down to less than half that number today. Force modernization plans appear limited to developing and producing an advanced MiG-31, if and when

procurement authorizations permit.⁴⁶ The Air Force has done its best to sustain Mikoyan's new I-42 or MiG-37 fighter program but has admitted that it would be "not soon" when it would come to fruition.⁴⁶

One problem for Russian strategic aviation has been the loss of about half of its bombers to the Ukraine, especially 15 Tu-160 bombers representing 65% of its fleet of that type. The negotiations between the two countries have resulted in the return of ten of these at a reasonably equitable price.⁴⁶ Development plans also exist for a new model, the Su T-60s middle-range supersonic bomber.

Strategic transport aviation has experienced similar problems to those affecting the bomber wing. About 30% of the Il-76 transport aircraft remained in the Ukraine, as well as the majority of the factories producing their parts. The oldest types, the An-12 and An-22, will reach the end of their service life in ten years, but if new types are not produced, the lack of air transportation will be one of the most serious factors limiting the application of Russia's new military doctrine. The small number of tankers will also limit combined long-range operations, as the current tanker fleet is almost entirely occupied with strategic bomber operations. The Air Force leadership has stated that the present priority number one in military aviation is the air transport capacity.⁴⁶

A joint project exists with the Ukraine to build a transport aircraft, the An-70, to replace the An-12. This was planned to go into production early in 1990, but the programme has been delayed. The only heavy transport aeroplane being produced in Russia at the moment is the An-124, to replace the old An-22s and some of the Il-76s. There are about 50 An-124s now in use.

The present tankers, of the Il-78 Midas model, are based on the Il-76 transport airframe. No information is available about the continuity of production, but there is an obvious need for more tankers. The Il-78 can refuel types such as the Tu-95, Tu-160, Su-24, Su-27, MiG-31 and their variants.

The Mi-24 and its various versions represent the main attack helicopter currently in use in Russia, but there are two candidates to replace it, the Mi-48 and Ka-50. The service life of the Mi-24 will come to an end somewhere around 2005, so that production of its successor should begin fairly soon.

The basic weapon of the strategic bomber force is the AS-15 cruise missile, with a range of 2500 km. This can carry either a nuclear or a conventional warhead. An additional weapon is the AS-16 Kickback short-range attack missile, which is designed to eliminate the defence strongholds. A new cruise missile, the AS-19, is in the initial development phase.

The main weaponry for the Tu-26M2 Backfire B bombers consists of aerodynamic AS-4/6 missiles, which have a range of 300-400 km. These are designed for use against both land and sea targets. The long-range Tu-26M3 Backfire C bombers can be equipped with AS-16 ASM missiles in addition to the AS-4/6 missiles. The conventional bomb load for the Tu-26 bombers is about 20 tons.

The main attack aircraft type, the Su-24, has a Kaira-24 laser and TV sighting system, and its maximum external load of 8100 kg can be made up of a wide variety of weapons e.g.:³¹

- laser-guided bombs KAB-500L
- conventional HE bombs FAB-100, FAB-250, FAB-500
- incendiary bombs ZAB-500Sh
- retarded runway-cratering bombs BetAB
- cluster dispensers RBK-180 or RBK-250 for PTAB-2 or PTAB-5 anti-armour bomblets
- rocket pods S-8KO with 20 x 80 mm rockets or S-13 with 5 x 130 mm rockets
- gun pods SPU-6 housing 23 mm GSh-23 twin-barrel cannon and 260 rounds of ammunition
- air-to-surface missiles Kh-23M AS-7 Kerry, Kh-25 AS-10 Karen, Kh-29 AS-14 Kedge, Kh-31P AS-17 Krypton, Kh-58E AS-11 Kilter, Kh-59 AS-13 Kingpost

The main weapons for the interceptors are the semi-active radar missiles AA-9 and AA-10. A new active radar missile, AA-12, R-77, was introduced in 1994. Two new active, obviously anti-AWACS, long-range radar missiles are being planned: the R-37, with a range of 150-300 km, and the KS-172, with a range of 400 km. These two may prove to be rivals, competing for the same, at the moment uncertain development resources. The main infrared missile is the R-73, which can be used with a helmet sight.

The Mi-24 attack helicopter's main weaponry consists of a portable gun, missiles and rockets. The use of rockets is decreasing

and the use of missiles correspondingly increasing. The use of air-to-air missiles as a form of self-defence armament will be increased in the future.

The military air organizations of Russia inherited about 60% of the Soviet Union's combat aircraft and 40% of its air bases,³³ and the basic organizational structure remained initially more or less the same, the obligation to carry out operations far away from the homeland tending to prevail among the various categories of mission. A three-step reorganization plan was then established to carry out:³³

- an analysis of the status and resources of the air forces in 1992
- reception of units from abroad and introduction of a new organization in 1995
- balancing of the functions of the combat air support units in the new organization from 1995 onwards.

