Army Aviation

NOVEMBER 30, 1968

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VOLUME 17, NUMBER 11

ARMY AVIATION

NOVEMBER 30, 1968

Endorsed by the Army Aviation Ass'n of America

CONTENTS

AAAA CONVENTION PHOTOGRAPHS

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THIS month I would like to take a few moments of your time for some random thoughts that have received attention at Department of the Army.

First, the AAAA Convention was an unqualified success and the highlight of the convention was the heart of the Chief of Staff's remarks (which you will read in detail in the next issue) that Army Aviation has been "*voted in*" as a full member of the combined arms team by the people who depend on its capabilities on a day-by-day basis. This has been echoed by the present commander of our forces in Vietnam, General Abrams. No finer tribute can be made to the need and the professionalism of Army Aviation, than our most senior commanders giving this recognition.

Second, the very presence of the Secretary of the Army, the Chief of Staff, and a host of distinguished guests reinforces what I mentioned in this column a few months ago – no one really considers this Association to be a side-element or special category of the Army.

Not a side element

You will hear more and more the phrase "*three-dimensional Army*". It is an irreversible fact of our military experience that no ground commander will be satisfied without some degree of airmobility. He may not employ it as we have done in the last few years in Vietnam; the inherent flexibility of airmobility allows him to employ it to his particular situation.

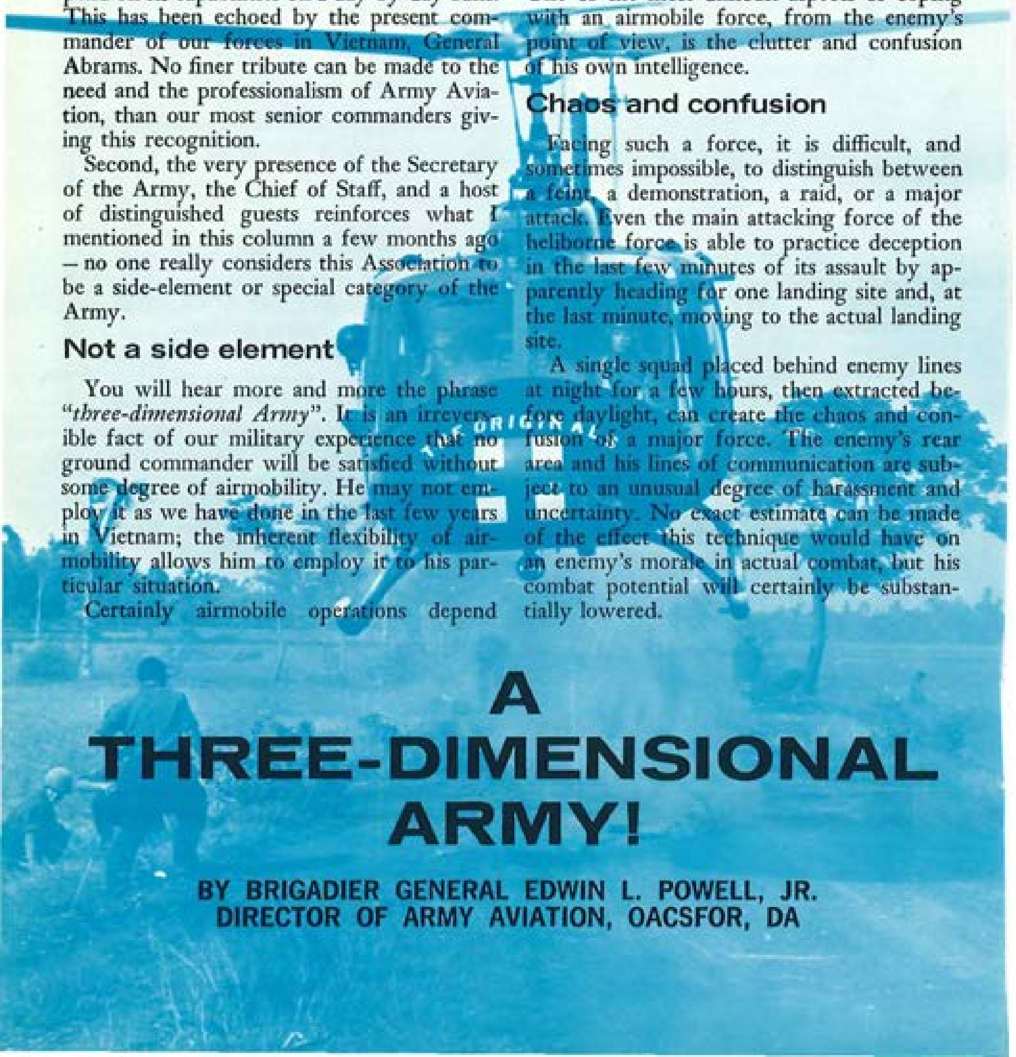
Certainly airmobile operations depend greatly on the air defense environment and the sophistication of the enemy weapons system. This has been recognized since the earliest tests of the *Howze Board* and the 11th Air Assault Division. The Army has not put on blinders when it calls itself a "*three-dimensional Army*." With all the tools of war you adapt to the threat that faces you.

Have you ever tried to picture what the presence of an airmobile force means to the enemy commander? Consider his problems. One of the most difficult aspects of coping with an airmobile force, from the enemy's point of view, is the clutter and confusion of his own intelligence.

Chaos and confusion

Facing such a force, it is difficult, and sometimes impossible, to distinguish between a feint, a demonstration, a raid, or a major attack. Even the main attacking force of the heliborne force is able to practice deception in the last few minutes of its assault by apparently heading for one landing site and, at the last minute, moving to the actual landing site.

A single squad placed behind enemy lines at night for a few hours, then extracted before daylight, can create the chaos and confusion of a major force. The enemy's rear area and his lines of communication are subject to an unusual degree of harassment and uncertainty. No exact estimate can be made of the effect this technique would have on an enemy's morale in actual combat, but his combat potential will certainly be substantially lowered.



A THREE-DIMENSIONAL ARMY!

BY BRIGADIER GENERAL EDWIN L. POWELL, JR.
DIRECTOR OF ARMY AVIATION, OACSFOR, DA

Another major problem of a potential aggressor to an airmobile force is the vulnerability of any daylight movement of trucks, tanks, or company-size or larger formations. The airmobile forces have so many *"eyes in the sky"* that any such movement will usually be detected and attacked within minutes – especially road travel. This capability complements and extends the efforts of the USAF to the degree that, in the daylight hours, the enemy, without significant loss, is unable to displace his artillery or move major portions of his troops, and may well be forced to make all major movements at night, including resupply.

An airmobile force, when used as the leading elements of an advance to contact, can cause an enemy force to deploy prematurely in the face of the early screening threat. The enemy commander is forced to speculate on the other's nearness, strength, and posture, not knowing whether the forces he is contacting represent the main thrust or merely a reconnaissance in force.

The simple fact that an airmobile division is within several hundred miles must continually be taken into consideration by the enemy commander, and he must continually devote certain of this resources to this potential threat. More so than the airborne divisions of World War II, the presence of this type force exerts a constant stress which will likely deteriorate and dilute enemy planning.

For example, in preparing himself for a possible air assault attack, an enemy commander might move more sophisticated anti-aircraft weapons unusually far forward, only to find that they were extremely vulnerable to other conventional forces which hit instead. He may be forced to devote unwarranted numbers of troops to protect his rear areas, thus weakening his forward elements to an unacceptable degree. He may even devote extensive effort to develop anti-helicopter airborne systems only to find these systems, in turn, extremely vulnerable to USAF aircraft. Many other examples of forcing an enemy off balance are obvious.

The preceding comments on the airmobile concept are meant to relate to last month's letter when I suggested we not focus

General William C. Westmoreland, Army Chief of Staff, addresses attendees at AAAA's Tenth Annual Honors Luncheon in Washington, D. C.

all of our future thinking on another Vietnam. If we are to be a truly *"three-dimensional Army,"* we must be able to adapt the Army to a wide variety of contingencies. This will largely lie in the imagination of the commander.

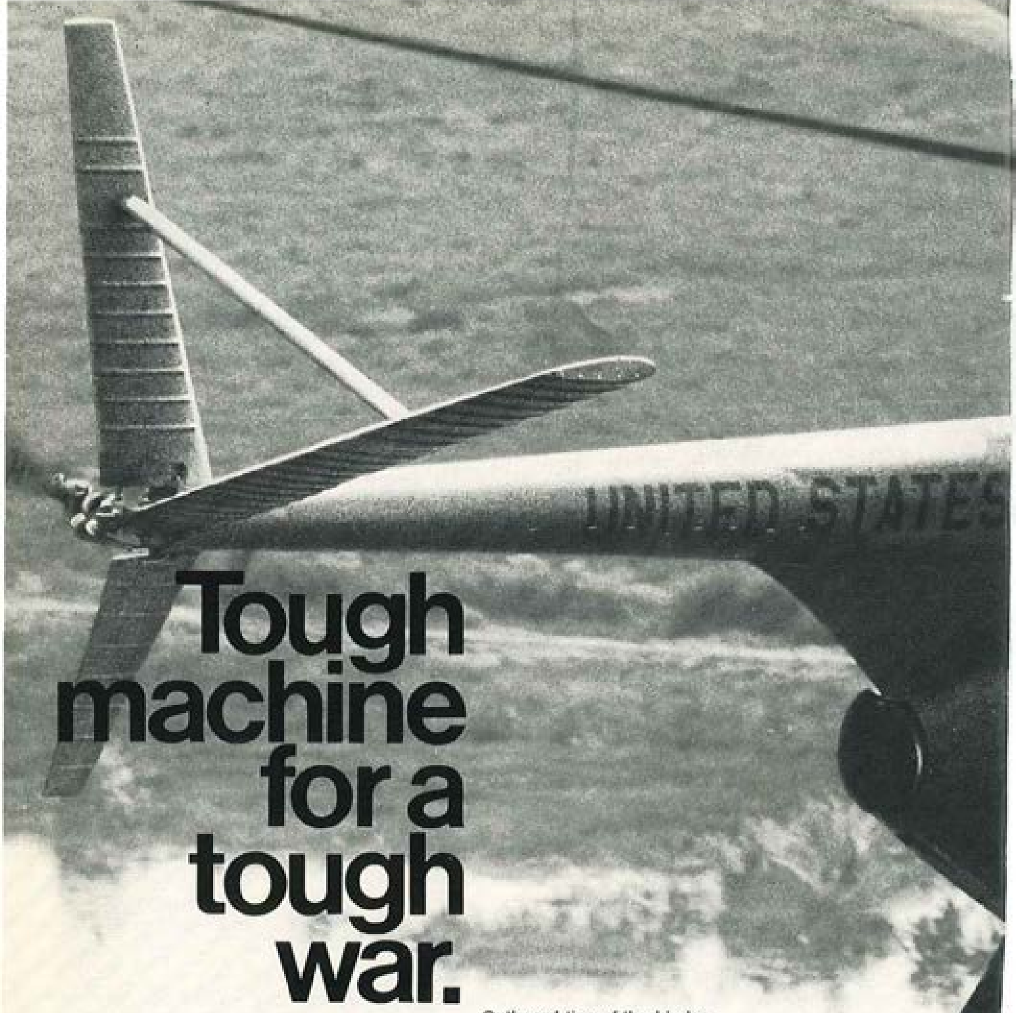
Non-aviation assignments

Turning from tactics to personnel, you will be interested to note that the increased number of aviators returning from short tour areas and the continuous improvement in the aviator inventory now makes it practical to resume non-aviation assignments for aviators Army wide.

In this regard, Department of the Army has advised all major commands that they are authorized and encouraged to assign commissioned officer aviators, regardless of grade, to other than aviation duties for career development purposes.

