The ROUNDEL

VOL. I, No. 11
SEPTEMBER 1949

ROYAL CANADIAN AIR FORCE

The ROUNDEL

Issued on the authority of
THE CHIEF OF THE AIR STAFF
Royal Canadian Air Force

VOL. 1, No. 11 SEPTEMBER 1949

★ ★ ★ ★ ★ *CONTENTS* ★ ★ ★ ★ ★

EDITORIAL

ARTICLES

REGULAR FEATURES

MISCELLANY

EDITORIAL OFFICES:
Room 3130, D.N.D. Bldg. "B,"
Ottawa, Ont.


JUST DROPPED IN TO SEE THAT EVERY-THING'S OKAY !
GONE ON LEAVE
EDITOR
OUT
Ray Tracy

Northern Skytrails: Part XI

The Story of the Work of the RCAF in Canada's Arctic and Sub-Arctic

by FLT. LT. E. P. WOOD, D.F.C.

(In this issue we bring Flt. Lt. Wood's series of articles to a close. He writes: "Once again I would remind your readers how sketchy my narrative has, of necessity, been. I shall, however, be quite content if I have managed to give a reasonably correct impression of the general trend of the RCAF's northern activities. The last chapter, which I enclose herewith, carries the story on to within about eighteen months of the date of this letter . . ." — Editor)

THE POST-WAR PICTURE

Photographic Survey

ONE OF THE MOST VALUABLE SERVICES performed by the peacetime RCAF is Photo Survey work, which is helping steadily to push back Canada's frontiers and thus further the northward march of civilization.

1948 was the busiest photographic season since the Air Force began this type of work in 1924. Nos. 413 and 414 Squadrons, based at Rockcliffe, sent out a total of nine detachments, comprising 22 aircraft and about 250 air and groundcrew personnel. The first aircraft left the Rockcliffe base on April 20th—one of the earliest starts on record. At the season's end, the area photographed exceeded 900,000 sq. miles, as contrasted with the 1947 figure of 700,000.

The types of aerial photos taken by the RCAF to-day fall into two groups: vertical and tri-camera. Vertical photography, the original method, is used for mapping and for *detailed* exploration and analysis. Tri-camera photography is intended for *basic exploration.*

Specific examples of the two types are as follows:

Vertical

Water power development (e.g., the Columbia River Valley project).

Soil reclamation and irrigation projects, and land development for soldier settlement.

Mineral exploration.

Hydrographic survey for inland waterways.

Forestry Service.

Photographic coverage of flooded areas at flood height, for dyke projects.

Tri-camera

Coverage of large areas where photos are needed immediately.

Coverage in cases where large-scale maps are not required.

General survey from which likely areas will be chosen for detail survey.

In vertical photography only one camera is used. It takes a series of overlapping pictures (a line overlap) of the ground. In theory, the centre of each picture represents the ground directly below the aircraft at the time it was taken.

From tri-camera photos geologists can select areas for further investigation where ores or oil are likely to be found. Agricultural experts who understand photographic interpretation can tell where good farm lands are located. The cordage of forests can be estimated more accurately from the air than from the ground. Similarly, experts in other fields can obtain from tri-camera photographs information which will lead to the most economical use of the facilities available for vertical photography.

Housed at Rockcliffe is No. 1 Photo Establishment, one of the most modern air survey photographic laboratories possessed by any country. This unit processes all survey films and makes the necessary prints to be used by the various survey sections. During 1945 and 1946 approximately 3,320 reels (or 372,930 feet of film) were developed as the result of squadron operations. One printing room alone produces over 100,000 Service prints per month. This unit is also the centre for many other photographic processes of value to the RCAF.

The detachments sent out each summer may be stationed in airport buildings or under canvas, depending upon their location. In camps in out-of-the-way localities, as for example in the North West Territories, living conditions are rigorous. Firearms are carried and the men shoot most of their own requirements of fresh meat. They also, naturally, catch their own fish.

All operations are controlled from the 'Ops' Room at Rockcliffe. Detachments are shifted here and there to take advantage of the best weather conditions. Detachment commanders in the field, however, are given wide powers of discretion. All the work is recorded in the operations room as soon as it is signalled in by the detachments. When one operation is completed, the crews are told where to move for the next job.

The RCAF does not subscribe to competition with civil air lines for the easiest jobs. Instead, it accepts those assignments which would not make workable contracts. Hence the large proportion of northern survey accomplished by the Air Force crews. Even prior to governmental insistence on co-operation, mapping operations had been dovetailed. The Army Signals and the Meteorological Service also benefit from the Air Force work, and these in turn assist the air survey detachments and other RCAF units.

One of the most interesting recent contributions to correcting the existing charts and maps was the re-discovery in 1946 of the Spicer Islands in Foxe Basin, north of Hudson Bay. These islands were reported in the ship's log of an American whaling vessel skippered by a Captain Spicer of Groton and New Bedford, Massachusetts, as follows:

Spicer Islands

"On the 7th August (1869) was beset. What I took to be water ahead turned out to be reefs and low-lying land, now called 'Spicer's Islands', hardly seen from the decks at high water."

Spicer's discovery is mentioned in a Department of Marine and Fisheries report entitled "An Expedition to Hudson Bay—1897." But when the American arctic explorer Donald MacMillan sailed over the supposed location in 1921, he found nothing. In 1946 the RCAF confirmed the existence of the islands and a dead reckoning position of latitude 68° 08′ North and longitude 79° 10′ West was obtained.

Search and Rescue

The RCAF Search and Rescue organization stands ready at all times to carry out mercy flights in the Arctic; and it has many successful flights to its credit.