Respect for air power seems to be on the increase in Russia, especially after the results of the Gulf War. The then Chief of the General Staff Academy, now the Minister of Defence, Colonel General Igor Rodionov, said in a speech in spring 1992 that any future war will be fought with airborne weapons.³⁴ At the same time, however, resources are diminishing, and therefore some severe cuts in priorities among the mission categories are to be expected. Also, the inertia of the old Soviet system, which routinely favoured strategic missiles and armour, is still slow to die. Aviation equipment accounts for only 12-15% of Russia's arms purchases, in contrast to an asserted 25-30% in the United States, whose major combined operations have been successes.³⁵ Actually, the proportion of the budget allotted to air resources is frequently used nowadays as a yardstick to measure the effectiveness of the defence systems of different countries. If the percentage of air resources is low, the defence forces will not be capable of modern warfare but will be oriented towards either internal security missions or guerilla warfare. Or worse, they may be making Iraqi-type false investments in a capability for conventional warfare.

Throughout most of the cold war, the Soviet Air Force operated a specialized undergraduate pilot training program consisting of a dozen Higher Military Aviation Schools for Pilots.

The new system entails initial flight orientation in secondary boarding schools, followed by screening and selection for a five-year undergraduate pilot training program, with flight training solely on the L-39. Now cadets receive three years of classroom academic instruction. Only afterward it is determined whether they will continue on to the flying phase, which is now compressed into two years rather than spread out over three as before. Of the twelve original undergraduate pilot training schools, the Air Force now operates only four.⁴⁶

A certain decrease in the number of applicants has been noted due to changes in service conditions. The commandant of the former Kharkov Higher Military Aviation School for Pilots (VVAUL), for example, noted that where 790 applicants were accepted in 1989, only 312 entered the programme in 1990. It was common in the early 1970s for six to eight applicants to vie for each available pilot training slot nationwide, but today one finds a maximum of 1.5 applicants competing for each position. On the other hand, there is no shortage of pilots at the present moment relative to the number of aircraft, because the radical reduction in the latter means that certain units have as many as five pilots queuing for one aircraft.³⁵ This, combined with the high price of fuel, has cut the annual number of flying hours per pilot down to an alarmingly low level.

The anti-aircraft defence system includes:

- Space Defence Troops
- Air Defence Anti-aircraft Troops
- Army Anti-aircraft Troops
- Naval Anti-aircraft Troops

Anti-aircraft fire is coordinated by the control centre of each Air Defence Sector, and all anti-aircraft troops in the sector are subordinated to that organization. The basic organizational unit is the anti-aircraft missile brigade, which establishes a centre to control the fire of its own units, the separate units in the area and the army anti-aircraft units. Both air defence and the army organizations have anti-aircraft missile brigades, which are deployed so that only one brigade is responsible for each area and controls the fire of all the units in that area.

The air defence missile brigades have the Baikal-1E control system and the army missile brigades the Polyana-4E system,

allowing them to communicate with neighbouring brigades, the air defence corps Universal-1E centres and Mainstay AWACS aircraft.

The main weapons of the air defence anti-aircraft missile brigades are the SA-5 long-range missile and the SA-10 multi-purpose missile. There are several versions of the SA-5, which is a semi-active radar missile with a range of 200-300 km and a cruise speed of 3-4 mach. The system is basically moveable, but the majority of the arsenal is obviously deployed in fixed, fortified positions. A brigade normally has a group of 2-5 battalions belong to it, and target acquisition is normally carried out by the brigade control centre radar. Every battalion has its own fire control radar.

The SA-10 is designed to intercept ballistic missiles (excluding intercontinental and middle-range missiles), aircraft and cruise missiles. One of the missile types is optimized for anti-missile functions. The range of the older missiles, designed for aerodynamic targets, is 100 km, while the newer types have a range of 150 km. The height coverage is 30 km and the top speed of the missile 6-7 mach. The anti-aircraft missile brigade has 1-3 SA-10 battalion groups, each normally of 3 battalions. Each battalion group has 2 target acquisition radars, a 3-D multi-purpose radar and a CW radar optimized for low flying targets.

Each battalion has its own CW target acquisition radar and a pulsed doppler fire control radar equipped with an electronically phase-arrayed antenna. For anti-missile capability, a brigade must be equipped with a special target acquisition radar, also with an electronically phase-arrayed antenna. This is obviously not yet standard equipment in all brigades.

The older, massively deployed SA-2 and SA-3 systems are gradually being phased out, but they will probably remain on the inventory until after the turn of the century. The SA-2 and SA-3 battalions are deployed as separate units under direct control of the brigade control centres. They are evidently not connected to the brigades' automatic Baikal-1E control systems.