Further, DA has requested commanders to develop the widest possible opportunities for utilization of aviators in meaningful career broadening assignments in both branch material and branch immaterial positions consistent with local requirements for their use in authorized aviator positions.

This is a step forward which should encourage every officer aviator as to his long range professional career potential. There is no doubt that this action will allow the major commanders greater flexibility and the aviator more opportunities.



Tough machine for a tough war.

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Hughes Helicopters

General Howze to Lead AAAA in 1968-1969

General Kinnard – General Howze

INSTALLED in office at Washington, D.C. upon the conclusion of the Tenth Annual Meeting of AAAA, a new ten-member slate looks forward to its '68-'69 service starting with a quarterly meeting to be held in January at Fort Rucker, Ala.

General Hamilton H. Howze, USA (Ret.), was reelected as National President for a second term. The Bell Helicopter vice president was joined on the National Executive Board by new members *Colonel Clarence H. Ellis, Jr.*, Washington, D.C., as '68-'69 Secretary; *Colonel Robert R. Corey, Ret.*, Trumbull, Conn., Vice President for National Guard Affairs; and *Colonel E. Pearce Fleming, Jr., USA (Ret.)*, Atlanta, Ga., Vice President for Reserve Affairs.

Incumbent National Executive Board members who are completing normal three-year Board terms were elected to specific office as follows: *Lieutenant General Richard D. Meyer, USA (Ret.)*, Akron, Ohio, Senior Vice President; *Major General Delk M. Oden*, Fort Rucker, Ala., Treasurer; and *Brigadier General Allen M. Burdett, Jr.*, USARV, Vice President for Army Affairs.

Also, *Colonel Richard L. Long, USA (Ret.)*, Fairfield, Conn., Vice President for Industrial Affairs; *Eric H. Petersen*, Florissant, Mo., Vice President for Public Affairs; and *Anthony L. Rodes*, Washington, D.C., Vice President for Public Functions.

Arthur H. Kesten, Executive Vice President, an appointee; Past Presidents *Colonel Robert M. Leich*, Evansville, Ind.; *Bryce Wilson*, Glenbrook, Nev.; *Joseph E. McDonald, Jr.*, McLean, Va.; *Darwin P. Gerard*, Washington, D.C.; and *Brigadier General O. Glenn Goodhand, USA (Ret.)*, McLean, Va.; along with USAREUR Regional President *Colonel Kenneth D. Mertel*, fourteen CONUS Chapter Presidents, and approximately six to eight National Members-at-Large to be appointed by the President constitute the full executive board.

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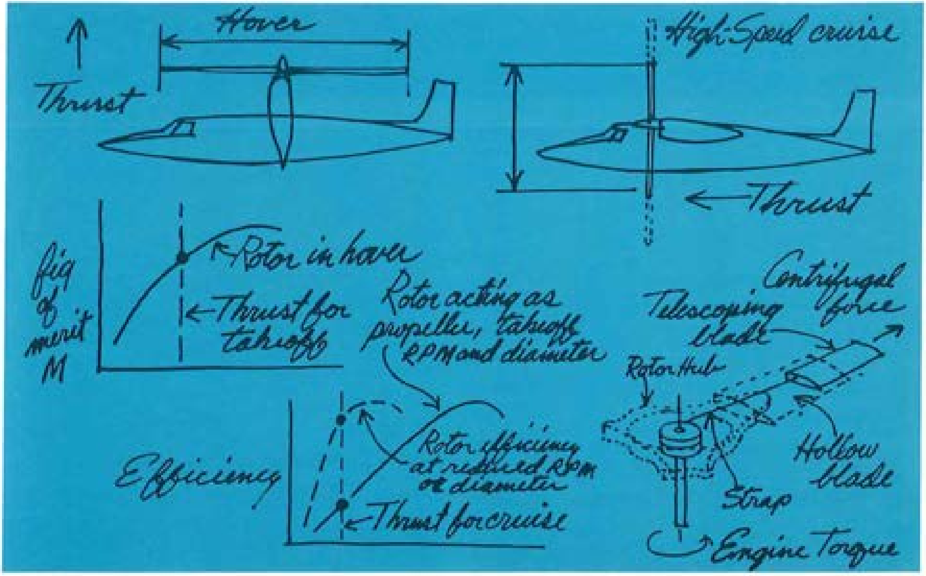

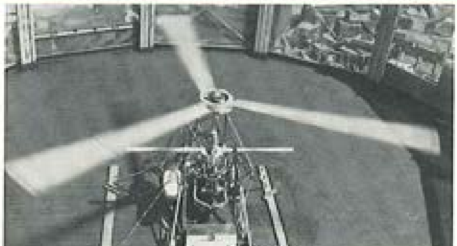

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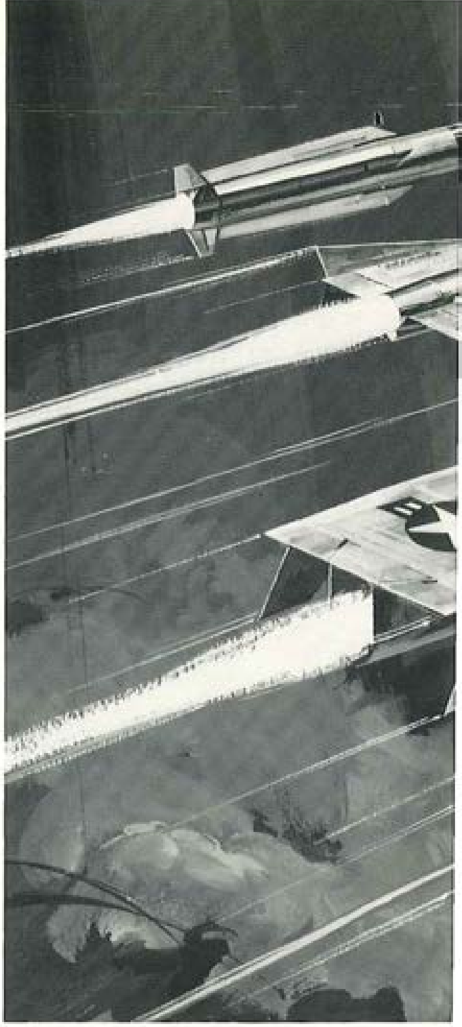

This Beech AQM-37A target missile is used as the test-bed for the first U.S. hybrid rocket propulsion system, developed by United Technology Center, Division of United Aircraft Corporation. During first tests the missile was sent to altitudes up to 80,000 feet, to speeds in excess of 2,000 mph and demonstrated its maneuverability at supersonic speeds – exactly as planned.

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VTOL IN THE USSR

Introduction by
LTG Harry W. O. Kinnard
Commanding General
U.S. Army
Combat Developments Command

■ *LTG KINNARD*: Good morning, gentlemen. We're going to do something highly unusual this morning on the last day of this AAAA Meeting. We're not going to start on time or late, but early. We're about a minute or two early, but I want to get going because after a breakfast meeting with this panel, it is quite clear to me that they have a fascinating presentation this morning. Second, it's very long. Third, it's going to call for many questions, and I want to be certain we have plenty of time for these.

That being true I'm not going to make an elongated introduction. I felt – and many others have felt – that it's most appropriate for us to tell what we know and what we are able to tell about the competition. I think many of us have been interested for many years in what the Russians are doing technically, operationally, and otherwise with respect to helicopters. The logical approach seemed to be to get the people who knew the most about the helicopters themselves.

General Kinnard

I would just pass on the definition of a competitor since *General Howze* yesterday gave us the definition of a teetotaler . . . "A competitor is a fellow who goes into a revolving door behind you and comes out ahead." (Laughter) . . . These people are not only going to tell us about the competition; they're going to tell us about how we can keep coming out ahead. *Mr. Lee Douglas* will take over as moderator at this point. Thank you, Lee.

Keynote Address by
Leon L. Douglas
Assistant General Manager
Boeing Vertol Division

■ *MR. DOUGLAS*: At *General Kinnard's* suggestion, we have brought together pilots and engineers who have flown or who have been associated with the design of Russian helicopters. You might ask, "*How do these people know so much about Russian helicopters? How come they can be experts in our competitive environment?*"

I might add that other than having the opportunity to fly Russian helicopters most of the panel members have had opportunities to discuss design and flight characteristics with the Russian engineers and pilots who, under the proper environment and circumstances, are quite free to discuss their approaches, their programs, their design objectives, and what they are looking forward to in the future.

General Kinnard has pointed out that our time limitation is such that we're going to try to make this crisp and short, and allow about a half hour for questions and answers at the end of the five short papers that will be presented by each of the panel members.

I'll start with the introduction of our first speaker, *Ralph Alex* . . .

NOTE: All addresses and presentations were transcribed from tape recordings made at the time of the Oct. 30 - Nov. 1 AAAA Annual Meeting in Washington, D.C.

VTOL IN THE USSR

A History of USSR VTOL

Ralph P. Alex
Chief, R & D Sales Applications
Sikorsky Aircraft Division

The Russians began their helicopter development back in the '30's, approximately the same time that we did. Having been with Sikorsky and in the industry for over a quarter of a century, and having been a part of the delivery of the first helicopter in the Western Hemisphere, I'm familiar with all of the offshoots of Sikorsky and a few of the others who began the rotary wing field here in this country.

They all say that Russia followed us and that they copied our designs. Well, maybe they did and maybe they didn't. With all of my contacts with them I don't think they copied them, but I think they were of the same caliber (as us at the time). For instance, *Igor Sikorsky* and *Tupolev* were in the same aero design stage way back in 1907, and when I was in Russia, *Tupolev* said, "Igor Sikorsky hasn't the same birth date as I have, because my birthday is today. I was his assistant, so he must be older!"

"Dedicated and devoted . . ."

This was the type of attitude they conveyed, and you felt that the type of people you met there in the aerospace industry, especially in the helicopter field, were as dedicated and devoted, and believed in the VTOL field as much as we did. With that, let's go into a slide presentation showing many of the typical models built in Russia from about 1950 on, and I'll try to describe some of the design features of these machines, what they are being used for, and what the Russian idea is for helicopter usage.

While on a visit, we were shown some of the museum pieces . . . the Mil-1 . . . which they had on exhibit in the Kharkov Institute, and this design had the typical three-bladed rotor and was an aircraft similar to our Sikorsky S-51, and you felt quite at home with it . . . similar design of transmission, power plant installation, etc. As a matter of fact, the whole machine was quite similar and when I came back to this country in 1959, everybody said they had copied our S-51's. The ship had three-blade friction dampers on the top, tapered blades, steel spar of the old Autogiro type and the type we started out with. All winterized with forward shutters on the engine; every Russian design from this one on was winterized so

The Mil-1

that it could operate in variable climates from day to day, and not by a kit to be put on for operation in a different latitude or climate.

They redesigned the Mil-1 into the Mil-2 which they called the V-2, and again this

Mil-2

was done in about 1958, when they began with turbines, and we started out about 1954 to build turbines, and whether they followed us or not, they built a family of turbines from 400 hp on up to 6,000 hp for their big machines.

The Mil-4 had an Aeroflot role. In the military role they built about 4,000 of these

Mil-4

machines. The ship is being produced in China, Finland, Poland, and in a few other of the Soviet bloc countries.

A photo (Page 16) shows the first public demonstrations of the Mil-6 beside the Mil-1. Incidentally, there are about 4,000 of the Mil-1 helicopters and these are used in their training programs for their National Guard type of instruction; they have about 800,000 students and with all of these helicopters, they're training a lot of pilots. Back about five years ago, they said they were training 4,000-5,000 a year.

