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THE DESIGNER OF THE LEGENDARY IL'S

P. Astashenkov

Foreign Technology Division  
Wright-Patterson Air Force Base, Ohio

4 October 1972

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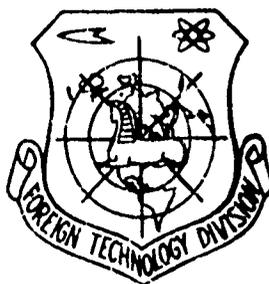
# FOREIGN TECHNOLOGY DIVISION



THE DESIGNER OF THE LEGENDARY IL'S

by

P. Astashenkov



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UNCLASSIFIED  
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Aircraft Design						

I-6

UNCLASSIFIED  
Security Classification

UNCLASSIFIED  
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Foreign Technology Division Air Force Systems Command U. S. Air Force		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
		2b. GROUP	
3. REPORT TITLE THE DESIGNER OF THE LEGENDARY IL'S			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Translation			
5. AUTHOR(S) (First name, middle initial, last name) P. Astashenkov			
6. REPORT DATE 1970		7a. TOTAL NO. OF PAGES 124 129	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO.		8b. ORIGINATOR'S REPORT NUMBER(S) FTD-HT-23-2088-71	
b. PROJECT NO. AAER			
c.		8c. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES Details of illustrations in this document may be better studied on microfiche.		12. SPONSORING MILITARY ACTIVITY Foreign Technology Division Wright-Patterson AFB, Ohio	
13. ABSTRACT The book is a popular biography of the aircraft designer, S. V. Il'yushen, highlighting his successful aircraft. Brief descriptions are given of the IL-2, IL-4, IL-8, IL-10, IL-16, IL-20, IL-22, IL-28, IL-30, IL-40, IL-46, IL-54, IL-12, IL-18, and the IL-62 jet passenger plane. The book, however is largely inspirational in tone without much scientific value.			

DD FORM 1 NOV 60 1473

I-a

UNCLASSIFIED  
Security Classification

# EDITED TRANSLATION

FTD-HT-23-2088-71

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By: P. Astashenkov

English pages: 124

Source: Konstruktor Legendarnykh Ilov, Izd-vo  
"Politicheskoy Literaturny," Moscow,  
1970, pp. 1-120.

Requester: FTD/PDXS

Translated by: Francis T. Russell

Approved for public release;  
distribution unlimited.

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PREPARED BY:

TRANSLATION DIVISION  
FOREIGN TECHNOLOGY DIVISION  
WP-AFB, OHIO.

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## THE DESIGNER OF THE LEGENDARY IL'S

P. Astashenkov

On the picturesque bank of the Istra - a tributary of the Moscow River - there stands an unusual monument - to a combat aircraft, the IL-2 Stormovik. The formidable machine is pointed upward and all of it seems to breathe with the effort of those warriors who seethed here in the autumn of 1941 when the Hitlerite horde tore at Moscow in frenzy. But in their path there stood the courage of the defenders of the capital, a tornado of fire from the ground to the heavens. In our winged formation was the Stormovik, called by the Germans "Black Death."

It was well described by Twice Hero of the Soviet Union, pilot-cosmonaut Georgiy Timofeyevich Beregovoy, who knew it well in combat missions, in battles with the German-fascist aggressors.

"The IL-2 as a battlefield aircraft - he said - was a successfully designed combination of speed, maneuver, armor, and firepower. Its strikes against the enemy were unexpected and shattering."

How was this IL-2, and the other IL's, born and created, which were so glorious in battles with the enemy in the years of the Second World War, and which represented the amazing creation of human intelligence and which plowed the world's air ocean in our day?

For the answer to this question it is necessary to recount the glorious life of their creator and author, the general aircraft designer Sergei Vladimirovich Il'yushin.

#### PATHWAYS TO THE SKY

On 31 March 1894, a son Sergei was born into the peasant family of Vladimir Ivanovich Il'yushin of the village of Dilyalevo in the province of Vologda. The village where Sergei passed his childhood was picturesquely situated close to Kubenskoe Lake which extended in a winding and rather wide ribbon for almost fifty kilometers. Leaving the outskirts of Dilyalevo, one could see the lakeshore forest over the dark wall of which rose the gold cupolas of ten churches shining in the sun. And behind, in the hollow, shone the water.

As long as Sergei remembers, the impression of the lake never left him: it was deep and silent, it was quiet and stormy with great waves, it was speckled gray from the force of the wind. The color of the water changed several times in a day. The lake not only furnished the lad with a wealth of delights both summer and winter, but also helped to feed the whole family.

And in the family there were neither many nor few - nine children. True, two little ones died. But five boys and two girls grew up and it required resourcefulness on the part of their parents to provide for them.

The grain from two strips of land (and the strips were given only for the adults) was not sufficient. The soil was poor, the crop was scanty. It belonged to the state, and each autumn a substantial quitrent had to be paid. No matter how Vladimir Ivanovich worked from dawn to dusk he could never gain enough, besides, he had to do without - huts, horses, cows, for a poor peasant's goods and chattels. Later on it became necessary to even sell the horse.

The mother, Anna Vasil'yevna, was a match for her husband, she was strong and capable. When he went away in search of a living, she herself ran the whole house. And he went away almost every year to take a job as a navy. The father used to go far away, hiring out for work on the channel in St. Petersburg.

As soon as the eldest son Vasily became fifteen, he too got ready to go in search of a living. He never came back to his native village.

Nikolay, Pavel, and Stepan left home in the footsteps of the eldest. And their ages were 15-17. Only the youngest, Sergei remained with his parents. The nine-year old went to the council school in the village of Berezniki, two and a half kilometers from Dilyalevo. More than any other subject, the lad liked mathematics, geography, and Russian.

Sergei had learned how to read from his brother Stepan at the age of six. His first books were "The Prayerbook" and the "Old Testament." In school, he devoted himself to learning. As soon as the bell rang, his chums rushed flying from the school porch, but Sergei remained in the classroom at the bookcase - selecting books for study at home.

At the age of nine he began work.

...On a hot July day little Sergei helped his father cut hay by the lake. Next to them was the allotment of the village's wealthy tradesman, Nikulichev. Evening approached, the sun was already setting, when the impressive figure of Nikulichev appeared at the scene of the haying. He stopped at the marker designating his allotment and turning towards Sergei's mother and father, cried suddenly:

"Damned beggar! My allotment has been cut down!"

Sergei saw how his father faltered, holding the scythe, how his mother let go of the rake where she had been raking the rows. They hung their heads and remained silent although they had not touched any one else's blade of grass.

And again the humiliation sprang up in the soul of the youngster which he felt when holding onto his mother's coarse skirt he went with her into the store of this same Nikulichev. It was before a holiday. His mother specially waited until there were the fewest number of people in the store and the vindictive Nikulichev could not publicly humiliate her. In order to arouse the merchant's pity, she had brought Serezha with her. All his life he would remember how guiltily his mother entered the store and how she humbly asked for credit:

"Could I have a little bit of flour and sugar, too..."

Serezha very much wished at this moment that he was strong enough to protect his mother from insult, so that she would stand up - slender and beautiful - and would never again be afraid...

Serezha knew in his childish mind that if he studied and mastered some specialty which was important and necessary for people he would then stand on his own feet and be able to help his parents.

In 1905 his father reached sixty-five, and his mother - fifty-eight. Vladimir Ivanovich stopped setting fish traps in the lake, the task of catching fish fell to Sergei.

The new tasks and difficulties did not hinder him, however, at age twelve from finishing council school and with the help of his teacher from continuing independent study.

Life for the family was hard. In the winter of 1909 his mother went with Sergei to the contractor who was recruiting unskilled workers for the factory in the village of Yakovlevskoe near Kostroma. The husky fellow looked the youngster over in a fault-finding manner. Remarking to the mother that her son was "anything but tall, but sturdy in the bones," he threw up his hands:

"He will do," and gave Sergei an advance: five roubles.

Thus at fifteen Il'yushin began work as an unskilled laborer. In May he was sent to Kostroma province to a factory. The work at once proved to be unbearably heavy - he was given a hook, and his job the whole day was to pull barrows with dirt. By evening his body was filled with lead, his back was breaking, his hands were sore. The night brought no relief. In the shed where the workers slept on planks it was stifling. The food was scanty, and the cost of it was withheld from the ten roubles due him each month.

With this journey, the wandering of Sergei Il'yushin over Russia in search of a living began. Where indeed had not his fate tossed him!

In 1910 he left for St. Petersburg. The capital proved cold towards the lad from Vologda. A job as an unskilled worker in a dye-works - was all that he could find. His job was to clean up outdoors the gutters through which the liquid waste flowed from the workshops. The strong smell assailed his nostrils, the spattering which got on his shoes and clothing was almost impossible to wash off. The work day was so long that it seemed endless.

Somehow Sergei managed to meet fellow-villagers in St. Petersburg. They gave him the information that there was well-paying work at the Kolomyazhskiy hippodrome which apparently was just then being converted to an aerodrome. There, they said,

is where the first aviation week is to be held. Sergei was not sure what the words "aerodrome" and "aviation week" meant, but the proposition appealed to him. He left the dye-works and got a job at the hippodrome. From the middle of July he worked on levelling the future flying field - he filled in holes and cut down hillocks. His fellow-worker was a long-legged, long-armed lad. But little Sergei never lagged behind him at work by as much as a single step. But nevertheless, when the field was levelled and the pay was issued, Sergei, as the most junior one, received the least of all. And this hurt his feelings...

His first acquaintance with aviation stunned Il'yushin. Then it was all around him: flights, planes, pilots. He didn't leave the aerodrome until late, he helped fill boxes with parts and helped assemble wings. Seeing their big light construction similar to that of a bookstand, he did not believe they could fly, let alone lift a man.

But with the arrival of a vast throng of the public the flights began. The enthusiastic crowd of admirers of the new attraction gasped and sighed when the planes soared into the air, executed turns, and settled down on the flying field. No one then noticed the lad of small stature on the aerodrome wearing a cotton Russian blouse: he never took his eyes off the winged machines.

The flight of Nikolay Yevgrafovich Popov made a particular impression on the spellbound Sergei. When Popov rose into the air two bands burst into a hymn. The throng greeted the pilot with a thunderous "Hoorah." And then it was announced that N. Ye. Popov had surpassed all the foreign flyers and had set an altitude record - 600 meters. He received first prize.

Later on, recalling his first aviation week, Il'yushin said: "It was right then and there that my love for aviation was born."

At first it was hard for Sergei. The exhausting work, the oppression by the bosses, the malnutrition - how much of all this would it take to shatter his youth! But Il'yushin was hardened by adversities.

Sergei lived in a hostel. Eight bunks stood in the large room. The residents were divided into "corner people" who paid at the rate of three roubles a month, and "bare dwellers" who paid one rouble a month and slept on the bunks by the door.

Il'yushin - a "bare dweller" made friends with a lanky student named Urvachev, a thin and genial fellow who had attended the institute for six years. He helped Sergei in studying mathematics, physics, and chemistry.

But the work at the aerodrome came to an end and Sergei had to return to Dilyalevo.

#### INTO AVIATION - FOREVER

After a short period of work as a milk driver in a cooperative, Sergei signed up for work in 1912 on the construction of the Amur railroad. He saw with his own eyes the wild but beautiful places in the taiga.

Upon his return he spent the winter in Dilyalevo, and in the spring he left by the first steamer to again begin his search for his fortune. This time, fate sent him to the city of Revel' (now Tallin) to work in the shipbuilding yard of a Russo-Baltic enterprise. Here he first saw huge machines and first began to work on them. But at first he was a general laborer, he helped move the power shovel digging foundations. Six-eight men climbed under the machine and, leaning with their shoulders, moved it to its new position. The operator took a fancy to the diligent, well-read, modest lad. When his assistant who directed the boom

went off to another machine, the operator put Il'yushin in his place. There were no limits to Sergei's joy. He was ready to work around the clock, to watch how the scoop in obedience to his will bit into the earth and then carried it with care to the wagon. And Sergei himself, and those who worked with him, saw clearly: machines - they were his true passion...

The First World War interrupted the work on the excavator. Il'yushin was called into the army and assigned as an assistant clerk in the headquarters of the military chief of the city of Vologda. But the duties of a clerk proved to have little interest to one who had been in contact with materiel. Once again, chance came to Sergei's assistance: a call was received for seven men for service in aviation.

And then the orders to the airfield headquarters in the Northern Region from the Directorate of Air Forces were in Sergei's hands. Again he was in St. Petersburg, at the command aerodrome. Much had changed since the memorable aviation week. Hangars, workshops, a building for officer assemblies and a messhall had gone up. Close to the Lebedev and Shchetinin plants there were rows of military airplanes which had just been assembled.

Sergei was assigned to aerodrome headquarters to serve on the committee to accept the aircraft produced by these plants. The planes were of two types - the "Voisin" and the "Swan-12." The committee included a group of pilots who tested the planes in flight. The flying machines, as soon as they came out of the workshops, were placed in the hands of the machinists and engine mechanics of the aerodrome command. They were inspected, checked, made ready for flight, and after recording the notes made by the pilot, they were turned over to the plants as rejects to have the defects eliminated.

The work was interesting and alive. But the more Il'yushin learned of flight technology, the stronger became the urge to go up in the air himself. Engine mechanic Il'yushin and the defects inspector Klimov were the first of the aerodrome crew to express a desire to learn to be pilots. Pilot Grigorov was assigned to teach them.

The day came when the instructor took Il'yushin up. Sergei paid attention to the pilot sitting in front, trying to remember his motions. The plane gained altitude, Grigorov demonstratively threw back his arms, and from his expression gave him to understand: "Il'yushin, take over the control of the 'Voisin' yourself."

What an experience that was for Sergei! Here it was, a dream come true - he is flying the winged bird, while below the ground flows past. First green, then blue, then gray. And because it seemed that the world had suddenly opened up before him in all its majesty and variety, he felt like breaking into song. But he contained himself - Grigorov would laugh.

The flying lessons became more frequent and longer. Sergei possessed a tenacious memory, his movements were light, he got the feel of the aircraft. No wonder that after one of the flights Grigorov said to him:

"Now you are able to fly without me, you are ready for your pilot's examination."

The solo flights began. One of them he remembers especially. A pilot was killed at the field. Sergei Vladimirovich, according to tradition, flew his "Voisin" over the funeral procession. Lower and lower...

This flight was made on the eve of his official examination which Il'yushin took at the flight school at the command aerodrome.

The exam included two flights - one at altitude, the other on manouvering in the air. Sergei completed both successfully - he took his "Voisin" up to 2000 meters, and then performed the turns and the vertical climb...

Thus, in the summer of 1917, Il'yushin became a pilot. On the field he continued to perform his previous duty. But he had been given something new, a clear understanding of the characteristics of flight. He firmly resolved: his life would be forever dedicated to aviation.

In 1917 the revolution commandingly entered Il'yushin's life. For him there was no question of whom he would go with. He immediately joined the ranks of those who recognized the government of the Soviets as the authority of their native land.

The aerodrome headquarters seethed. With the October victory, sympathies became sharply divided. The officers who sided with the overthrown regime were opposed by the mechanics and the engine mechanics of the aerodrome headquarters, who in their hearts and minds understood the rightness of the Bolsheviks. From the result of who came out on top would depend the fate of the tens of planes standing in the outskirts of St. Petersburg - the heart of the revolution. Everything was decided in a stormy meeting which lasted several hours.

Markovskiy, a Bolshevik, was unanimously chosen as the chairman of the aerodrome revolutionary committee. Six more men made up the committee, one of whom was Il'yushin.

At night, after the election of the soldiers' committee, the majority of the officers fled from the aerodrome. Only two remained, who were close to the aerodrome crew, - Markov, who worked with Il'yushin and Grigorov, who taught him to fly.

So that the enemy could not make use of the planes - and attempts to do so were made - the committee organized a guard roster of true people of the revolution. Just then several autos drove up to the aerodrome. A group of people approached the flying field. Upon the signal from the one on watch, the aerodrome crew was alerted. The suspects were detained and sent before the city party committee. The autos were confiscated by the revolutionary committee. After this incident it was decided to send the planes to a more suitable aerodrome. The bureau of commissars of the Air Fleet assigned the pilots, the mechanics readied the planes, and they headed for their new base site where they created one of the first detachments of the Red Air Fleet.

The Shchetinin and Lebedev plants were nationalized. But the raw materials were not captured and production was reduced to a flicker. The aerodrome crew was disbanded. Everyone in St. Petersburg became hungrier. In March 1918 Il'yushin decided to go to Dilyalevo. There too, the ruin made him think. His own relatives were getting by on potatoes alone.

Once more it would be necessary to go to the city, and Sergei went to Vologda where his brother Stepan worked. He went to the city Soviet.

"An engine mechanic from Red St. Petersburg?" - the chairman of the city Soviet was glad to hear the news when the arrival of Il'yushin was made known to him. That's just what we need.

After a detailed conversation, the chairman gave an order: "You will be assigned to the department of industry of the Soviet. Get into the swim of things as soon as you can."

So the twenty-four year old Il'yushin got the nationalized plants and factories going again. It was difficult under the conditions of ruin to secure the raw materials, only certain enterprises could achieve the production necessary for the young republic.

In 1918 Il'yushin and three of his comrades - Aleksandr Ivanov, Vladimir Firulev, and Aleksandr Birillo - upon orders of the Party provincial committee founded a party cell in the pedagogical institute. The collective of this institute numbered 600 men and was known in Vologda as difficult due to the conflicts being stirred up there by reactionary minded teachers. Before a cell could emerge there a lot of work would have to be done.

The peaceful work of Sergei did not last long - in May 1919 he was called up into the Red Army and again fate took him to aviation. He became a mechanic in the 6th Airtrain of one of the armies on the Northern Front. Thanks to this, he happened to meet two old acquaintances from the aerodrome crew - the chief of aircraft repair of the train Vorontsov and the commissar Raugevich. They soon spoke to the military commissar about assigning Sergei as an aircraft repair mechanic.

The situation in the north was threatening.. The English interventionists had captured Arkhangelsk and were approaching Vologda. The White Guards were attacking from the east. Revolt had broken out in Yaroslavl. The high command of the army, on orders of Lenin, strove to make use of all the capabilities of aviation. The repair train was urgently patching up battered machines. It was a source of joy when they succeeded in giving a plane a second life.

The chief of flying and air navigation, A. V. Sergeev, said that repair would be the main source of the air forces replenishment. The calculation of each adopted operation was based on repair...

Many machines underwent 7-8 overhauls before they were finally entirely out of commission. From the remains of ten such planes they could assembly one-two more or less airworthy craft.

After some time, A. V. Sergeyev in his report to the Revolutionary Military Soviet repeated; "The detachments live almost exclusively on the repair of old beat-up machines..."

The young air force had a need not only for combat planes but also trainers, in order to teach its young pilots - the Red combat pilots.

In connection with this, a special mission was assigned to Sergei Il'yushin; to journey to the Petrozavodsk region where the First Rifle Division was deployed, where, according to reports from the ground forces, a White Guards plane had been knocked down. It could be used to create the first Soviet trainer.

The trip was a tough one. But the hardest part lay ahead - the plane turned out to be located far from the railroad in wooded terrain. The only thing left to do was to dismantle it at the site, in impassable mud, to carry it by hand to a clearing in the woods and from there to get it with the help of horses to the railroad station. The commander of the rifle division assigned five Red Army men to help him.

They worked and lived in the woods, almost without provisions, but the plane was dragged out, loaded up, and sent by train to Moscow. Along the way, finally the famished ones sold their last pieces of soap and bought a hunk of bread and two onions, to fortify themselves. In Moscow they turned the plane over to the plant.<sup>1</sup>

<sup>1</sup>It proved useful in developing and building the trainer which was well-known to all veterans of our aviation under the designation U-1. The plane had a long life.

It was a biplane with a 120 horsepower M-2 engine, and was used from 1922-1932 as the basic primary trainer. As a training plane the U-1 had good flight characteristics. Many thousands of our pilots underwent training in it. In 1922-31 a significant number of them, for that time, were produced - 670. In the thirties it was replaced by Polikarpov's U-2.

Il'yushin found himself in Saratov for some time. Voronets and Raugevich, who were assigned to the aircraft pool of the Caucasus Front, managed to have Il'yushin transferred there.

In comparison with the airtrain which consisted of several old wagons with lathes for turning out the simplest parts, the pool appeared to Il'yushin to be a major enterprise. Here they not only rebuilt but also restored aircraft (it would be truer to say that the planes were built anew, since for several of them all that was left was the number on the tail). The planes were tested before being sent off to the front by two Red military pilots. Mechanic Il'yushin worked with them. His task, as a rule, was to perform the most complicated and most delicate operations. And he did everything quickly and precisely.

In 1919, Il'yushin officially proclaimed his connection with the Party - his Party card was given to him by commissar Raugevich in the name of the Saratov city soviet. He embraced Il'yushin and, instead of the official congratulations, said:

"I believe in you, Sergei. And soon you will be ready to work in my place. I am going off closer to the front."

Thus a mechanic-commissar appeared in the air pool. Sergei Vladimirovich continued to restore the winged machines with his own hands. How many aircraft he had to "resurrect"! There were "Farman's" and "Nieuports" and "DeHavillands," all old and battle-scarred. In the absence of the necessary materials, he made use of anything that could be liberated from the Whites. Il'yushin and his comrades of the airtrain had learned to restore aircraft under almost unbelievably difficult conditions. They recovered over them as if they were stricken birds. And then what a joy it was to again take the revitalized machine back up in the air!