The army anti-aircraft missile brigades are equipped with SA-4, SA-6/11, SA-12 or SA-10 missile systems. The SA-4 system is old and will probably be abandoned entirely fairly soon, while the SA-6/11 is a kind of hybrid system in which an attempt has been made to rectify certain fire control limitations and multi-

target functions in the SA-6 system by means of the combined use of SA-11 launchers. Both missiles have a range of about 30 km. The SA-12 Gladiator/Giant system S-300V was obviously intended originally to replace the army anti-aircraft missile brigades' SA-4 and SA-6/11 systems, but it is possible that the SA-10, S-300PMU1, will become the main equipment for the army units as well.

The anti-aircraft missile regiments of the mechanized infantry divisions are equipped with either SA-8 or SA-6 missile systems. These will be replaced, probably in some ten years, with SA-15 or SA-18 missile systems, which are under development. Both are typical short-range systems. The anti-aircraft missile battalions of the mechanized infantry regiments are mainly equipped with SA-9 and SA-13 systems, and both will be replaced later with a new SA-19 system.

The Russian Air Force as a branch has been mainly an administrative organization, its combat units being subordinated to other branches. The Strategic Air Force, with its missile-equipped bombers, operates as a part of the Strategic Forces, while the main mission of the Frontal Air Force was to provide tactical air support for the army forces, and the air armies and tactical bombers of Long-Range Aviation were subordinated to the military districts. Only the Transport Air Force was operationally subordinate to the Air Force Commander at times of crisis. However, recently constituted Frontal Aviation Command (KFA) operates and maintains all tactical aircraft in the Air Force inventory. Its establishment withdrew Russian fighter aviation from immediate ownership of the regional military district commanders, long the practise throughout the Soviet era, and reassigned it to the Air Force.⁴⁶

The Air Defence Air Force is independent and directly subordinated to the Ministry of Defence, at least at present, but it is subordinate logistically to the Air Force.

The Naval Air Forces have common maintenance systems with the Air Force at various coastal bases, but operationally they are subordinate to the navies. The leadership of the Air Force has initiated an effort to simplify and concentrate the operational use of the country's air assets, as the current system of forces, divided vertically into branches and horizontally into districts, is ill-prepared for dynamic, high-tempo air operations.

The traditional organizational resistance naturally prevails, however, and the additional vision of several local conflicts having to be handled simultaneously may have had its own effect on the planning process.³⁶

The future prospects of Russian military aviation are not good in the short-term, due to the lack of resources. Many of the new projects will have to be postponed or even rejected and the modernization process will be slower than expected. Combined with the difficulties in recruiting and shortages in training hours, this will mean turbulent times for the leaders of the various aviation branches. The massive initial size of the force structure nevertheless offers opportunities for making sensible cuts within well established priorities and for extracting greater efficiency from the remaining capabilities by streamlining the overall command organization.

Sweden

The peace-time deployment plan of the Flygvapnet for the year 1997 is as follows (Figure 8):^{31,43}

F 4, Östersund

- 2 JA 37 divisions

F 7, Sätenäs

- 1 JAS division

- 1 AJS 37 division

- transport division

F 10, Ängelholm

- 1 AJS 37 division

- 1 J 35 division

- SK-60, basic flying training

- Ground Schools; technical, base

F 16, Uppsala

- 2 JA 37 divisions

F 17, Ronneby

- 2 JA 37 divisions

F 21, Kallax

- 1 AJS 37 division

- 2 JA 37 divisions

Uppsala Schools; officers, air surveillance and control, interpreters, signals, meteorology

The force has about 110 attack and reconnaissance aircraft, about 190 fighters, and about 70 SK 60 Saab 105 trainers. The peacetime personnel is about 8500 and the wartime strength about 70,000. In addition to the air force organization, there is a formidable air force department in the Defence Materials Establishment (FMV).

The long-range radar equipment of the air surveillance system was renewed in the 1980s, incorporating modern 3-D technology, and renewal of the short-range radar systems is now in progress. The old tower-installed radar scanners from the 1960s will be replaced with new Falcon systems.

The optical air surveillance system was written off on 1st July 1994, and will obviously be phased out according to the pace of the material rejection. It has been partly replaced by the LOMOS system, which based on equipment acquired during a crisis, has been developed to reach the operational stage within a couple of years.^{37,38} The new system reduces the optical air surveillance personnel from some 15,000 to under 6,000.

An air surveillance and control aircraft, the Saab 340 AEW/FRS 890 or S 100B Argus, has been under test since July 1994, and six are to be purchased. The fleet is expected to be operative in four or five years. The plane will carry only pilots and sometimes a technical operator, but most of the operators will work on the ground via a data link system. The antenna is installed to cover both sides of the aircraft by means of an electronically phase-arrayed technology.⁴³

The oldest Drakens and Viggens will be phased out before the turn of the century, but a certain number of Viggens are being modified as AJS 37 multi-role fighters, to be replaced later with JAS aircraft.