They are purported to have built over 150 of the Mil-6 design with modifications. The wing of the Mil-6 is to partially unload the rotor, but the ship is still called a helicopter. They were shown at the Paris Air Show, were available for export, and can be bought by any country, including the U.S. They are making a concerted effort to sell this design to the Western World.

The military machine has rear ramps for loading up to 6 x 6 military trucks, and they can carry two in this machine. They do this on maneuvers, and I've seen films with 20 to 25 of these birds flying at one time. Later models have external tankage. One late model, with the external tankage removed, has flown 212 mph for a closed course speed record and it has lifted 2 metric tons. This two-turbine machine is similar to U.S. helicopters but is considerably larger.

Its interior cabin space is about 8 feet high and 8 feet wide, and is quite similar to the cross-section of the C-141. Its cockpit is quite clean, and one of our panel members will describe the cockpit display and the pilot's view of it. The ship's forward station can be used for the mounting of weapons.

The big one! . . . The Mil-10

There's the Crane, the Mil-10, a takeoff on the Mil-6. Today, it's at 6,500 hp per engine, and for a world's record it has lifted 55,000 lbs, or 27½ tons, to about 8,000 feet, and in the Mil-6 version, it has lifted 10,000 kilograms (22,000 lbs) to about 17,000 feet. This Crane has flown at about 218 mph. There is a long landing gear and short gear version; they want to use the latter in mining and in agriculture to carry heavy equipment in external loads, and the small tricycle gear saves them about 3½ to 4 tons.

The Kamov KA-15 which I flew has contra-rotating blades. The machine has fiberglass blades right now. On the Mil-8 they have aluminum spar blades similar to the U.S. The Kamov machines are a large family . . . he makes an agricultural machine and a small

Crane of about 8,000 gross. The Navy uses a 16,000 gross machine to carry weapons, and commercially, they're trying to sell it as an air taxi machine in Europe. It has a 51-foot rotor and two 1,500 hp turbines with automatic folding blades for shipboard use.

Some Mil-4's have larger diameter rotors, but with 5,000 hp turbo-prop engines that drive the rotors for vertical and hovering performance, the ship holds the world's record for convertiplanes at 227 mph. It has also lifted over 20 tons. The Yakovlev 24 when I was there was the big machine for commercial and air taxi transport.

(At this point, Mr. Alex presented a brief film on Russian helicopters, and added the following comments.)

While this movie is going on and you are seeing some of the operations of the Russian Crane, I would like to tell you just a little bit about what I have learned about their usage and ideas about the helicopter.

Military uses

The military want to carry and be completely airmobile. They want to carry Armor, Artillery, and everything that their Army needs, and that means that they want to build helicopters up to 40 and 50 ton payloads. As late as February of this year, I heard that they have a contra-rotating machine that is flying and is capable of carrying their medium tank. This machine grosses at about 250,000 and is flat rated at about 40,000 hp. It has 70,000 hp installed. I hope that we'll soon see pictures of it.

The commercial field

In the commercial field, they've been trying to get the Mil-6 into the field and the smaller Kamov designs for air taxi service, and they have not been too successful. They have 47 to 50 air terminals and places where they have helicopter service from city to city, and airport to the seashore summer resorts. They want to do a lot more of it for their railroads are sparse. Their development of the outlying districts and building of urban areas away from the present cities require big road complexes or will require more trains. In lieu of this, they expect to do this by helicopter. They have a very ambitious program; whether or not they will succeed, I don't know, but they feel that they want to lift every load so they are building the biggest machines they can, and they want their helicopters built for speeds which are economical, and they are flying at the 200+ mark now experimentally and state of the art-wise. They may be doing 200+ mph routinely sometime in the future.

Ralph P. Alex

The current Chief of Research and Development Marketing at Sikorsky Aircraft Division, Ralph Alex has been with Sikorsky since 1941. He's served as a project engineer, a senior production engineer, head of production components design, and assistant chief of aircraft design and development. The president of the International Helicopter Commission of the Federation Aeronautique Internationale (FAI), he has many opportunities to visit Russian installations and to meet with Russians under very favorable circumstances. He's one of several founders of the American Helicopter Society and has served twice as that organization's national president.

Anxious to export

The export market is a big thing with the Russians. They want to try to get their helicopters to be used universally in all of their Soviet bloc countries – like their aircraft – and they're also trying to build them for certification in the Western world. France now has representatives going back and forth to Russia, and they're trying to certificate their aircraft under the French Registration Board, and they feel that from there, they will then try to get it certificated for use in the U.S. . . . This is for the Mil-6 and the Mil-10; the Mil-8 is not in contention at the present time.

In crop-spraying and in their agriculture, they have over 1,500 helicopters. Some of these are involved in lifting heavy external loads, but this is mostly experimental at this time. With the big machines, they're doing a lot of mining exploration; they're sizing oil

A History of USSR VTOL by Ralph P. Alex

rigs to be carried by the Mil-6 and the Mil-10; and parallelling us in many, many ways in the development of the industrial, commercial, and military uses of the helicopter, and they seem to be succeeding in doing it on a larger scale and quicker than we.

To summarize, speed-wise they are flying at as high speeds as anything we have in the state of the art. The French have a 217 mph world speed record; the Russians with the Mil-6 are up to the 212 mph mark. They say that they have flown the Crane at 220 mph, but they haven't an approved official record of this. The Mil-8 has done 1,000-kilometer records that are quite impressive. The Mil-6 has flown for 621 miles in a closed course at 190 mph average, which is a very impressive record, and that with a payload of 5,000 kilograms.

In building their new turbine-powered family, they went to a twin configuration. *Mr. Mil* and *Mr. Kamov* both went to multi-engine so that they could fly and live with people in cities and land on roofs. They have the idea of huge heliports over the cities suspended on big towers with many helicopters servicing that area. Moscow is a city of over 7 million people and they feel that with the development of the outlying districts and no roads that the vertical transport over-the-top will be brought along in a very great way, and sooner than it will be in the U.S. where they are many other forms of transportation to compete with the helicopter. Commercially, their costs are lower and they are building a good machine for maintenance, and you'll hear more about this from the other panelists. Thank you very much.

Next Month

Detailed photographic coverage of the business and social sessions of the 1968 AAAA Annual Meeting will appear in December 31, 1968 issue of ARMY AVIATION MAGAZINE. The issue will also report upon the AAAA National Awards presented at the Tenth Annual Honors Luncheon.

RALPH ALEX IN KA-18 COCKPIT

YAK-24 CARRYING 4-TON TRUCK

RI

MIL-6 WITH MILITARY MARKINGS

M

MIL-10 WITH UNDERSLUNG BUS

KA-22 TWIN-TURBINE

KAMOV KA-25K TWIN-TURBINE

THE KAMOV KA-26

EX IN MIL-4 COCKPIT

MIL-1 (FOREGROUND) AND MIL-6

AN AEROFLOT MIL-6

H BOMBER-TYPE NOSE

REAR END VIEW OF MIL-8

ROTOR DETAIL OF THE MIL-10

MOV, ALEX, AND MIL

DON SEGNER, PHIL NORWINE, MIL-8

DR. MIL (CENTER) IN MIL-8

VTOL IN THE USSR

The Characteristics of the Mil-6

By Joseph Mashman
Vice President—Special Projects
Bell Helicopter Company

THE Mil-6 that I flew and evaluated on several occasions represented a considerable improvement in helicopter design and technology as compared to the Mil-1 and the Mil-4 that I had flown in previous years.

The most significant rates of improvement were in stability and control; cockpit design and instrumentation – which I thought was outstanding; emphasis on ease of maintenance, which included color-coding of fuel, oil, and hydraulic lines, quick disconnect fittings, access to fuel tanks and electronics; communications; and other areas that we, by our standards would consider important as far as ease of access.

The other area of improvement was emphasis on multi-mission capability which, as Ralph has indicated, includes armament potential. If you look carefully, you can see good, logical hard points throughout the aircraft exterior and in the interior, and as you'll see in the slides, in the nose of the aircraft.

The Russian design philosophy appears to continue to emphasize flat-rated power plant installations to assure adequate high altitude, hot weather operations, and also long periods between overhauls. Now, it's true that in the Mil-4, the ship had reciprocating power but then again, it emphasized flat-rating and it got its altitude performance in hot weather – it actually wasn't flat-rating – by way of a two-stage supercharger which gave it sea level performance up to about 17,000 to 18,000 feet.

Mil-6

The other design philosophy emphasis appears to be on all-weather flight capability and that includes a good autopilot; electric de-icing provisions for the main rotors and tail rotors and the engine air inlets, of course; built-in oxygen provisions for altitude if you have to get above the weather; the comforts provided the crew – to the pilots, in particular – I thought were outstanding. You have hydraulically-adjustable seats in three directions to reduce fatigue on long missions; the cabin heating and ventilation were excellent.

Detail and structural design appeared to be of the 1940-1950 period with comparatively little use of fiberglass and plastics. There was no evidence of bonded panels, etc.

Although there was no evidence of any breakthrough in helicopter design and technology, it is my considered opinion that the performance, handling characteristics, cockpit layout, and detailed design evidenced in this aircraft, class it with many of our present free world production helicopters.

The rotors of the Mil family of helicopters are characterized by their low rotor inertia, resulting in gust sensitivity and inferior autorotation capability. Autorotations were possible in this aircraft, but are not practiced due to limitations. These included being able to employ only a small percent of main rotor collective pitch during the final touchdown and then only for a short period of time while easing the cyclic forward to prevent the blades from contacting the tailboom.

Aircraft Description

This aircraft is normally operated by a flight crew consisting of pilot, co-pilot, flight engineer, radio operator, and navigator.

Crew compartment is entered via the main cabin. The engineer crew position is on the left and radio operator on the right. Pilot stations are on the same deck with command pilot position on left and co-pilot on right. An entrance below the center portion of the pilot's instrument panel provides access to the navigator compartment. This compartment has ample space for a seated occupant, with a total volume of approximately 30 cubic feet. An external hinged 4 foot by 3 foot door is provided on the right side of this compartment.

The visibility is excellent due to generous use of Plexiglas or its equivalent. The forward portion of this transparent enclosure includes a section of approximately 24 inches in diameter mounted in a structural framework similar in ruggedness to the Russian jet aircraft nose designs. It can be surmised that this panel is designed to be removed to permit the installation of special purpose equipment. The main cabin has provisions for seating approximately 65 persons. These seats run parallel to the fuselage and were not equipped with safety belts. There are provisions to accommodate 40 litters.

The pilot's instrument panel and controls were in general conventional by our standards and required similar procedures for operation.

Detailed Information

(1) Complete IFR flight instruments for pilot and co-pilot.

(2) Four axis auto-pilot with side arm controller located on forward end of right arm rest on command pilot seat. This arm rest swings up to vertical position when not in use. Auto-pilot is used primarily for cross country flight and is not necessary during take-off, landing and general maneuvering due to the apparent adequate inherent stability of the aircraft.

(3) Instrumentation presentation similar to western design providing similar form of flight information, powerplant monitoring, etc.

(4) Co-pilot has auxiliary instrument panel which comprises additional powerplant instruments (2″ dial size) that are normally

Segner, Mil, Mashman.

covered by a hinged 6″ x 12″ oval metal shield. It can be assumed that this panel is utilized in the event the engineer leaves his station. The shield covered the instruments during the evaluation flight, *but* was disclosed upon requst.

(5) Built-in oxygen provisions (pressure demand type) at all crew stations.

(6) Convex sliding side windows at pilot and co-pilot stations permitting good downward and rearward visibility. These approximate 24 inch by 30 inch long windows are equipped with explosive-type jettison devices actuated by a cylindrical release located on upper forward portion of each window frame.