The job may be almost anything—from looking for a missing airliner down at sea to landing on a 'home-made' landing strip to bring out an Eskimo or missionary requiring immediate hospital attention. But behind all such operations is a carefully-planned organization, stretching from coast to coast, and co-ordinated and largely operated by the RCAF.

Search and Rescue, however, is not designed to displace existing means of assistance to distressed persons. Though it may operate as a mercy organization within Canada whenever a life-and-death matter comes up that is too big for anyone else to handle, its primary responsibility is to carry out Canada's international commitments under ICAO.

Control is carried out from five major co-ordination centres at Halifax, Trenton, Winnipeg, Edmonton, and Vancouver. Aircraft earmarked for mercy flights or search operations are stationed at Greenwood, Mingan, Trenton, Winnipeg, Edmonton, Ft. Nelson, Whitehorse, and Vancouver; and although planes at these points held for specific Search and Rescue work are allowed to

Search and Rescue Norseman

carry out certain other duties, they are never allowed to undertake jobs which would prevent them from being instantly ready for their primary responsibility.

Recent additions to the list of primary facilities of the Air Force for Search and Rescue work include helicopters, as well as a group of 21 carefully trained airmen who recently finished an intensive course in para-rescue work near Jasper, Alta. These men, now stationed at Greenwood, Trenton, Edmonton, Whitehorse, and Vancouver, are available to parachute at any time from Air Force planes to aid persons in distress. All hand-picked volunteers, they were selected for their woods experience, physical ability to carry out arduous duties in the wilds, and general keenness and intelligence. So carefully have they been trained that any one of them could, if the occasion arose, deliver a baby.

Also ready for Search and Rescue work are the vessels and men of the RCAF Marine Section. Marine units are stationed at Dartmouth, Vancouver, and Trenton.

Nerve centres of the work are the major co-ordination centres, for from them are directed all operations by Search and Rescue. Huge charts in the operations room at each centre show the location of all Service and civilian aircraft known to be flying in the area—and, where applicable, ocean-going shipping is also plotted. Ready for instant use are lists of all three Services' facilities (including Navy carrier planes, Army paratroops, etc.), bodies of men for seach parties, vessels, and sources of civilian aid.

Supplies dropped by aircraft often play a big part in Search and Rescue work, and ingenious methods have been worked out, especially for marine operations. Most spectacular of these is the Lindholme gear, a series of five containers linked by rope and dropped from the bomb racks of a Lancaster without parachute. The centre pack contains a large rubber dinghy which inflates upon striking the water, bursting open the container. The other four containers, containing emergency supplies, float upon the surface, still linked by rope to the dinghy. The gear is dropped in such manner as to drift down wind upon the survivors, spread out in a wide line.

In the fall of 1947, at the difficult freeze-up time, word was received that Canon Turner, a Church of England clergyman at Moffet Inlet, had accidentally shot himself in the head. An Army parachute squad with an Army doctor was flown in and dropped to aid the wounded man, and, when a landing could be made on skis, he was flown out. Unfortunately Canon Turner died; but though the difficulties of the operation seemed insuperable at times, the members of the rescue crew surmounted them with a spirit and courage that is highly commendable.

Just before Christmas in 1947, on lonely Nottingham Island, one of the Department of Trans-

A.T.C. North Star

port meteorologists developed a heart condition that was steadily becoming worse. 435 Squadron received the call, and two weeks after leaving, the rescue Norseman arrived back at Stevenson Field, Winnipeg, with the sick man aboard. This flight covered 3130 miles of forest, barren land, and the treacherous ice floes of Hudson Strait.

The detailed accounts of the above two incidents read like adventure stories: here they are merely mentioned as examples of work of the RCAF Search and Rescue organization. They are neither the most nor the least spectacular of many similar operations.

Air Transport Command

In 1943 transport work in the RCAF came under the direction of the Directorate of Air Transport Command controlled from Air Force Headquarters. Domestic mileage on Service routes amounted to 7,500 miles—combining to make a total route mileage of 11,596 miles. During the year a total of 6,079,753 pounds of urgent express was transported within Canada, Labrador and Newfoundland, as well as to the Yukon. Passenger traffic over the routes amounted to 18,238 passengers during the same period. In addition, nearly 500,000 pounds of Dominion of Canada mail was carried between Moncton and Goose Bay.

In February 1945 the Directorate was established as a Group. The Group was responsible for all transport duties including the carrying of freight to hinterland stations, ferrying of aircraft, aerial photographic survey, and the carrying of mail to troops overseas. Special missions included mercy flights and the carrying of VIP's, as well as co-operating on combined Services exercises.

During 1947, No. 9 (T) Group flew 16,897 hours on transport operations, a total of over two million air transport miles. More than 23,000 passengers and over four million pounds of freight were carried. Fifty-five hundred hours were flown on photographic operations and special projects.

The inauguration of a new schedule of fast RCAF Air Transport flights, linking Canada from Coast to Coast, was announced by the Minister of National Defence on May 17th, 1948.

Operated by the newly-formed Air Transport Command, four-engine North Star aircraft were used on the main runs linking principal terminals from Goose Bay in Labrador to Whitehorse in the Yukon, while the servicing of intermediate terminals was taken care of by an interlocking feeder system utilizing twin-engine Dakota aircraft.