The mechanics managed to think up various devices which they would use as surrogates for gasoline to run the engines - such as "aviacognac" (an alcohol mixture) and other combinations of gasoline, alcohol, kerosene, and ether. Each pound of fuel was recorded.

Soon Il'yushin was called to Moscow, to the Directorate of the Air Force. There he was told: "We have invited you to announce a new assignment - as chief of the 15th train outside of Rostov. You were recommended by Vorontsev and Raugevich. The orders are ready. Report there at once."

He arrived, went to the headquarters, and reported to Vasilii Vladimirovich Khripin, the chief of aviation for the Caucasus Front. The serious, wise, 27-year old chief seemed older than his years. He studied the new arrival closely. Then he exchanged glances with Ivan Iosifovich Petrozhitskiy, on whose chest Il'yushin suddenly noticed the then rare Order of the Red Banner. (This order, as Il'yushin then learned, had been awarded for a daring flight with a wounded hand to reconnoitre the White cavalry). Khripin and Petrozhitskiy in turn scanned the assignment orders and were interested to know what Il'yushin had been doing prior to this. His answers were apparently satisfactory. Quietly conferring with each other, they surprised Sergi Vladimirovich with the proposal:

"Aren't you going to the Caucasus airtrain? There we have nothing important, only troubles."

"But could I bring order there"? wondered Il'yushin when he had learned the details of the work of this train.

"We are relying on your experience."

The actuality was even more serious than Khripin and Petrozhitskiy had visualized from a distance.

Il'yushin was greeted more than coldly. Discipline had come to an end. Il'yushin went at once to the Front headquarters to Khripin and Petrozhinskiy. They had not surmised that the situation was so dangerous. "We shall deliberate on what must be done," - they made their decision and proposed to pay a visit in three days.

At the headquarters they told Il'yushin:

"The Caucasus train is being transferred to the jurisdiction of the Independent Army in Tiflis. The train has already been dispatched. Join up with it."

There was no time to ask any questions. Il'yushin, without delay, set off on the railroad to catch up with his subordinates enroute. He knew that some of the rowdies had been taken off the train, the rest were pretty quiet. Il'yushin conducted a Party meeting. At the meeting the offenders said that order was once again complete...

Sergei Vladimirovich rode on the platform. At the stops he quickly rounded up personnel. All the people and equipment on the spot. The whistle blew. And the train went farther south. On the way there would be time to think about the future. With aviation it was sublime. But was he ready for this? The commissar had said that the Institute of Engineers of the Air Force had opened in Moscow to which those who fought on the front would be sent on detached service. What a piece of fortune it would be to get sent there!

The train did not get to Tiflis. It was halted at Navtluga. From there Il'yushin made his way to report to the capital of Georgia. Mentally, he was considering how much better it would be to set up work here, and was even mulling over proposing his plan, but he was surprised to learn from the chief of aviation

of the Caucasus Front that the train was being sent back up north. And where but to Moscow, to reinforce units being newly formed.

Carrying out his orders, Il'yushin asked permission to request a personal favor.

"Regarding what?" - the chief was curious.

"I should like to be sent to the Institute of the Red Air Force..."

"That's an excellent idea!" - the chief enthusiastically agreed. "We have a need for specialists. We will issue travel orders for you."

Il'yushin hastened to the roasting hot square of the city, and ignoring the growing heat, hurried to the main railroad station. After a lengthy journey, Ilyushin was in the capital. He sought out the assistant to the chief of the Field Administration of Aviation and Air Navigation, Ivan Adol'fovich Buob to whom he was to turn over the train. Buob had formed air units for battle against the Whites and questioned him in detail about the repair train. At the conclusion of the report, Il'yushin told him about his travel orders:

"After the train is turned over I ask that you release me for training..."

"Well that requires looking into..." - Ivan Adol'fovich answered evasively, but he did release him for training. At Air Force Headquarters Il'yushin cordially greeted Vasilii Vladimirovich Khripin who had been transferred to Moscow:

"Aha, old friend... What chance brings you here?"

"I wish to enroll in the Institute of the Red Air Force."

"Splendid, - enthused Vasili Vladimirovich, the farther we go, the more knowledge of aviation will be required of us. Tomorrow you will receive the necessary papers."

The Institute of the Red Air Force, converted under the leadership of Professor N. Ye. Zhukovskiy from the aviation school in 1920, was then located in Great Kozlovskiy Lane. The equipment consisted mainly of an old "Nieuport" standing out of doors. Not far away, in Furmann Lane, the students' living quarters were located. Here Ilyushin settled in. At last, his real training had begun.

#### SATISFYING A THIRST

Everywhere Il'yushin went: in the plants and at the airfields, in the woods and at the front, - his free time was devoted to books. This was a help to him when he went to the institute. Famous professors delivered the lectures on higher mathematics. Il'yushin listened with delight. In 1922, the institute was converted to the Academy named in honor of N. Ye. Zhukovskiy, and the mathematics course was completely repeated since new students had joined the ranks. Il'yushin once again went through the course without missing a single lecture.

Now, looking back to the past, he mentions to a friendly circle:

"The fact that I took the course in higher mathematics and strength of materials twice helped me greatly." And he added jokingly: "Maybe this is advisable for future designers."

On the whole, he recalls with pride the program which was set up for the first aviation engineers. The high scientific standards were imposed on the students by the father of Russian aviation, N. Ye. Zhukovskiy. It reflected his main desire, - not to set a limit but to develop in every way the initiative of the student.

Studies then were conducted in nine series of lectures: physical mathematics, polytechnical studies, aeromechanics, aircraft construction, engine construction, lighter-than-air construction, air force operations, organization of production, and military science. It is evident from the list of subjects covered in the physico-mathematical course alone how wide a scope of knowledge was required of the future engineers. It included analytical geometry, differential and integral calculus, integration of differential equations, the theory of analytical functions. Physics, chemistry, and particularly technical mechanics, were dealt with in depth, including statics, grapho-statics, kinematics, system and point dynamics.

The applied disciplines also were taught very solidly and with great scope. For example, in the polytechnical series, in addition to subjects pertaining to aviation itself, such as structural design, the then young branch of science - radiotechnics were included. And the series on organization of production covered the scientific organization of labor, plant management, and accounting.

The subjects of aeromechanics and aircraft construction were especially deep in scope. The former included hydromechanics, aeromechanics, experimental aerodynamics, and propellers. The latter-dynamics of aircraft, structural design of aircraft, and aerodynamic design. The influence of these series of lectures on the students is further explained by the fact that they were conducted in the academy by the brilliant teachers Boris Nikolayevich Yur'ev and subsequently by the academician and professor Vladimir Petrovich Vetchinkin.

V. P. Vetchinkin is famous for many valuable studies, especially on flight dynamics and structural design of aircraft. B. N. Yur'ev further developed Zhukovskiy's vortex theory of propellers, and became one of the founders of the theory of helicopters. Vetchinkin taught the course in the academy on

flight dynamics, and Yur'ev - general aerodynamics. These lectures, later published in the form of the first textbooks on these new disciplines, were a delight to the students. They put before the young students pointed questions and forced them to the limit to find the answers. Il'yushin still remembers the lessons of his favorite professors.

Sergei Vladimirovich specialized in aircraft construction, and therefore took additional courses on parts and structures of aircraft, aircraft layout, and the installation of electric, radio, and photographic equipment.

Il'yushin was very enthusiastic about the construction of gliders, a subject that had interested him since the first year of schooling at the academy. He became an active member of the glider club and as early as 1923 created a glider of his own design. He obtained help in building it from the Moscow heavy artillery workshops. It was the "Mastyazhart" - a light training glider with a wingspan of 9 meters and a length of 5 meters. It weighed 32 kilograms in all.

Il'yushin and his motorless apparatus took part in the first all-union glider meet in the Crimea. The site chosen was Koktebel', which was noted for its ascending air currents. In the fall of 1923 a noisy crowd of glider enthusiasts arrived at this picturesque Crimean locality.

On the morning of November 10th Sergei Vladimirovich was nervous - he was facing the first flight of his "Mastyazhart." A pilot named Denisov was to fly the craft. The glider lifted off the ground but its tail inexplicably sagged. Finally the craft fell off on a wing and... crashed. With his heart throbbing, Ilyushin ran to the crash site. One consolation came to him on the way:

the pilot was casually strolling around the overturned craft. It meant that he was not injured. The glider was damaged but could be repaired (just like the planes he had restored at the front). The designer himself determined that the cause was imprecise balancing of the craft. Besides, the lever with which the pilot controlled the glider was in an unusual position. It was not underneath, as is usual, but came down from above, from a slot in the wing. The control lever was re-installed. He installed a landing wheel in place of the runner which was used when the glider touched and slid along the ground. Each modification required adjustment and the craft had to be checked for balance in flight. "This did not permit gliding with all its excellent flight characteristics on long flights from mountain tops and forced restriction to short test flights at rather low altitudes" - so wrote "Airplane" magazine.

The remark was well made regarding the excellent flight characteristics of Il'yushin's glider. It was a pity that there would be no long flights in it. An even greater pity was the fact that the second craft designed by Sergei Vladimirovich, which had also arrived for the meet could not fly at all: it had been damaged so badly during shipment from Moscow to the Crimea.

Those flights, all of which were made in the "Mastyazharo," were the highlight of the meet. The press of those days reported on the celebration for the participants in the first all-union glider meets. It was held on February 17, 1924 at a ceremonial session of the organization of Friends of the Air Force. To the applause of the assemblage the designers who were to receive prizes were brought on stage. Those were - I. P. Tolstykh, V. S. Pyshnov, M. K. Tikhonravov, N. D. Anoshchenko, S. N. Lyushin, S. V. Il'yushin. They were all included in the honor roll.

Among the designers who were honored, three were representatives of the Zhukovskiy Academy - V. S. Pyshnov, M. K. Tikhonravov, and S. V. Il'yushin. And what was even more remarkable was the

fact that all three later contributed much to our aviation and to our rocket technology.

A. S. Yakovlev, the noted aircraft designer recalls with gratitude the first glider meet and his meeting with Sergei Vladimirovich. He writes - "I met Il'yushin in the fall of 1923 at the first glider meet held in the Crimea. He was a student at the Air Force Engineering Academy and one of the first Soviet glider enthusiasts, while I was a Moscow schoolboy about to faint with love for aviation.

I do not know by what sign Sergei Vladimirovich divined that this 17-year old was to be a future designer. But I am indebted to his help and constant attention for whatever I have achieved."

After his return from the Crimea, Sergei Vladimirovich went diligently to work on a new glider. He named it "Rabfakovets." It was constructed by the club made up of the workers' faculty of the Institute of Means of Communication. The construction of the "Rabfakovets" was directed by the designer himself. One of the club members told of how the work went.

"We very soon discovered the energetic and active instructor, S. V. Il'yushin and received support from the management of the institute. We were given space in the former assembly hall. And then the work was in full swing. We were trained and coached at the joiner's benches, tools were assembled. The club drew the attention of many students - from three it grew to sixteen.

Twice a week the circle was visited by Sergei Vladimirovich with military precision and accuracy. He checked to see how the 'glider was 'growing' and gave assignments to the members of the club. By the time it ended we were familiar with the theory of aviation. On May 9, 1924 the project was finished..."

In design it represented a monoplane with thin-profile wings and wire tensioning. In the center of the craft there was a box to which the nacelle was attached. This accommodated the steering and aileron controls. The elevator and rudder controls were installed on a vertical truss. The wingspan was 12 meters, the length was 6 meters, and it weighed 48 kilograms. The load per square meter of wing was 5 kilograms.

In describing the design of the glider, Il'yushin especially emphasized that 2nd and 3rd category materials were used. Yet, despite this, the craft displayed very high performance. In the press of these years in an account of the second glider meet it was remarked that the "Komsomolets" and "Rabfakovets" gliders were the best ones for training purposes.

Sergei Vladimirovich recalls his "gliding" youth with pleasure. The future noted pilots of Soviet aviation received their tickets to the sky on his training gliders.

The construction of the record-breaking glider "Moskova," which Sergei Vladimirovich named in honor of the city and which became his favorite, was completed in 1925 and Il'yushin was taking his fourth course at the academy. This glider was designed for long-distance soaring flight.

Usually the competitions were held in the fall, and Sergei Vladimirovich planned to finish work on building the craft by this time. But, unexpectedly the Soviet glider enthusiasts received an invitation from the German sportsmen to join them in their summer competition. Pilots Artseulov, Zernov, Kudrin, Sergeyev, Yungmeister, and Yakobchuk went over there. With them went the gliders designed by Il'yushin, Vakhmistrov, and Chesalov...

The competition in Germany proceeded under difficult conditions. The rain drizzled constantly, the ground got soaked, and it was difficult to drag the gliders up the hill. They lived in crowded

barracks. There was a good deal of anxiety for all, especially Sergei Vladimirovich. His glider "Moskva" was still not fully regulated, but thanks to the determination of the designer, he soon managed to flight test it. The experienced pilot Artseulov demonstrated his proficiency in it.

The first prize for duration of flight in a single-glider went to Yungmeister (he remained aloft 1 hour 45 minutes 16 seconds). Second place went to Yakovchuk (1 hour 31 minutes 30 seconds). For these achievements the USSR team were awarded a crystal cup, a silver plate, and two silver goblets. The overall technical achievements and successful flights were honored with a special award - a compass for the gliders.

Needless to say, gliding contributed much to the future designer, although in the academy there was plenty of practical experience. Il'yushin worked in the joiner's shop, in the blacksmith and machine shops, and in the aircraft plants. He completed training projects on machining of parts, propellers, and aerodrome and plant construction. The course projects were devoted to aircraft engines, the aircraft factory, and air lines. The project for Sergei Vladimirovich's diplomate was a fighter-aircraft. The defense showed: his project was mature, Il'yushin was excellently prepared, although according to the procedure then adopted, there were no marks for each subject... The Decree of the Revolutionary Military Soviet of the USSR, No. 750 for 1926 read: S. V. Il'yushin is awarded the rank of military mechanical engineer in the Air Force.

His assignment pleased and excited him: he was assigned as head of the 1st section of the scientific and technical committee of the Air Force. This section was then determining requirements for military aircraft which were in prospect of being built for the Air Force. He worked on this assignment a little over four years, and these years were very significant for the future

designer. He knew thoroughly the requirements for a young air force which was setting out on the path of independent development.

Working with the scientific-technical committee of the Air Force, Sergei Vladimirovich continued to be interested in gliders, finding the time in the evening and the days he had off. True, he didn't build any more gliders, but did head the technical committee for glider competitions. The magazine "Airplane" regularly printed his articles on the needs of gliding and more aviation.

In the second issue of "Airplane" for 1930 there was an article by Il'yushin entitled "Immediate problems in the field of gliding." Without the glider there will be no gliding - this was the author's main theme.

Understanding that gliding is a stage on the road to more aviation, Sergei Vladimirovich called for it to be part of the studies in the training of sportsmen. "In the line of discipline - he wrote - amongst gliding enthusiasts there are a series of ills which must be dealt with, with all decisiveness. For example, some young glider enthusiasts, when it is pointed out to them that such things must not be done in flight which they were not permitted to do, will answer: 'If it's an offense, then what concern is it to this organization, I am responsible for myself alone.'

Bravery, generally, is a praiseworthy thing, when it is appropriate, otherwise it turns simply into stupidity. Moreover, then when bravery is called for and necessary, it may not be possible to display it. In creating the Air Force we need those people who are able to take a risk not only when they feel like it, but always, whenever there is a demand for it. This requires restraint and discipline, which are obtained by persistent work on one's own part."

Il'yushin was not saying this for the sake of rhetoric. Restraint and strictness in all things were natural to him from the very beginning of his work in aviation.

In the same 1930 "Airplane" magazine in an article entitled "What kind of training glider do we need?", Iliyushin wrote: "The main thing is a low-priced glider." If he had put a period here, then this requirement would sound typical. But Il'yushin continued his thought thus: "...simplifying the construction of the glider must not come about at the expense of impairing its performance and strength. On the contrary, these qualities must at least be preserved, and in the best case, - and this must always be striven for - they must be improved."

Here we have a paradox: it is necessary to build more cheaply and simply, but better quality-wise! But this was something Il'yushin devoted his whole life to: he always strove to achieve the most with the least resources! True, constructing his own planes was as yet a dream. He formulated the requirements for the planes of other designers.

In the magazine "Airplane" No. 10 for 1933, Il'yushin thoroughly analyzed the path of development of light aviation. He emphasized in his article that "thanks to the giant successes of the first five-year plan, and in particular in the field of the aircraft industry, the USSR could in the course of the next two years develop on a massive scale, could ensure massive requirements for this type of aviation. This would urgently require the establishment of starting lines for the development of light aviation.

Even then in the midst of problems on this form of aviation, Sergei Vladimirovich set forth the initial training for pilots, the escorting of military units, and the communications between them. And he also precisely drew up the main requirements for a light-engine aircraft: simplicity in piloting, short takeoff, slow landing speed, and maneuverability.

And still Il'yushin worked on his article for increasing the engine power for future light planes and the existing U-2 (subsequently the PO-2). "To increase the engine power on the U-2 aircraft as a trainer to 160 horsepower is not the main reason, but keeping in mind that the aircraft, in addition to its training mission, would also perform a number of other functions, when the payload was greater... it is necessary to increase the horsepower..."

And actually in the future the PO-2 did perform "other functions," in particular, night bombing in the last war.

After four years of work in the Air Force, Sergei Vladimirovich transferred to the Scientific Testing Institute. He became the assistant to the chief of the institute for the scientific-technical unit. Here Il'yushin was closer to the planes, the flying field, and to flying.

An even more desirable shift came about in August 1931. He went over to the Central Institute of Aerohydrodynamics - TsAGI. This was done at the personal request of Il'yushin and in accordance with the proposal of the chief of the Main Administration of the Aircraft Industry, Petr Ionovich Baranov. Sergei Vladimirovich was assigned as chief of the Central Design Bureau of TsAGI.

Baranov himself was obsessed with aviation and loved people who were in love with it. He numbered Il'yushin as one of these. Not only was Il'yushin grateful to Baranov for his support on the way to the summit of creativity. Petr Ionovich also heartily supported F. A. Tsander and S. P. Korolev when they were founding the noted Group for the Study of Jet Propulsion (GIRD) for developing a liquid-propellant rocket engine. His vigilant eye also observed the outstanding capabilities of the flyers M. M. Gromov, Ye. K. Stoman, S. A. Shestakov, V. P. Chkalov, and V. K. Kokkinaki.

The great services of P. I. Baranov are marked by the success which was achieved by aviation in the first five-year plan. On the first of May 1932, about 300 planes flew over Red Square. And all of them were Russian-built. And in 1933 the government established Air Force Day. On the occasion of the first holiday, Petr Ionovich was awarded the Order of Lenin.

In the flowering of his forces, the life of a great Bolshevik and airplane design enthusiast came to an end. He perished in an aircraft accident on September 5, 1933.

The personal contact with Baranov taught Sergei Vladimirovich a great deal. Among his words of advice was the following: "In aviation as nowhere else it is important to gain worldwide experience." Il'yushin was previously well aware of the trends and results of the development of aircraft abroad. And now he watched them even more attentively. He went to the air displays in France and in England, and went again to France to become familiar with engine construction.

The work of Il'yushin in aviation and gliding and air navigation was taken note of in 1933 with his first government award - the Order of the Red Star. That same year, for his part in building the gondola of the high-altitude balloon "USSR," Sergei Vladimirovich received thanks and was awarded a monthly stipend.

1933 was a memorable year for Il'yushin due to the fact that he went from TsAGI to a plant with N. N. Polikarpov, D. P. Grigorovich, and S. A. Kochergin. Here they developed their central design bureau which Sergei Vladimirovich headed up. In this bureau first thoughts and plans occurred to him, which would bring glory to the future Experimental Design Office (OKB) and glory to our entire aviation.

### SPEED, SPEED, AND MORE SPEED

...The heading - Berlin. The navigator lay on the floor of the cockpit of the IL-4 in order to be better able to fix the position. Scattered tiny lights were visible below. The winding ribbon of the Oder flashed past. Berlin was ahead. The capital of fascist Germany was in darkness. The lights were forced to be extinguished by Soviet air power which the Hitlerites had announced as destroyed...

"I see the lights of Berlin" - shouted the navigator, he observed in the darkened city the lights in homes and steel-furnaces. "The target is beneath us. Bombs away!"

The IL-4 quivered, the bombs were headed for the lair of the enemy. A mission for the Motherland had been completed.

The audacious strikes on the enemy had been made in IL-4 aircraft by the crew of Major Shchelkunov, Captain N. V. Kryukov, V. G. Tikhonov, and others. On September 17, 1941 many glorious pilots were awarded the title Hero of the Soviet Union. Other participants in these outstanding flights were also awarded orders and medals.

The attacks of Soviet bombers in August 1941 on Berlin and other cities of fascist Germany made a colossal impression on the

whole world. The bombing of capital and political-administrative centers of the aggressor in the initial period which was the hardest for us showed the whole world that Soviet air power not only existed but could strike the enemy precisely. The fascists' leaders were disheartened. Where had the Soviets obtained these forces, these long-range bombers?

These planes had appeared in our arsenal just prior to the war. They were well conceived by Sergei Vladimirovich Il'yushin as early as 1933. Initially, Il'yushin was engaged in the design bureau in administrative matters, directing the teams headed by N. N. Polikarpov and D. P. Grigorovich and S. A. Kochergin. But he could not simply direct, he wanted to design and build planes.

When Hitler came into power it was clear that the fascists were preparing for war against the USSR.