Surveys aimed at replacing the Viggen fighters began in the 1970s, and when the B3LA project was abandoned in 1979, the idea of a multi-role fighter capable of flying fighter, attack and reconnaissance missions was officially included in the plans. The possible alternatives were:³⁹

- purchase of a foreign fighter
- construction of a foreign fighter in Sweden under licence
- construction of a fighter in cooperation with one or more foreign manufacturers

- construction of a Swedish fighter, but with a larger proportion of foreign systems than previously to keep down the cost

The recommendation of the defence committee was to build the Swedish JAS (Jakt, Attack, Spaning) Gripen aircraft to replace the Viggens in the early 1990s and to produce 140 of these before the year 2000.

Parliament approved the proposal in 1982 and an agreement was signed between FMV and the JAS Industry Group on 30th June 1982. The first production batch of 30 aircraft was ordered in April 1983 and the first prototype was unveiled on 11th February 1986.

The recommendation regarding foreign systems led to incorporation of the following:⁴⁰

- Flight control system, product series 1, Lear Astronics, USA
- Flight control system, product series 2, Martin Marietta, USA
- Basic engine F404 General Electric, USA
- Air conditioning control Hymatic Engineering,UK
- Landing gear AP Precision Hydraulics,UK
- APU and engine start aggregator Microturbo, France
- Emergency power and transfer Lucas Aerospace, UK
- Inertia navigation Honeywell, USA
- Cannon Mauser-Werke, Germany
- Ejection seat Martin Baker, UK
- Main generator Sundstrand, USA
- Hydraulic system and transfer Dowty, UK
- Brakes Aircraft Breaking Systems, USA
- Fuel system Intertechnique, France

The first flight was on 9th December 1988, but the prototype was destroyed in a landing accident on 2nd February 1989 on account of shortcomings in the flight control system.

Test flights started again in May 1990, and the second batch of 110 aircraft was ordered in June 1992. The first production aircraft, JAS 39.102, was delivered on 8th June 1993, but this crashed at an air show on 8th August in the same year, again due to shortcomings in the flight control system. Test flights were continued on 29th December 1993 and the next production delivery to FMV took place in March of 1995. The current

production programme is planned to be completed in 2002. As noted above, the first Viggen to be replaced by the JAS 39A Gripen are those of the attack type, whereas the last Viggen fighters are expected to be withdrawn in 2010.⁴⁰

The weaponry of the JAS (two wing-tip positions for IR missiles plus four under-wing and two under-fuselage strong points) consists of:⁴⁰

- Fixed 27 mm Mauser cannon
- Two Sidewinder AIM-9L infra-red missiles
- Maverick Rb 75 air-to-ground missiles
- Bofors M70 rocket pods
- Rb 15F anti-ship missiles
- DWS 39 Dispenser Weapon System
- Active radar missiles

The evaluation for active air-to-air radar missiles was carried out between the following candidates:

- AMRAAM AIM-120, USA
- MICA, France
- Active Sky Flash, UK

The decision to buy a small number of the American AMRAAM AIM-120 active radar missiles in order to continue development of the JAS fighter version was made in 1994.

The traditional objective of the post-war Flygvapnet has been to push the defensive circle beyond the country's boundaries by virtue of quantity and a fairly high proportion of attack aircraft. During the years of decreasing resources, when the number of the aircraft was reduced to about 30% of the figures for 1945 and the number of personnel to about 50%, the percentage of fighters increased. Eventually the dedicated attack wing was abolished on 1st July 1996. It is envisaged that a new multi-purpose aircraft will allow continued flexible variation of the proportions of the various mission categories.

The yearly intake of trainee pilots has also been reduced, the earlier figures of 100-150 having been adjusted to the smaller number of units. After the phases of basic and advanced training, there are type introduction courses and then separate training for fighter, attack and reconnaissance pilots in their respective mission areas. After the introduction of the JAS system every

pilot will divide his flight hours among these three mission categories.

The modernized Hawk Rb 77 anti-aircraft missile battalion has been in the use since the 1970s and was modified in 1994 by addition of a mobile launcher system. Its main mission is to protect the capital city.

The army units have their own organic anti-aircraft systems, the main weapon being the RBS-70 anti-aircraft missile. A modified system, the RBS-90, based on laser guidance, was introduced in 1991. It is highly jam resistant and its only shortcoming is that it is not capable of all-weather operation. There are over 100 RBS units in existence, and in addition to the army units, it is used to protect air bases and other important targets.