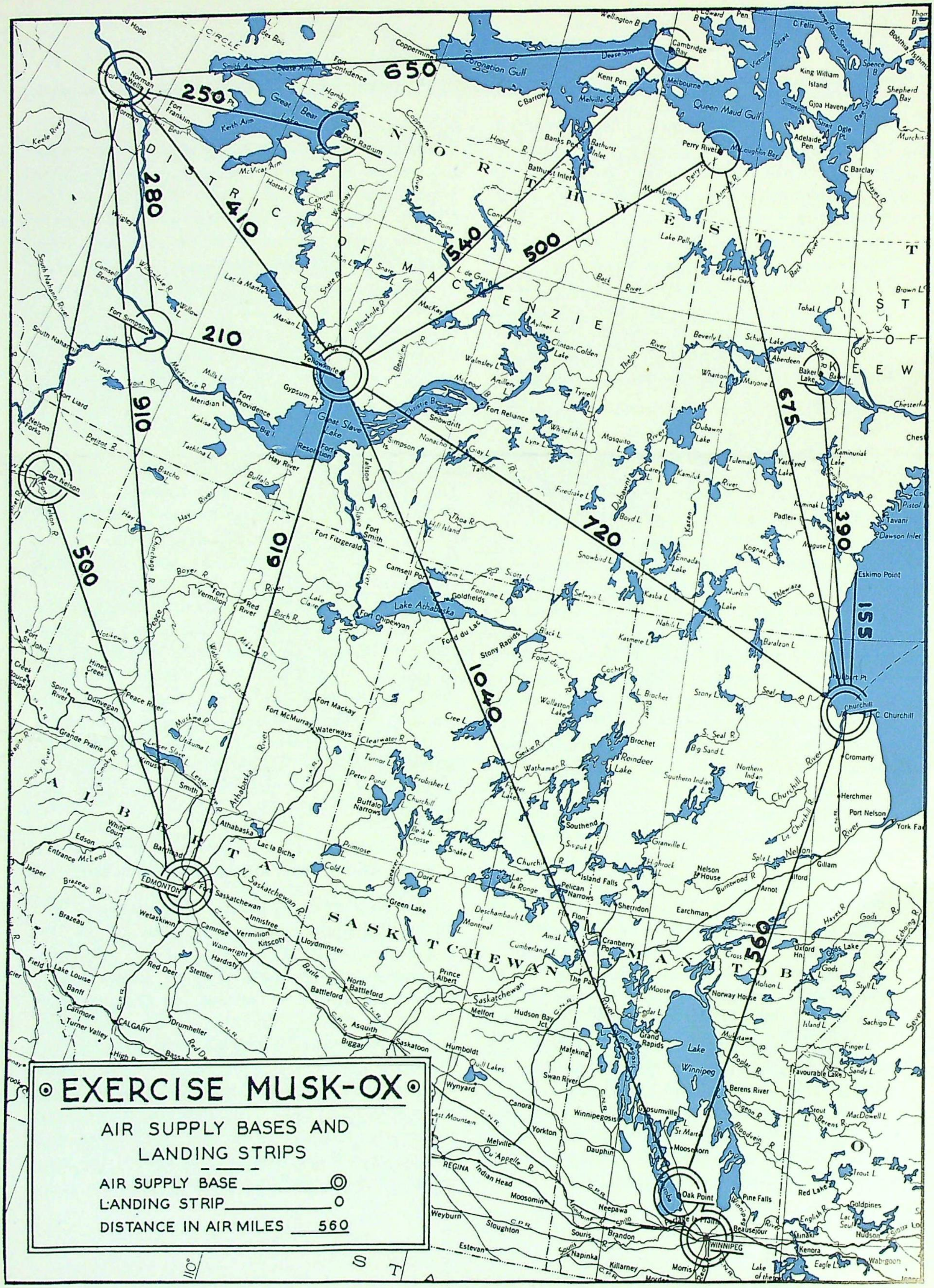
Main terminals for the scheduled runs are Montreal and Edmonton. The Eastern Division of North Star flights operates from Dorval aerodrome in two sections—one direct to Goose Bay, and the other on a twice-weekly schedule via Moncton and Dartmouth. The feeder service of the Eastern Division, operating Dakota aircraft, includes Ottawa, Trenton, and Toronto.

The fast North Stars fly twice weekly between Dorval and Whitehorse, and connect with the Western Division of feeder service operating into Winnipeg, Churchill, Baker Lake, Rivers, Regina, Calgary, and Vancouver, as well as various stations on the North-west Staging Route.

The new schedule is designed to facilitate the rapid movement of Service freight and personnel between various units and bases throughout the Dominion. In this way Air Transport Command does useful work while carrying on essential training. In the event of an emergency, Transport Command would supply units like Fighter Interceptor Squadrons, in addition to providing the planes and trained personnel for camping and servicing airborne troops.

Winter Experimental Establishment

The Winter Experimental Establishment was set up at Kapuskasing in the winter of 1943-44, and moved to Gimli in March 1944. The unit was subsequently transferred to Edmonton in October 1945, and to Namao, ten miles north of Edmonton, in 1946. In that year advanced bases at Fort Nelson and Churchill were located. The following year the Winter Experimental Establishment was based at Edmonton with advanced bases at Watson Lake and Churchill. The aircraft proceeded to these bases late in October and, except for a short break at the end of the year, remained there until the middle of March.


EXERCISE MUSK-OX
AIR SUPPLY BASES AND
LANDING STRIPS
AIR SUPPLY BASE
LANDING STRIP
DISTANCE IN AIR MILES 560

The aims of this Establishment are to provide guidance in the design of new equipment for use in cold weather and to rectify faults in current equipment which limit the temperature at which it may be operated. The Establishment, which is an RCAF organization throughout, carries out

W.E.E. aircraft at Watson Lake

tests not only for the RCAF, but also for the RCN, the U.K. Ministry of Supply, and the USAF.

The following aircraft and engines were tested with their associated equipment during 1947-48:

Aircraft	Engines
Lincoln II	Merlin 68A
	Merlin 621
Lancaster X	Merlin 224
North Star	Merlin 620
Dakota III	Twin Wasp R1830-92
Sea Fury X	Centaurus XVIII
Meteor IV	Derwent V
Firefly IV	Griffon 74
Mustang IV	Merlin V1650-7
Prentice	Gypsy Queen-32
Vampire I	Goblin II

Operations

The RCAF has, since the War, also been constantly engaged in Operations of various kinds other than Search and Rescue—magnetic survey operations, joint operations with the Army or Navy, reconnaissance operations, etc. It is not proposed to describe any of them at length, but brief mention may well be made of one of each of the three types referred to above.