Our Party and government saw this threat and took measures to reinforce the defense capability of the country. The Air Force was developed as much as possible. It was decided that it needed a long-range bomber capable of inflicting strikes on the aggressor. This would require a range of action of 4 thousand km. Moreover, it naturally followed that a sufficient (not less than 1000 kg) bomb load should be provided for.

Il'yushin selected the classic design of a low-wing monoplane for the future bomber. Why did this configuration appear the most suitable to him? It possessed good combat characteristics and permitted location of the bomb bay in the midwing section. This compartment could accommodate ten bombs - "hundred pounders."

Sergei Vladimirovich decided to use a smooth skin for the aircraft, to make the wings tapered, and to use an increased specific loading. In order to give the future aircraft the

necessary range and a speed of up to 400 km/h, two air-cooled engines of 750 hp each would be required. But as yet our industry had not produced such engines.

After preliminary planning, the question was put before the leaders of the country.

In 1933 Il'yushin was invited to meet with Stalin. And this is his recollection of what took place:

"Voroshilov, Baranov, Alksnis, Tupolev, Pogoskiy, and I were invited to the dacha. We went there in the afternoon. It was a warm August day. On the lower veranda of the dacha the host and guests discussed the production of a flying boat by one of the plants. Voroshilov and Baranov did most of the talking. Stalin listened, not uttering a word. This went on for about an hour. Understanding that it was evident that a decision was difficult to reach quickly, he finally stopped the discussion with the proposal:

"It would be better to play a little gorodki."

Everyone agreed willingly. And about four o'clock on the gorodki field a jolly bustle prevailed. At six o'clock sharp we were invited to dine. But the dinner, one might say, was a business one. Stalin began the conversation:

"We need to have air-cooled engines. They are something we do not have as yet."

Baranov proposed:

"There is the thought of buying a license in order to move this whole design matter briskly ahead."

Stalin asked the opinion of each one sitting around the table. The judgement of all reduced to the same thing: it is expedient that this be done soon.

Here a proposal was made that a commission be sent abroad. It would include Klimov, myself, and other comrades. Stalin summarized very decisively:

"A commission without a license will not come back..."

The mission was fulfilled. The Soviet engine builders brought creativity to foreign experience. In the end, the air-cooled M-85 engine was born. They were produced by the enterprise headed by the former general designer, S. K. Tumanskiy. The engines were 760 hp. Work on the aircraft came to life in the Central Design Office.

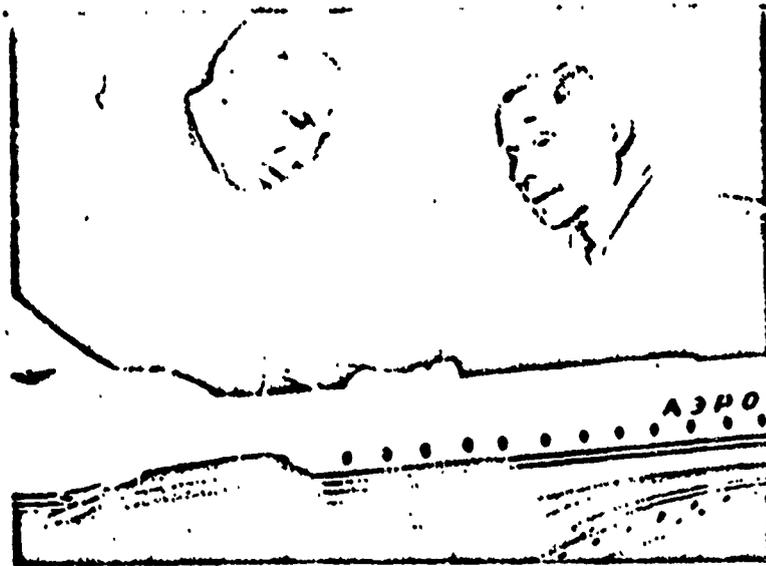
Needless to say, Sergei Vladimirovich was in the affair heart and soul. He was successful in leading the designing and coordinating the data on the future plane with the military and ordered everything that was necessary for its production. From the very first plan, he was scientist, designer, and organizer. The director of the aircraft plant wrote about him on August 20, 1935: "He is worthy of advancement to the highest position in the field of experimental aircraft construction."

Advancement was actually effected, but somewhat unusually. From chief of the Central Design Office, Il'yushin became leader of the team... which was continuing to design the TsKB-2<sup>0</sup> bomber (subsequently the IL-4). Initially, the team consisted of seven young institute graduates. With the advancement of the project, the team was converted into a test design office. Il'yushin knew that the creation of a creative group was a far from easy problem, and he gathered around him not simply specialists but enthusiasts with a single mind. The friendly group was collected gradually and on August 17, 1936 the team was officially renamed the Test Design Office and was headed by Il'yushin.

GRAPHICS NOT REPRODUCIBLE



M. I. Kalinin hands an award to S. V. Il'yushin at the Kremlin.



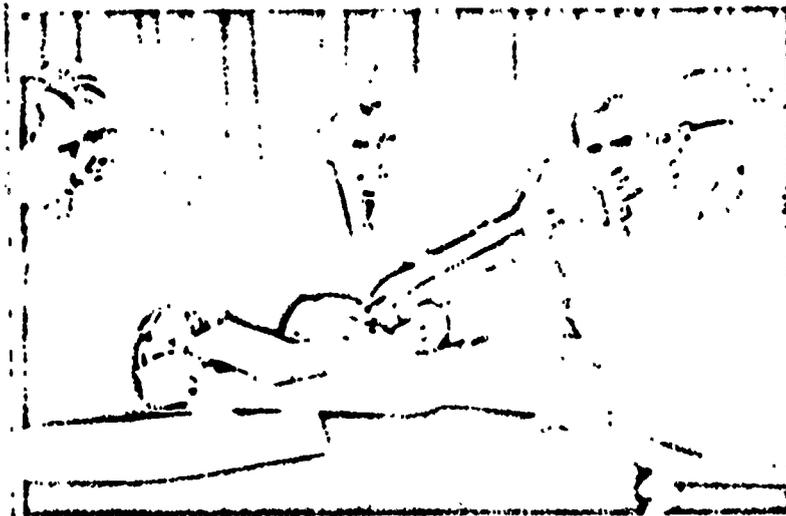
In the design office, at the plant, on the flying field - S. V. Il'yushin made an appearance everywhere during the working day.

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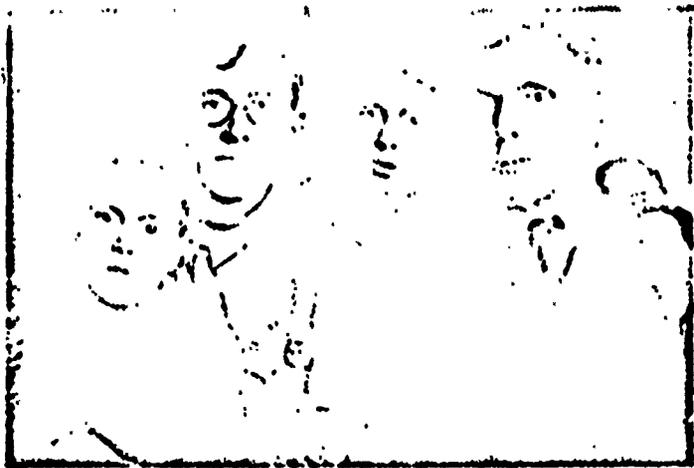
The general designer in his office. A new idea is being born.



Il'yushin discusses a first new project with his brilliant assistants.



Il'yushin has flown his own plane for many years. In the picture: Sergei Vladimirovich in the cockpit.



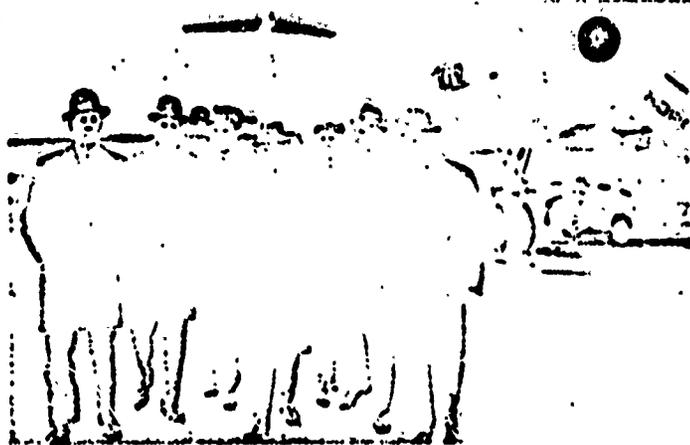
The children receive the baton from their fathers. S. V. Il'yushin's son Vladimir became a pilot, while his comrade - designer A. A. Sen'kov had four sons who became pilots. In the picture: S. V. Il'yushin and A. A. Sen'kov with sons Vladimir and Valentin.



S. V. Il'yushin relaxing.

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During the Lenin jubilee year a group of colleagues of the design office, led by S. V. Il'yushin, were awarded the Lenin Prize for the creation of the IL-62 jet liner. In the photo: S. V. Il'yushin, who had earlier been awarded the Lenin Prize for creation of the IL-18, with the new Lenin Prize laureates (left to right: A. A. Ovcharov, D. V. Leshchiner, V. I. Smirnov, Ya. A. Kutepov, G. V. Novozhilov, V. M. Sheynin).

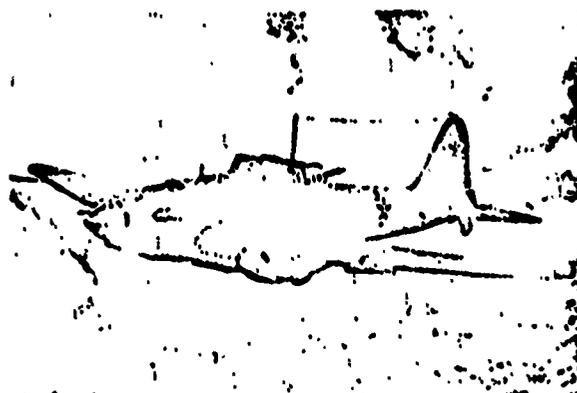


A chat between two leading aircraft designers of the present, A. N. Tupolev and S. V. Il'yushin.

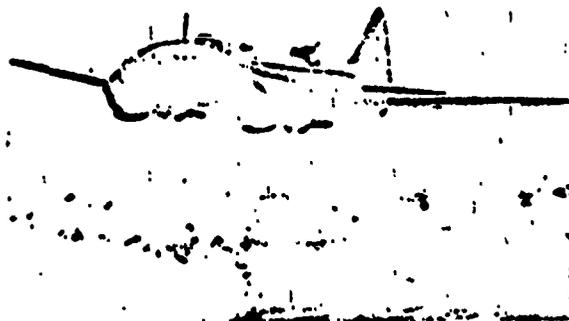
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S. V. Il'yushin and V. K. Kokkinaki.

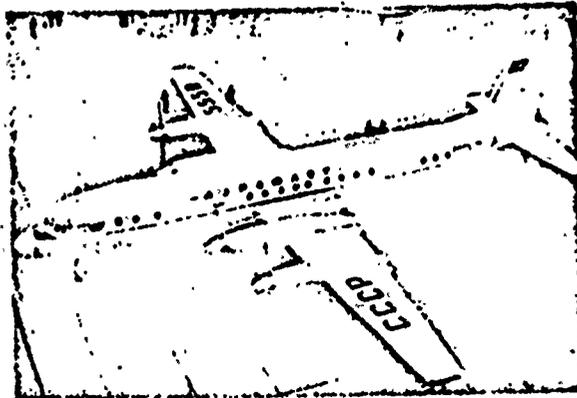


IL-2 aircraft.

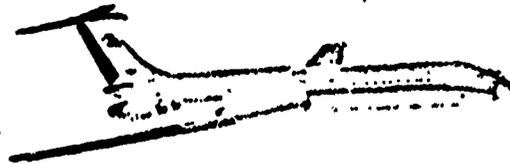


IL-4 aircraft.

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IL-18 aircraft.



IL-62 aircraft.



IL-28 aircraft.

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Someone asked one of the first colleagues of the design office, G. L. Markov, whether Sergei Vladimirovich was outstanding among his colleagues in the first years of the design work. The veteran answered: "Yes, he was outstanding. Not in size, not in voice, but in the burning energy he had. His strength seemed enormous. He was then in his forties while we were in our twenties. And whenever we went, barely keeping up with him around the shops, he never once with rancor said:

"You are lagging as if you were all in. Faster, faster. Time doesn't wait."

One time, Sergei Vladimirovich was taking part in static testing of the future bomber. His colleagues were adding weight to the craft in measured amounts, making calculations for each ten percent. Il'yushin could not contain himself.

"Why is everything being done so slowly? You are not going to break the structure..."

"We are acting in accordance with the program," - the testers replied to justify themselves. But he brought a marked life to the work. Speed, speed, and more speed, - that was the motto of Sergei Vladimirovich. But he had other requirements also for a designer. He introduced a unique code of rules into the collective, a code of which he was the author:

"Be a man of principle. Never support a different opinion if you are not in agreement with it.

Never give way to despair - this saps your strength.

Be cheerful and energetic - this sharpens the mind.

If in the course of a day you do not learn something, consider it a lost day as far as you are concerned."

The quick tempo adopted by the Design Office bore its first fruits. By March 1936 a new bomber stood on the airfield, ready to accept a crew of three - pilot, navigator, and gunner. True, it was not entirely as the designer had envisioned it. Duralumin was still very expensive, and for the tests the fuselage of the first model was made of plywood. But a second model was already being built - entirely of metal.

The first one flew on a cold March day in 1936. Vladimir Konstantinovich Kokkinaki tested the aircraft. The plane easily lifted off from the ground and in flight displayed good control and good flight performance. Il'yushin congratulated his comrades on their work as representatives of the Air Force.

Kokkinaki tested the machine thoroughly and was convinced: the machine would cover the calculated range of 4000 km and develop an average speed of 310 km/h. The speed of the DB-2 plane then in production was 90 km slower - a substantial difference.

The maneuvering capabilities of the TsKB-26 astonished even the designer. Il'yushin made a flight in the navigator's cockpit, and Kokkinaki, unexpectedly for him, put the bomber into one loop after another.

That same year, Il'yushin's plane was included in the makeup of the parade. The designer was among the guests on the reviewing stand at the flying field. Sergei Vladimirovich was elated: his first one would be viewed today by thousands of Muscovites. A bright sun shone, the sky was a clear blue, as if washed for the holiday.

And then the planes appeared in the distance. The thrilling roar grew louder. The TsKB-26 was next to last to fly over the field, its shadow slipped over the decorated square. The last plane thundered in the sky, and everyone followed the departing winged formation. What's this? One of them has dropped out of

formation and is headed back to the square. Il'yushin recognizes his own plane with astonishment. "What is he doing?" wondered the designer, about Kokkinaki. And then, flying towards the aerodrome, it soars sharply upward. For an instant the plane seems to stop in an inverted position, and then heading downward, completes a loop. The first one is followed by a second and a third... The spectators gasp in astonishment. Il'yushin notices the animation on the governmental reviewing stand.

Before he had time to return from the aerodrome he received word from the design office: tomorrow Il'yushin and Kokkinaki will wait on Stalin at the Kremlin.

"Tell me about your plane" - he said when the meeting took place.

Il'yushin described its construction and dimensions in detail, and Kokkinaki - its performance. Stalin listened as he paced up and down his office. Ordzhonikidze and Voroshilov were interested to know how complicated it was to produce such a plane. But the main thing that interested them was whether its range actually was 4000 km.

"It's true - replied Kokkinaki - it has been tested at such a range.

"Test it again to make sure," Stalin decided. And turning to Ordzhonikidze, he added: "If the range is confirmed, put this plane into series production immediately."

Preparations were quickly made for a round-trip flight from Moscow to Baku and back to Moscow. Kokkinaki made a successful flight, the plane easily covered the whole distance. It was adopted as part of the armament and given a new designation - DB-3. In the Design Office the drawings were scanned once more and then sent for series production. But here Il'yushin met with a surprise.

A. S. Yakovlev has this to say about it:

"In series production of the aircraft a serious defect appeared in installing the oil cooling system: the engines overheated.

The defect could be eliminated entirely - it only required time for reworking. But an unhealthy atmosphere was created at the plant. The criticism was directly at Il'yushin, that he had not paid sufficient thought to the cooling system, that he had neglected to verify the drawings. Ill-wishers began to cast doubt on his work in general.

The government, learning of the conditions, came to Il'yushin's assistance and after a while the IL's began to come forth from the factory without interruption."

How was the defect eliminated? At the suggestion of Sergei Vladimirovich, a series of flight tests were made, one after the other. These solved the question of what was occurring in the cooling system. Sections of the tubing were made out of transparent material. When the engines were running it could be seen that the oil was not reaching there to remove the heat, and an emulsion was barely removing heat. The fact of the matter was this: the power of the engine was stepped up, which means that the heating also increased. This required boosting of the cooler pumps. The engine designers installed two pumps instead of one to pump the oil in. But there was only one to draw it off. The net result was that more oil was being forced into the sump than was being drawn off. Accumulating there, and heating up, it was converted into an emulsion and the cooling system performed more poorly. It took exactly one month to discover the cause of this malfunction. It was quickly eliminated and the factory began once more to produce bombers.

Even the first Il'yushin brought back a number of world records to the Motherland. On July 17, 1936 V. K. Kokkinaki with a load of 500 kg attained an altitude of 11,458 m in it, which surpassed by 1173 m the record held until then by the French pilot Cygnerine. Nine days later Vladimir Konstantinovich lifted a ton of cargo to the same altitude. And again a short time later Kokkinaki demonstrated that Il'yushin's plane had many undiscovered capabilities. He went to an altitude of 12,816 m with a half ton of cargo. And then with a ton of cargo he "captured" 12,101 m, and with two tons - 11,105 m.

In this same long-range bomber, which was named "Moskva," Kokkinaki and navigator A. M. Bryandinsky accomplished noted altitude and distance flights. The designer and the pilots decided to prepare for a flight in which speed, range, and altitude would be combined. The flight they planned would be made over the Moscow-Khabarovsk route without landing. The airline distance over this route at that time was 7500 km. Il'yushin with his pilot and navigator decided to follow the shortest line distance - in a great circle course, as navigators express it. Then the distance would be a little over 6000 km. But the flight would have to be made over little-known areas, crossing the Ob, Yenisey, and the Zeya. The difficulty of the route did not stop the designer and crew. They had faith in the plane which had reliable engines. In order to reduce drag, the designer had made provision for the landing gear to be retracted in flight, had streamlined it well, and had provided a carefully manufactured skin.

In the course of preparing for the flight, all elements of the structure were checked over again. A special flight chart was compiled. Basically, it set forth the requirements so that for each gross weight of the aircraft there would be shown a specific ceiling, most suitable altitude and speed, and following from this - the engine settings.

The chart took the form of a combination of curves on one drawing. It made it possible for the pilot to know precisely at any given moment how much the craft weighed, how much fuel remained, how he could reach the ceiling, and set the most advantageous engine operating conditions. In a word, it would be possible at all times to fly under the best conditions.

The cockpits for the pilot and navigator were fitted with the latest equipment for those days - a radio compass, radio sets for long-range communication, and a set of oxygen devices. For a forced landing, they had provided rubber sacks with provisions for 21 days, weapons, supplies, equipment, even to wading boots, mosquito nets, medical supplies, etc. Without a doubt, Il'yushin was aided in preparing these collections by his "personal" familiarity with the Far East in his youth. In order that the flight would be made under the most suitable conditions and that it would be possible to observe the terrain over which no one had yet flown (inasmuch as the charts were not sufficiently accurate) the flight would be scheduled so as to avoid flying at night.

The bright-red machine, loaded to the limit, and bearing the inscription "Moskva" left the runway of the aerodrome at 8:36 Moscow time on June 27, 1938. Completing a turn, the plane flew on course. For a long while the designer accompanied it with his eyes. And then he waited with excitement for a telegram from V. K. Kokkinaki and A. M. Bryandinskiy.

"Moskva" meanwhile rushed on eastward, cutting through the dark gray overcast. She landed in Spassk on the morning of June 28th. The average speed was 307 km/h, the distance - 7500 km, and in a straight line - 6850. Thus one more international aviation record was gained for the Motherland.

After this, S. V. Il'yushin and V. K. Kokkinaki thought about a flight from Moscow to America via the shortest route. The route of the daring flight would extend over the territories of the USSR,

Finland, Norway, Iceland, close to Greenland, and over the countries of North America. Half of the route lay over the waters of the gulfs of Finland and Bothnia, the Norwegian Sea, Denmark Strait, and the northwestern part of the Atlantic Ocean.

Preparations were made carefully and with foresight. Two new engines were installed in the redwinged bird. In the event of a water landing the plane was designed to float. (A balloon of rubberized material was placed in the nose part of the fuselage. Before landing it would have to be inflated.)

On April 28, 1939, the red machine set course westward. At first the weather was favorable for pilot V. K. Kokkinaki and navigator M. Kh. Gordienko. An altitude of 7,000 m was reached. The oxygen supply dwindled. They went to a semi-starvation ration. They crossed the Atlantic in a solid overcast. The wind drove the aircraft at enormous speed, and then severely retarded the flight. The oxygen was getting ever lower, and then it became necessary to climb higher, to 9,000 m. Position finding was by instrument alone, the crew was heading for New York blind. Then the weather deteriorated. The airfields were closed. The situation became desperate. One can imagine what Il'yushin went through during these minutes as he remained at the command post in the Central Telegraph building on Gorky Street.