Many of the automatic anti-aircraft artillery batteries are equipped with radar-guided 40 mm guns. The Super-Fledermaus fire control systems are in the process of being replaced by PEAB radar systems. In addition, there are anti-aircraft machine guns and 20 mm cannons for use as short-range troop anti-aircraft weapons.¹⁸

The anti-aircraft fire control system is integrated into the national air defence control system Stril-90. The basic structure of the anti-aircraft defence's own target acquisition radar system is derived from various versions of the Ericsson Giraffe.¹⁸

A major change in the organization of the defence forces was made in Sweden on 1st July 1994, in which the earlier independent branch commanders and staffs were combined into one headquarters to form the production administration departments. The country is divided into three military regions, North, Central and South, and the combat flying units are subordinate to the military commands of these regions. National operational responsibility lies with the operations department at headquarters, and areal responsibility with the area commanders.⁴²

The future prospects of Sweden's air defence are very much orientéd towards the renewal of its combat aircraft system. The JAS system is planned to be ready in 2006, a new infra-red air-to-air missile is to be acquired during the development phase and a reconnaissance pod for the JAS 39 Gripen should be ready by the year 2001.⁴⁰

The changeover from AJS 37 Viggens and J 35 Drakens to JAS 39 Gripen is scheduled to take place in 1997-2001, and the change from the Viggen JA-37 fighters to the JAS planes is scheduled to begin in 2001. The light attack system SK 60 has been cancelled, but the material will be stored and kept at the ready.⁴³ The SK 60 Saab 105 trainers will be fitted with new engines, and the S 102B Korpen signal surveillance system will be operative in 1998.⁴³

Development of the ground control system will be continued, but the original planned number of ten StriC control centres will be reduced to five. The flying air surveillance and control system FSR 890, two groups of three S 100 Argus aircraft, is planned to be ready by the turn of the century.⁴³

The contemporary reductions, already taken into account in the organization list, are F 15 at Söderhamn, the target squadron in Malmen, the F 5 flying school at Ljungbyhed and the Halmstad schools.⁴³ There is an estimation that 4 or 5 wings (flottilj) would be the final number.⁴⁷

The next development phase in terms of anti-aircraft defence will be the Bamse Rb 23 anti-aircraft missile, obviously a boosted version of the RBS 90 system, with an increased range.^{43,18}

CONCLUSIONS

All of the countries examined here can be included among the nations which are aware of the importance of air power and have typically devoted continuous efforts to keeping their air defence assets up to date. Their historical and economic backgrounds have naturally left a definite mark on the air defence solutions adopted by each.

Finland's Air Force was created in the midst of the War of Independence, and prompt action was needed. This eliminated effectively any administrative jealousies. The principle of establishing it as an independent branch of the armed forces therefore seemed natural.

In Norway the advances made in aviation technology were fairly soon taken into the service of the already existing Army and Navy organizations, an arrangement which, once established, was naturally quite difficult to dissolve. Thus this organizational principle continued up to the Second World War.

In Russia, military aviation was initiated by the Imperial Army well before the First World War and was substantially extended during the war. Activities were interrupted by the Bolshevik revolution, but importance was soon attached to it by the Soviet regime as well. The Air Force as organization was nevertheless confined to a subordinate status in the Party-Army hierarchy.

Military aviation had very similar beginnings in Sweden as it did in Norway, but the question of an integrated air organization was resolved sooner, and thus an independent air force was established seven years after the First World War.

Anti-aircraft artillery started out as an Army function in all of these countries. It was then transferred to the Air Force in Finland and Norway, but in the case of Finland it returned to the Army after the Second World War. In the Soviet Union it became part of the independent air defence branch, while in Sweden it has always been the responsibility of the Army.

The early development phase in Finland was characterized by sound plans but inadequate implementation. Motivation towards armed defence was high among the people, as shown by the voluntary training undergone by the Home Guard and

the Air Defence Association. On the other hand, the political will for material investments in defence remained low even during the threatening years of the late 1930s. Thus the well balanced programme was suddenly exchanged for a series of emergency aircraft purchases once the Winter War had broken out.

The special needs of the Army and Navy very much dictated the early development of their respective air corps in Norway, which did not provide an ideal basis for building up a national air defence doctrine or acquiring the proper equipment.

In the Soviet Union the subsequent pattern of development was dominated by a big country's ambition for big numbers, with the Army very much dictating the organizational philosophy, doctrine and material development of air assets.

Quite detailed development objectives were laid down in Sweden after the founding of the Flygvapnet. International douhetism with very heavy bomber priorities was in evidence in these plans. But the necessary resources were not granted in Sweden, either, and the organization was poorly equipped when military activity started to break out in the neighbouring countries.

The lessons of the war for Finland were straightforward enough:

- There was no guarantee in counting on foreign help, the country has to be ready to face any challenge alone.
- One can fight successfully even against apparently impossible odds given sufficient determination and quality.