Exercise Musk Ox

Musk Ox was a non-tactical exercise, the main objects of which were to study:

1. Army-Air Force co-operation.
2. Mobility of over-snow vehicles under a wide range of winter conditions, beginning on the Barren Lands and terminating in the spring in the northwestern bush country.
3. Methods of air supply, including the possibility of establishing temporary landing strips on the Barren Lands.
4. Certain technical research projects in Arctic warfare.

No. 1 Air Supply Unit, under No. 9 Transport Group Headquarters, was formed in November 1945, its function being to supply the Army Moving Force of Exercise Musk Ox with fuel, food, and replacement parts as required. The Unit, with its six Dakotas and three Norseman aircraft, was based at aerodromes within flying range of the Moving Force at all times. A total of 224 RCAF personnel of various trades and ranks manned the Unit and supplemented the Army services by supplying chefs, M.T. personnel, hospital staff, and clerks.

The Main Base at Gimli, Man., was transferred to Churchill on January 6th, 1946, with Gimli remaining as a maintenance base. All flying operations were carried out from Churchill until the Gimli detachment moved to Yellowknife on February 14th. Two Dakotas and one Norseman were then stationed at Yellowknife to lay in gasoline caches for the Moving Force and provide alternate cover on the first leg of its journey. On March 21st, the Main Base was moved to Norman

Supply dropping: Musk Ox

Wells. The task of supplying the Moving Force was completed on schedule and excellent co-operation was received from the Army. Gasoline consumption of the snowmobiles was approximately 75% greater than planned, which necessitated a greatly increased number of supply-dropping sorties. Hadrian gliders, towed by Dakota tugs, were employed with limited success on the last leg of the journey.

Maintenance crews at Churchill worked in an unheated hangar on 50 and 100 hour inspections, while daily inspections and minor repairs were performed in the open. With no hangars available at Yellowknife and Norman Wells, all maintenance and servicing was performed out of doors with the help of Dakota work tents heated by Herman Nelson heaters. One major inspection on a Dakota aircraft was carried out at Yellowknife and was completed in approximately one week.

The Norman Wells Base was evacuated on April 21st, 1946, and Yellowknife on April 29th, with the majority of personnel proceeding to Edmonton for leave and re-posting.

The Army Moving Force, which had set out from Churchill on February 15th, arrived in Edmonton on May 7th, two days behind schedule.

Operation Investigator

The purpose of Operation Investigator was to determine likely aircraft bases. The party, consisting of eleven personnel, left Edmonton at the end of June 1946, and proceeded to Aklavik via Yellowknife and Fort Norman. For the next two months they carried out a number of reconnaissance patrols, in two Norseman on floats and one Canso amphibian, over a large area of the Arctic Archipelago and along the mainland coast.

In the course of making their observations, they had several interesting encounters with natives. At Holman Island and Liverpool Bay they met Eskimos who had much to tell of their own experiences with Stefansson, and at Minto Inlet they found an unusual little community whose members, in addition to being of a decidedly superior type, appeared to be the only natives having any knowledge of the large copper deposits in that area. They came upon several curious relics of the white man's early venturings in the Arctic, and on one occasion they flew for twenty minutes over a herd of caribou which must have numbered several million.

While camping during a patrol around the north end of Banks Land, the pilot with whom the party was flying fell ill and felt that an immediate return should be made to base at Holman Island. They were very reluctant to do this, as they knew that strong gales were blowing to the south and they were afraid that conditions might be unsuitable for landing at Holman Island. However, as the pilot appeared to have appendicitis, it was decided to break camp and take off. On their arrival at Holman Island a gale of 60 miles an hour was blowing across the bay, which made it impossible to land in this narrow stretch of water. The pilot attempted to land in the lee of the cliff outside the bay. The landing was almost completed when one float caught the top of the surf. This punctured the float and allowed the wing to drop in the water. After some two hours' drifting far out at sea, where the waves were beginning to break over the aircraft, it was decided to take to the dinghy. The party attempted to battle towards shore at right angles to the waves. They kept this up for approximately an hour and a half and were gaining slightly, when the masts of the Holman Island Mission ship were sighted in the distance. A white rag, tied on to a paddle, caught the attention of one of the ship's Eskimo crew, and what might well have been disaster ended as nothing more serious than a good soaking.

Operation Polco

The aim of this Operation was to establish ground magnetic stations surrounding the general area of the North Magnetic Pole. This done, magnetic soundings were to be taken to ascertain

Canso used for Photographic Survey

the magnetic field of the earth at these locations. With the results obtained the exact location of the Pole and the strength of its magnetic field could be determined.

A single aircraft, RCAF Canso 11060, was used for the operation. The party consisted of four men of the Department of Mines and Resources and eight RCAF personnel. The group was joined during the later stages by a geographer and a botanist.

In locating the present position of the North Magnetic Pole, ten ground stations surrounding the general area were established. At each of these the horizontal and vertical angles of the compasses were determined. Along with this a new electronic instrument was used to measure the strength and fluctuating factors of the earth's magnetic field.

The party left Rockcliffe on July 18th, 1947, and proceeded to the Arctic via Churchill. Ground magnetic survey stations were established at Aberdeen Lake, Yellowknife, Cambridge Bay, Greely Haven on Victoria Island, Tasekyoak Lake on King William Island, Guillemard Inlet on Prince of Wales Island, Agnew River on Boothia Peninsula, Allen Lake on Prince of Wales Island, Point Lake on Mainland, and Jully Lake on Mainland.