(7) Hydraulic-powered individual windshield wipers are provided for pilot and co-pilot windshields, controls of which are located on the outboard portion of instrument panels.

(8) Electrical de-icing is provided for the main rotor and tail rotor blades as well as crew windshields, and engine air inlets.

(9) Fuel management instruments (quantity and fuel flow, etc.) are identified by a circular ½ inch diameter yellow symbol painted on instrument glass. *Note*: Exposed fuel lines in engine compartment and elsewhere are color coded in yellow.

(10) Cabin heating throughout the aircraft is provided by an engine tail pipe muff installation.

(11) External cargo is suspended by a unique four-point cable mounting from the main cabin upper structure. The four cables come together approximately mid-point between the ceiling and cabin floor. A single

cable and cargo hook is suspended from this point. This in effect results in a vertical and lateral center of gravity cargo suspension similar in principle to the Bell HU-1 series helicopters.

(12) Collective and rotor brake controls emerging from the floor move in an arc through a brush type barrier to prevent foreign objects from dropping into linkage.

(13) Access to main powerplants is by means of roof hatch situated in cabin area between the engineer and radio operator stations.

(14) Engine cowling is opened by hydraulic actuators and provides a work deck the full length of powerplants and approximately four feet wide.

(15) The rotor controls are operated by three completely separate and independent hydraulic boost systems. A hydraulic accumulator or supplementary boost source was apparent by virtue of being able to operate numerous hydraulic powered installations when the aircraft engines were shut down.

(16) The twin power plants produce 5,-500 horsepower each and are flat rated to approximately 10,000 feet under standard temperature conditions. They are capable of producing 7,000 hp each under emergency conditions. The main transmission is designed for this contingency power rating. The power plants have individual inputs to the main transmission. This transmission includes a four stage planetary as well as a spiral bevel system.

Flight Procedures

(1) Engine starting procedure was initiated by the engineer upon command of the pilot. Both engines were started within an approximate period of one minute. Collective pitch situated to left of pilot seats operated the main fuel valve by conventional twisting of the cylindrical hand grip.

(2) A rotor brake handle emerges from the floor to the right of the pilot's seat. A micro switch is actuated when rotor brake is in full forward (brake released) position. This feature prevents the fuel control from being advanced beyond ground idle position unless rotor brake is released.

(3) Upon releasing rotor brake and accelerating engines, a moderate form of pylon whirling frequency was encountered at what appeared to be 25% to 30% of normal rotor operating R.P.M. The 105 foot diameter rotor operates at 120 R.P.M.

(4) The cockpit check prior to take-off appeared to be very nominal.

(5) Taxiing was accomplished by use of cyclic and anti-torque controls utilizing "British type" of cyclic handle type brake control with foot pressure on anti-torque pedals selecting the wheel to be braked and cyclic hand lever pressure controlling the degree of braking action. Taxiing prior to take-off involved a sharp 180° turn with pilot employing approximately 30% to 40% of left pedal while braking to achieve an approximate 60° or more per second turn rate. There was a noticeable lateral "G" acceleration experienced due to the combination of high turn rate and distance of pilot's compartment from pivot point of the turn.

(6) The take-off was rather abrupt with the pilot hovering only momentarily and immediately accelerating to forward flight with an approximate four to five inch forward movement of the cyclic stick.

(7) During the flight, lateral cyclic stick

Joseph Mashman

The Vice President — Special Projects and member of the corporate staff of Textron's Bell Helicopter Company, Mashman is one of the foremost helicopter experts and has demonstrated rotary wing equipment throughout the world. With approximately 16,000 flight hours, of which over 11,000 have been in helicopters, he remains active as one of the corporation's test pilots, a responsibility he has maintained since joining Bell in 1943. Tagged "Joe Helicopter" by a magazine writer, Mashman has flown high ranking military officers, U.S. cabinet members, foreign presidents, and President Lyndon B. Johnson in flying on five continents.

AAAA INDUSTRY PANEL

The "Rotary Wing in the USSR" Panel at the AAAA's Tenth Annual Meeting in Washington, D.C., included from left to right, Clyde A. Davenport, Donald R. Segner, Ralph P. Alex, LTG Harry W. O. Kinnard (Programming Chairmen), Leon L. Douglas (Moderator), Joseph Mashman, and Leonard J. LaVassar.

displacements of approximately 2 inches produced roll rates of approximately 30 degrees per second.

(8) The auto-pilot was not employed during this flight. The over-all stability and control response appeared to be adequate.

(9) Cockpit vibrations were confined to a moderate main rotor five per rev which peaked during transition through translational speed, and continued to reduce in intensity above 90 knots. The vibration was at its lowest level at cruising speed of 130 knots, and acceptable at the max speed of 155 knots.

(10) During the entire flight, the cockpit noise and vibration levels were considered to be quite acceptable. Cockpit visibility and over-all general ease of handling also appeared to be acceptable. The transition from forward flight to hovering was accomplished in a normal manner with a high amplitude soft peak five per rev main rotor vibration as the aircraft decelerated through translational speed. A normal touchdown was accomplished and the powerplants were shut down within ten to fifteen seconds.

Improved Version

On a more recent occasion an opportunity presented itself to fly a Mil-6 helicopter

By Joseph Mashman
Vice President—Special Projects

with an up-dated cockpit configuration. This included: (1) A single pilot capability of starting and operating the aircraft, and (2) An improved automatic stability system.

The aircraft was estimated to be at approximately 70,000 pounds gross weight at take-off. The aircraft cruised at an indicated speed of 250 kilometers per hour while employing 60% engine torque and with the main rotor collective pitch at a 7° setting. Moderate to steep turns were conducted at indicated air speeds of 230 kilometers per hour to 260 kilometers per hour. The aircraft stability and controllability appeared to be good and quite comparable to our own large single rotor helicopters.

I'll sort of sum it up, and I'll be reading something that Ralph said, but the performance of the aircraft, as far as the loads it can carry, are indicated by some of the records the ships holds and, of course, when you establish a record, you are pushing all out on the aircraft, but even back in 1959, they carried loads as heavy as 22,000 lbs up to an altitude of 17,000 feet, and 45,000 lbs. roughly up to about 10,000 feet, and at speeds of 170 knots for a closed course record of 100 kilometers and this was established back in 1964.

I have a few slides that I'll go through very quickly . . . It all started – that is my being invited to fly Russian helicopters – when we were at the Paris Air Show in 1965 with a *Huey* and I took it upon myself to invite *Dr. Mil*, who happened to be walking around the aircraft, for a ride in the machine. As a result of that, he invited me to fly in the various aircraft that he had there. His people were very congenial and they answered all of the questions I had pertaining to the aircraft; I didn't ask any tactical questions. I checked out about five of their pilots, that is, I let them fly our aircraft.

Rotor system reversed

(My Mashman's commentary then turned to the slides being shown). That's the tail rotor system . . . For our Bell engineers, note that it's on the side that we don't use . . . (Laughter) . . . This is the cockpit of the Mil-6; the pilot's station is on the left. In '67 the autopilot was integrated right into the control system. Up forward there, you can see that heavy structure which could very well be used for reasons other than navigation. Ordinarily that's the navigator's position up front. The most recent model that I flew was a one man operated machine; the pilot can do everything, start the engines, run it up, takeoff, fly, land.

This slide happens to be the Mil-10. Note the overhead console and that everything is readily available. It's all color-coded; the instruments are even color-coded . . . That's a close-up of the nose with the structure that you see is capable of mounting equipment. You'll also see a similar nose on some of their early jet transports which were combination military and commercial transports . . .

Ruggedness cited

As an indication of the ruggedness of the aircraft, let me relate that on one particular day a number of us were invited to fly in the Mil-6. There was a Mil-6 and a Mil-10 running up alongside of one another; actually the Mil-10 was taxiing by the Mil-6 as it was running up and the blades sort of intermeshed a little bit. They just very calmly flew the ship the next day again. They couldn't get spare blades so they just took the blade tips off in the first pocket, and they put on a darn good show with the reduced diameter rotor system.

The pilots I met were very personable men; they spoke reasonably good English and didn't require an interpreter around us; they were excellent pilots and from an engineering standpoint, they were excellent engineers as far as what little engineering conversation we carried on.

After the exchange of rides and towards the end of the Air Show, through the efforts of *Harry Pack* (Boeing Vertol) who was very instrumental in getting the U.S. and the Russian representatives together, *Dr. Mil* threw a luncheon for all of us in a chalet with typical vodka toasts . . . That concludes my presentation.

VTOL IN THE USSR

The Characteristics of the Mil-8

By Donald R. Segner
Engineering Test Pilot
Lockheed-California Company

MY first contact with the Soviet built Mi-8 was in Paris in June of 1965. During this period an invitation was extended by Dr. Mil to examine and fly his Mi-8. This occasion led to subsequent meetings with his engineers and test pilots.

The Soviet personnel openly discussed all their aircraft in detail and their operational capabilities related to civil application in the Soviet Union. This report is based upon experiences gained from these contacts.

The Mi-8 was designed as a replacement for the Mi-4 which at the time was the basic helicopter in production during the late 1950's and early 1960's.

First shown in 1961

The Mi-8 had its first public appearance at the *Soviet Day Air Show* in 1961. The original prototype was a single-engine turbo-powered helicopter with a 4-bladed main rotor. This engine was rated at 2,700 SHP

Mil-8

and the cabin was designed for both passenger and cargo missions.

I feel that the original main rotor, tail rotor, and their drive components were modified Mi-4 systems. Subsequently, the single powerplant design was replaced with the now standard arrangement of two 1,500 SHP Isotov TB-2-117 turbine engines. This design was first displayed in 1962. In 1964, a 5-bladed main rotor system was developed and is now the standard Mi-8 rotor configuration.

In 1965, the Mi-8 was displayed outside the Soviet Union in Aeroflot markings. This particular aircraft was one of three prototypes flying at that time. The helicopter is now in service with Aeroflot and appeared in military markings in 1967.

The Mi-8 is about half the physical size of the Mi-6 and Mi-10 helicopters. The fully-articulated main rotor is just under 70 feet in diameter with the 3-bladed tail rotor approximately 12½ feet from tip to tip.

Both the main and tail rotors are equipped with electrical de-icing systems. The fuselage external length is 60 feet, ¾-inches with an overall height of 18 feet, 4½-inches. With the rotors turning the overall length is just under 83 feet.

Empty weight varies with the configuration. The 28-passenger version (Fig. 2) is reported to have an empty weight of 16,352 lbs. while the cargo version weighs out at 15,787 lbs. Internal cabin dimensions vary slightly in length with the cargo version reduced to 17½ feet in length from the passenger version which is approximately 21 feet. The difference is accounted for by the 6 ft. by 7 ft., 8-inch rear loading cargo door.

I found the passenger version to be very stylish and comfortable (Fig. 3). The 7 ft.,

Fig. 3

The devastating look of Cheyenne

Cheyenne's pilot can focus devastating firepower where he looks. With armament slaved to the movement of his head, he can accurately direct a veritable hail of fire.