Norway experienced occupation by the Germans and then liberation under the allied forces. Thus the NATO alliance was a natural choice for the country's post-war defence arrangements.

The Soviet Union failed to reach its objectives on the north-western front in both the Winter War and the Continuation War, but even after the heavy losses inflicted by Germany it was able, as part of the allied forces, to occupy eastern Central Europe. The extremely deep area of defence, a heavy emphasis on quantity and the importance of international support from allies were among the main war lessons. As a result, the Warsaw Pact organization and the steering of industry towards military production were the Soviet Union's defence solutions after the war.

Sweden had a ringside seat, as it were, for watching the war raging around the country. The natural reaction was to build up a preemptive force to maintain the country's neutrality and keep it out of any crisis.

The post-war development of air defences in Finland was characterized by a modernization programme which started out rather slowly but then pressed forward steadily. A certain amount of progress has been made also in matters of quantity, and this overall build up has been an important motivator in terms of both recruitment and job satisfaction.

Norwegian air defence programmes have been part of the NATO build-up, and have advanced accordingly. Now, with the ending of the Cold War, there have been signs of reduced alliance commitments on the northern flank. This will shift the emphasis more onto national initiatives and programmes, although the NATO system will no doubt maintain a high level of integrity.

The Soviet Union's massive air defence build-up has given way to substantial reductions in present-day Russia, brought about by the implementation of international agreements and the economic situation in the country. A certain quality shift can be perceived in this reduction process, as it is inevitably being concentrated on older equipment. There seem to be notable difficulties in initiating new projects, however, and the quality of training is also suffering at present.

The extensive air defence development programme carried through during and after the war in Sweden culminated in the 1960s, after which the first signs emerged that the system was becoming too expensive to maintain. This marked the beginning of reductions, which are planned to continue in the future. These have been carried out gradually and in a controlled manner over a long period of time, and thus there has been no dramatic downgrading of the status of the Swedish air defence. Actually, the effect among the personnel must have been more psychological, as they have seen many traditional units and functions disappear.

The contemporary air defence organization in Finland is based on the lessons learned in the war. The limited manpower resources of a small nation, matched with the need to maintain a good level of manning in combat units, have eliminated the multi-layered areal staff system with its large liaison personnel.

Each branch has its own operational, material and training responsibilities, and decisions are made without delay at most professional levels. This system emphasizes effectiveness and calls for good cooperation between the commanders in the various branches. It was applied during the critical summer of 1944 and worked well.

Norway's air defence structure is part of the NATO joint command system and is organized accordingly. The readiness to adapt to major changes in force levels is one of the capabilities needed in the allied management environment.

Russia has divided its air defence resources vertically into branches and horizontally into districts. An initiative has originated from the air force to streamline the organizations and concentrate the deployment of forces. This is an expected objective in the effort at rationalization in context of the major post-Soviet transformation.

Sweden has a tradition of areal commands with units that serve well to cover the entire country. The numbers of both areas and units have decreased, but the original organizational principle persists. Air assets are administered in two organizations; personnel and training in the Air Force Department and material and equipment in the Defence Materials Establishment (FMV). The Commander of the Air Force has initiated an effort to streamline the command structure towards a more flexible and effectiveness-oriented type; actually very much to the same which is used in the Finnish Air Force.⁴⁹

There are many sectors of air defence which have not been touched upon in this review. One is electronic signals surveillance, which is an important part of the total air surveillance system. All of the countries in question have their unique solutions in that area, and also seem to assign it fairly high priority in every organization.

Another is the system of bases, which very much dictates the flexibility of air operations. This has been considered carefully in every country and certain national or allied characteristics are visible in these structures. Finland and Sweden use their wide areas of countryside and make use of public roads as landing strips, whereas Norway and Russia favour large bases with a high input of local resources.

The aviation industries in all these countries have designed and produced original aircraft types, and have also built many foreign designs under licence. Differences in national philosophies

have begun to develop in this respect since World War II, however. In Finland the home market was estimated to be too small to support continued economic production of fighter-class aircraft, whereas the war had shown the importance of autonomous maintenance, repair and modification capabilities. Thus the aviation industry is integrated into the Air Force's technical system, constituting a vital part of it.

In Norway the equipment received from NATO gave no room for local production, and the aviation industry was adjusted to support the allied technical organization.

In the days of the Soviet Union the aviation industry was a part of superpower competition, and this meant that considerable resources were devoted to it. In present-day Russia, however, with declining order books, a kind of survival game is going on in the aircraft industry, although it is clear that there will be some survivors.

In Sweden, large domestic orders gave a good basis for the development and production of tailor-made aircraft types on a national basis, but gradually the economic burden has become heavier, so that the cost structure of the JAS 39 Gripen project has aroused a national debate. The government and the military are nevertheless committed to the JAS.