The operation was completed on Sept. 6th, with a total of 190 hours' flying time.

Conclusion

By and large, it would seem that the very first thinking on Polar aviation problems did not differ greatly from the very latest views held to-day. In fact the Polar Concept was just as real in the mind of Sqn. Ldr. Logan in 1922 as it is in our minds to-day.

Between the time of Sqn. Ldr. Logan's expedition to Ellesmere Island in 1922 and the present there have been many faltering steps taken and many mistakes made—fortunately very few fatal ones—and the lessons learned from the mistakes have been of enormous value. Much knowledge has been gained on methods of survival by close association with trappers, Hudson Bay Company personnel, the RCMP and natives—sometimes also by bitter experience—and great progress has been made in maintenance technique, servicing facilities, and actual operating methods.

With the War's end, our efforts are turned northward again. It has become increasingly evident that our arctic areas must be developed and protected, and that it is our responsibility to do so. The job is so gigantic that in some instances the United States' aid has been sought and received, but it is the policy of the Canadian government to replace American with Canadian personnel, when the latter are available.

Numerous operations and exercises have been carried out by all three branches of the Service, and the task of photography and mapping is an annual one for the RCAF in the summer months. However, the more we learn the more we realize our need for ever greater knowledge of the Arctic—until now we are perhaps indeed reaching the stage where (as some Service wit has remarked) our motto might well be, not *Per Ardua ad Astra*, but *Per Ardua ad Arcticum*.

Pensions Information

(Air Force Headquarters believes that the Appendix to AFRO 298, which was officially published on July 8th of this year, may be of considerable interest to a much wider audience than it has so far reached. It is therefore reprinted below verbatim.—Editor)

General

1 There are two Acts of the Parliament of Canada applicable to members of the permanent naval, army, and air forces of Canada (hereinafter referred to as members of the forces) or, in the event of death, to their widows and certain dependents, which provide for the grant of pensions or other benefits as are set out in the Acts in question. It has come to notice that a number of members of the forces do not fully appreciate their position under the two Acts mentioned, and the purpose of this circular is to set out, as simply as possible, certain information which may be of assistance.

2 The two Acts of Parliament are:
(*a*) The Pension Act; and
(*b*) The Militia Pension Act.

The Pension Act

3 This Act specifically provides that in respect of military service in peacetime, pensions for disability or death may only be awarded when the injury or disease or aggravation thereof resulting in disability or death arose out of or was directly connected with such military service. It follows that a disability or death resulting from natural or *accidental* causes, and which in no way arose out of or was directly connected with the individual's military service, would not be pensionable.

Pensions granted under this Act are not subject to income tax.

The basic scale of pension awards for disability and death is the same for all ranks up to and including that of flight lieutenant.

4 The act provides for the payment of compensation by way of pension in accordance with the extent of the degree of disability found on medical examination from time to time; additional pension is also payable for dependents. Length of service is in no way a factor in determining the amount of pension. Provision is also made for the payment of pensions, at a fixed rate, to the widows and dependent children of members of the forces who are killed or who die while on service, *if such death is related to service as heretofore mentioned.* The actual award of pension payable being the same for all ranks up to and including that of flight lieutenant. In certain instances pensions may be awarded to the parents of a deceased member of the forces and the amount awarded is discretionary, being governed by the statutory limitation and the degree of dependency. In exceptional cases a claim for pension may be considered for a dependent brother or sister.

The Pension Act is administered by the Canadian Pension Commission.

The Militia Pension Act

5 This Act is in no way related to The Pension Act. It applies only to members of the permanent forces whereas The Pension Act applies to all members of the forces, whether permanent or otherwise. The pensions or other benefits for which The Militia Pension Act makes provision are computed on the factors of length of service and rates of pay and allowances; the nature of disability or the circumstances under which the member of the permanent forces died does not enter into the calculation of the benefits which may be granted.

6 The Act comprises five Parts, numbered I—V. Parts I—IV apply only to members of the permanent forces who were appointed thereto or enlisted therein on or prior to 31 Mar. 46. Their number is comparatively small and is constantly diminishing. Those to whom these four Parts apply are sufficiently familiar therewith as to obviate the necessity of furnishing information thereon in this circular. Part V of the Act, by an Act of Parliament which came into operation on 31 Aug. 46, applies to all members of the permanent forces who were not members thereof on 31 Mar. 46, but were appointed to or enlisted therein after that date. It also applies to those members of the permanent forces to whom Part I—IV were applicable and who elect to become contributors under Part V.

7 All members of the permanent forces to whom Part V applies are required to contribute in respect of their service, during the period such Part is applicable to them, a percentage of their pay and allowances ranging from five per cent, in the case of those who are in receipt of pay and allowances of $1,200 per annum or less, to six per cent in the case of those whose annual rate of pay and allowances exceeds $1,500.

8 Subject to the conditions set out in Part V, a member of the permanent forces may, dependent upon the length of service, receive either:
(*a*) a pension; or
(*b*) an annual retiring allowance; or
(*c*) a gratuity; or
(*d*) a refund of his pension contributions without interest.

The more important factors to appreciate are that a minimum of 10 years' service in the permanent forces is required to create eligibility for an annual payment; to this service may be added, prior non contributory service, if the contributor so elects and, in the manner prescribed by the Acts, agrees to pay, by way of deductions from his pay and allowances, the amount of contributions covering prior non contributory service in respect of which the contributor has so elected. These arrears may be payable in a lump sum or over a period of years or during the contributor's life time, said periodical payments being calculated on an actuarial basis. In those cases where the member of the permanent forces is released prior to the completion of 10 years qualifying service, he is eligible, depending upon the circumstances whereby he is released, for a gratuity computed on one month's pay and allowances for each year's service or, in any event, he is eligible for a refund of his pension contributions notwithstanding that he was released by reason of misconduct or manifest inefficiency.