But all ended well. In the approaching twilight, finding themselves over the Gulf of St. Lawrence, Kokkinaki was able to glimpse a small marshy island more or less suitable for a landing. The pilot headed for this little island and set the machine down without lowering the landing gear, as the aviators say, on its "belly." The island of Miscou which was hitherto unknown to everyone suddenly became known to the whole world. In a flight lasting 22 hours and 56 minutes, the heroic crew of the "Moskva" had covered a distance of over 8,000 km, and in a straight line - 6,516.

Thus, the shortest route from Europe to America was laid out. And it was done by Sergei Vladimirovich Il'yushin's plane.

The story of the astonishing fortunes of the DB-3 would not be complete without speaking of its life in the war. It was modified in 1938 and redesignated the DB-F3, and then in 1940 by the first two letters of the designer's name - IL-4. More powerful engines were installed, each with 1,100 horsepower, and bomb load was increased to 2,500 kg, it was reinforced with defensive armament and armor. The IL-4 had two movable and one fixed gun mounts. For overhead defense, it had a heavy caliber machine gun. And quick-firing guns were mounted below forward and aft. The bottom and the back of the pilot's seat were made of thick armor steel. The all-round rifle and effective armor protection and also the toughness of the construction made the plane highly invulnerable.

In flight it attained a speed of 430 km/h, its ceiling was 9,700 m, and the range - 3,800 km. In its speed, load capacity, and range, the IL-4 was ahead of many of its aircraft contemporaries.

What was it that ensured the long life of its design? The innovations laid down at its very creation. Il'yushin rejected the then traditional tubular longerons as stress beams for the wings, and went over to pressed shapes. Another original decision of the designer was to accommodate the fuel directly in the wing structure. In the military aircraft it was only partly put into practice: for purposes of ensuring protection against enemy fire, the main fuel supply was accommodated in reliably protected tanks. In the future, the idea of carrying fuel in the wing structure was more fully embodied in Il'yushin's transport planes.

Yet another design feature was the capability of the plane to continue further flight on one engine in the event of failure of the second.

So it was that this plane which had been made part of the armament five years prior to the war, and which went through the war from the first to the last day, speaks for the vision of Sergei Vladimirovich and his group, speaks about skill to perfect the plane and to keep it on a level with foreign modern materiel. And in aviation this is very difficult, since it is developing actually in seven-league strides. The massive series production of the IL-4 reached great proportions - the Air Force received 6,890 planes.

The IL-4's work in war as a long-range bomber began with the celebrated attacks on Berlin, Dresden, Stettin, Koenigsberg, Frankfurt-am-Main, and Danzig. Even from the beginning of the war, it shattered the hope of the aggressor of going unpunished, and made the German cities plunge into darkness for all the long war years.

The IL-4 was also used directly at the front to annihilate concentrations of troops and materiel of the enemy.

Thus, in the critical days of the defense of Moscow against the hordes of German aggressors, the IL-4 crews conducted night hunts for trains on runs, cause breaks in the tracks by their strikes, and blocked from the air the night flying fields of the enemy trying to bomb our capital. Frequently our pilots in IL-4's followed the fascist planes as they returned from a mission, and at the moment of landing when the lights were turned on, would make a precision strike on the parking ares of the fascist planes.

The pilots had faith in the Il'yushin bomber. Unbelievable as it may seem, cases have been known of returning from the target on long flights with only one operating engine. The second one had stopped as a result of a hit by an enemy shell. This was just the case with F. Parashchenko's plane. He completed 350 missions in his IL-4 and became a Hero of the Soviet Union.

Notable flights are known to have been made by pilots in IL-4's striking enemy airfields. In them, in a few days in April 1943, 70 enemy planes were destroyed on the Sarabuze airfield and 100 planes on the field at Saki (in the Crimea).

Strikes by IL-4's deep in the rear of the enemy are in the annals of our victories. The partisans from Belorussia reported to Moscow: "In Mogilev on the night of May 28, 1943 up to 3,000 Hitlerites were killed. Destroyed: the railroad bridge across the Dnepr, the wooden bridge across the Dnepr, the railroad stations 2 and 3 at Mogilev. On the tracks, 6 trains were destroyed. On May 28th the city was cordoned off, everything was mobilized for the removal of bodies."

The sailors of the Northern, Baltic, and Black Sea fleets knew the IL-4 as a torpedo bomber. The plane was especially equipped for carrying torpedoes. The crews of the torpedo bombers pursued and sank the German ships and guarded allied convoys. The combat performance of the IL's made it possible to carry out the most complicated missions.

In August and September 1942, the Germans began making attacks on our and English ships in the Barents Sea from airfields in Finland and Norway. How could the German aviation in the North be suppressed?

The question was brought before the Chairman of the State Committee for Defense, J. V. Stalin. The majority of those present were inclined to throw four-engined PE-8 bombers into the polar region.

"The proposal to use PE-8 aircraft is incorrect - said A. Ye. Golovanov, the commander of the long-range air forces, - it would not ensure the fulfillment of the missions assigned."

Stalin emphasized the importance of ensuring the major operations of our fleet and the allied fleet.

"I fully understand - remarked the commander of the long range air forces, - but the P-8 planes cannot fly from Arctic fields which have a limited length of runway."

Then Stalin asked whether Golovanov had any concrete suggestions.

"Yes, I consider it expedient to employ for this purpose the units equipped with IL-4's."

Two regiments of IL-4's were transferred to the North. They made major strikes on the enemy airfields in Norway and Finland. Regarding one of these strikes, it was announced: "...It had been established that in one of the major strikes by Russian aircraft on Lakselv, 60 planes were destroyed on the airfield and a great number of German soldiers and officers were killed, caused by the great destruction of buildings on the airfield.

The German's air force was significantly reduced by our activity in the Arctic.

The IL-4 finished the war over Berlin. In the Berlin operation in the course of six days the pilots each night made five hundred sorties. More than three thousand tons of bombs were thrown on the lair of Fascism.

"The IL-4... - recognized the American magazine "Flying," ...proved to be one of the most important planes in the Soviet Air Force."

## THE FLYING TANK

The combat glory of the Stormovik was preceded by the most strenuous efforts, although the design work which would make the feat possible was not evident at all. Still working on the Scientific-Technical Committee of the Air Force, Il'yushin was fully aware of how much the forces needed the stormovik plane. He knew about attempts to create such a plane being made by D. P. Grigorovich, N. N. Polikarpov, and S. A. Kochergin. These were noted aviation specialists, but the plane of the battlefield, as they called the stormovik, eluded them. The "Flying Tank" remained a puzzle.

"I didn't come to design the stormovik all at once, -- recalls S. V. Il'yushin, -- approximately three years were needed. Machines already in being were analyzed for parts. A conclusion was reached: the important thing -- was make the best combination of weight, armor, weapons, and speed. Finally, who would not be enticed to make the most reliable armor, for example, twenty millimeters? Or why not install a 50-millimeter gun? But such a plane had never been flown. This meant that it was necessary to seek the most effective combination of combat capabilities."

Il'yushin's own experience was a help in this respect. His twin-engine DB-3 bomber was still the basic aircraft of long-range aviation. Il'yushin relied on his own resources in designing the single-engine TsKB-32. For this plane the then most powerful engine in the country was used, the AM-35. It had liquid cooling and 1350 horsepower. The plane was built as a fighter. It had a well-streamlined, slim fuselage, in a word, its form was such that in flight the drag was slight. In order

to reduce the drag still more, Il'yushin went to an innovation -- to get away from the honeycomb radiator. He made use of surface cooling by evaporation. On the wing, surface radiators were placed in which the vapors coming from the engine were cooled and returned in the form of water to the engine. The plane was built in 1938.

In tests the TsKB-32 showed far greater performance than the I-16 then in the armament. The speed of Il'yushin's fighter was 500 km per hour, the ceiling -- 10,000 m, and the range -- 950 km. Its armament was impressive -- two guns. But the plane did not get into the equipment of the Air Force. At first its weight was objected to -- about 2 tons, and then the new cooling system was considered to be vulnerable under combat conditions.

The experience in working on the TsKB-32 was a great help to Il'yushin from the very beginning in correctly determining the form of the future stormovik. When the design of the IL-2 was in full swing, the designer was assigned as chief of the Main Administration of the Aviation Industry. Time and effort had to be divided between administrative and creative matters, and Il'yushin was wholly wrapped up in the idea of the unusual aircraft. This is what Sergei Vladimirovich has to say about this period of his life.

"I decided to turn to J. V. Stalin with a request to free me from the assignment to the Central Board (Glavka) in order to concentrate on design work. I wrote to Stalin and he called me.

Entering the familiar office, I immediately saw my application on the table. Stalin quietly greeted me and then started the conversation. Evidently he had decided to persuade me of error.

"Now then once an assignment is made -- he said -- that means it is necessary to work. You are not a fellow of chance, but very well prepared. If you go others will go and who will run the government?"

I then had to give in. Stalin tore up the application in my presence, held onto the paper scraps for some time over the waste basket and slyly squinting, looked at me as if asking: "Now what, throw them?" and he threw them in the waste basket."

But the designer was not appeased. He still had a great desire to give the country the needed aircraft. So then he wrote his next letter in six copies, addressed to -- Stalin, Voroshilov, the leaders of the aviation industry and the Air Force. The letter said:

"With the modern depth in defense and the organization of troops, and their vast firepower (which will be directed against attack aviation) attack aviation will suffer major losses.

Our types of attack planes, such as those constructed in the series -- VULTI<sup>1</sup>, KhAI-5 (designed by Neiman) and the test types "Ivanov" (designed by Sukhoi) and the "Ivanov" (designed by Neiman) are very vulnerable since these aircraft do not have a single vital part: crew, engines, oil system, fuel system, and bombs, -- which is protected. This can reduce the attack capabilities of our attack aviation to a serious degree.

Therefore, the necessity is today imminent for the creation of an armored attack plane, or to put it another way, a flying tank in which all vital parts will be armored.

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<sup>1</sup>Translator's note: VULTI - VULTEE (American aircraft manufacturer).

Being aware of the requirement for such a plane, I have been working for several months on the solution of this difficult problem, with the result that there is now a design for an armored attack plane...

In order to realize this outstanding experiment which will immeasurably enhance the attack capabilities of our attack aviation, giving it the power to inflict shattering blows on the enemy without loss or with very slight losses on its part, I request to be released from assignment as chief of Glavka, and that I be directed to turn the plane over for government testing in November 1938.

The mission of creating an armored attack plane is an exceedingly difficult one and involves great technical risk, but I will undertake this matter with enthusiasm and full confidence of success."

This time he was not summoned anywhere. The question was settled at a session of the Politburo in his absence. The session went on, as was often the case then, far after midnight. Il'yushin knew that his fate was being decided, he sat at Glavka looking over papers and mail, but barely catching their meaning. At three in the morning the telephone rang, Sergei Vladimirovich had no idea that this piercing sound was for him...

In the earpiece he heard the voice of the Commander-in-Chief of the Air Force, Laktionov:

"You are released from your assignment."

Il'yushin could not suppress a sigh of joy.

Afterwards, the designers joked: "Il'yushin flew out of Glavka in an IL-2."

A joke is a joke, but the advances he gave to the leadership of the party and the nation were far from jokes. And best of all, Il'yushin himself knew this.

What did he have in mind in order not to repeat the dismal experiences of his predecessors? The attack planes which were created prior to his were, as already mentioned, overheavy -- the chain armor "smothered" them. What had he made up his mind to undertake? The innovation was simple, but it was not easy to arrive at. It was not without reason that A. S. Yakovlev in his memoirs emphasized now important a trait Il'yushin possessed -- "he was a master of simple solutions. His machines all bear witness precisely to this, and you know how hard it is to create the simple."

So in the case of heavy armor Il'yushin proceeded from the simple view -- he made it not as a dead weight as had been done previously, but as a component of the structure of the plane. Thus the idea of an armored body was born. He included all the important vital parts of the plane in it: the engine, cockpit, oil and fuel systems, and the engine water-cooling system.

And that was not all. The designer decided to vary the thickness of the armor -- to have the most vulnerable places protected most thickly, and the least vulnerable -- the most thinly.

And there was yet another true logical course -- to give the armored body a streamlined aerodynamic form. This alone would make it possible to achieve a good shape for the machine as a whole and to attain the necessary speed of flight.

But it is truly said that the most skillful designer cannot forget the capabilities of technology. He must know what is possible and how best to fulfil the design in production.

This awareness of production, one might say excellent technological flair was revealed by Sergei Vladimirovich at the critical moment -- in transferring the design of the stormovik on paper to its actuality in metal. The trouble for the producers consisted of the armor-body which would have to be stamped. Some specialists categorically warned in advance: to stamp aircraft armor is impossible! Specialists in working of materials, plant engineers, master craftsmen, and the workers supported Il'yushin. Scientific colleagues Tumanov, Sklyarov, Kishkin, and the plant director Zasl'skiy did everything possible to give the armor-body the needed technology and production cycle. Armor would not stand in the way of their enthusiasm.

The production of aircraft armor-bodies became a reality.

Under pressure from the designer and the entire Design Office, the obstacles in the path of the stormovik were pulled down. Il'yushin flew to the enterprises where the parts of the future plane were being produced. In order not to lose time in the slow-moving PO-2, he got A. S. Yakovlev to give him a fast tri-motor liaison plane, a red one, suitable, and simple to handle. Sergei Vladimirovich himself controlled the plane well and flew without fatigue.

On April 21, 1938, together with his friend and designer, Ivan Vasil'evich Zhukov, he flew to Voronezh. "They rang up -- said S. V. Il'yushin, -- to say that a plane created in our Design Office had taken off and landed on a house. That is why we flew at once to the site of the accident. During the flight I noticed that the speed indicator on the plane was not working. It was already after six o'clock, and by about eight or nine it would be dark.

When I approached Zadonsk I looked to the west, the sun was already half set. I see that Ivan Vasilievich is dozing. On my left

was the Zadonsk monastery. I made a left turn and saw an airfield near the monastery. I flew on for approximately 30 kilometers, already in the dark. On the left, a huge black cloud was moving from the southeast. I knew this airfield well. I thought that I would drop a note, the lights would spread out before me and all would be well. But when I had flown off 30-40 kilometers the instrument needle reached the red mark. Then the engine gave one pop, a second, and a third, things were going to be unpleasant. I went from the left side of the Zadonsk highway and on the right I saw the winding Don. It was clear to me -- that I would have to cross the road so that I could line up the light poles. I hopped over the road and saw: here black ground, there greyish ground. Aha, I thought, where its black there is ploughed land, and where it's greyish there is the edge of the road. Therefore I must not set down at all costs on the gray. When I reached the black strip I began to set down. Then this was an interesting thing: both wingspans cut through a haystack."

And right at this time in Moscow, Yakovlev received a call from chief of the airfield:

"I've just received a report that on the way from Moscow to Voronezh the designer Il'yushin cracked up in some red plane or other..."

Yakovlev stood stock still with terror. How had he crashed? Why? He fretted. Finally, a new report came in: the plane crashed but the pilot was alive.

Il'yushin appeared in Moscow in a few days. He had a bandaged head.

"Sasha, -- Yakovlev said to him -- there is no grudge against you. The airplane is a remarkable thing, but no engine

will run without oil, this little detail must not be lost sight of."

It turned out that on the route between Moscow and Voronezh the engine had gone out of commission due to oil starvation. The entire blame -- an oil leak. Il'yushin had set the plane down in darkness in an unknown spot. After this, for the rest of his life Sergei Valdimirovich wore a scar on his forehead. And the day of the flight -- April 21 -- Sergei Vladimirovich began to observe as his second birthday.

The flights to plants and meetings with the producers continued. And this had its results -- construction of the first stormovik went ahead full speed. Even firing was conducted against the finished armor-body. A swarm of bullets and shells was brought down on them. Tests and measurements were made and data prepared regarding the character of protection for the pilot in the future machine.

A finished stormovik appeared on the airfield in 1939. It was a great victory for Soviet science. It was not accidental that the testimonial to Il'yushin in 1939 noted:

"He has shown himself to be an exceptionally valuable, energetic, and innovative worker.... For his exceptionally outstanding services in the designing of new types of aircraft, by decision of the government he is awarded the Order of Lenin and the Red Star."

A short while after this Sergei Vladimirovich was awarded the Order of Labor of the Red Banner. He was awarded the title of Aircraft Designer, First Class. The higher certifying commission conferred the degree of Doctor of Technical Sciences on Il'yushin.

The flight tests of the IL-2 were entrusted entirely to

the universal pilot Vladimir Konstantinovich Kokkinaki. The stormovik pleased him greatly and he saw a great combat future for it.

In February 1940 everything was in readiness to start series production of the IL-2. But sceptics appeared who claimed that the new plane was slow and lacked climbing ability. Finally, this was a development of shortsightedness. True, the stormovik was not a fighter, it was unique. It has the necessary guns, machine guns, bombs, and most important, the armor which would permit employing all these weapons against enemy tanks at a low flight level. Now this all sounds most reasonable, but then it had to be demonstrated and demonstrated...

One sceptic after another had to be convinced.

"What's the armor like?" -- they asked.

"Six-twelve millimeters."

"That's weak protection. It won't do."

And again Il'yushin and his assistants pointed out the error. Bullets and shells would penetrate such a sheet of armor point blank. But the body of the IL-2 was curved, and the plane would fly at a speed of 120 m per second. The protective effect grows drastically.

But there were sceptics who advanced newer and newer doubts.

Time is passing, the money for the stormovik has not yet been allocated and the enthusiasts headed by Il'yushin continued working on it without a plan. After construction, Sergei Vladimirovich spent almost a year in proving the necessity for the new machine and in demonstrating its prospects. But it still

stood in the hangar awaiting a decision as to its fate. Il'yushin again turned to the government. He was summoned for a report.

"Tell us how you find the machine."

Il'yushin reported on the IL-2. Then, what he heard gave him hope.

"This is the kind of plane we need."

For three days a conference was held in which the members of the Politburo participated. One thing was emphasized at the conference: the Air Force needed the IL-2 stormovik. Some specialists who were at the conference reported that if such a plane was needed, then it should only be in the single-seat version. They said, why have a gunner, you see, there is heavy armor to protect against attack from the rear. Despite Il'yushin's arguments against this proposal, the decision was adopted. It meant: the finished stormovik would have to be modified, the gunner's cockpit would have to go.

For a half year prior to the war, in December 1940, series production of the IL-2 in the single-seat version was begun.

In March 1941 S. V. Il'yushin was recognized with a Government Prize, 2nd Class.

At the beginning of the war, about one hundred of Il'yushin's "flying tanks" were to be counted in combat formations. And then when battle commenced the stormoviks at once were shown in their best light. Moreover, the IL-2 had a stunning effect on the enemy: "There is nothing more terrifying than the IL-2 -- the German prisoners acknowledged, -- they drove us crazy." The pilots who flew them confidently smashed at concentrations of troops and material, including guns, machine guns, and rocket launchers,

and with their bombs sowed terror, panic, and confusion in the camp of the enemy.

The Design Office received letters of special thanks from the front regarding the truly invaluable role played by the IL-2 in combat with enemy tanks. In the first period of the war, the enemy had a preponderance of tanks. While our army, straining all its forces to the limit, fought with them using artillery, antitank weapons, and grenades. But ground means could be used only directly on the battlefield. The IL-2 made it possible to annihilate tanks on the march, on the advance to the front, on the line of departure. Even the first strikes of the "Il'yushins" against the German tank and motorized columns which were tearing at the east led to very perceptible losses for the enemy. Only a single air force unit flying IL-2's in three months of battle before Moscow annihilated 608 enemy tanks.

All reports from the front regarding action by the stormoviks were pasted in a special album. In the Design Office "flashes" were posted.

In the period of the battles for Moscow in December 1941, in one of the "flashes" it was announced that three air force regiments were converted to Guards regiments. Among them was the 215th attack regiment under the command of Major L. D. Reyno. Another attack regiment (the 61st) was awarded the Order of the Red Banner for its successes in battles near the walls of the capital. These awards were in tribute to the courage and mastery of the flyers in perfecting the use of a formidable weapon -- the IL-2 aircraft.

The labor of the designer and the builders received high praise. In the fall of 1941, Sergei Vladimirovich Il'yushin for exceptional services in the creation of military aircraft was awarded the title Hero of Socialist Labor.

In the course of the war, the designer and his collective awaited a new test. The plants which were producing the IL-2, with the approach of the front lines, had to be evacuated to the east. It was an extremely difficult thing -- to relocate such giants. But an even greater difficulty was to organize production under unfavorable conditions.

The relocation of the plants was a real feat. In this severe situation the people worked with organization and with selflessness. Sergei Vladimirovich, getting ready to take his Design Office to its new site, saw how one after another, almost without pause, trains arrived and arrived with equipment, how well-planned and exceptionally rapidly the machines were unloaded and transferred to accommodations in the electric power plant set aside for the plant. "The rolling stock came to a stop -- Il'yushin said with amazement in his voice -- and the heaviest and most complicated equipment was as if blown by the wind from the station platform."

The accommodations where the plant for producing IL-2's was deployed had no roof, but the workshops went to work on schedule despite the cold and a snow storm. Old men, women, and children stood at the lathes. In order for the childish hands of the "artisans" to reach the lathes, special wooden stools were made for the youngsters.

At the end of October, part of Il'yushin's Design Office arrived at the new location. Il'yushin's people were given a two-storey book store building. The shelves and books were removed and tables installed. The first nights they slept right on the floor.

In the morning, some of the designers were sent to the plant where they could help the technicians and engineers get the production process going, and others sat at their drawing boards --

to begin preparations for the next modifications to the stormovik. It was right during these difficult days that J. V. Stalin's famous telegram came to the plant: "The Red Army needs IL-2 planes like air and bread. I demand that more and more IL's be produced..."