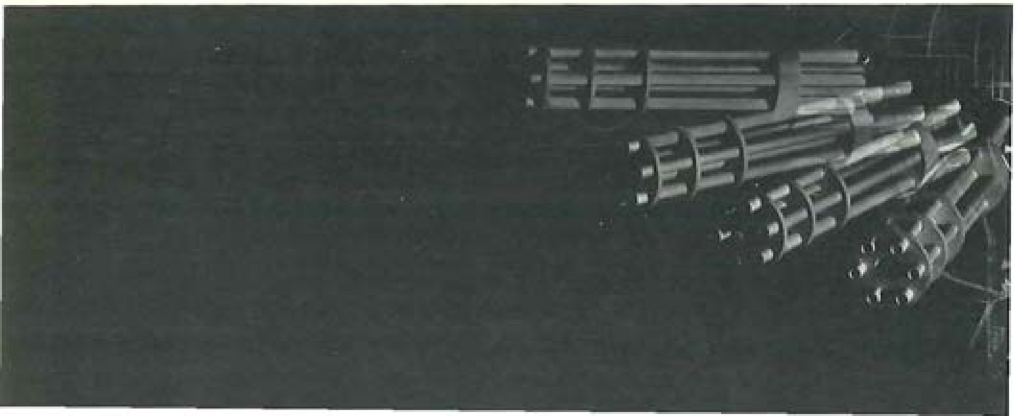
The Army needs a specialized armed escort vehicle capable of efficiently protecting heliborne assault columns en route, suppressing hostile fire at landing sites, and directly supporting engaged troops.

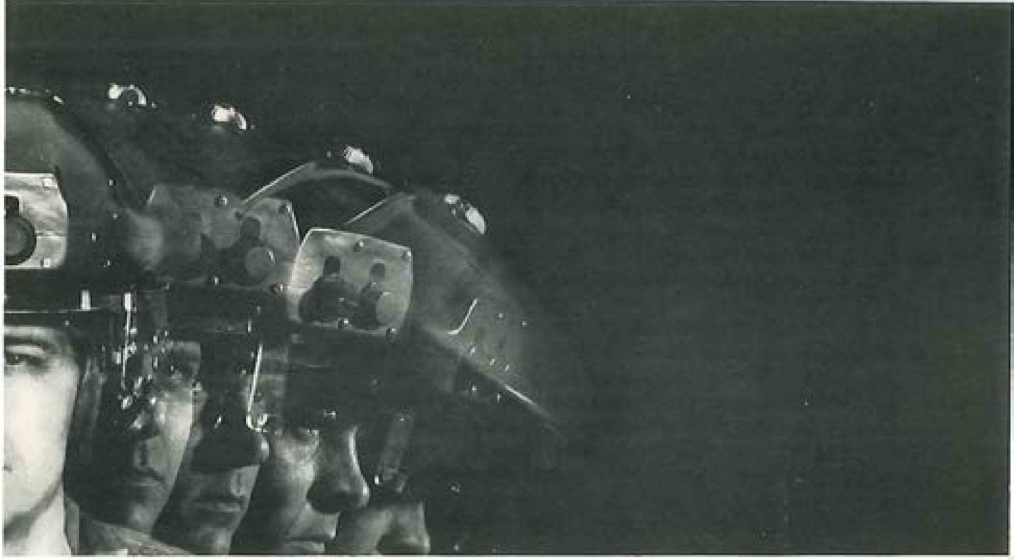
The Rigid Rotor compound AH-56A is Lockheed's response to that need.

Cheyenne is more stable, more maneuverable and much faster than any previous Army rotorcraft. And armed to the teeth.

Readily interchangeable nose turret assemblies house a 40mm grenade launcher or a 6,000 round-per-minute 7.62mm Minigun. A 30mm light point weapon is mounted in the belly turret. Cheyenne can carry up to 12,000 pounds of external armament stores (including TOW missiles and 2.75 inch FFARs), pod-mounted on wing and fuselage pylons.

Cheyenne's swivelling co-pilot/gunner's station rotates through 360°, and either or both armament turrets can be slaved to its motion. It is equipped with an open sight and a periscopic optical sight with selectable degrees of magnification up to 12X.





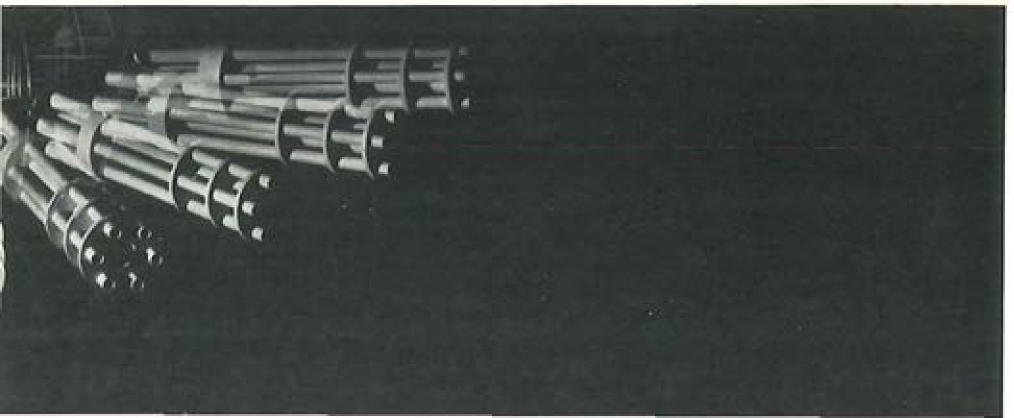
Sighting data is fed into Cheyenne's central computer. Additional inputs from Cheyenne's doppler radar system, inertial platform and laser range finder inform the computer of windage, vehicle attitude and speed, and target range and motion. Together with ballistics data stored in the memory core, these inputs enable Cheyenne's computer to maximize firing accuracy.

Under an Army contract, ten prototype AH-56A Cheyennes have been built at Lockheed-California Company's Van Nuys facility. Preparation for large scale production of Cheyenne is under way.

The proven ability to understand present mission requirements and anticipate future ones, coupled with technological competence, enables Lockheed to respond to the needs of this nation in a divided world.

LOCKHEED

LOCKHEED AIRCRAFT CORPORATION



The Characteristics of the Mil-8
By Donald R. Segner

2½-inch cabin width by 5 ft., 11½-inch cabin height gave ample room for the 2 x 2 – four seats in a row – seating arrangement. The cabin area was well sound proofed and had a very low vibration level with excellent passenger visibility. Boarding is accomplished from the left forward portion of the cabin.

The Mi-8 flown also had a galley, a bar with stewardesses, and Vodka along with an air conditioner which is an optional feature on the Mi-8. Total cargo volume is 812 cubic feet.

The passenger version is convertible into an ambulance which can accommodate 12 stretchers and a seat for a medical attendant. The helicopter has a removable external hoist and an external sling system capable of lifting 5,510 lbs.

Takeoff and payload data

Normal takeoff weight is 24,470 lbs. with a vertical takeoff capability up to 26,455 lbs. With sling loads the overload gross weight is reduced to 25,195 lbs.

As can be seen from these figures, the Mi-8 has about doubled the payload capacity over the Mi-4; however, it is obvious that the empty weight is somewhat higher than expected in U.S. designs of comparable capabilities. The performance for the installed power and rotor size is also somewhat lower than what is achieved in U.S. designs. The hover ceiling at takeoff gross weight is only 4,330 feet in Ground Effect while the Hover Out of Ground Effect ceiling is nil. This, of course, must be compensated for with reduced useful loads, range or both.

The Mi-8's normal fuel system consists of a smaller internal fuel tank with a capacity of 763 lbs., plus two external fuel tanks mounted in the sponsons on each side (Fig. 3) for a total fuel capacity of 2,433 lbs. The internal mounted ferry tank increases the capacity by 1,565 lbs. which adds 140 miles to the normal range capability of 244 miles with 28 passengers on board.

Level flight speed is red lined at 230 KM/Hr. or 143 mph with a normal cruise speed of 124 mph. I found that above 124 mph the pilots' cabin vibration increased rapidly. At the light weight at which we were flying I was permitted to fly out to 260 Km/Hr. or 160 mph. Here I found the vibration to be exceedingly high.

Crew, cockpit, and controls

The crew of the Mi-8 consists of three members. The pilot occupies the left seat with his co-pilot in the right seat and flight engineer sitting between and behind both. Visibility and cockpit roominess were exceedingly good. I found the cabin arrangement and visibility better than any of a comparable class that I have flown. Visibility in all directions was excellent.

The pilot and co-pilot's consoles are separately mounted on an inverted U-shaped structure in front of both the pilot and co-pilot. The instrumentation was adequate although somewhat behind our standards. The arrangement was similar on both panels with the pilot have the necessary flight navigation and power instruments. The co-pilot panel, shown here in Fig. 5, had additional system

Fig. 5

monitoring gages. An annunciator warning panel was large and easily seen. The overhead console contained all the auxiliary systems and radio controls, leaving a clean floor area between the pilots. Night lighting was the older post lighting type.

The controls were the conventional collective and cyclic, with the control system being boosted by two independent hydraulic systems of 640 to 925 psi capacity. The

Above: Full view of the Mil-8 helicopter

electrical system consists of a DC electrical supplied from two 18 K-watt starter generators and six storage batteries. AC for the deicing system and some radio equipment is supplied by a single 30 KVA generator.

The navigation system appeared to be basically ADF homing and possibly a VOR RMI type of homer. The radio altimeter was of the vintage used in the Korean episode and, in fact, the antennae located on the aft tail cone were identical to those used on earlier U.S. aircraft in Korea.

The Mi-8 was equipped with an Automatic Stabilizer System with an attitude hold feature. The operation and characteristics were very similar to those used on the Sikorsky Navy H-34's. The system incorporated a turn rate function and autopilot disconnect on the cyclic stick. With the ASE operating the stability and control felt good with the lateral axis somewhat weak and easily overcontrolled.

The wheel brake system was a single lever on the cyclic control used with the right hand so familiar in World War II British aircraft. It operates on both main wheels with all directional maneuvering accomplished by tail rotor control.

Good, rugged, and reliable . . .

From an overall aspect, I found the Mi-8 to be a very comfortable helicopter to fly. The performance was disappointing to me for the installed power; however, the increased empty weight factor was explained to me as necessary for a good, rugged, and reliable aircraft. As one of their pilots put it, "*Have you ever flown in Siberia?*"

Donald R. Segner

A veteran of the U.S. Marine Corps with service from 1943 through 1962, Don Segner has been with the Lockheed Aircraft Corporation since retirement. Involved in Lockheed's VTOL, fixed wing, and rigid rotor R & D flight tests, he's a past president of the Society of Experimental Test Pilots. He currently is the Project Test Pilot for the U.S. Army AH-56A Cheyenne aircraft.

VTOL IN THE USSR

Russian Helicopters from the Commercial Operator's View

By Clyde A. Davenport
General Manager, Com'l Opns
Petroleum Helicopter, Inc.

PETROLEUM Helicopters recognized some years ago that one day a major area for the application of the helicopter would be in the heavy lift field. The time is now!

A European consortium, recognizing the leadership of PHI in the commercial helicopter field, and interested in the exploration for petroleum and minerals in South America, Africa, and other areas of the world, contracted with PHI to evaluate the capacity and practical potentialities of the Mil-8 and Mil-10 helicopters.

Bear in mind that, since the use of V/STOL equipment by commercial operators is primarily in underdeveloped areas and is done under contract with demanding clients, it behooves the operator to look for certain qualities and characteristics in the equipment he purchases. Some of these desired qualities and characteristics are:

1. *Versatility*. The client normally has many tons of material and equipment in assorted sizes, shapes, and densities to be transported. The variety of the loads requires a great deal of versatility and the Mil-10 fulfills this requirement admirably. Its high quadricycle gear, external cargo platform with cargo platform attachment system, and external sling equipment give it a load-carrying capability difficult to match.

2. *Reliability*. The client wants his equipment transported from an infrequently serviced base camp, by helicopter, to an otherwise inaccessible spot somewhere within a 100-mile radius. This means that the operator, in order to maintain continuity of service, must either have an inordinate amount of spare parts on hand in the immediate area, or have an extremely reliable vehicle assigned to the job. *Reliability* is the answer here. The Mil-10 has far exceeded our expectations in this area. The maintenance manhour per flight hour ratio is exceptionally low. Nonscheduled maintenance has been practically nil.