9 Provision is also made for the payment of pensions, annual allowances, gratuities to or in respect of widows and dependent children of all members of the permanent forces to whom Part V applies and these, generally speaking, are calculated by reference to the benefits being paid or which would be paid at the date of death, to the deceased member. Pensions and other benefits granted under The Militia Pension Act are subject to income tax and other taxation because the amount of annual contributions is deductible from taxable income.

10 No deduction is made from pensions awarded either under The Pension Act or The Militia Pension Act by reason of the fact that the recipient is entitled to benefits under both Acts.

11 The foregoing information is in no way exhaustive, but is intended solely to indicate the general principles which are involved. If detailed information is required in any particular case, this should be obtained through an examination of the two Acts of Parliament mentioned or preferably, by seeking the same through the proper service channels from those who are in a position to advise.

Modern Rain-Makers

by Dr. T. How

Superintendent Public Weather Services, Meteorological Division, Department of Transport

"Little drops of water,
Little grains of snow,
When mixed together make the rain
That falls on us below."

IT'S AS SIMPLE AS THAT. The theory of modern rain-making can be described in nursery-rhyme words. But the idea took years to develop and, possibly because it was so simple, it was overlooked for a long time by the best scientists. Indeed, most meteorologists had given up trying to "make" weather. They were convinced that weather science was restricted to the study of the natural elements as they occurred. Weather was too big to bring into the laboratory.

Dr. Tor Bergeron, a Norwegian weatherman, had provided the idea for "seeding" clouds back in the early 1930's. Until that time science could give no satisfactory explanation of why rain drops could grow to such a size that they would fall to the ground. They could explain nothing heavier than a drizzle. Bergeron's theory became well established long before the sprinkling of powdered dry ice on clouds was commonplace. He reminded meteorologists that water and ice behaved differently when they are allowed to saturate air with water vapor. This has been known by scientists for a good long time. The actual difference is this. If we sprinkle air with drops of super-cooled water (say at 27°F) we can saturate it with an invisible water vapor. However, when the air is sprinkled instead with small crystals of ice at the same temperature there is a little less evaporation. Ice evaporates almost, but not quite, as readily as water. For instance, the density of saturated water vapor at 27°F, when caused by evaporation from ice, is 3.8 grams per cubic metre; by evaporation from water it is 3.9. At lower temperatures the difference is greater. In this relatively small difference lies the secret to the production of the rain and snow which fall by the billions of tons each year over our country.

Inside a cloud where ice crystals are mixed with water droplets, the air is thoroughly saturated, but, so far as the ice crystals are concerned, the air is overloaded or super-saturated. The result is that vapor condenses on the ice crystals and they grow in size. This in turn takes some water vapor out of the air, and the water droplets are allowed to evaporate a little more to keep the air saturated. In this way, crystals of snow fall earthward at the expense of the water droplets in the cloud.

These ideas, first expounded by Bergeron, can be tested out by any pilot. For one thing, in our latitudes it is almost impossible to find snow or rain falling from a cloud which does not reach above the freezing line. This corresponds with Bergeron's idea that crystals of ice must be present for the water to condense in increasing amounts. Should a pilot ever notice rain falling from a cloud which doesn't reach up to the freezing line, the observation will be very useful to meteorologists.

This photograph was taken just after the cloud in the centre had been seeded with dry ice, and shows the development of ice crystals just beginning.

Indeed, in the tropics, rain is known to occur in moderate amounts where the rain cloud is warmer than 32°F. Temperatures at various heights through the cloud, the exact time, and the location, would be pertinent data on such an occasion.

More evidence of the important rôle of ice crystals can be seen in the appearance of heavy cumulus clouds which are growing into cumulonimbus. Just when rain can be noticed to start falling from the base of the cloud, the towering turrets of the storm cloud lose their sharp white popcorn appearance. A fibrous texture associated with ice crystal cloud becomes plainly visible. The rain starts just when the ice crystals begin to form.

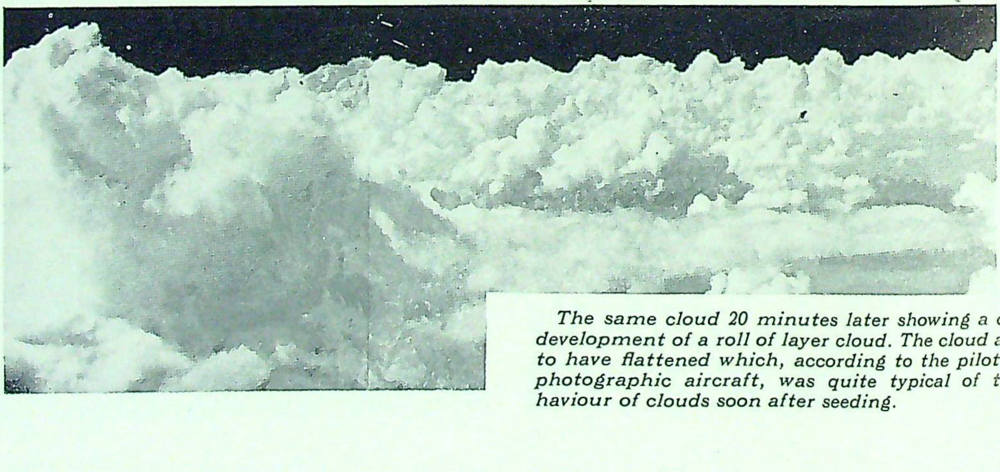
As early as 1930, experiments were attempted to produce the necessary crystals inside a cloud of water droplets. There were further attempts in 1935, but success was not attained until 1946 when Dr. Vincent Schaeffer, of the General Electric Research Laboratories in Schenectady, sprinkled dry ice on clouds. This ice, which is frozen carbon-dioxide, is at a temperature of −110°F or less. As these extremely cold particles drift through the cloud, they cause water vapor to condense as very minute crystals of ice. Each of these serves as a nucleus for the deposit of more ice at the expense of other water droplets in the cloud. The larger ice crystals float downward to fall as snow, or, if it is warm enough near the ground, as rain.