It is obvious that there will be only three instances capable of genuine fighter development and production in the future: the USA, Russia and some kind of European cooperation group.

The importance of air power, and accordingly that of air defence, has aroused many traditional attitudes in leadership circles. The major strategic and operational lessons from the Gulf war are as follows:⁵⁰

- Strategic attack works
- If a nation loses air superiority, it is at the mercy of its attackers; its military operations are highly circumscribed
- Surface forces are vulnerable and fragile
- Surface operations in the face of enemy air superiority are almost impossible
- Precision and stealth redefine mass and concentration
- Asymmetric attack works and gives huge advantages to the attacker
- Air forces can defeat large surface forces by themselves
- A static force takes longer to destroy from the air than a mobile force

- Rapid exploitation of information is essential
- Standard hierarchial organization is not conducive to rapid processing and exploitation of information
- Airpower has become the dominant force in war.

Many observers look askance of airpower because they believe it costs too much. To the contrary, high tech airpower is extraordinary cheap when the cost is measured against the results. The only measure which makes sense today is the effect one can produce on the opposition. And nothing can match airpower when the accounting is done correctly.⁵⁰

Competent politicians and officers have realized the nature of the modern dynamic conflicts, and many air defence modernization programmes can be seen to be in process in northern Europe. Modern material and equipment of good quality is essential in the extremely unforgiving arena of aerial warfare, but the most important force multiplier continues to be carefully selected, well motivated and thoroughly trained combat-ready personnel. The key factor for any country is to maintain steady standards of personnel quality and to ensure this by means of good training with a diversity of exercises and plentiful flight hours. Any country that is capable of this can look to the future with confidence. Certain material improvements can be made once a conflict has started, but personal skills must be available at once. Only the winners will be there to continue the fight, as coming in second in an aerial engagement means loss, and the ability to continue air combat with success is a necessity for total defence.