3. *Self-Sufficiency*. In spite of constant and thorough planning, situations arise on these remote operations where the helicopter, for assorted reasons, may have to be shut down or serviced away from the Base Camp. Therefore, the helicopter should be capable of operating independently of airfield support equipment. Independence requires self-sufficiency and the Mil-10 has a lot of built-in independence.

In addition to the installed pressure refueling system, it has an on-board pump and filter system by which it can refuel from drums or other containers at the rate of 110 gallons per minute. The turbo-generator can be used as the power source for the on-board refueling system, the electric pumps for the main and auxiliary hydraulic systems, engine starting, and for ground checks within these and any of the other electrical systems.

4. *Economic Feasibility*. As you are aware, we have subjected the Mil-8 and the Mil-10 to extensive and prolonged testing and evaluation. Naturally, we do not intend to divulge the fruits of our labor; however, taking into account the fact that the initial cost is *less* than the cost of comparable equipment,

Clyde "Dave" Davenport

Joining Petroleum Helicopters, Inc., in 1954, Clyde A. "Dave" Davenport has had the opportunity to engage actively in the operation of various types of helicopters in the U.S., South America, Canada, and Greenland. As the manager of the company's project for the evaluation of the Mil-8 and Mil-10, he is directly concerned with the introduction of these aircraft into commercial operations. A bear for work, he keeps the company's 139 aircraft airborne for many clients.

that operating costs are on a par with comparable equipment, and looking at the (favorable) tons per hour graph, it is obvious that the Mil-10 is very competitive in the heavy lift field.

This combination of desirable characteristics does not come entirely free of charge. Versatility in the Mil-10 costs the additional weight of the high landing gear and hydraulic gripper system.

Reliability also costs, to a certain degree, in weight, and, to a degree, in flying qualities. A good example here is in what is, by our standards, a heavy fuel control lacking Nf governing. This, in turn, precludes those maneuvers that require rapid changes from low to high power settings.

The major obstacles . . .

The major obsacles to the use of the Mil-8 and Mil-10 in the United States are in the legal area. It apears that FAA regulations, for the foreseeable future, will prevent anything other than experimental certification. This will preclude any commercial usage of a remunerative nature.

The Mil-8, in the main, follows the same pattern as the Mil-10, as far as versatility and reliability are concerned. In addition to normal passenger-carrying and external sling capability, the Mil-8 has clamshell doors at the rear of the main cabin, providing a rear loading feature.

It is a more sophisticated machine than the Mil-10 in most respects. Nf governing and load sharing are incorporated in the fuel control system and the magnetic brake-type stick trim in the Mil-8 is quite an improvement over the motor-type trim in the Mil-10.

Successful competition against other commercial helicopter operators requires that an operator scan the world for equipment. On balance, we feel that the assets of the Russian helicopters far outweigh their liabilities. We welcome this additional choice of equipment afforded by the Russian manufacturers.

VTOL IN THE USSR

The Characteristics of the Mil-10

By Leonard J. LaVassar
Chief Test Pilot
Boeing Vertol Division

DESIGNED by Dr. M. L. Mil, the Soviet Mil-10 crane helicopter exploits the Mil-6 engines and dynamic system through installation in a modified crane fuselage. The time period when the aircraft was designed and initially flown is obscured by the usual Soviet reticence to publicize new models. However, it appears that the vehicle had completed its initial development testing in the 1957-1958 time span. Initial notoriety of the Mil-10 was presented in a Soviet flight magazine.

In October, 1957, it was reported that a courageous Soviet pilot had lifted a maximum load of 26,409 lbs. to an altitude of 6,560 feet. Although specifying that this was accomplished with the Mil-6, accompanying photographs clearly pertained to the Mil-10 flying crane. Soviet accounts have occasionally failed to differentiate between the basic Mil-6 and the Mil-10.

The aircraft was demonstrated at Tushino Airport in 1961 carrying a portable house and transporting other bulky, low density external loads. It is speculated that the initial development of the Mil-10 was predicated on a requirement for transporting military equipment, particularly empty liquid fueled missiles.

For reference, the length of the Mil-10 is 137′5″ and the overall height at the main rotor hub is 32′5″ with a ground clearance to the underside of the fuselage of 12′9″. (See Figure 1 for silhouete comparisons with our CH-47 and CH-54.)

The Mil-10 is a single-rotored configuration powered by two free turbine engines.

The Characteristics of the Mil-10
By Leonard J. LaVassar

These laterally-positioned engines drive aft to the main transmission. At this location the power turbine input shaft speed reduction ratio is 69.2 resulting is a normal vertical shaft speed of about 120 rpm. Torque from the power turbines of each engine drive two bevel gears of the transmission first stage; accordingly the gear box is provided with a differentially equalized mechanism which distributes the torque received from each engine to the two driving bevel gears. The transmission second stage utilizes four spur gears, two transmitting the torque to one large gear train and the other two stages of the transmission presenting a closed differential mechanism consisting of planetary stage and gear train drive.

The main transmission is lubricated by a forced pump system and also by a splash-type system. Lubrication is fed to all bearings and gears by complicated internal passages. Two free wheeling clutches on the engine input shaft are installed to permit transmission overrun during one engine out or power off operation.

Positioned at the base of the aft pylon is the intermediate transmission between the primary and the tail rotor transmission. The input shaft rotates at 2,065 rpm with a reduction ratio of .9714 resulting in a tail rotor rpm of 678.

The aircraft is equipped with a quadricycle landing gear, each gear utilizing oleo-pneumatic shock absorbers and dual wheels. Referenced model included equal gear tread for the fore and aft wheels of approximately 25 feet. During the initial notoriety accorded this aircraft a platform was positioned beneath the fuselage and attached at each gear slightly above wheel height. Several photos were released disclosing the capability of the vehicle to taxi over large loads and take advantage of ground effect for vertical liftoff or forward speed runs as a STOL to improve payload capability.

Although the Mil-10 was intended to perform the crane mission other capabilities have been compromised but not neglected. The aircraft features an internal cargo compartment of 46′ in length, 8′2″ wide and 5′6″ high with provisions for 28 troops. A more contemporary version of the Mil-10 aircraft was displayed at the Paris Air Show in 1967 (Figure 2). The forward wheel tread has been reduced to 19′10″. A pilot/observer greenhouse-type compartment has been configured at the underside of the fuselage below the cockpit area. This rear-facing seat with conventionally positioned stick, yaw pedal, and thrust lever is added to provide an external load visibility and precision positioning of the aircraft relative to an external load. The rear facing external load observation compartment is accessible in flight.

Flight Testing

The methods of substantiating the structural integrity of the dynamic system of the Mil-10 in flight testing is similar although apparently less stringent than current American techniques. The structural tests of all Soviet helicopter main components include:

(1) Measurements of loads applied to the critical components during all possible flight conditions.

(2) Laboratory structural tests of these components that simulate the in-flight loads and determination of their static or fatigue strength.

(3) Comparison of in-flight loads with component strength determined when testing. In this case both fatigue and static strength must be higher than the applied loads by a given and higher value called a safety factor or safety margin.

A typical flight plan profile for stress measurement tests includes hovering in ground effect, acceleration to 80 km, climb to approximately 3,000 feet, acceleration to maximum level flight speed, partial power descents, autorotation, and deceleration to hover and touch down.

Load and stress measurements are generally accomplished up to 3,000 feet. It is claimed that the in-flight loads measured at the higher altitudes at identical speeds are similar to those encountered at 1,000 feet.

In flight tests the following helicopter components are instrumental for in-flight loads and stresses. The main rotor blade, the hub, the swashplate assembly, the main transmission, tail rotor blade, tail rotor transmission, tail boom, pylon, and stabilizer, and engines supports and landing gear.

The main rotor spar is unique in design featuring a steel tubular spar of variable spanwise sections. At the blade tip the spar through two prior form variations is elliptical to prove additions chordwise rigidity.

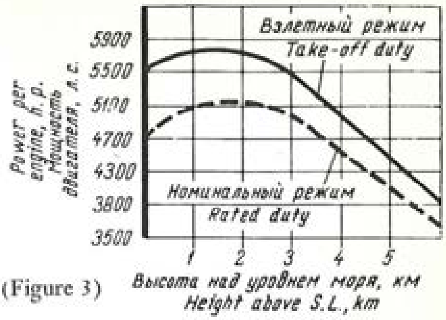
We've made a plot that can be interpreted as a representation of the fuselage vibration level. The "hump" through the 20 to 60 km speed band accurately portrays the heavy transition vibration peak experienced on occasion by passengers and pilots who have flown the aircraft. Russian pilots when demonstrating the vehicle accelerate through the critical low speed band to top off these peaks and minimize the aircraft and passenger exposure to this undesirable environment. The aircraft is judged to be unacceptable from a vibration viewpoint above 120 knots.

Another plot identifies the main rotor shaft vibratory stress amplitude versus forward velocity for various c.g. positions. The aircraft has a c.g. range from −7.88 aft to +9.84" fwd. The aircraft would possilby be flight limited at the forward c.g. in consideration of the relatively high rotor shaft bending.

Another plot is unique in that it not only identifies the Vmax speed vs Altitude, but also the Vmim/Altitude, which is something we don't have. As you can see, the plot displays a minimum speed vs altitude, which shows zero airspeed at ground level, and the aircraft is then limited to about 90 kilometers at 500 meters (or about 1,500 feet), progressing upward as you increase in altitude, which narrows the speed band or the available speed at which the pilot can maneuver the aircraft.

Power versus altitude

A plot of power available versus altitude (Figure 3) very well substantiates Joe Mashman's comments. The Soloviev engine will develop 5,500 hp at sea level and this builds up to about 5,750 hp at about 4,500 ft. and it falls off to intersect the 5,500 hp line at about 3,000 meters, or 10,000 feet. A lower



(Figure 3)

plot shows the tremendous power available the engine can develop versus ambient air temperature displaying that at sea level it can develop 5,500 hp up to 40° C.

A plot of hovering ceiling out-of-ground effect shows the takeoff weight and resultant useful load of cargo and fuel. The curve between sea level to 1,000 meters (3,000 feet) is nearly vertical. The maximum takeoff weight using the hover out-of-ground effect as a criteria is 82,600 lbs with a useful load of 20,900 lbs. The aircraft can hover out-of-ground effect at 2,460 feet.

The takeoff useful load of the aircraft is substantially enhanced where the vertical performance is predicated on hover in ground effect. Using the standard atmospheric as a reference, the vehicle can perform a vertical takeoff at a gross weight of 94,600 lbs with a useful load of 33,000 lbs.

Cockpit arrangement

The cockpit is equipped with three seats for pilot, co-pilot, and flight engineer. A center aisle of approximately 28 inches in width provides good accessibility to each of the seats. The flight engineer is located on the left side of the cockpit behind the pilot's seat. Cockpit presentation favors the left side of the aircraft; in fixed wing aircraft the pilot or plane captain is seated in the left seat. Aft of the cockpit area is an auxiliary compartment approximately five feet long, positioned between the cockpit and troop/cargo area. The main entrance door opens into the left side forward of this compartment.

The apparently contemporary cockpit includes a panel across the forward section of

The Characteristics of the Mil-10 By Leonard J. LaVassar

the cockpit area featuring a continuous straight line baseline with an elliptical shaped top. In this configuration the instrument panel outline seriously impeded visibility over the console and this was more apparent in the flare attitude. (Figure 4).

On one prior occasion the cockpit presentation included a circular panel of 8″ in diameter for pictorial presentation for a closed circuit TV. The camera lens were mounted on the underside of the fuselage to improve rearward and downward visibility during cargo loading. The camera lens could be controlled in azimuth and elevation through a four-way beep-type control on the stick.