These first successful experiments have led to intensive research in many countries. The economic value of a sure-fire method of rain-making is a glittering prize. Leading the attempts to master the technique is Dr. Schaeffer, whose imaginative genius has brought the snowstorm into the laboratory. Vincent Schaeffer did this very simply, too. Together with the complex equipment to be found at the research laboratory, he installed an ordinary home deep-freeze unit. In this was his "atmosphere" where he was to produce snow, to photograph the growth of snowflakes, and to show that it takes more than cold weather to produce ice crystals in ordinary rain clouds.

The United States Weather Bureau, under Dr. Ross Gunn, aimed its strategy at determining whether or not artificially-produced rain could be made to fall in amounts of economic value to the country. They set up operations at Wilmington, Delaware, and over the course of a year compiled an extremely valuable set of observations.

In Australia and in Hawaii cloud-seeding experiments got under way quickly. In tropical and sub-tropical climates the problems were different. The air was warmer and held more moisture, but the freezing level was higher.

In Canada last year experiments began as the National Research Council, the Meteorological Division of the Department of Transport, and the R.C.A.F. worked out a co-operative plan of attack. Experiments were to be carried out at Arnprior, Ontario, and Suffield, Alberta. To be used in the



The same cloud 20 minutes later showing a curious development of a roll of layer cloud. The cloud appears to have flattened which, according to the pilot of the photographic aircraft, was quite typical of the behaviour of clouds soon after seeding.

project was the latest type of radar equipment for the detection of rain. The usual observation of rain by observers on the ground is not sufficiently accurate to prove convincingly that the rainfall developed from seeding ice crystals. Ahead of them also is the job of finding out just how much dry ice should be used to give the best results. Present reports are contradictory. It was seen early in the research that if rain was successfully produced by cloud-seeding, only to find that natural rainfall also occurred in the area in question, then little had been proved concerning the value of the cloud-seeding method.

However, Dr. Irving P. Krick, a Californian meteorologist who is widely known as the man who sells weather forecasts, felt that even if rain could only be produced on normally rainy days there was still a lot of value to it. He cited the case of the California irrigation reservoirs which have been operating well under capacity because of lack of rainfall. "We can't make it rain when the air is dry," he argued, "but let's see if we can't make it rain harder and over more ground when the weather situation is favourable." His experiments are still in progress.

Everyone agrees that cloud-seeding is hopeless unless there's an ample supply of moisture available. For this reason there is no hope of using dry ice to bring rain to a drought-ridden area. If the Western Prairies lack rainfall because dry westerlies sweep across the district, no amount of seeding in the thin cumulus or altocumulus clouds of the Polar Pacific area will bring relief.

But just the same, there are lots of useful ways to take advantage of "artificial" rain in other less difficult situations. Let's take a look at what the various experimenters have found out.

Down in Australia the rain-makers are very pleased with the results and claim success in producing copious amounts of rain in localized showers and under favourable weather conditions. On the other hand, the United States experiments at Wilmington gave little indication that rain amounts of any consequence were possible in that area. In Canada, the preliminary tests have been more hopeful, and, providing the proper cloud conditions are selected, it is not very difficult to

The same cloud, 40 minutes after seeding. The cloud now appears to have digested its "dose" of dry ice and is building up rapidly—much more rapidly than the surrounding clouds.

produce a little rainfall. The experiments, which are under the immediate supervision of Mr. J. L. Orr, of the National Research Council, have also indicated that the sprinkling of dry ice can modify clouds considerably. Water droplet clouds can be dissipated and ice crystal clouds can be formed in the right sort of atmosphere.

There are several private concerns attempting to test the value of the seeding experiments. "Rain-maker pilots" have operated sporadically at various points in Canada and the United States. Tommy Fox, of Associated Airways in Edmonton, tells this story:

"We took off from the Edmonton Airport at approximately 1925 hrs. and climbed to 19,200 feet. We were above the top of a large cumulus type cloud at 19,000 feet and seeded it with approximately 17 lbs. of dry ice. I flew through the edge of this higher portion of the cloud, flying towards the sun, and it seemed to be formed by ice crystals.

"We seeded the cloud at approximately 2000 hours, and at this time it was located about 8 miles west of the Edmonton Airport. The cloud was travelling in a northerly direction and by the time we had descended to an altitude of 5,000 feet above sea level, it was located considerably north of Edmonton. It seemed at this time to be giving solid rain over a width of approximately 15 miles. We checked available sources the next day and received information that they had had showers at Morinville and Legal between 2000 and 2030 hrs., and that they had received one-half hour's heavy rain at Clyde commencing at about 2030 hrs. We feel reasonably sure that the rain from this cloud was caused by the seeding with dry ice, since at the time of our experiment the clouds in this area were dissipating rapidly, and it would seem there would be lessening tendency for them to give off precipitation."

Scientists, however, are reluctant to claim the seeding of clouds is a successful rain-making routine. They do point to several important successes in the unfolding of the mystery of rain production. One of the most fundamental of these is the finding in the General Electric laboratories that water droplets won't freeze by themselves unless they are cooled to −102.2°F.