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FIGURES

Figure 1 THE PEACE TIME DEPLOYMENT OF THE FINNISH AIR FORCE



Figure 2 THE PEACE TIME DEPLOYMENT OF THE ROYAL NORWEGIAN AIR FORCE



Figure 3 THE PEACE TIME DEPLOYMENT OF THE RUSSIAN
76 AIR ARMY



Figure 4 THE PEACE TIME DEPLOYMENT OF THE RUSSIAN
6 AIR DEFENCE ARMY

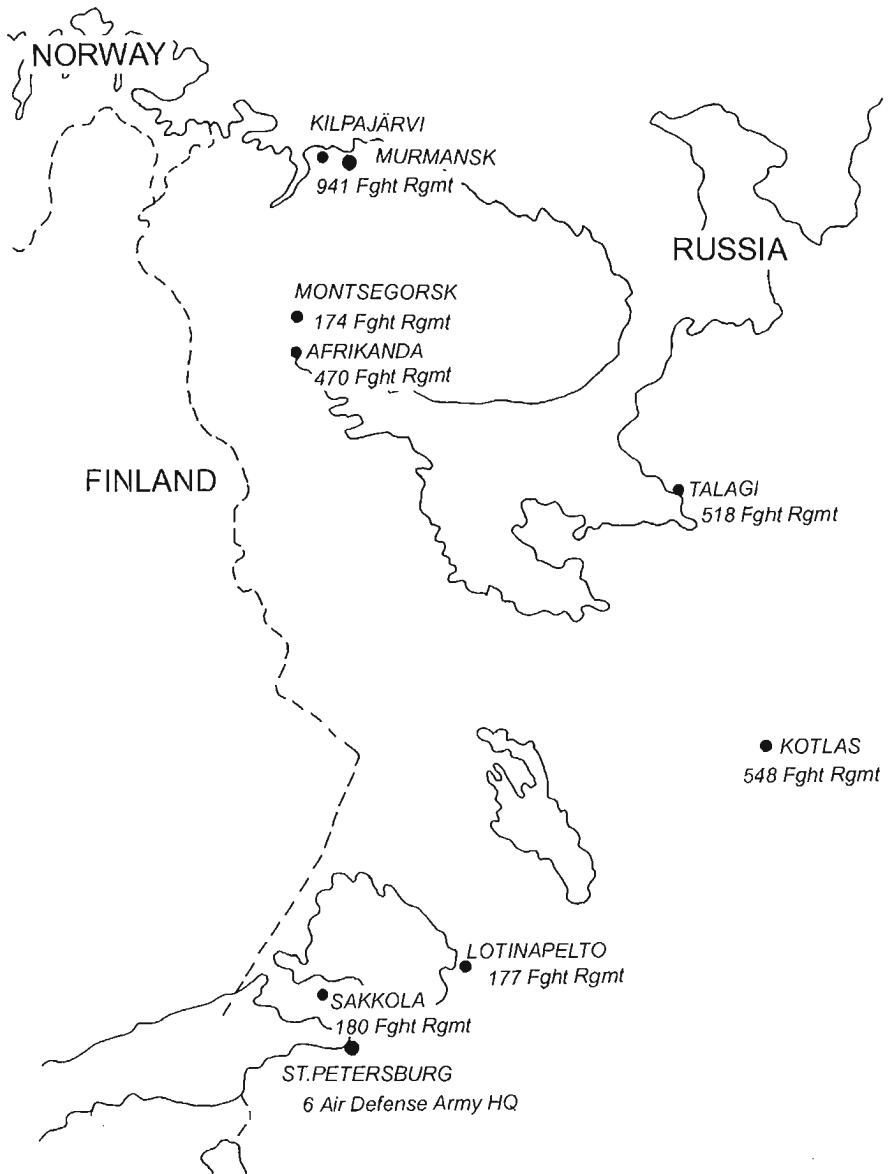


Figure 5 THE PEACE TIME DEPLOYMENT OF THE RUSSIAN
NORTHERN MILITARY DISTRICT'S ARMY AIR FORCE

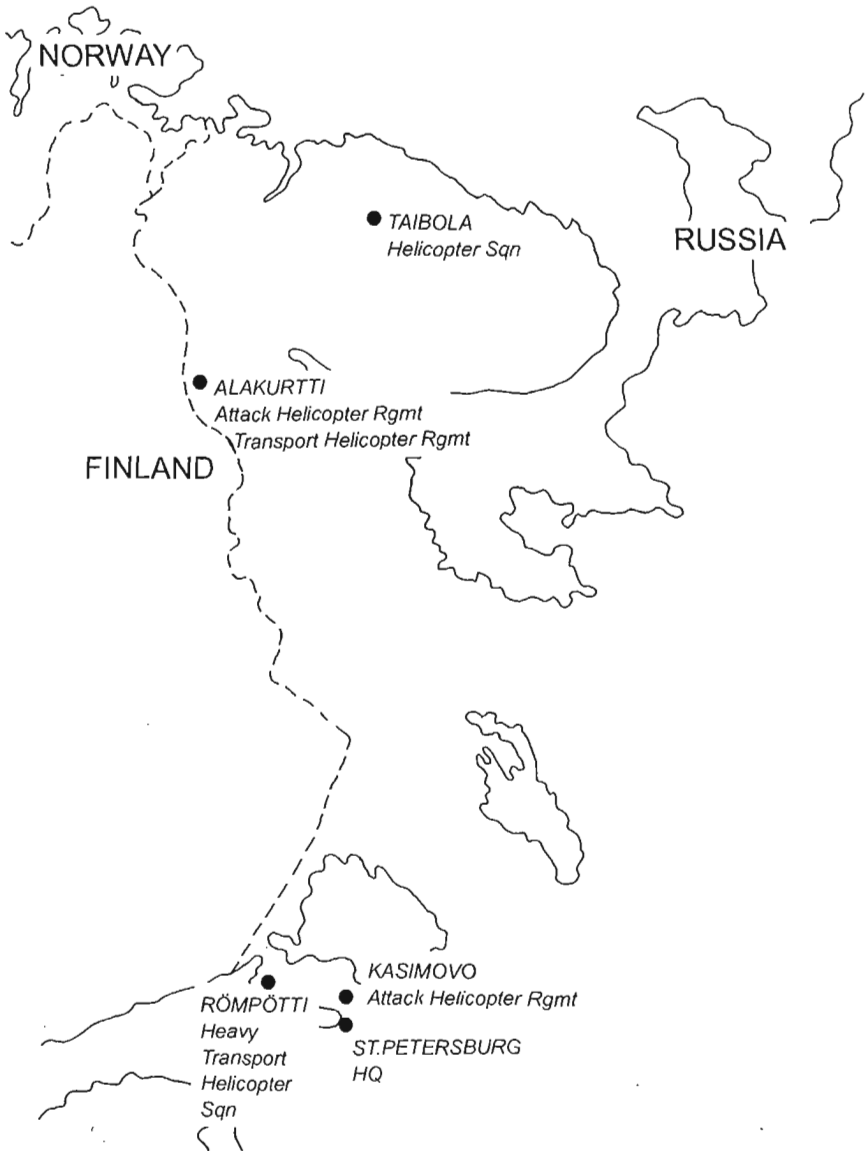


Figure 6 THE PEACE TIME DEPLOYMENT OF THE RUSSIAN NORTHERN NAVY AIR FORCE



Figure 7 THE PEACE TIME DEPLOYMENT OF THE RUSSIAN
BALTIC NAVY AIR FORCE



Figure 8 THE PEACE TIME DEPLOYMENT OF THE SWEDISH AIR FORCE (DEFENCE FORCE PLAN 97)



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