Sliding windows of approximately 28″ were provided on either side of the aircraft. Each of the windows was bowed outward to permit either the pilot or co-pilot to improve his sideward and rearward visibility.

Maintenance

Ease of maintenance was obviously a predominant pre-requisite during the design of the Mil-10 helicopter. No special tools are required for inspection of the powerplants, transmissions, or the rotor head. For blade inspection a ratchet wrench approximately three feet in length is stowed in the main transmission under the cowling. This special wrench can be inserted into the transmission case for rotating the blades to a proper position for inspection or removal.

Four platforms are provided on either side of the aircraft and may be hydraulically controlled from the cockpit. An electric-powered hydraulic pump is available to provide hydraulic power when the engines are not operating. Each work platform contains two hydraulically-actuated latches and a trunnion-mounted hydraulic actuator which opens the work platform to the horizontal position. The platforms are of two-piece construction and forged struts at either end are hinged to the work platform at the upper edge. During opening of the work platform they rotate downward along the fuselage skin and slide into a fixed receptacle. This method of work platform retention is positive and eliminates the use of cables from the fuselage to the upper surface of the platform which may be hazardous when proceeding from one platform to another. Handrails are permanently attached to the fuselage structure approximately four feet above the work platform on each side of the aircraft.

One of the unique design features of the Mil-10 is that the fuselage complete with powerplant, main transmisison, and main rotor shaft is rotated 1° 30 min. to the right in relation to the cockpit and cabins. This insures simultaneous liftoff of all wheels in the vertical liftoff.

Observations summarized

The following summary of the various aspects of the Mil-10 is predicated on personal observation, augmented by comments made by qualified observers during flight operations or by pilots who have flown the Mil-10:

1. The general workmanship is good.
2. The design of the aircraft is oriented to maintenance.
3. The ratio of empty weight to approved maximum takeoff weight is extremely high.
4. In view of the time the aircraft has been in service, the TBO times are low.
5. Flat rating of the engines to 10,000 feet is an admirable concept.
6. Cockpit presentation and flight handling characteristics have been accorded relatively low priority in design.
7. The most impressive feature of the Mil-10 is its size.

Leonard J. LaVassar

The Chief Test Pilot at the Vertol Division of the Boeing Company, Leonard LaVassar joined Vertol in 1950 as a production test pilot, being promoted in 1952 to Chief Test Pilot with responsibility for all flight activities. A graduate of the U.S. Navy Flight Training Program, he flew transports in the Pacific and also served as a pilot with Pan American World Airways. He was project test pilot on the first tilt-wing VTOL, the Vertol Model 76.

QUESTIONS AND ANSWERS

FOLLOWING THE "ROTARY WING IN THE USSR" PANEL PRESENTATIONS

PARTICIPANTS: LTG Harry W. O. Kinnard, CG, USA Combat Developments Command; **Leon L. Douglas,** Assistant General Manager, Boeing Vertol Division; **Ralph P. Alex,** Chief, R&D Sales Applications, Sikorsky Aircraft Division; **Joseph Mashman,** Vice President, Bell Helicopter Company; **Donald R. Segner,** Engineering Test Pilot, Lockheed-California Company; **Leonard J. LaVasser,** Chief Test Pilot, Boeing Vertol Division; **Clyde A. Davenport,** General Manager, Commercial Operations, Petroleum Helicopters, Inc.

■ **MR. DOUGLAS:** Gentlemen, ladies . . . In the remaining 25 minutes to a half hour, I will entertain questions from the floor. I'll ask that we not make speeches from the floor and that the questions be pertinent to the subject at hand. Please identify yourselves as you raise your hands and I recognize you, and if you would, please address your question to one of the panel members so that he may answer your question directly. With that introduction, we're open for questions . . .

■ **MR. ROBERT WAGNER** (Hughes Tool Company) : I'd like to address this to either **Ralph Alex** or to **Joe Mashman.** Considering the fact that the aircraft that you were talking about were in production ten years ago and you said that that technology was away ahead of what we had at that time, I wonder if you would comment about more current equipment.

■ **MR. DOUGLAS:** Ralph, why don't you take that on since you are going to talk about future Russian helicopters?

■ **MR. ALEX:** On the present designs, the contra-rotating model has gotten up to 16,000 lbs and we hear that they're going one step higher . . . I mentioned that before but I was pretty cut off here . . . (Laughter) . . . but I heard in Paris about a 180-foot contra-rotating crane at 230,000 to 250,000 gross and 40,000 flat rated horsepower installed with 70,000 actual horsepower at sea level. We have had two Western observers see something similar to this, but they didn't know what they really saw. They saw what they thought was a tip-jet driven machine which **Bob Wagner** would like, but he now says the reason he thought it was a tip-jet was because he didn't see any tail assembly or rotor, or he might not have seen the second rotor on it.

This is what we hear and I hope that we'll get pictures of it and some more information authenticated by a picture within the next three or four months. But they do feel that they need the big machines. **Kamov** feels that contra-rotating is the only way to go for real big ones. He told me that and (Dr.) **Mil** pooh-poohed him, and I don't know who is right. We hear that there is another machine over there that is about that same size, and which one will be authenticated, I don't know.

■ **MR. DOUGLAS: Joe (Mashman),** would you like to add to that?

(Continued on the Next Page)

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QUESTIONS AND ANSWERS

■ **MR. MASHMAN:** No, I think **Ralph** covered it.

■ **MR. DOUGLAS:** Fine.

■ **MR. JACK SOBELMAN** (General Dynamics) : **Mr. Segner,** what about the Russian developments in any type of a rigid rotor application?

■ **MR. SEGNER:** I'm not really in a position to say. I do know that they were very curious as to our equipment at both Paris Air Shows, and they talk as though they were working on one, but nothing was spoken on this directly and we did not ask direct questions on this. The interest of their flight test engineers and engineering test pilots was extremely high. **Dr. Mil** indicated that it was nothing new to them so whether or not they are looking at it or not would be pure speculation.

■ **MR. DOUGLAS:** Perhaps I can add a little to that . . . I would commend your reading a translation of **Dr. Mil's** book on aerodynamics published by NASA. It's a very excellent book and to some extent might also answer **Bob Wagner's** question on the currency of their technology. My understanding is that they do have a research program on a hingeless or rigid rotor; I differentiate between the two. Next question?

"Dave" Davenport on the firing line.

■ **MR. PAUL F. ANDERSON** (ODCS-LOG, DA) : **Mr. Davenport,** what are the FAA restrictions (involved in your test of the Russian commercial craft) ?

■ **MR. DAVENPORT:** The problem with the FAA — although this is a legal area and you must recognize that I'm only in the operational end of this — but as I understand it, since the FAA cannot go to their factories and see their manufacturing processes and what sort of quality control they pursue, they won't recognize or certificate the ships without going through a full-blown program here in the States which would be prohibitive from a cost standpoint.

■ **MR. ANDERSON:** There are no specific aerodynamic restrictions that you know of . . . it is strictly a quality control?

■ **MR. DAVENPORT:** That's right. Not to my knowledge.

■ **UNIDENTIFIED:** I've noticed that each time we've seen pictures of the Mil-10 it always had the same tail number . . . 402. Do you have any indication of what the inventory of these things are? . . . and also, along the same line, **Mr. Davenport,** what is the lead time they're talking about in producing these things should you buy them commercially?

■ **MR. DAVENPORT:** I'm sorry but I don't have any information of that nature.

■ **MR. DOUGLAS:** Perhaps **Ralph Alex** might have some information.

■ **MR. ALEX:** On production, they say that they've built over 50 Mil-10's and another commercial operator has been over there and has flown their machines and he says that delivery would be within 12 months. The purchase price is about $2 million, or a lease at $200,000 a month. This is what the general figures are and add the export if you buy one from Russia. And as **Mr. Davenport** said, how do you operate it and prove this aircraft is airworthy and show them all the design data and the quality control and prove that the aircraft is a production aircraft? Those things are almost impossible (to do) but they are trying it and France is entering a mutual program with the USSR and they are attempting to certify the aircraft in France, and since the U.S. has a reciprocal agreement with France on certification, they may then try to get a U.S. approval for use in the Western Hemisphere.

■ **GENERAL KINNARD** (Hq, CDC): I'd like to ask about the dust problem. I gather that they do design their machines for operating in all environments, but do they have anything different? What is their approach on foreign particle separation and so forth?

■ **MR. DOUGLAS:** Dave, why don't you try that first? What do you do (at Petroleum Helicopters) about sand operations?

■ **MR. DAVENPORT:** We have asked them if they have any sort of air separation for the engine inlets and I haven't had a reply on that. We've asked several questions, of course, for we're interested in a lot of things . . . the possibility of converting to the K Model if we wanted to go straight sling. Apparently, the size of the engines gives them some protection by itself. We've had a little ingestion but with no apparent problem. As far as anything being actually available from the aviation export, I don't know of it.

■ **MR. DOUGLAS: Joe** and **Leonard,** can you add anything to that with respect to operations in a hot, sandy environment? **Ralph?**

■ **MR. ALEX:** As far as we know, in discussing this with some of their engineers in Paris, they have no design

"I'd like to ask about the dust problem. What is their approach?" — LTG Kinnard

that prevents particle ingestion and they have ignored that. Most of their real operations have been in all-weather, but the dust part of it they just ignore it. Whatever their engines ingest, they feel that their engines can eat it just as we did for years and they keep out of the ground effect condition and ingest as short a time as possible. They have not faced up to that problem.

■ **MR. DOUGLAS:** Are any members of the Israeli Defense Force here this morning who might want to answer that question? . . . I did discuss that with members of the Israeli Defense Forces and they felt that their equipment was very seriously deficient — all of their equipment, the tanks, the helicopters, and everything else. They made reference to and anecdotes to tanks being delivered with fur-lined helmets as a "for example" in the Sinai Campaign. They also talked of what they knew of the Russian helicopters specifically not being adequately designed for hot, sandy operations. Are there any other questions?

■ **MR. HANK KURT** (Grumman): Do we have any information from Russia

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on the development of higher-speed VTOLs that might . . . disc loadings, or of interest in jets, tilt wings, tilt rotors, anything of that sort, fans?

■ **MR. DOUGLAS:** Ralph, you might want to show your film at this point, the clip on the autorotational capability of the . . .

■ **MR. ALEX:** We could show the film, but it wouldn't answer **Mr. Kurt's** question. Basically, they've come up with lift fans and as we all know at the last show at Tushino Aerodrome, they showed three or four VTOL fighters and amazed the Western world by doing it so cleverly, and quickly, and operationally, and not just one aircraft, but many. They've done that in all fields, but in the helicopter field, they've got the compound, big machines at 80,000 gross, and they've filled it, made some world records, and shelved it. They think helicopters are the only way to go and from then on it's got to be a very fancy VTOL with fan in wing, and this is about what we hear in Paris. This may not be the complete case, however.

■ **MR. DOUGLAS:** There was one question asked before the meeting started on whether or not they hold competitions like we do. Do they make unilateral decisions or do they go through a competitive exercise?

■ **MR. ALEX:** Well, I was in the Design Bureau and **Mil, Yakovlev,** and **Tupolev** were all there, and as an example, on the Mil-6, **Mil's** wife is his chief of stress and she said that she had two people assisting her, and that was the extent of the stress analysis on that machine. It's a little different than in the U.S.

The design team that built the **Yakovlev** machine was part of **Mil's** team, and 35 to 40 people did the whole job. What they did was to take the Mil-4 complete power package, rotorhead, gear box, and all; modify them slightly; and then put two of these proven powerplant and dynamic component packages, one on each end, and the only modification was the connecting rods. This is the fast way to do it. Their design teams are very small; their accomplishments are very big. This was similar to the way we did it in the early '30's and the '40's when eight or nine people would be the extent of a design team for a machine, aircraft or helicopter.