They worked in two shifts, and there were those who did not get away from the shop for days -- until the mission for the front was fulfilled.

Within two months after the evacuation of the plants, IL-2 stormoviks again began to reach the front. Production was decisively expanded and soon it was possible to turn out as many as forty stormoviks in a day.

At the beginning of 1942 a conference of front line pilots and technicians of attack units was held. Sergei Vladimirovich and colleagues from his design office took part. The front line pilots told of their experiences in the use of the IL-2 in combat. One after another they remarked on the high combat performance of the machine and its long life. In addition, the front line pilots suggested that the protection of the rear hemisphere be increased. They cited examples where enemy attacks from the rear had ended with the destruction of the stormovik. Combat experience demanded an increase in the protection of the rear hemisphere. The proposal of the front line pilots became known to the State Defense Committee.

J. V. Stalin summoned the People's Committee of the Aircraft Industry, Shakhurin and his deputy Yakovlev, representatives of the Air Force and the designer Il'yushin. After mutual greetings he turned at once to Sergei Vladimirovich:

"Our planes have good combat performance, and the IL-2 stormovik is especially praiseworthy. But in going into series

production we made the decision in favor of the single-seat version without heeding your objections. The question now is one of shifting over as soon as possible to the two place version. Do what you wish, but don't stop the assembly line."

Il'yushin recalls -- "I said that the problem was not an easy one, -- we had only just recovered from the evacuation and were deployed far from the center of Moscow. The State Defense Committee watched the production of the IL-2 and the work on improving its construction. They frequently summoned me to the Kremlin, even late at night. Moscow then was completely blacked out and it was not easy to reach the Kremlin. J. V. Stalin remarked on this and once when I and the People's Commissar for the Aircraft Industry, Shakurin, were at a session, he asked me:

'Why does it take so long to get here?'

'Darkened streets and the greater distance -- those are the reasons.'

Right then Shakurin received the order:

'Move Il'yushin closer to the Kremlin and give him a vehicle.'

Literally that same day I was settled in the "Moskva" hotel. I had not yet managed to get settled in the room when the telephone rang. The report was from the People's Commissar: a vehicle had been assigned to me. Finally, now I was literally only minutes away in the event of an urgent summons to the Kremlin."

Work at the Design Office went on around the clock. The engineers slept right on their drawing boards. It had been decided to make the plane two-place, but without changing over

the technology and equipping of the plants: to stamp the gunner's cockpit out of armor. In order to compensate for the weight increase it was decided to change to more powerful engines. All this vast amount of work would be performed in a short period of time. The first two-place stormoviks appeared at the front in October 1942. All the single-seat stormoviks in regiments were modified within two-three months. Gunner cockpits were added to them. Thus, by harmonious efforts the "flying tank" was given still greater terrible power.

In 1942 the specific data for the two-place IL-2 were finally determined. The engine designed by A. A. Mikulin was, as the experts say, boosted, and had a takeoff power of 1750 hp -- which was 150 hp greater than before. In addition, in boosting the engine the compression ration was lowered, which made it possible to fuel the IL-2 with a heavier, lower-octane gasoline. And what is more, the engine became more reliable in operation. Speed of the aircraft at the target was 420 km per hour and the range -- 800 km. The empty stormovik weighed 4.5 tons, and on takeoff -- 6.3 tons.

The armament was increased. New, significantly more powerful 23 mm guns were put aboard. In the gunner's cockpit a movable heavycaliber machine gun was installed.

Introduction of the rear gun installation widened the range of combat application of the plane. The IL-2 crew could now independently wage war in the air not only with bombers, but also with enemy fighters, especially at low altitude.

For his successes attained in the most difficult period of the war in perfecting a new type of combat aircraft, Sergei Vladimirovich was twice awarded the State Prize, 1st Class in 1941 and 1942.

Il'yushin was happy and felt inspired by the good reports on the military feats of the stormoviks at the front. Combat experience gave rise to more and more uses which the crews found for the flying tanks. On the Stalingrad Front, an outstanding pilot, a daring and brave man, Stepan Dmitriyevich Prutkov, who subsequently became a Hero of the Soviet Union, employed the famous "circle" of stormoviks when attacking targets. This innovation on September 7, 1942 made it possible for Prutkov and his comrades not only to smash a column of enemy tanks, but to actively withstand enemy fighter attacks. S. D. Prutkov's group of stormoviks knocked down two fascist fighters.

S. V. Il'yushin strove to do everything possible so that the flow of stormoviks to the front would grow continuously. With the help of the designers in the Design Office, the workers not only fulfilled the production plan for stormoviks, set up a factory, but also gave the Air Force combat planes over and above the plan. In the spring of 1943, the producers so far exceeded the plan as to equip three regiments in General N. P. Kamanin's corps.

The designer was happy when, as he arrived at the plant, he saw the uniformly humming rows of machines and the figures of the workers bent over them. Pilots visited the plant, quiet as he was also, observing the measured-by-the-minute process of the birth of the combat machines. Sergei Vladimirovich participated more than once in turning over finished planes to the front-line fighters. The speeches which were delivered on this occasion were brief but deeply moving. The workers who had built the plane with their own hands turned it over to the pilot, admonishing him before his deadly encounter with the enemy:

"Son, fight the fascists bravely, the plane won't let you down."

"Thank you for a good weapon. Let's make it hot for the enemy" -- was the reply that followed.

And then from the front to the plant and to the Design Office letters would come recounting feats in the sky at the front and telling how the IL-2 fought. Such a letter was received by the designer from N. P. Kamanin: "Your production passes through our hands. We are satisfied with it and we fight it well. Soon things will get even better." One letter from a pilot excited everyone -- from designer to lathe worker -- which was received in 1943. "Now our slogan is: 'Let us die but not retreat! Not one step backward! Work harder, put out more planes and engines. Work so that when we meet after victory we can say to one another: 'We battled with honor for our native land!'

The aircraft builders answered this call of the pilots with action. The fact that the designer and producer had worthily performed his duty was shown in reports from the front. This is what G. Gofman wrote to S. V. Il'yushin: "I want to thank you with all my heart for your machine in which I have completed 160 combat missions and flown 190 hours. The plane is No. 1873290. The plane never once failed during all these flights. During this time, after exceeding the flying time, the first engine was replaced and now the second engine has almost run its full time.

During its time of combat this plane has received more than 200 hits from enemy antiaircraft artillery. After the damages were repaired by the resources of the army field shops and despite the great number of "patches," the plane has not changed in its performance."

In 1943 at the plant airfield Sergei Vladimirovich looked with pride at the line of IL-2 planes with glorious names inscribed on the fuselages: "Nikolai Ostrovskiy", "Oleg Koshevoy", "Vladimir Mayakovskiy."

And the pilots, as the designer later learned, worthily fought in their named planes. The crew of the stormovik "Vladimir Mayakovskiy" headed by Captain Bogdanov reported several weeks after the plane's arrival at the front: "This outstanding stormovik has already made 15 successful missions. Our Komsomol crew has already received orders and medals. The "Vladimir Mayakovskiy" during this period has struck at personnel, railroad stations, and strong points of the enemy. On its red-starred wings it has brought death and destruction to fascist rascals: 20 cars loaded with goods, three depots with ammunition, 10 vehicles, and up to two companies of infantry have been annihilated."

To send more stormoviks to the front -- this was the goal which constantly faced Il'yushin. He resolved to help this with his own savings. This money, together with means collected by other Muscovites permitted forming the famous "Moskva" air unit whose pilots traveled a heroic combat trail.

With each year of the war our attack air force grew bigger and stronger. Making use of the exceptional characteristics of the IL-2, the pilots artfully and frequently made surprise attacks on the enemy. In May 1943 Sergei Vladimirovich learned that the People's Commissar of Defense of the USSR in a special order had set forth as an example the skilful actions of two stormovik pilots -- Lieutenant Smirnov and Junior Lieutenant Slepov.

The decree noted that the brave pilots had accomplished a combat mission hunt. This had taken place over the North Caucasus on a dull January day. The two stormoviks were almost inconspicuous in the gray-white sky. Flying over the Malorossisk station, the leader Smirnov saw a string of tank cars and along with them three freight trains. The stormovik pilots went into a descent. The enemy antiaircraft gunners bristled with fire but the pilots held their dangerous course. In the encircling

bursts of antiaircraft shells they were able to drop their hundred-kilogram bombs with delayed action fuzes accurately. Then they hit the station with their guns and machine guns. Breaking off the attack, they glanced back: the targets could not be seen -- they were hidden in thick smoke. Satisfied, Smirnov and Slepov set course for Tikhoretsk.

In four days, when our troops reached Malorossisk station, the details regarding the losses inflicted on the enemy by the two stormovik pilots became known. Four trains were burned out, including one with explosives, and another with tanks. The explosions had destroyed the transport system. Prior to the arrival of our troops, the Hitlerites had been unable to restore traffic on this section of the road.

With this joyous news from the front a holiday mood set in at the Design Office. People went to Il'yushin and proposed that something more be done to the IL-2 to increase its combat power. Mainly -- it was to try to provide the stormovik with a truer "antidote" against these newer types of weapons which the enemy was receiving. Along with the armed conflict on the battlefield went the invisible but vital for victory ideas of the builders of materiel. It was well known what great stakes the Germans strategy played for with the surprise use of the "Tiger" and "Panzer" tanks with increased armor in the Kursk bulge. They had counted on reducing the vulnerability of their tank columns to our artillery fire and to our stormoviks.

But the calculations of the fascists did not prove true. By July 1943, two powerful automatic cannons, not 23 mm but 37 mm, occupied their places on the stormoviks! This was the first surprise for the fascists who had planned to launch a new tank strike in the Orel and Kursk region. Then in the makeup of the bomb load of the IL-2, S. V. Il'yushin included a second surprise. -- antitank aircraft bombs [PTAB] (ПТАБ) with shaped-charge

(directed) action. These bombs were capable of penetrating the thickest tank armor.

The PTAB was invented, as is often the case in time of war, by a Leningrader, I. A. Larionov who was certainly not a specialist in bombs. The PTAB's proved to be an exceptionally suitable means for the stormoviks in combat against tanks.

In early 1943 J. V. Stalin received a report regarding the new bomb. The high command staff decided to put it into production. The Minister of the Armed Forces, B. L. Vannikov, was charged with making 800,000 bombs for the Air Force by May 15th. These bombs initially were delivered to the Orel-Kursk front of the advance. Each stormovik could take up to 300 PTAB's on board. However it was forbidden to employ the new devices until special permission was obtained from the Staff of the High Command. The pilots wondered what it would be like to operate with the new weapons.

When the fascists began their attack against Orel and Kursk, the stormovik pilots attacked the enemy tanks with their fire and bombs. The crews of the squadron commanded by Hero of the Soviet Union, A. N. Vitruk, alone on the first day of battle annihilated 30 tanks.

In the Design Office's album on the employment of the IL-2 in combat in 1943, a dispatch from the Kursk region is reproduced: "Tiger" burn! And there are pictures of burning "Tigers" and details of the attacks by our falcons.

The endurance of the IL-2 and its ability to take off even from unsuitable fields more than once came to the aid of pilots in combat. Such was the case in the breakthrough of the Miuskiy defensive line constructed by the fascists in the Donbas. The stormoviks, supporting the ground forces, made up to 4-5 stories

a day and met with attacks by the fascist fighters and fire from antiaircraft gunners. During one of these attacks, the leader of a group of six stormoviks, Senior Lieutenant Stepanishchev, came under antiaircraft fire. His wingman, Junior Lieutenant Lavr Pavlov, dove on the battery which was firing and silenced it with a burst of cannon fire. The commander then radioed: "The engine isn't pulling, I will have to land." And below was enemy ground and above the commander a mortal threat. Pavlov decided that there was nothing to do but go to his assistance. He managed to set down on the ground rutilated by ditches and shell holes alongside the commander's stormovik. Seeing this and counting on an easy plunder, the fascists were hurrying to the site of the landing of the Soviet planes. But on the way a wall of fire came from the four IL-2's which were in the air. The fascists could neither get through by forcing their way or by crawling. They lay pinned to the ground by bullets and shells. And at this time Stepanishchev hurried away from his plane to Pavlov and climbed into the cockpit. After him came the gunner -- climbing into the other cockpit. The engine of the serviceable plane was started, trembled with the strain, and the IL moved forward. After a short run the plane took off. The angered fascists tried to reach the heroes by sending fighters. But it would be hard to catch up with the dare-devils. A group of our pilots got them safely to their own airfield.

The tenacious life of the IL evoked the warmest feelings for the plane on the part of the pilots. Frequently this would happen. Straining his last efforts, the pilot lands his wounded stormovik, and the tractor tug is already conveying it from the landing strip to the parking spot. But the pilot does not leave, supporting the plane by its wing, as if to encourage a friend who had suffered in battle....

At all costs the big railroad complex must be photographed after the massive attack by our planes -- this was the mission

assigned to stormovik pilot V. A. Mednonogov, a subsequent Hero of the Soviet Union. The antiaircraft guns which had been repaired after the attack opened heavy fire, as if trying to vent their anger for all their defeats. Mednonogov's plane was riddled, almost half of the right surface was knocked off. However, the pilot managed to fly back to the airfield. The pictures he delivered helped the command verify the destruction of the complex.

After this flight the pilot joked: "The IL got out of the battle on my honor and on one wing."

And the poets composed these lines about it:

"Its Ural armor  
Put a spell  
On every shell"

And it's true, the "Il'yushins" would return home no matter what the damages. In the corps commanded by General N. P. Kamanin, on one IL-2 which returned from a mission more than five hundred holes were counted, and yet the pilot had flown "home" in it. After "treatment", the stormoviks went back again to battle. In the language of aviation this is called the high reliability and repairability of a machine. These properties were the foundation of the design of the IL-2.

The most unusual missions fell to the lot of the "Il'yushins" at the front. At the end of May 1943 nineteen stormovik pilots came under the command of the commander-in-chief of the North Caucasus front, General I. Ye. Petrov and the commanding general of the 4th Air Army, General K. A. Vershinin. "The mission assigned you, Comrades, though simple in concept is very difficult to execute, -- explained Petrov to the pilots, -- our forces are scheduled to break through the "blue line" of the fascist defense.

But first it is necessary to conceal the advancing troops, -- to set up a smoke screen. This is what you will do."

Certainly, this would subject the defensive capabilities of the IL's to a most severe test. This is the way the flight is recalled by one participant, Hero of the Soviet Union, Senior Lieutenant of the Reserves A. Timofeyeva (Yegorova), former navigator in the 805th Attack Air Regiment:

"At the "blue line" we were greeted with dense fire. The shell bursts blocking the way of the stormoviks became a wall. Our group broke through this curtain at minimum altitude and went on to the large Cossack village of Kievsk. The sky was again cut by ominous traces. The shells of the antiaircraft gunners drew red circles in the sky, fragments of shattered metal drummed on the armor of the plane. Even the enemy mortar shells and heavy caliber machine guns were hitting. We are flying in hell. We couldn't change course or altitude. We had to go straight ahead. All around was a sea of fire, and I involuntarily pressed back against the armor backing of the seat. Seconds seemed an eternity. And suddenly from under the fuselage of the plane ahead of me smoke streamed out. 'Twenty-one, twenty-two, twenty-three' -- I count three seconds and I press the button...

We did not swerve from the course. As much as one wished to look at the ground to see how the smoke curtain spread and whether it had broken up, there was no time for distractions."

The mission was accomplished. Even in the air, the stormovik pilots knew that for the successful performance of the mission and for the fortitude displayed, all pilots who had taken part would receive the Order of the Red Banner. In the evening the news reached them -- the "blue line" had been broken by our forces. A joyous feeling of participation in a notable event swept over the stormovik pilots...

The unlimited capabilities of the IL are attested to in the course of the war by the growing number of examples of battles between stormoviks and attacking enemy fighters. The basis of all these examples -- a surprise attack at low altitude and hedge-hopping flight, precision and coordination in group manouvers by the stormoviks. In case of an attack from the rear by enemy fighters, the gunners opened fire, creating an impressive and reliable covering screen. Therefore, by the summer of 1944 attempts by the enemy to attack stormovik formations usually ended very sadly for the fascist fighters. They vented all their fury on stragglers or damaged planes.

But no constraint was felt for the lone IL pilot. In the 4th Air Army during the time of the battles over Belorussia a flight of six ME-109's attacked the plane of Senior Lieutenant A. N. Vasil'ev which was all by itself. By successfully manouvering and by using the full fire power of the IL, the pilot not only made a successful attack on the ground target, but also engaged all the weapons of the air enemy. He knocked down one ME-109, and then without damage, got away from the pursuing enemy fighters.

The high combat performance capabilities of the stormovik were even more clearly reflected in the flight of Hero of the Soviet Union, pilot Yu. D. Ivliyev who was leading a twenty-four plane Il'yushin raid on an enemy airbase at Seshcha on the Smolensk heights.

The fascists had strongly defended the base with antiaircraft artillery. Even before the approach of our stormoviks the enemy antiaircraft gunners opened up a hurricane of fire. But this fire was of no help, the stormovik pilots broke through to the base and destroyed 15 planes at once. Due to the heavy fire the stormoviks became scattered. There were quickly taken advantage of by "Focke-Wulf 190" vultures.

Ivliyev's plane was attacked at once by two fighters. The crew of the IL beat off two attacks. In the third one, the fascists managed to hit the stormovik. The armor of the cockpit was pierced, the gunners machinegun was hit and the gunner himself wounded. Fire broke out in his cockpit. Exerting his last energy, the gunner put out the flames. He repelled the ensuing fourth attack of the enemy fighter with...of all things... the flare pistol.

The fascist vultures, seeing that the plane was damaged, went in for a fifth attack. The right wing was pierced and the left wheel damaged, and the fin and fuselage were holed. Our fighters came to the aid of the IL and chased off the fascist vultures.

The damaged craft lost altitude. But in another half hour the IL managed to reach its own airfield. -- and this was after so many hits! It managed to set down on the nearest field where our own fighters had already landed. Ivliyev had to set the damaged stormovik down parallel to the fighters and in addition, had to do it on one wheel! Even with a perfectly good plane on a specially prepared strip this was not easy to do. Here a real threat of crashing into the setting fighters arose to threaten the IL. But the flying skill of Ivliyev and the remarkable qualities of the IL ensured an excellent landing. -- the stormovik touched the ground lightly with one wheel, and as if nothing had happened, ran along the airfield and then, already losing speed, heeled over, fell on its wing, and gently slewed around towards the landing mark.

Regarding the IL-2, the Commander-in Chief of the Air Force, Chief Marshal of Aviation K. A. Vershinin had this to say: "The IL-2 stormovik in the course of the Second World War in all the air armies, including the 4th which I commanded, had a deciding significance in the outcome of many air operations."

During the battles for the liberation of the Crimea a case occurred which clearly reflected the feeling of fear and even terror which one appearance of Soviet stormoviks evoked in the fascists. On April 9 and 10, 1943, the German forces hurriedly withdrew towards Sevastopol in order to be in time for a sea evacuation. To hold up the enemy columns -- this was the mission given to the IL-2 stormovik pilots. They afterwards said that the German soldiers, moving in large columns, at the appearance of an IL-2 put their hands up as one man to signify that they were ready to be taken prisoner. But the stormoviks, naturally, could not take prisoners, they used their own fire power to hold up the columns of the enemy, trapping them for encirclement by the ground units.

In the battle for the liberation of Belorussia the stormoviks particularly showed their worth in shattering the fascist forces retreating across the Berezina river. After each IL-2 strike, in the place where the enemy was located, there remained literally mountains of smashed materiel. The former commander of the 4th German Army, Kurt Tippelskirch recalls with terror the panic retreat of his troops across the Berezina: "The unceasing enemy air attacks were the cause of heavy losses and also caused unending congestion among the retreating columns. The Russian stormoviks every now and then destroyed the bridges over the Berezina, after which on the east bank huge accumulations of vehicles formed..."

The IL-2's cooperated brilliantly with our ground forces in all aspects of the war.

The pilots of attack aviation became especially trained to act as fighters.

An amazing fact from the combat biography of the IL's was reported on February 22, 1945 by the 4th Air Army newspaper "Wings of the Soviets." An unusual and unparalleled air battle

took place between four IL's and eighteen German fighters. The battle lasted more than 15 minutes. More than forty attacks were repulsed by the fire of their IL's by the crews headed by Senior Lieutenants Chernets and Novikov and Lieutenant Fleshakov and Junior Lieutenant Zubko. They emerged from the battle the victors, having knocked down two enemy planes.

Naturally, these are only strokes and still not a recreated picture reflecting the great combat work, daily and dangerous, which was performed at the front by our pilots in IL-2 stormoviks, justly nicknamed peerless toiler of the war.

It seems that the fascist command did not give up the idea of creating such an attack plane as the IL-2. Hitler's aircraft designers undertook a number of attempts to create an armored flying tank but never reached a satisfactory solution. The "Henschel" firm, for example, announced a project for a plane called a tank destroyer. This was the XE-120 armed with a 30mm cannon. However, it showed negative results and the hopes which were pinned on it were not justified.

Sergei Vladimirovich followed the combat fate of his planes attentively and sought for ways of improving them. He met with combat pilots and drove out to Vyazma which was recaptured from the enemy, where stormoviks were then being based.