■ **MR. DOUGLAS:** I'm not going to let you off that easily, **Ralph,** because I've debated the management system with the Russians. Let me ask you this . . . when they build a prototype, where does the production redesign go then?

■ **MR. ALEX:** After **Mr. Mil** made his prototype, the production design was then bid for by manufacturing facilities. Again, this is as I heard it when I was over there. The Mil was built in Irkutsk in Siberia. The factory there bid on the design; they had the technology; the State Central Committee knew they could do it; they got the job and they did it completely with **Mil** as a consultant. He was out of the direct line of fire on the redesign for production.

■ **MR. DOUGLAS:** So the designers that we know well for the most part design and build prototypes and production redesign is accomplished by other design teams in other places.

■ **MR. ALEX:** . . . complaints!

■ **MR. DOUGLAS:** They have some real problems! . . . (Laughter) . . . So it doesn't come that easy.

■ **MR. ALEX:** For example, they took one of our helicopters and gave it to an automotive facility and they built Kelvicopters and refrigerotors for quite awhile! . . . (Laughter).

■ **LTC RUSSELL BAUGH** (Fort Rucker): My question is directed to **Mr.**

Mashman, or to **Mr. Segner,** I believe. . . . Some months ago, **"Fish" Salmon** came out to Fort Rucker and gave us a talk on Russian helicopters and alluded to the fact that they seemed to be quite unstable immediately prior to landing and shortly after getting to a hover . . . (Remainder of question undecipherable).

■ **MR. MASHMAN:** The aircraft that I had occasion to fly was such that I wasn't aware of any particular instability, nor was there any requirement to go about a ground effect prior to accelerating. In fact, as **Ralph** indicated, due to the transitional lift vibrations, they accelerate very rapidly to get through that (phase or) period so as to provide maximum comfort for the passengers. I believe that the movies that **Ralph** has pretty much confirm that.

■ **MR. DOUGLAS:** Don, can you add to that?

■ **MR. SEGNER:** In observing a lot of the films, particularly taken at Paris, you can see that there is a lateral axis overcontrolling problem which I mentioned in the Mil-8, but this isn't a major problem and the ASE (Automatic Stabilization Equipment) damps it out. It does a very fine job and it hovers, and I found no deficiencies in any of the hovering regimes.

■ **MR. PAUL ANDERSON** (ODCS-LOG, DA): **Joe,** if you'll remember on the Mil-6 that we flew, I noticed a very definite wallowing effect just prior to breaking ground, not in the hover itself, but as you moved out but after that, it was (insignificant).

■ **MR. MASHMAN:** During your run-up, you do go through a couple of what appears to be resonant frequencies, and due to what I believe to be the low rotor rpm . . . what was it? . . . about 100 rpm? . . . so as you go through these frequencies, and I'm just guessing that one was about 20 and the other was at about 50 or 60, instead of being a vibration, it was more of a waddle. But in flight, I wasn't aware of anything but

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what the pilot might induce into it when you are flying without the stability system.

■ **MR. LaVASSER:** Once it has attained cruise speed, the aircraft never held trim. It was constantly purpoising, some pitch, and occasionally it would roll, and when the uninitiated pilot who was not a Russian pilot . . .

■ **MR. DOUGLAS:** I'd like to ask a question of you, **Leonard.** You made reference to the unique blade construction of the Mil-6 and the Mil-10, which provides an unusually flexible blade, more flexible than what we are used to in this country. Did you find any unusual flight characteristics associated with that kind of flexibility, either from a ground rev up point of view, transition, forward flight, high speed?

■ **MR. LaVASSER:** I really couldn't associate any deficiencies with the particular blade design. The transitional speed regime, I thought, was extremely high and it was reminiscent in some respects, you might recall in 1953, to the XH-16, the largest helicopter in the Free World at that time. That also had these characteristics . . . if you sustained the aircraft in that particular speed range and we used the same technique the Russians did to minimize the exposure time when the aircraft was in that particular regime. It was a very undesirable characteristic, but I couldn't particularly apply it to the blade design.

■ **MR. RAY F. DONOVAN** (Sikorsky): **Mr. Davenport**, I've been told that the Mil-10 has a leakproof hydraulic system. Would you care to comment on that?

■ **MR. DAVENPORT:** As far as the ship we have is concerned, this is apparently the case. I don't think in the 170 hours that we have operated it that we've had as much as a cupful of hydraulic fluid leak from any of the systems. It's remarkably well sealed.

■ **MR. DONOVAN:** What do you attribute this to?

■ **MR. DAVENPORT:** The pressures, I think, are a litle lower than ours which is probably a contributing factor. Other than that it must lie somewhere in (design) policy or something like that. I couldn't say for sure.

■ **MR. DOUGLAS:** We may have some members in the audience who are familiar with the details of this system having viewed them. Is there a detailed design feature which provides this almost leakproof hydraulic system? . . . To my knowledge on that, i.e., lower pressure systems, they have spent attention to design detail, not only in the hydraulic system but in the electrical system. Almost every joint, every coupling in the electrical system or the hydraulic system looks like it has been very carefully cnsidered.

■ **UNIDENTIFIED:** I'd like to hear something about the downwash. I gather that it must be lower (with the Russian designs), but I don't really know. I'd like to get some feel for this.

■ **MR. DAVENPORT:** I don't have any figures and I haven't taken any readings or anything of that nature.

■ **MR. LEE WILHELM** (Lycoming): I note with interest here their apparent lack of chemical blade de-icing equipment and apparently they are using an all-electrical system. Does that mean they have given up on the chemical system?

■ **MR. ALEX:** They have chemical on the Mil-4 and on the Kamov 15 and 18. Everything from here on has been electrical for they concluded the chemical was unsafe. They think the electrical cycle system is the only way and they have gone to 325 to 375 volts A.C. and it seems to be doing an excellent job.

The Mil-8 (forefront) is dwarfed by the Mil-10 during their static display at a recent Paris Air Show. A take-off on the Mil-6, the Mil-10 has lifted 27½ tons to 8,000 feet.

■ **MR. WILHELM:** Another question here about the relative difference between U.S. and Russian helicopters. They have de-icing equipment on all of their aircraft and we have it on very few. How come?

■ **MR. ALEX:** It would take about three weeks to argue that. We've been arguing de-icing and anti-icing vs none required for twenty years, but in the main we don't fly in icing conditions so we have very little requirement for it. And now every time that we want to extend our operations during icing conditions, we get into trouble with the Civil Board in England, or with the FAA. We're trying to develop it, but when you try to get people to pay for it, they want you to wait awhile.

■ **MR. DOUGLAS: Ralph,** let me ask you another question. How do the Russians feel about operations in Siberia day in and day out without rotor blade de-icing and engine de-icing?

■ **MR. ALEX:** They would not operate at all. In a movie I saw them operating during a whiteout in the Antarctic, and as the pilot got into the ship, they said he was testing his electrical de-icing system on the Mil-4 and he blessed himself as he got into the cockpit . . . (Laughter) . . . and the Russian beside me said, "We even have superstitious pilots yet!" . . . (Laughter).

(Note: The initial reel of magnetic tape ended during the subsequent reply and the recording did not re-start in sufficient time to pick up the final question and answer).

■ **MR. DOUGLAS:** We've about run out of time. Thank you, gentlemen, and thank you, panel members and **General Kinnard** . . . (Applause).

■ **GENERAL KINNARD:** And may I also thank you, Lee . . . I thought it was an outstanding presentation.

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OBITUARIES

The following obituaries of AAAA members cover the April-October, 1968 period. The AAAA has verified the address of the next of kin with the Department of the Army:

COLE — In Vietnam, Warrant Officer Timothy Cole, Jr., assigned to the 54th Medical Detachment, on October 18, 1968, due to hostile action; husband of Mrs. Peggy J. Cole, Rural Route #2, Newman, Georgia.

CROWE — In USARCARIB, Major Charles Mantey Crowe, assigned to Fort Clayton, Canal Zone, on October 4, 1968, due to an aircraft accident; husband of Mrs. Elsie D. Crowe, c/o Mr. Willis Jenne, 1526 East 10th Street, McMinnville, Oregon.

JACOBS — In Vietnam, Warrant Officer Thomas Carlyle Jacobs, assigned to the 7th Squadron, 17th Cavalry, due to hostile action on September 13, 1968; husband of Mrs. Elaine A. Jacobs, 1605 South Main Street, Bloomington, Illinois.

PHILIBERT — In Vietnam, Chief Warrant Officer Brian Hardman Philibert, assigned to the 101st Airborne Division (Airmobile), due to hostile action on April 24, 1968; son of Mr. and Mrs. Harold Philibert, Route #4, Box 172, Fort Worth, Texas.

The publication has received notification of the death of the following Army Aviation personnel:

Anderson, Curtis L., WO, September 13, 1968.
Brant, Dave W., 1LT, October 14, 1968.
Brinkoetter, James A., WO, October 5, 1968.
Bixler, Martin E., WO, October 3, 1968.
Carstens, Thomas H., 1LT, October 26, 1968.
Clemmer, Derrell W., WO, September 20, 1968.
Conroy, Ronald L., WO, October 3, 1968.
Crowley, James A., 1LT, October 16, 1968.
Daugherty, Ralph O., Jr., WO, October 17, 1968.
Fogde, Lance E., CWO, September 23, 1968.
Fox, Reinis, WO, October 7, 1968.
Groth, Dennis A., WO, October 19, 1968.

AAAA Scholarship Aid

The AAAA Scholarship Foundation, Inc. announces the availability of $3,500 in 1969 scholarship assistance funds for the sons and daughters of members and deceased members of AAAA. Student applicants are to request the appropriate forms by writing to the AAAA Scholarship Foundation, Inc., 1 Crestwood Road, Westport, Conn. 06880. Eligible are high school graduates or H.S. seniors who have made application to an accredited college or university for Fall, 1969 entry as a freshman. Applicants are asked to furnish their father's name and address in their initial letter request.

Harris, Jerry L., WO, September 29, 1968.
Hurst, Quenton F., 1LT, September 27, 1968.
Howe, Thomas J., WO, October 6, 1968.
Johnson, David H., MAJ, October 15, 1968.
Johnson, Thomas E., CWO, October 3, 1968.
Morris, James A., Jr., CWO, September 27, 1968.
McPhail, Franklin L., WO, September 30, 1968.
Ovaitt, Richard A., WO, August 8, 1968.
Oveson, Geoffrey, 1LT, October 9, 1968.
Partridge, Norman W., WO, September 16, 1968.
Rollins, William P., WO, September 29, 1968.
Ross, Morris J., WO, October 9, 1968.
Silberberger, Paul J., MAJ, September 24, 1968.
Strong, Richard W., Jr., WO, October 21, 1968.
Tieman, Alan B., WOC, October 9, 1968.
Wallace, John C., WO, September 26, 1968.
Washburn, Fred Z., 1LT, October 2, 1968.
Werner, Stuart A., WO, April 24, 1968.
Zeimet, James G., WO, September 4, 1968.

Marvin E. Dempsey

Major (Retired) Marvin E. (Jack) Dempsey died suddenly of a heart attack on August 23, 1968. He leaves his wife, Jeanne, of 5015 Caryn Court, Alexandria, Virginia; and two daughters, Mrs. Constance McEliece, and Carol. Dempsey retired from active duty on August 31, 1959, and served as a marketing representative for Dalmo Victor Company at the time of his death. Services were held at the Fort Myer Chapel. He was buried with full military honors in Arlington Cemetery on August 27.

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