Many hero pilots of stormoviks came to the Design Office. For example, Hero of the Soviet Union, Major Bondarenko came to Moscow to receive a high award -- a second Gold Medal, having destroyed in his IL-2, 48 fascist tanks, 20 planes, 600 officers and men. Immediately Il'yushin invited him to visit the Design Office, warmly congratulated him on the award, and questioned him in detail about the plane.

A tape recorder has preserved their conversation.

"How do you like flying it, Comrade Bondarenko?" -- asked S. V. Il'yushin.

"Not bad."

"What's the fire power of the plane?"

"I have dropped bombs many times, and with the correct combination of a bomb strike and cannon and machinegun fire good results are obtained against ground targets."

"How is the armor" -- the designer is interested to know.

"The armor never helped me," answered the pilot.

"Your capability to attack the enemy?"

"Along one reinforced line I was ordered to inflict a strike, -- recounted the hero, -- The enemy had concentrated tanks on the slopes and in ravines, there were many fire points. We struck from the rear and, preserving surprise, set fire to many tanks of the enemy, supported an attack by our infantry and tanks, and remarkable results were obtained. The enemy complex of resistance was taken. In this battle my plane was severely damaged...The machine has exceptional vitality..and I came out of the battle in good shape."

"As a designer, I would like to discuss with you in more detail the behavior of the IL-2 in combat..."

The conversation was continued...

Front line experience prompted ever new improvements. But not all of them could be effected on a machine which was still on the assembly line. Then the designer decided to build some

new test models of the stormovik -- the IL-8 and IL-10. Why two? This was in order to embody in them two lines of development of the stormovik: with the IL-8 -- to increase the armor as much as possible, for the other, the IL-10 -- to increase maneuverability. Both differed decidedly from the predecessor, the IL-2. Aerodynamic shapes were improved. The engine on the new plane was more powerful. As a result, the IL-10 achieved a speed of 550 km per hour. Lift capacity was increased. The machine gun armament became more formidable.

In external appearance the IL-8 and IL-10 were different. Due to the increased weight of the armor, the first had somewhat greater dimensions than the second.

The test decided their fate -- the more maneuverable IL-10 was put into series production. Tests were made on the IL-10 - in June 1944, and in August 1944 the plants began to organize their production. Beginning in October 1944, the new stormoviks began to reach Air Force line units. The IL-10 was widely used in battles over the territory of Germany in February 1945.

And so in the closing stages of the war the IL-10 came out -- a younger brother of the IL-2. Ever closer closed the thunderous peals of retribution over the heads of the chief fascist criminals in their citadel -- Berlin.

The strikes by our aircraft on the den of the enemy were shattering. On the First Belorussian Front alone in the course of the first two hours of the Berlin operation a massive strike was carried out with a force of 730 stormoviks and 455 bombers. Just as wide use was made of attack aviation on other fronts. More than 41,000 IL-2's and IL-10's were produced. This was a record number of machines of the same type built in the history of world aviation.

The high performance of the IL helped a great number of our pilots to demonstrate their skill, valor, and courage. Every third pilot awarded the high title of Hero of the Soviet Union in the years of the war was a stormovik pilot. Among the 65 pilots who were twice awarded the title of Hero of the Soviet Union during the war period one third were stormovik pilots. Of the 47 aviators -- cavaliers of the Order of Glory 1st Class -- 36 were aerial gunners of attack aviation.

Can there be any greater joy for a designer than to realize that he has provided the weapon which was a match for the heroic spirit of heroes?

The idea of developing an attack plane reigned in the mind of Sergei Vladimirovich after the war. The Design Office under his leadership developed and constructed two new test models of a more modern flying tank with piston engines. They were designated the IL-16 and IL-20. The former was reminiscent of the IL-10 but was smaller in dimensions and had better aerodynamics, which meant higher performance and maneuverability. The IL-16 displayed very high flight performance and was produced in series. In September 1945 when its production was curtailed the 53rd specimen passed through the gates of the plant.

A new arrangement was employed on the IL-20 which provided better field of view and increased shooting accuracy. The power of the engine was increased and the armor strengthened. The gunner had at his disposal dual 23 mm cannons in a remote controlled barbette. The pilot had four fixed cannon for firing straight ahead. The armament also included rockets and bombs weighing 1000 kg.

The IL-20 developed a speed of 515 km per hour, and had a range of 1680 km and a service ceiling of 7750 m. Despite such outstanding figures, the IL-20 did not go into series production,

and the order was limited to the construction of a test model, as if to symbolize everything that the technology of piston aviation could give to the development of the attack aircraft.

#### THE ENTRY INTO THE JET AGE

In S. V. Il'yushin's design office there is a large and bright hall where skillfully fashioned models of planes mark the entire history of the design office. They stand there in shining metal and their entire display reflects the advance of the designer's thought from the first experimental model to the latest most modern.

The models speak further still of the characteristics of the designer's creativity. How many types of planes are known in the world with the proud designation IL? First of all, there are two stormoviks, two bombers, four passenger airliners. But the design office developed ever so many more models of flying machines. The fact is that under each famous name of an Il'yushin plane -- be it the IL-2 or the IL-28 -- there is concealed a whole series of modifications. And it was on these test models which never reached the passenger routes nor ever dropped down onto military airfields that the designer and his creative collective studied new ideas and sought for prototypes of the future planes.

On a pedestal, the glass nose tilted slightly upward, resting lightly on a landing gear with a nose-wheel, there sets a model of a jet bomber with four engines. To the uninitiated the inscription "IL-22" on the pedestal doesn't say much. All the more so because aviation literature seldom mentions it.

The idea of creating an experimental jet bomber goes back to the war years when all the efforts of the Design Office were being directed to improving the stormovik and producing ever more formidable "Il'yushins" for the front. The collective

creative feat of the Design Office was highly regarded by the Soviet government: for outstanding services in the field of development of aviation technology and the creation of new types of military aircraft, the experimental design office headed by S. V. Il'yushin was awarded the Order of Lenin in 1942, and in 1944 -- the Order of the Red Banner.

And although the work was in full swing for the front, Il'yushin and his brilliant colleagues had time to glance into the future. It seems that it was not just curiosity that guided them. They knew that after the victory over the enemy the development of aviation would not stand still but would advance even more swiftly.

Yes, the capabilities of the piston engine would soon be exhausted for bombers, not to mention fighters, although it had served thus far truly and well, -- as Sergei Vladimirovich had remarked to his colleagues in the Design Office when speaking of the future of aviation. For a high-speed fighter with jet thrust, the slow moving bomber with piston engines would be easy plunder.

His confreres -- the leading specialists in the Design Office -- agreed with him. Towards the end of the war it became known that a jet thrust engine had already been tried out on fighters, and the Germans had even employed them in combat. A report also came to light that the German designers had made an attempt in 1944-1945 to construct a jet bomber.

The first jet engines required a great expenditure of fuel. Because of this, the German experimental heavy plane had a rather short range of up to 1600 km and the payload did not exceed 500 kg with a speed of 700 km per hour.

Finally, S. V. Il'yushin commented on these results, saying that such figures were weak for a seriously considered front

line bomber. But it was clear here that there was something to be discovered.

Sergei Vladimirovich, while still in his middle thirties, had intently followed the birth and development of the jet engine. The works of K. E. Tsyulkovsky, V. S. Stechkin, and other theoreticians in this field inspired confidence in the reality and great possibilities of the jet power plant. Sergei Vladimirovich was well acquainted with the design for a by-pass jet engine proposed by Archip Mikhailovich Lyul'ka in 1937. This design developed an idea expressed five years before by K. E. Tsyulkovsky in his noted work "Semijet Stratoplane."

"How is Archip Mikhailovich making out with his idea?" -- Sergei Vladimirovich often caught himself thinking, and he was obliged to conclude that the designer of engines has something new. The year 1944 made him happy. Il'yushin learned then that Archip Mikhailovich had built an experimental jet engine, the S-18. Sergei Vladimirovich inspected the first-born with pleasure: its long elastic body breathed fire and howled on the test stand. "What a voice that engine has" -- joked someone. It was gratifying that the ideas of native scientists and the calculations of the designers had proven correct. During the static tests the instruments indicated that the first-born gave significant thrust and that it would "pull" well in flight. But, it seems, there still lay ahead the problem of getting the new-born engine into operating condition. In final form the engine received a new name: TR-1. The first four models of this engine were placed at Il'yushin's disposal.

How did Sergei Vladimirovich plan to use them? At that time, various ways of converting to jet thrust were under consideration. There were designers who suggested doing it in two ways: first to install the new engines in an old style aircraft, and then, making tests, to construct specially a jet aircraft. Thus the

designers advocated the construction of the first jet fighters on the basis of Russian wartime aircraft. Sergei Vladimirovich thought otherwise: to build a new aircraft under new engines, this is the way to step forward into the jet age at once.

The IL-22 -- the first jet bomber with native-built engines was the forerunner of modern bomber aviation. Its construction was completed in 1946. V. K. Kokkinaki conducted the tests of the IL-22. Not without uneasiness he sat in the cockpit of the unusual plane. It was known that entry into the jet era had been accompanied by catastrophe -- especially abroad, in Germany, England, and the USA. A certain unbelief in jet technology had grown. Vladimir Konstantinovich cautiously began taxiing and making preflight tests, and then on July 27, 1947 S. V. Il'yushin's first-born jet was lifted into the air.

On the airfield they waited in the Design Office with tension: How would this flight end? How many surprises would there be in it! But the flight itself, which was watched intently by the designer and a group of his closest assistants, dispelled their doubts -- the machine "knew how to fly." And Kokkinaki's report after the test in the air was completely cheering:

"I felt at ease, just as if I was in a flying jet laboratory."

After the first climb into the air, methodical flight studies were begun. The characteristics of the behavior of the new engines in flight were studied. The plane acquired a speed which was unattainable for earlier bombers. The pilot and the designers sought to find out what shapes the plane needed for such high speed. And after each flight study there were reports, reports, and more reports...

The Magazine "Flying" (USA) wrote in regard to the creation of the IL-22: "The first Soviet bomber, the IL-22, was planned from the very first as an aircraft with a jet power plant and

was a purely experimental plane with a relatively short career during which it had its "hour of glory" at Tushino." This hour of glory was well written up in "Pravda" on August 4, 1947 where there was an account of the fly-past of jet aircraft over the Tushino airfield:

"The limit of the spectators delight was reached when over the field there flashed past the jet planes designed by Comrades Yakovlev, Lavochkin, Mikoyan, Gurevich, Sukhoi, Tupolev, and Il'yushin. Among these craft was a plane piloted by Major-General of Aviation, Comrade V. K. Kokkinaki.

The thousand-voiced exclamations were lost in the noise and whistling of the passing planes. The eye barely had time to catch their lightning-fast movement.

'Again, again, and again!'

'How many they are!'

At close interval the planes swept by one after another. Enthusiastic amazement gripped all who were present."

Together with V. K. Kokkinaki, his brother K. K. Kokkinaki took part in the testing of the IL-22. Five men comprised the crew of this plane. Various variants of armament were worked out for it. Its full bomb load weighed three tons. The bomber had a dual cannon forward and two cannons in the tail, 37 mm. Its wing span was 23 m, the length - 21 m, maximum speed -- 718 km per hour, service ceiling 11,100 m, and the range -- almost 2000 km.

The experiences of the tests and the scientific analysis of the reports of flights helped in determining the basic configuration of a future bomber which was to receive the name of IL-28. The

flight tests with the first jet opened many a designer's eyes, and the front line bomber was designed in a very short time.

In one article in "Pravda" devoted to the success of the IL-2 stormovik it was very accurately stated: "The creation of the stormovik represented a significant tactical (!) discovery." So it was with the IL-28. Sergei Vladimirovich probed deep into the essence of the change in the tactics of combat operation of aircraft called for by the beginning of the jet era.

Proceeding from this, he determined the character of the defensive armament of the plane. Il'yushin made the selection of the armament before making the final layout of the aircraft, its dimensions, number of crew, and weight of the craft.

Sergei Vladimirovich studied an interpretation of the problem of bomber armament in world aviation of those years. It became evident to him that a single approach to this problem had not been worked out up to that time. English designers, for example, in creating high-speed jet bombers did away entirely with tail defense of the aircraft. They considered that the great speed made it possible for the bomber to run away from fighters. Initially, they had even not installed guns for firing forward, and the sole armament of the plane was its bombs.

Sergei Vladimirovich well understood that invulnerability of the bomber at the expense of speed could be achieved only for so long and no longer. After some period of time the enemy fighters would surpass the bombers in speed, and as a result of this not a trace of its invulnerability would remain.

In Sergei Vladimirovich's opinion it was impossible not to consider that radioelectronics, which had come into being in the war years, gave the fighters a very impressive reinforcement: aiming with the use of radars. They helped the fighter pilots

to observe the target many kilometers away, to conduct fire on a visually unseen bomber. The bomber crew in the opinion of the designer, would have to have the capability to answer blow for blow no matter what direction it was being followed from.

Thus Sergei Vladimirovich made it a basis for himself that it was necessary to defend the rear hemisphere of the future bomber. It was decided to work out a stern (the stern is the rear part of the aircraft) barbette with two 23 mm cannons. The barbette would have to be actuated not manually, but by hydraulic devices. It was also considered expedient to protect the cockpit located in the stern of the plane with metal and transparent armor.

For firing forward two fixed gun installations were designed with cannons of the same caliber as for firing to the rear. The crew up front were defended by armor. Maximum bomb load was designed to be three tons.

Due to all of this, the other characteristics of the plane became clear. The crew: three men, - pilot, navigator, gunner. For each of them -- reliable life-saving gear: ejector seats, the ones for the first two to eject upward in the event of danger, and for the third man, -- downward.

For the aircraft he designated jet engines designed by V. Klimov -- VK-1. They would ensure achieving a speed of 900 km per hour at an altitude of 10,000 m. The range amounted to 2400 km, the ceiling more than 12,000 m. Gross weight reached 21 tons, and payload totalled 40 percent of total weight.

Thus in 1949, four years after the end of the war against Hitlerite Germany, we had discovered the jet bomber, incomparably more advanced in its performance than its front-line brother. The speed and working altitude of the IL-28 were twice that of

similar combat aircraft of the not so long ago. Bomb weight had grown and gun armament had been increased. In equipping the plane, there were instruments provided for piloting, for search and destruction of targets at any time of day and under adverse weather conditions.

But no matter what new and promising plane the designer proposed, he never received recognition right away. In creating the IL-2 there were sceptics who did not believe in the stormovik. They were also there when the IL-28 was built. Moreover, simultaneously with the building of Il'yushin's plane, other front-line jet bombers were being constructed. This is what S. V. Il'yushin recalls of the matter:

"Just as with the IL-2, the matter was brought before the government. In making a decision regarding the plan for experimental construction of aircraft, data on the proposed planes was announced to prospective designers. As usual, J. V. Stalin, puffing on a curved pipe, paced his office in reverie. With mention of the IL-28, he approached the table behind which the designers were seated, pressing his hands down on the back of an empty chair and staring at me, he proposed:

'And can we put your plane straight into series production?'

Apparently Josef Vissarionovich had full information on the IL-28 and the idea appealed to him. I should have been flattered by this proposal, but was in no hurry to join forces with him, understanding that it was risky to go right into series production.

'You have decided correctly, Comrade Stalin, -- I replied diplomatically, -- to put the IL-28 in the plan for experimental construction. The machine will come out more reliable, stronger, and we will even gain time.'

"So it shall be. We shall confirm the IL-28 for experimental

construction," -- that summed up the conversation with J. V. Stalin.

When the experimental plane was finished it displayed high flight performance and piloting characteristics during factory testing. At high speed the IL-28 was simple to control and was outstanding in stability and manouverability. True, the dead weight of the loaded plane was considerable. The stern barbette increased the weight of the IL-28. In order to install it, the tail assembly had to be made more complex. And getting such a barbette to work was also complicated. But the designer went to any length to ensure that the plane would have protection against attack from the rear hemisphere.

In spite of the high qualities displayed by the IL-28, its fate was obscure -- at the time two new craft has appeared. When the decision was made to go into series production with a front-line jet bomber doubts were expressed regarding the IL-28: "The stern barbette is still not perfected. This is still not a combat aircraft." However, the results of the tests dispelled all doubts. But inasmuch as there were other planes for the same purpose, K. A. Vershinin, then Commander-in-chief of the Air Force, commissioned the formation of three crews in accordance with the number of jet bombers being offered. The crews were to fly each of the planes in turn and render their opinion.

And that's what was done. Each crew test flew all three planes. When all the indicated flights were completed, the crews then individually spoke in favor of the IL-28. Subsequently, this was the plane that was accepted into the armament.

May 1940 went by. The time for introduction of the plane into series production was fast approaching. That year the plants were scheduled to build no less than 25 IL-28 bombers. The new jets were to take part in the fly-past over Red Square May 1, 1950.

All the workers in the Experimental Design Office headed by Sergei Vladimirovich worked tirelessly to see that the IL-28 would go out through the plant gates on time. They went into series production at several enterprises. The creative collective of the Experimental Design Office sought ways to speed up production of the plane they had created. In these searches a new proposal was initiated by S. V. Il'yushin in the field of technology of IL-28 production.

The idea was a daring one. Now it has been adopted by industry for armament. But then it staggered many in its unusualness and originality. S. V. Il'yushin suggested assembling the wing, tail section, and fuselage from two simultaneously prefabricated halves. This, as the production workers say, expanded the work front twofold at once, opened up free access to the construction, and cut down on labor. The tempo of production increased sharply, and the cost of the new method was insignificant -- the weight of the construction increased the overall weight of the empty plane one and one-half percent.

In order to simplify construction, the designers headed by Sergei Vladimirovich suggested using large one-piece panels for the wing, fuselage, and tail. They were finished on milling machines. The improvement in technology not only simplified production but reduced the weight of the structure of the plane.

The close collaboration between the design office and the plants permitted fulfilment of the government mission. On May 1, 1950 the new bombers were displayed in the aerial parade over Red Square.

This is how "Pravda" described it on May 2, 1950: "The flight of the jet planes was swift. One after another, squadrons of planes flew out from behind the pointed spires of the Historical Museum..."

The planes designed by Il'yushin flew in the parade formation. They were flown by glorious pilots who had mastered the new technique exceptionally well. In the first plane the pilot was Hero of the Soviet Union, Lt. Colonel A. A. Anpilov."

The factories built IL-28's for many years and put out several thousand aircraft. There were IL-28's made as reconnaissance planes and torpedo bombers. Such modifications have been in the armament for many years. The flying schools know the training version of the IL-28. It was the basic plane for training bomber pilots.

Sergei Vladimirovich was already engrossed in new ideas. He saw as his first mission the building of a swept-wing bomber -- the IL-30. This wing at that time, since it was very successful for high speed flight, was devoted strictly to fighters. But this was its first time to be used on a bomber, and as they say, it proved to be just the thing. This was the first Soviet bomber designed for what was then a high speed -- more than 1,000 km per hour in level flight.

For the IL-30 the designer use a "tricycle" landing gear, so-called because of the resemblance to the arrangement of wheels on a tricycle. Only the plane had dual wheels and they were spread far apart. On this plane the engines were designed by Lyul'ka, and were very powerful for that time (4600 kg thrust). Carrying the same bomb load as the IL-28, the new bomber with the swept wings might exceed the range of its predecessor by 1,000 km and more.

"Why 'might'?" -- asks the reader. That's because the finished IL-30 had not been in the air with a load. With the work on this plane in full swing, a problem was put before Il'yushin: to replace the IL-28 engines with more powerful ones. And the deadline was very rigid. But no matter how the Design

Office workers tried they couldn't make it in this time. The fact is that work was going on in parallel on the IL-30. The order followed:

"There'll be no distractions. Devote yourselves only to the IL-28."

When the collective of the Design Office completed the rush order, the experimental work of development once again went on full force. A second idea of Il'yushin's was realized: to build a longer range, more powerful jet bomber than the IL-28. This was the problem which Il'yushin put before the collective of the Design Office. This problem was successfully solved in 1951. The wing used was straight and this whole new plane, called the IL-46, looked like a junior IL-28 in its dimensions. Finally, not only the dimensions were increased, but its speed (by 30 km per hour), range and bomb load doubled (all this in comparison with the IL-28).

V. K. Kokkinaki performed the first flight in the IL-46 on August 15, 1952. In his opinion the plane handled well, and it passed all the examinations to which it was subjected. But it didn't go into series production: preference was given to the bomber offered by A. N. Tupolev at the same time, which subsequently became known as the TU-16.

Then Sergei Vladimirovich decided to continue the line of medium swept-wing bombers. A very original continuation of this line was the IL-54. In configuration the IL-54 was high-wing, which meant placing the swept-back wing above the fuselage. It reminded one of an eagle with outstretched wings on the lookout for prey. The plane had a tricycle landing gear and in addition small wheels on struts at the tips of the wings. In flight they retracted as did the main gear. It was built in 1954 and underwent full-scale testing. During the tests, the IL-54 displayed

very high speed -- 1150 km per hour. Range and ceiling were approximately the same as for the IL-28.

In many respects the IL-54 was the most advanced plane of its time. Much that was innovative and daring was incorporated into it. For example, the design of the fuselage provided for a section underneath along the entire length for the two compartments for the landing gear and bomb bay. This bay could be loaded with large size bombs and torpedoes. The plane was the personification of an invariable Il'yushin rule: the least size and tonnage to ensure the required flight and tactical requirements.

S. V. Il'yushin approached this plane with characteristic creativity, as reported in one of the aviation journals:

"Il'yushin actually never displayed a tendency towards pursuit for an effect, but the use of classic layouts for his most successful planes should not be considered an indication of reluctance on Il'yushin's part to introduce innovations. On the contrary, many of the planes created in Il'yushin's Design Office, although they remained practically unknown, were without doubt, daring in concept, and some of them represented a combination of the usual with the unusual.

In the era of jet aviation, Sergei Vladimirovich turned to his cherished idea of a stormovik -- a plane for the battlefield, known under the name of IL-40. For such a plane he planned to have a low-wing configuration with swept-back wings and two jet engines with cockpit for the pilot and the gunner. The engines were located in the central part of the fuselage below the gunner's seat. Four 37 mm cannons were pointed forward. In the gunner's cockpit there was a dual 23 mm cannon.

The jet stormovik, just like its predecessor, was heavily armored. In 1953 the Design Office constructed several models

of the IL-40. The IL-40 passed all tests, including the government tests, successfully. It represented a qualitative leap forward in the development of attack aviation.

## WORKING WINGS

Once, on one of those winter days in 1943, the telephone rang in Sergei Vladimirovich's office. It was a long-distance call from the plant where they were building the stormovik. Il'yushin was needed at once at the production site. It was a short trip to the IL-2 plane standing by at Central Airport in Moscow. But the trip via air would be a long one. The slow-moving IL-2 was vexing: it was very difficult to make kilometers in it. The needle of the speed indicator "wandered" around the 250 mark.

So on this far from conspicuous winter day Il'yushin finally made up his mind: to build his own passenger plane. He looked around the cabin appraisingly at the plane which had served well and truly, but nevertheless was now an aging aircraft - a copy of the American Douglas (DC-3). During the time this plane had been in service aviation had gone forward, and Il'yushin was burdened by its obsolescence.

Upon arriving at the plant Sergei Vladimirovich discussed his thought with the director and chief engineer. They both, up to their ears in producing stormoviks for the front, joyfully gave their approval in a single voice:

"It's a doubly good idea. Such a plane is needed, and everything speaks as it were for the development of it: our power stands

firm, but it's time we look to the difficult times ahead."

In approaching the work on the design for a new class of plane, Sergei Vladimirovich studied everything pertaining to the development of civil aviation both at home and abroad. He knew of the plans of V. G. Yermolayev, the designer, to construct a passenger plane. Yermolayev had decided to convert his ER-2 bomber with two diesel engines into a passenger plane. Il'yushin evaluated the possibility of this conversion sceptically: the fuselage of this plane was so constructed that people could not stand up in it to their full height. How could this speak of comfort for the passenger?!

In January 1944, A. S. Yakovlev told Sergei Vladimirovich about a meeting with J. V. Stalin and the interest expressed in the Kremlin in regard to developing a passenger plane. Stalin's plan called for an air express for 10-12 passengers with a range of 4-5 thousand kilometers without landing. In this a wish was expressed: would it be possible to adapt one of our existing bombers for transport of passengers. And although the initiative of S. V. Il'yushin in beginning to design a new plane was approved, all ideas of turning bombers into passenger planes were not rejected. Stalin wished to think, in particular, about the possibility of the ER-2 as a basis for the passenger machine.

After a thorough study regarding conversion of the ER-2 it was deemed inexpedient. Because of this, V. G. Yermolayev's plan was not implemented. It was at this time that the life of the talented designer was tragically snuffed out - he died of typhoid fever. Moreover Il'yushin felt compelled to realize his idea for a passenger aircraft. Soon after S. V. Il'yushin's memorable flight to the design office, the project for a passenger liner was discussed in detail. The novelty of the problem aroused heightened interest. Initially it was decided to build a passenger plane with diesel engines. The first experimental model was built.

Tests showed: the engines had not yet been perfected, and that at present a reliable aircraft with diesels suitable for passengers could not be produced. Sergei Vladimirovich then settled on regular air-cooled aircraft engines designed by A. D. Shvetsov, the ASH-82-FN which had performed well in the fighters of S. A. Lavochkin and the bombers of A. N. Tupolev.

Peering into the future of transport aviation, Sergei Vladimirovich understood that for our country with its vast expanses and rapid development of the national economy, and the rising tempo of life, this aviation must and would become the most massive, the most suitable form of transportation. And he decided to treat the building of the plane, not as an episode, but as the beginning of a whole epoch in his design activity.

In building military aircraft, he had learned tactics, and now he set out to learn the economics of air transport and the trends in transport aviation. In the final analysis, he strictly emphasized the qualities which a passenger craft would have to acquire. First of all, it was necessary to guarantee complete safety and regularity of flights. Transport via air must be economically feasible. This meant that the cruise speed of the plane would have to be the maximum, while fuel consumption would have to be minimum. The passenger plane would have to have a long life and to be able to fly in all weather. The passenger had a right to expect comfort in flight, and minimal noise both in the cabin and in the vicinity of the airport. At the same time, for servicing personnel and crew there would have to be the necessary conveniences during preparation for the trip and also during overhaul and in the air.

All these things would seem to be evident requirements, but now to bring them to reality was far from evident. A search for the best solutions was begun under the leadership of Sergei Vladimirovich. The alpha and omega of this work was considered

to be the achievement of the highest flight safety possible. Il'yushin took the view from the beginning that reliability would have to be installed even in the layout of the plane. The safety concept had to be reflected in the selection of the number of engines, in determining the aerodynamics of the plane, and in working out the control elements. Il'yushin's collective strove to make the future IL passenger plane easy and simple to pilot and to operate.

"The absence of acuteness in control of the plane, smoothness and harmony in the control elements, - said S. V. Il'yushin, - lighten the work of the crew and in the final analysis have an effect on flight safety."

And the thought of the economy of the future aircraft was never for a moment out of the designer's mind. Along with economy went the guarantee of weight efficiency of the plane. "We could well imagine, - recalls Sergei Vladimirovich, - that only a plane which was outstanding along with safety and also in light construction could prove to be a massive means of transport."

It became clear that for a passenger plane it would be expedient to reduce the empty weight of the plane and thereby to increase the commercial load (the payload). In reducing the empty weight of the plane by only one percent there would be an almost five percent increase in payload.

That is why Sergei Vladimirovich in designing rigidly demanded that volume and weight be cut down. All dimensions must be rationalized and structural solutions must come from requirements for minimum weight. It was decided that all types of equipment would be located with a high degree of density.

The colleagues of the design office considered version after version in the makeup of the plane and its individual parts without

finding the best one. This often occurred close to the time of the military midnight alert. Then much was done on overtime. The designers headed by Sergei Vladimirovich drifted home only just before dawn. It pleased them greatly to fulfill the first civilian order during wartime.

What then was the result achieved? The plane had two engines with a takeoff power of 1,850 horsepower. On takeoff the plane lifted more than 17 tons, and the heaviest payload amounted to 3,000 kilograms. This load included 32 passengers. And what about speed? Had it grown in comparison with the LI-2? Yes, the cruising speed had increased thirty percent and reached 350 km per hour. In so doing, the range exceeded 3,300 km. Maximum speed at an altitude of 2,060 m was 407 km per hour.

Increased flight safety in the IL-12 was ensured by the fact that flight and even takeoff could be continued in the event of failure of one engine. On one engine the machine could climb to an altitude of 2,500-3,000 m. And if the failure occurred in flight, the trip could be easily continued.

The "Twelve" preserved the performance characteristics of the other IL's - unpretentiousness in regard to airfields. It could take off from rather short strips since its takeoff run comprised less than half a kilometer.

Outwardly it took the form of an all-metal monoplane with low wings which had a tapered shape. In contrast to the LI-2 it had a landing gear with a nosewheel and all landing gear struts retracted into the engine nacelles and the fuselage.

Inside, the plane had that style of furnishing and appearance which had come to be called in aviation "the style of pleasant simplicity."

By 1946 the IL-12 was ready. It was tested by the brothers Kokkinaki. After plant testing, the aircraft was presented to the Civil Air Fleet. The representative of the Administration of the Civil Air Fleet, test-pilot Hero of the Soviet Union Taran tested the new craft for the client. Steps were taken to increase the payload and the fuel capacity. The designers agreed and the IL-12 assumed its final form.

A slight digression is necessary concerning the testing of the IL-12 and the beginning of the flight biography of Il'yushin's oldest son, Volodya. Sergei Vladimirovich did not know that his oldest son, who had become friends with V. K. Kokkinaki, had gone up in the air with him. The son, as it were, had decided to retrace his father's path from the beginning. He had not gone on to the ninth grade, but had started in as a mechanic at the airfield. The mop-headed lad with the characteristic Il'yushin profile was servicing a PO-2 in which Kokkinaki made his first flights. Having been trained as a mechanic, Volodya wrote an application for military flying school and sent it off to the military commissariat. His application was reviewed and it was decided to send the lad to the preparatory course at the N. Ye. Zhukovskiy Academy. And since he had not insisted that he had to become a flyer at once and fly to the front, they told him: with your engineering training you will be needed.

Vladimir Il'yushin's training began at the N. Ye. Zhukovskiy Academy. The thought of flying did not leave the student. At that time Kokkinaki had just tested the IL-12. Volodya turned to Kokkinaki and asked:

"Could I learn to fly an IL-12?"

He did learn and did fly. He began to pilot with skill the transport aircraft created in his father's collective. For him,

piloting was astonishingly easy and pleasant. Maybe this was the reason for Il'yushin Junior at this time did not stop and "without a break from the academy" did indeed become a real pilot, and after graduation from the academy - a test pilot. He set world altitude records on modern rocket carriers, was the first to make a landing in a supersonic aircraft with the engine stopped, and was the first to shoot down a guided rocket drone at low altitude...

Sergei Vladimirovich also says of the future pilot with secret satisfaction:

"I have three sons, two made up their minds to be simply engineers, and one - an engineer-pilot."

These words were very pleasing to Vladimir Il'yushin, an Honored Test Pilot of the USSR, a Hero of the Soviet Union.

But let us return to Il'yushin Senior's first-born passenger plane - the IL-12. There were modifications of it, twin brothers, so to speak: a cargo and a paratroop transport. The first could deliver via air 3.5 tons of varied cargoes, the other one could provide ground and parachute landing of men and material.

Thus, S. V. Il'yushin and his design office ensured the uninterrupted military and labor relay race of their winged creations. Even in the first year after the war, the place of the front-line wings was taken by working wings. The IL-12 became the foundation of the creation of the modern civil aircraft fleet of the USSR. In the work on this plane there was laid down the system of design and development of passenger airliners which would provide even more modern machines of the future. But the first one never fades from the memory of Sergey Vladimirovich, he speaks of it in fond words...

The IL-12 opened up new boundaries to the talents of Il'yushin

the designer, which are so brilliantly revealed in the following. "Il'yushin, - said general designer Artem Ivanovich Mikoyan, - was a whole epoch in civilian postwar aircraft construction, an epoch absorbing all the modern qualities of aviation, - speed, altitude, simplicity of design, reliability in operation, and comfort."

In an account of the aerial parade, "Pravda" wrote on August 4, 1947: "A column of new passenger twin-engine airplanes designed by Comrade Il'yushin went past. These machines are fast and comfortable. They carry up to 30 persons. The column was headed by yet another of his designs, the four-engine 67-seat passenger plane."

We will speak a few words about the four-engined passenger giant which led the passenger column later on, but it is expedient here to follow the further evolution of the twin-engine IL's.

If we look at models of them, even a nonexpert easily notes the direction taken by the design office in perfecting the IL-12. It involves, first of all, the engines, wings, and fuselage. The engines became more powerful, the architectural forms and aerodynamic makeup of the wings were perfected, the fuselage was lengthened, and the equipment was enhanced by many modern instruments.

To the question of what all these measures contributed, Sergei Vladimirovich replies as follows: "First, - the number of passengers increased by 9-14, secondly, with almost the same range, the speed was increased by 30 km per hour, and thirdly, greater reliability and regularity of trips was ensured due to the installation of better instruments..."

The IL-14 appeared on the sky routes in 1954. For ten years the plants produced the IL-12 and the IL-14 and built more than a thousand machines in this period. The USSR's first passenger

planes were made in these copies. The IL-14, moreover, was built in plants in Czechoslovakia and the German Democratic Republic.

Where had not these first passenger Il'yushin's" not flown? They were to be seen in the north and in the south, they went from the North to the South Pole. They played the most varied roles: both as paratroop carriers and cargo carriers, and as official planes for transporting delegations. For example, it was in an IL-14 that the Soviet governmental delegation flew in 1955 to India, Burma, and Afghanistan, covering a distance of 22,500 km. In all these flights the planes flew without a failure despite the sharp changes in climatic and weather conditions...

When any important trip of "Il'yushins" began, Sergei Vladimirovich zealously followed the "behavior" of his children. And the warm testimonials coming in from far countries and continents cheered the designer and the whole collective of the Experimental Design Office.

Many significant dates in aviation history are linked with the passenger IL's. It was mentioned above that the plants produced IL-12's and IL-14's for ten years. March 1969 marked another round date - ten years of operation of the Il'yushin IL-18 on the Civil Air routes. On this occasion, the Minister of Civil Aviation warmly described the winged jubilarian, and called it the main aerial workhorse of our civil of our civil aviation.

The creator of this remarkable liner recalled: "Two IL-18's were built. The first one in 1947, and the second one ten years later. They were entirely different planes, although some considered that they differed only in the power plant. True, the main geometric parameters were common to both, but in technical-economic characteristics they had nothing in common.

"We undoubtedly made use of the experience of creating big

machines", - says Sergei Vladimirovich. Both planes appeared to be giants, especially the impressive IL-18 with the piston engines at the time it first flew. You know, that was more than 20 years ago. It was impressive in the number of passengers - more than sixty, and the unprecedented comfort for them, and the range, which exceeded 6,000 km, and a speed - greater than 500 km per hour. It was this same plane that served as the flagship for the planes in the aerial parade in 1947."

Why wasn't the IL-18 with four piston engines built in series? To answer this question, Sergei Vladimirovich points to an article in an aviation magazine. In it, it is said: "The first flight of the IL-18 took place on June 30, 1947. But in the following year tests were curtailed, i.e., it was hoped that the predicted volume of Aeroflot air cargo on long distance routes would increase immeasurably and that the IL-18 with its capacity would not be needed for many years more. After ten years the designation IL-18 was resurrected to be assigned to the future new turbo-prop passenger plane."

The following question was put to the designer: "Why had he settled on the turboprop engine for his liner?" You knew already of the reports of the success of the TU-104 and the "Comet" abroad, of the prospects of turbojet engines for passenger planes?"

The general designer answered thus:

"In this period, turboprop engines had a definite advantage over the turbojets - high economy in operation of the power plant. We, in the Experimental Design Office, estimated the possibility of creating an airliner with four turboprop engines built under the direction of Aleksandr Georgevich Ivchenko, and we were convinced that a good machine would be produced..."

Actually, the engines had sufficient power for their time,

specific weight in respect to takeoff power for them was almost half as much as for the most successful piston engines in this respect. The engine designer, according to S. V. Il'yushin's order, found ways of increasing the operating time of his creation and managed over several years to make them so that operating time, instead of being measured in hundreds of hours became - thousands.

But in lesser measure it would have been naive to consider that building a turboprop liner with one-third more speed, with one and a half more takeoff weight than its 1947 predecessor, and a flight altitude of 8,000-9,000 m would not contain in it something fundamentally new, and could rest as a whole on experience gained. First of all, it was clear how four engines of a new type would work together. On piston engines, in order to change the thrust you give more gas, that is, increase the number of revolutions. On turboprops - the number of revolutions is constant. The pilot can increase thrust by increasing the pitch of the propeller, varying the angle of its blades. At a given angle of the blades, the propeller may begin to produce negative thrust, that is, the plane is not pulled forward but backward. This could have very unpleasant consequences in flight. Thus, the aircraft designer in collaboration with the engine designer, had to be careful to adjust the engine-propeller group so that reverse thrust would be controllable and would appear in fully determined circumstances, for example, at the time of landing in order to reduce the landing run.

Another difficulty was in creating the fuselage for the new plane. The fact was that for the first time Sergei Vladimirovich introduced a pressurized fuselage into his passenger aircraft. The conditioning system would have to ensure within the fuselage, in the passenger compartment, normal living conditions at an altitude of 7-8 thousand meters. And as you know, the fuselage had huge dimensions and cutouts for windows, hatches, and doors. They searched a long time for the best construction which would

be sufficiently resistant to failure due to fatigue (metal, you know, also gets weary!). Moreover, it would be necessary that the framework of the fuselage even in the event of damage would not crack. In this case, the strength of the walls could not be increased by means of making them thicker - the weight of the structure would be increased. But the weight would have to be reduced in every way possible...

How many tests had to be made on a portion of the fuselage of the future plane before it was considered suitable in respect to strength and long life! It was shaken and submerged in a water basin. Only after testing was its service life determined - 30 thousand hours of flight. If you can imagine an uninterrupted flight of many days, then such a fuselage could be guaranteed to work in the air... three and a half years, undergoing vibrations, shaking, and shocks...

And so in July 1957, Vladimir Konstantinovich Kokkinaki started up the huge, multi-passenger, completely modern type of aircraft. A rarity, the tests of the IL-18 went rapidly and successfully. The plane went into series production. The Civil Air Fleet made preparations to accept the new machine, and in April 1959 it completed its first commercial run on the routes Moscow - Adler and Moscow - Alma-Ata.

The author of this book chatted with the pilots and other workers in the Civil Air Fleet. With one voice they all spoke about the economy, comfort, and reliable operation of the IL-18. Convincing figures were produced: the IL-18 overall was one and a half times bigger and twice as heavy as the IL-14, and with a range of 3,000 km it moved the same volume of cargo as six IL-14's.

And so it climbed above the clouds - a winged cigar with slightly raked nose and tail. Its maximum speed was 750 km per hour, and the payload - 14 t, and a range of more than 6,500 km.

In order to comprehend these figures, it is sufficient to refer to the case which took place with one correspondent who was preparing a feature story on S. V. Il'yushin. While at the airfield he listened to a report by the aircraft commander, Ya. Vernikov:

"The first test flight went off successfully."

The correspondent asked: "What test flight? The plane has long since been carrying passengers across the oceans!"

The pilot smiled and explained:

"Is it really impossible to improve a good machine? To take from each new machine everything that was put into its construction, - such is the law."

Such, actually, was the law in S. V. Il'yushin's Experimental Design Office. And it was conceived long before the IL-18. As applied to the IL-18, the law was expressed in the creation of five modifications: A, B, C, D, and E. From version to version the plane "grew", imbued with new power. Whereas the "A" version had a gross weight of something less than 60 t, the "E" version reached 64 t. Instead of the 64 passengers accommodated initially in the IL-18, the improved model now began to carry 122. The "population" of the above-the-clouds flying express had been almost doubled. The payload reached half of the overall takeoff weight of the plane. In the construction of the IL-18, along with metals - the veterans of aviation - duralumin alloys were used, and also titanium - a metal of exceptional strength.

The IL-18 was simple and convenient to produce serially. The basic processes of its manufacture were mechanized and automated. The fuselage, wings, engine nacelles, stabilizer and fin were assembled from individual panels. They were manufactured on

presses by the group riveting method. Production of the plane was quickly mastered.

Reliability of flight in the IL-18 was ensured by the fact that it could climb from the ground on three engines, and continue level flight on two of the four engines.

For creating the IL-18, by decree of the Soviet government of April 22, 1960, S. V. Il'yushin together with a group of designers and the test pilot were awarded Lenin prizes.

"This high recognition of the creative success of our collective, - S. V. Il'yushin told his comrades, - raised the total work of the designers, aircraft builders, and pilots in designing, testing, and series production and application to the IL-18."

As a matter of fact, even on the experimental plane lovingly nurtured by the hands of the designers and experimental construction workers, all the while in contact with the test pilot, V. K. Kokkinaki, two world speed records were established. On a warm August day in 1956, it covered a distance of two thousand kilometers with payloads of 1, 2, 5, and 10 t at a speed of 719.496 km per hour. Three and a half years later, at the beginning of February 1960, it covered a further distance of 5,000 km with loads of 1, 2, and 5 t at a speed of 693.547 km per hour. Four times in 1958 V. K. Kokkinaki set altitude records in the IL-18. With loads of from 5 to 20 t he reached altitudes of 12,000-13,274 m.

The IL-18 was well liked in the international aircraft market - it was purchased by many governments. Our airlines abroad were mainly equipped with this very plane. And certainly there was no country on earth which was not visited by the IL-18. It was seen frequently as well over the North and South Poles. Pilots made flights in it to the South Pole in Antarctica straight from Moscow.

But, once having given the plane to the airlines, Il'yushin and his collective did not consider that their mission in respect to their creation had ended. Immediately after the award of the Lenin Prize, Sergei Vladimirovich said: "The cost of transporting a passenger on an IL-18 is close to the cost of a ticket on a sleeping car on the railroad. Now we aim to increase even further the economy of the machine. There are possibilities of doing this. I am convinced that the time is not far off when the cost of flying in the IL-18 will be equal with the cost of a ticket for a train journey in third class. The efforts of our Design Office will be concentrated on a solution to this problem."

But as great an airliner as the IL-18 was, Il'yushin's new intercontinental express - the IL-62 differed as sharply from it as it had from the IL-14. To conceive and to design such a giant would require the firm faith of Sergei Vladimirovich in his own strength and that of his collective, and in the Soviet aviation industry.

Il'yushin understood, finally, that even the epithet "intercontinental" obliged him to provide a plane of unprecedented non-stop flight range with high speed and cargo capacity. And one thing more, it would require especially powerful and especially economical engines. What kind? At one time he had chosen turbo-prop engines for the IL-18. But now, his designer's flair prompted a different idea - to go over to turbojets, to get rid of the propeller. You see, 1960 had already passed, and the logic of development of aircraft engines led to the fact that in the family of turbojet engines new mighty youngsters had grown up, - turbofans, capable of providing thrust sufficient for the express-giant. For all their might, the specific weight and specific fuel consumption proved to be comparatively low. And these advantages gave the new creation of the engine-builders an addition to be basic contour of the compressor-turbine the so-called fan, by which an additional great mass of air was driven. The net result was a

more intensive flow of hot gases, an increase in thrust, and many valuable qualities were revealed. In comparison with the turbo-prop, the turbofan engine had no further need of heavy propellers which were especially burdensome at considerable speeds.

Thus, Sergei Vladimirovich settled on turbofan engines for his future airliner which had been designated the IL-62. The powerful engines of this type were born in the collective headed by Hero of Socialist Labor, N. D. Kuznetsov. Each one of them developed 10,500 kg of thrust, considerably more than the engines of the IL-18. And what a reserve of energy for a scope of design! A plane was conceived which was indeed intercontinental with a nonstop flight of 9,000 km, and passengers - almost two hundred, and speed - close to a thousand!

To employ this grandiose concept in metal meant that the selection of suitable engines would be limited. Much depended on the configuration of the future plane. Prior to this, all our passenger planes had engines located under the wings. This was the traditional layout, the habitual one, and it did not present particularly complex problems to S. V. Il'yushin. But he made a different, daring decision, which many could point to as debatable, - he proposed concentrating the engines in the stern part of the aircraft. He saw a huge advantage in this. Having freed the wings of underslung weight, they could be made aerodynamically better, the plane could be raised to a new degree of reliability, and comfort heretofore unattainable for the passengers could be achieved.

And what about the wing? How did Sergei Vladimirovich plan to improve it? The "clean" wing without engines, at the cruising speeds at which the plane usually flies, ensures high aerodynamic qualities. With a "clean" wing it was possible to create (and the Design Office did create) a more suitable mechanism for takeoff

and landing. And as for the reliability of the aircraft, inasmuch as the engines are compactly placed, it is easier to control the craft in the event of failure of an engine on one side. Also, the area of the vertical tail surface can be made smaller (this was later done). And there was no disputing the fact that placing the engines in the stern drastically reduced noise and vibration in the passenger salons and the flight deck.

However, it was known that no configuration of a plane yielded only plusses. Each one has a minus. The configuration selected by Sergei Vladimirovich made the plane heavier, and you know, the weight of the empty machine is the truest barometer of its economy.

How could this disadvantage be avoided? Sergei Vladimirovich answered this question thus: "This was a laborious business. But that's our designer's profession. It turns out, you go a half year and you all think the same..."

Sergei Vladimirovich did not specify how they went, all thinking about the same thing: how to combine a sort of uncombinable in the plan. In the final analysis it was decided: for weight economy (and for reliability as well) to shorten all communications between components, to place all the equipment connected with the engines close to them, right there in the stern. But, you know, this was not a wagon which can be loaded without particular attention to where things are put. But with an airplane, overloading the tail or the nose so disrupts centering that the plane can not fly at all. Finally, the designers saw that a great amount of weight was concentrated in the tail, and added special compensators to the unloaded plane. In the usual passenger trip, with salons filled, the weight of the stern is fully balanced.

No small gain in the struggle by the Design Office to achieve the least empty weight of the plane was afforded by the use of a new scheme for the takeoff and landing equipment.

Often in Sergei Vladimirovich's imagination his future machine had four engines at the back. It was perfectly clear that the empty plane would have its center of gravity close to the tail. According to the principles, the main landing gear struts would have to be placed behind this center of gravity. But the nearer they were to the tail, the greater would have to be the horizontal tail area, otherwise the machine could not lift its nose off the ground on takeoff. But to increase the area of the stabilizer and the rudder was what they didn't want to do!

For weeks Il'yushin sought the solution to the "tricky little problem." He frequently consulted with his comrades: "If you haven't got it, let's think it out together."

And finally at the technical session he said: "A means has been found to avoid increasing the area of the horizontal stabilizer. And the empty aircraft will not tip over." Sensing that those present were interested to the limit, Sergei Vladimirovich paused: then his words rang through the room: "We will make a fourth strut for the plane. This will be a tail support with a self-centering wheel. When the plane is loaded the support will be retracted into the fuselage. The weight gain will be almost three tons. Control will be simpler and more reliable. We will place all the basic equipment along with the engines."

Now the crew, abroad, meets such misgivings with a smile: "In what sequence do you load your plane so as not to tip it on its tail?" "In any sequence, - the crew usually answer, - you see, it's on four legs!" In England, France, the FRG, Italy, and India they have patented this scheme with engines in the tail part of the plane and with the new Il'yushin system of landing devices. A remarkable invention.

It was mentioned above that the wing, due to the fact that there were no engines on it, was smooth. But this was not its

only feature. Sergei Vladimirovich, together with his colleagues, gave the leading edge of the wing the shape of a beak. This, in combination with the special selection of the profile and other measures ensured capability of safe flight even in very disturbed atmosphere. Test-pilot, Hero of the Soviet Union, Edward Ivanovich Kuznetsov tested it under the most adverse conditions when vertical gusts of air reached very great force. In order that there would be minimal risk for the crew, Sergei Vladimirovich proposed that the plane be equipped with antispin parachutes. True, they were not needed.

A heavy plane with powerful engines, it would seem, would have to have a long landing run. However, the IL-62 did not, - the two outboard engines received devices which made it possible, as the specialists say, to create reverse thrust, that is, at the necessary moment to "turn around" the thrust vector opposite to the direction of movement of the plane and convert it to a force to slow the plane. As a result, the landing run was shortened, the IL-62 had the capability to taxi on a strip not only forward, but backward.

The foresightedness of the designer was also expressed in the fact that the engines were located sufficiently high. This meant less probability that they would suck in dirt or foreign objects on takeoff and landing.

And in case of a landing in a cross wind, the nacelles would not touch the ground, and even if it became necessary to set the airliner down "on its belly", the engines would not be affected by such a landing. And the fuselage was protected against this by a special powerful beam.

The features of the new power plant were such that the designer had given it the capability to safely continue takeoff in the event of failure of one engine, and to continue cruising flight - with the failure of two engines.

Designing the IL-62, - this was a mammoth piece of research work. Was the rational form of a "clean" wing necessary to the plan? "Make a model of the plane, Il'yushin told his colleagues in the Design Office, and mind the aerodynamic studies..." Day after day these studies were made under the direction of Sergei Vladimirovich.

Is it intended to replace the hydromechanical control by a manual type? On such a big liner? This required many hours of calculation and experiment in searching out ways for the hinge moments of the control elements to act. And these experiments were made in Il'yushin's Experimental Design Office.

What sort of crew cabin would be needed for flights between continents? More discussions, and more research....

Was there anything that the designer of such a huge airliner didn't have to think of? How to avoid the danger of fire? And mainly, how to protect the fuel against fire. The distance separating the engines which were located in the stern from the fuel tanks located under the fuselage - this was good. With any malfunction in operation of the engines the fuel is protected against combustion. In addition, it was necessary to insure that during flight the fuel could be dumped as quickly as possible from the tank under the fuselage. And suddenly there would be a "belly" landing.

And how will the passenger feel? The designer could not fail to think about this. The main thing, - the plane must be quiet and comfortable. In the IL-62 the problem of noise within the cabin and in the vicinity was successfully solved.

In confirmation of this, we refer to the opinions of foreign specialists. This is what was written in an American aviation magazine: "At the present time there are only a few modern planes

with three and four jet engines that meet noise standards. These include the American Lockheed C-141, the Soviet IL-62, and the English BAC VC-10."

And here is what an English aviation magazine had to say: "After the engines were started (the IL-62) hardly any noise was heard."

The passenger must be saved from shaking and vibration. And this Il'yushin has taken into account. "The IL-62, - it is said in foreign comments, confirms its effectiveness both in a technical sense and in respect to basic comforts for passengers. In flight the plane is quiet and comfortable. The flexible wing absorbs the greater part of loads due to turbulence, and therefore the passengers are hardly aware of the rough air when the plane passes through a zone of air disturbance." Conceived in 1960, built and flight tested in 1962, the IL-62 in 1965 was already shown in Paris at the time of the aerospace exhibit. Of all the many exhibits, it had the greatest number of visitors. In two years the IL-62 went back again to Paris for the next salon. And again it was one of the most attractive exhibits. The same thing was repeated in Turin in 1968 when the commander of the air show proclaimed it: "A most delightful and mighty ship."

The arrival of the IL-62 in New York as a result of a nonstop trip from Moscow evoked, according to the American correspondents, such curiosity as if a "flying saucer had landed."

At the air show on July 9, 1967, dedicated to the 50th Anniversary of Soviet Power it appeared before the Muscovites and guests of the capital assembled at Domodedovo in all its beauty and might. This is what "Pravda" wrote on 10 July:

"The rear of the column of civil aviation was brought up by the new intercontinental, 186-passenger IL-62. The cruising

speed of this giant ship designed by S. V. Il'yushin at the threshold of the stratosphere is 900 km per hour; its range - more than 9,000 km; the maximum takeoff weight is considerably in excess of a ton and a half. The IL-62 is capable of climbing rapidly. At the same time, on landing this colossus requires a comparatively short landing strip."

A landing was then demonstrated at the parade by the honored pilot of the USSR, Hero of Socialist Labor, B. Anopov. He touched down and the plane completed a very short run on the strip. "The plane came to a stop not far from one of the airport galleries and then taxied, - it was stated in the press. It moved not only forward but backward, as if sailing astern. Many of those assembled for the holiday had never seen such a thing."

Sergei Vladimirovich scanned the articles in the foreign press regarding his plane: Among them were these: "The opening last week of direct air service between Moscow and New York has again demonstrated the acquired capability of Aeroflot to compete with the international companies on the long-distance routes. There is no longer any doubt that it can go on an equal footing with the leading western airline companies." "As in all spheres of changing Soviet economy, the business circles of Aeroflot have very serious intentions of making a profit; they are already discussing sales of their new IL-62's, which are their pride."

Italian newspapers wrote, when the IL-62 was shown at the exhibit in Milan: "The IL-62 after a short run went up into the sky like a fighter."

An English newspaper reported: "The IL-62 is stable in flight as a rock and revealed not the least tendency to any sort of vibration.:

In the book of remarks made by visitors to the Paris aviation salon, those who inspected the IL-62 left enthusiastic comments:

"Grandiose! Congratulations on your technology and your people!"  
"An outstanding plane!" "Bravo! The plane is perfection!"

The designer, with all these remarks, is becoming acquainted with a new trail.

"Actually, the IL-62 evoked a real avalanche of opinion abroad.."

"What, in your opinion, in the method of approach to designing such a plane first of all determines success?"

"One can't create a new technique, replied Sergei Vladimirovich, without learning and without noticing the laws of its development. One must pay close attention to everything new which science and practice reveals, and must make use of this, considering the specific conditions of aviation..."

Indeed, the creator of modern aircraft must be wise and analytical. Behind these words, applicable to Il'yushin, stand the years of laborious research of the designer, the whole Design Office the processing of volumes of information, like ore, for the sake of a single gram of truth.

In an analytical scientific approach it is necessary to look for the sources of the outstanding results for which S. V. Il'yushin in 1968 was selected as an active member of the Academy of Sciences of the USSR. A constant search for what is new - was a characteristic feature of the creative trait of the designer, who in 1969 was awarded the gold medal of the International Aviation Federation.

We have endeavored to follow the life year by year, to go deeply into the character of the activity of the leading aircraft designer of modern times, Sergei Vladimirovich Il'yushin. It

will be fair to assert that just by glancing at the airplanes created by him one can sense the spirit of the designer. They also show how his aspirations developed. At first he thought of building a passenger plane with a comparatively light takeoff weight of 17 t, then he went to a plane with 17 t, and concluded with today's plane of 190 t. No one denies such a man in his consistency, methodicalness, and maybe, his wish to solve even greater problems.

Or let us look, for example, at the battle for the great life of the IL-4, IL-2, and IL-28, which did not receive immediate recognition, but afterwards, as they became part of the flight formation, won vast popularity. No one denies such a man his determination to the end to establish his design ideas.

How much that was new did Il'yushin bring to each plane! Let us recall the projects for stormoviks before his, and compare them with the IL-2. Let us compare the first plans for jet bombers with the IL-28. Finally, let us compare as well, the first turbojet passenger liners with the IL-62. In each case, the author of the IL-2, IL-10, IL-18, and IL-62 cannot be denied his bravery and the meaning of his thoughts in raising technique and technology to the level of world scientific thought.

How many sharp curves Russia, his Motherland, went through in his lifetime. The main turning point was Great October. Il'yushin met October in the ranks attacking Czarism. In 1918 he forever linked himself to the party of Lenin. In the years of restoring the economy, in the years of creating the first airplanes, he was in the main sectors of the battle for the winged might of the Motherland. And he met the aggressive fascist plunderers as a Communist-designer, performing his duty with honor. Il'yushin, together with his creative collective, sent to the front two remarkable combat planes, the IL-2 and the IL-4. More than a third of the planes at the front were made up of stormoviks and bombers designed by him.

Truly, he saw the demands of the postwar development of our air fleet at the time when the people's entire attention was devoted to the war, again - it was Il'yushin. Planes designed by him opened up the postwar routes of the Civil Air Fleet - reliable, unpretentious, modest workhorses of the sky. And he was the one who put into service the IL-18 and IL-62, - to the glory of Soviet science and technology.

Now having followed the life of the designer as expressed in his winged creations, - fighters and workers of the sky, how can it not be said of him that he is a true patriot of the Motherland, rejoicing most of all in its glory, in its development, and in its flourishing.

The Motherland has valued highly the inspired work of the general designer of aircraft. In the Order of the Presidium of the Supreme Soviet of December 12, 1957, it says: "For services in the creation of new aircraft, giving the right to the award of the title Hero of Socialist Labor, the award is made of the second "Sickle and Hammer" gold medal to Hero of Socialist Labor, general designer of the experimental plant, Il'yushin, Sergei Vladimirovich."

This man truly comprises an epoch in aviation. Small in stature, round of face, gray eyes, with a scar on his forehead. Due to this, his left eyebrow appears raised as if expressing wonder. He speaks softly but distinctly, involuntarily listening to his own words.

In conversing with him you see that he is keen of feelings and knows the works of classical literature. And here and there his speech flashes with a phrase from Pushkin, Lermontov, and Nekrasov. Even familiar lines ring with more life and are given new freshness coming from his lips.

To the question of how he conceived the IL-2, Sergei Vladimirovich replied:

"You would do better to look through my article in "Pravda." As they say, "It will never be said better."

One became accustomed to hear winged phrases applied to aviation.

He spoke very warmly and with feeling about Vologda where he was born. Sergei Vladimirovich often photographed his native places. Some time ago in his official office one could see a one and a half meter panorama pasted together from color photos. The photographs depicted a flat country, a few cabins, and a little farther on yellow stacks of harvested grain. And farther yet, on the horizon, - the blue surface of a lake.

Earlier, - with a tinge of sadness in his voice, Sergei Vladimirovich recounted, - "Each year I spent my holidays at our lake. Catching fish and hunting. On a little island I built a hut for myself and lived in it. I know of no better vacation!"

Actually, maybe this type of vacation from the great design complex in which he has spent more than thirty-five years was a necessity. Sergei Vladimirovich always showed a talent for natural science, an ability to dream, a striking understanding of the development of aviation.

S. V. Il'yushin from his first steps in the construction of aircraft confidently relied on science. His Design Office was connected with the Central Aerodynamic Institute (TsAGI). In TsAGI all models of future IL's were wind tested, their aerodynamics evaluated, as well as structural strength and the correspondence of each project to world achievements.

For a long time there has been a firm friendship between Il'yushin's Design Office and the Central Institute of Aircraft Engine's, the Flight Test Institute, and the Institute of Aviation

Materials. The Institute of Aircraft Engines was a direct participant in the creation of the original and contemporary power plants for the IL's. The materials scientists investigated, tested, and recommended to the designer metals, alloys, and plastics which were still unknown to aviation, but without which it could not have developed so rapidly.

Sergei Vladimirovich could frequently be seen in the midst of the scientists, - the aerodynamicists, technologists, and economists, the specialists on electronics and cybernetics. And when, for example, it was planned to finish a new liner, Il'yushin's "ambassadors" hastened to the institute of Silk and Wool - the Design Office needed modern, real aircraft fabrics.

Sergei Vladimirovich says:

"Not only does science have an effect on the plane, the plane has an effect on science."

This should be understood thus: daring design ideas induce the experts, the whole scientific collective, to bring up and to solve new complex problems, to move science forward. And. S. V. Il'yushin had a remarkable organization, without which any project would fail. This organization begins for him with a rigid routine for the day. The first half of the day is spent, just as for any colleague in the design office, at the drawing board. This is the designer's sacred time, upon which nothing can encroach without extraordinary reasons or circumstances. This is the time in the Experimental Design Office when there are neither telephone calls or moving about.

In 1969, Sergei Vladimirovich composed a memorandum regarding the working out of sections, components, and parts of the airplane. In this memorandum, in Il'yushin's laconic manner, he expressed the experience of many years of his and his comrades - veterans

who had participated in creating the IL's. "Henceforth, as the aerodynamic and general layout of the plane is produced, wrote S. V. Il'yushin in his memorandum, first form and dimensions will be established, composite diagrams will be made of the landing gear, controls, the power plant, fuselage, wings, fittings, etc, and the basic direction of the design will be determined, and the second basic creative stage of the work begins, - the construction of the parts, components, and units of the plane."

By enumerating what the designer must remember, Sergei Vladimirovich gives notice beforehand that all moments of work reflected in the memorandum are closely connected and mutually have an effect on one another, and that a change in one has the effect of changing the others. Sergei Vladimirovich emphasizes the decisive significance of calculating the technical requirements, the technical conditions, and operating experience. This means that he puts operation in the foreground as the initial point in designing. And another item catches the eye in the memorandum: the stress placed on rationality. There was no question of the fact that in functional, structural, or power diagrams that the requirement of rationality is emphasized (!).

And yet another Il'yushin principle is made felt in the memorandum: the simplicity in the design of any component, and its suitability for use. In the ninth item there are the words: "Convenience in assembling and disassembling," and in item ten it expressed further: "Convenience and simplicity in servicing and operation: access, inspection, and replacement."

The memorandum teaches the designer to be daring, to be an innovator, and at the same time to be circumspect. Thus, in one place Sergei Vladimirovich recommends wide use of magnesium alloys and titanium, in another - he alerts the designer and forwarns him of how important it is to keep in mind the degree of checking on the material in the structures. The author has a special

predilection in respect to adaptability for industrial production, that is, suitability for mass production. He tells the designer to consider maximum possible mechanization, particularly riveting. He tells him to consider the possibility of reducing the number of operations, the use of economical billets. Think about the fine points of construction. Wherever possible, make use of stamping, use cast ferrous and nonferrous metals and titanium alloys.

Sergei Vladimirovich begins and ends his memorandum with a concern for operation. The last four items demand that the designer foresee how preventive maintenance will be performed, what the service life of a component will be, and to consider how to increase it.

Even during the design stage, Il'yushin advises thinking about the instruments and appliances which may be needed in operating the proposed structure, and to make suggestions in the instructions regarding the use of the future machine...

It seems that in listing purely technical questions in his memorandum Sergei Vladimirovich understood that they alone do not determine the efficiency of the labor of the designer. In creating an airplane, in his opinion, besides the purely engineering talents and efficiency, it was necessary to have ability in the organizer of the personnel who effect the new ideas at all stages of designing, constructing and testing... To be able in the course of all this complex work to train and advance people, to unite them in a single friendly collective.

"I came to Il'yushin in the design office, - recalls G. V. Novozhilov, - in forty-eight as a student. I knew at once that to work here required a wide mental outlook. We, as students undergoing pre-graduation experience, were immediately entrusted to design critical parts for the IL-28 jet bomber. This lent wings and inspired faith in one's efforts, and compelled one to feel a

a great responsibility for the matter assigned. Sergei Vladimirovich treated us students with amazing warmth. We had hours to work on our graduation theses. He spoke with us as one equal to another. And we argued with him, and defended our technical solutions.

Now you recall with special force how many of them were invalid. But these chats with Il'yushin contributed much to us. What we gained from them helped us to understand the internal mechanism of the mastery of aircraft design, pits frequently deep laws. My comrades and I are proud of the fact that we were assigned to the Il'yushin school of aircraft construction."

In such an atmosphere of friendship and interdependence, people of various generations could easily breathe and work...

Regarding his own comrades - Design Office veterans - Il'yushin speaks with special warmth, - about M. F. Astakhov, V. M. Germanov, Ya. A. and M. A. Kutepov, D. I. Koklin, A. Ya. Levin, D. V. Leshchin, G. M. Litvinovich, G. L. Markov, N. I. Maksimov, G. V. Novozhilov, Ye. I. Sankov, V. N. Semenov, V. I. Smirnov, V. F. Sidorov, V. M. Sheynin....

And he certainly recalls V. K. Kokkinaki. He tested the most varied types of planes and never came amiss with them. The planes obtained the desired ticket to the sky. I consider that this praise best of all characterizes Kokkinaki's remarkable mastery.

When you speak with people who have worked a long time hand in hand with Sergei Vladimirovich they point out a main trait in his character: modesty...

He speaks of himself unwillingly and very laconically.

"The planes in the sky sing best of all regarding the designer" - he is fond of repeating.

It is difficult to raise an objection. You see, the planes do sing clearly and expressively of Il'yushin...