But we are accustomed to seeing water freeze at 32°F. What does this new idea mean? Well, most of us who have seen ice form on the leading edge of an aircraft wing know that water droplets can be cooled below 32°F without freezing; then in collision with the surface of an aircraft the super-cooled water changes to treacherous solid ice. In the laboratory, water has been cooled to −101.3°F and it has still remained a liquid.

There is convincing evidence that water vapor by itself will not condense to form ice crystals unless the temperature is −102.2°F or less. If the temperature is higher than this, foreign nuclei or ice crystals have to be already present.

To demonstrate this idea, Schaeffer used his deep-freezer to cool air down to its saturation point. He found then he could produce a mist of ice crystals when he waved a very cold wire through the air—but only if the wire was at least −102.2°F. He therefore claims that one sure-fire method of producing the all important nuclei for snowflakes to grow on is to cool a cloud down to this low temperature.

But he has found other ways as well. One of these is to "fool" the water vapor by using silver iodide crystals. These, like ice crystals, are six-sided in structure, and each serves as the centre of the snow crystal which forms around it. Silver iodide generators have been made which produce 10,000,000,000,000 particles per second.

The same cloud 55 minutes after seeding.

Dr. Irving Langmuir, who plans the General Electric rain-making research, estimates that a spherical pellet of dry ice about 1/6 inch in diameter will fall for 130 seconds before evaporation. During this fall it would condense 60 milligrams of water vapor into 10 million billion ice nuclei. If these could be scattered throughout a sufficiently large volume of cloud, they would produce a snowfall of 100,000 tons. Of course, such a distribution of ice crystals from one pellet of dry ice is quite impossible.

Production of ice nuclei by granulated dry ice can be used for other purposes. Canadian experimenters have made ice crystal clouds in an otherwise clear sky. Several researchers report success in dissipating super-cooled stratus cloud! But as yet there is no recorded incident where dry ice has been used to clear an airport in wintertime of zero-zero weather. Other men suggest that seeding of young thunderheads might prevent the accumulation of hailstones inside them—that the energy of a potential hailstorm can be dissipated before it gets under way.

There is one thing certain. A new science of "cloud physics" has been established. While it will not bring true the dreams of the magic rain-maker, it will almost certainly unravel the whole story of how raindrops and the all important ice-nuclei are produced in nature.

(The illustrations used in the foregoing article are reproduced by courtesy of the "South African Air Force Journal." They appeared originally in conjunction with an article on rain-making in South Africa.—Editor)

"Operation Vittles": Stalingrad, 1942

by Klaus D. Geerdtz-Strack

The following article was forwarded to the Editor by Wing Cdr. F. H. Boulton, D.F.C. The author, Klaus D. Geerdtz-Strack, (13b) Bayerisch Gmain Nr. 81 1-3, American Zone, Germany, formerly an officer in the German Army, saved the life of Wing Cdr. Boulton who was shot down over Germany on May 13th, 1943. He was about to be murdered by German soldiers in retaliation for Allied bombing when Geerdtz-Strack intervened and took him to a hospital.

Since his repatriation, Wing Cdr. Boulton has corresponded with Herr Geerdtz-Strack who, in a letter which we need not quote in its entirety, writes:

"To-day I am sending you my translation of an article written by myself for German papers . . . I was posted as army liaison officer to the air force during the German 'Operation Vittles' for the relief of Stalingrad, after I escaped from the 'fortress' . . . so my report is a first-hand impression."

The article appears exactly as it was written, except for the correction of several linguistic errors which might possibly confuse the reader.

* * *

The final agreement of the "Big Four" to lift the blockade of Berlin on May 12th, 1949, might well have drawn public attention to a comparative study of the German air supply system for Stalingrad after the surrounding of von Paulus' 6th Army by the Russians in the winter of 1942.

On November 21st, 1942, General von Paulus' 6th Army, fighting in and near Stalingrad, was encircled by the tanks, infantry, and artillery of Generals Rokossowski and Shukow. The original plan of the 6th Army staff to break through the Russian lines could not be carried out, since the German High Command had given orders to await help from the 4th Tank Army of General Hoth, who was advancing from the south-west. If necessary, our troops were to fight to the last man. Notwithstanding the fact that several of his officers (including General von Seydlitz, now a member of the "National Committee for Free Germany" in Russia) had vigorously objected, von Paulus obeyed his orders; and thus the historic battle of Stalingrad came to be fought out to the bitter end.

It was apparent, however, that the 6th Army's stockpiles of fuel, food, and ammunition would soon be exhausted. Therefore Hitler, following a suggestion of Goering's that the Luftwaffe could supply the Stalingrad troops by air lift for a year, gave instructions that the 350,000 besieged men be kept equipped with their needs by plane. Transport groups of the Luftwaffe were ordered to the Eastern Front from France and other occupied countries.

The types of aircraft used were Junkers 52's, Heinkel III's, and a few Focke-Wulfs. The Ju 52 could carry between 1 and 2 German tons*, and a He III about ¾ of a German ton. Fighter support was almost unavailable, and the Ju 52 had only a light machine-gun in its tail. The Russians, on the other hand, besides their fighters, had anti-aircraft guns of all calibres. To make matters even worse, our transport groups were not prepared for a winter campaign in Russia.

The number of planes engaged in the air lift proved inadequate. The former Colonel Selle, engineer officer-in-chief of the 6th Army, stated that *at least* 750 tons of supplies were needed

*One German ton = 2,250 lbs.

daily by the besieged troops—and even this seems a curiously low figure. According to Hitler's orders, about 200-300 planes were to make three trips each per day into Stalingrad; but, in actual fact, this goal was not once achieved. Colonel Selle estimated that, during the first days of the blockade, an average of 50-70 planes made daily landings at Pitomnik and Gumrak airfields, near Stalingrad—and even this number decreased rapidly as time went on.

The Stalingrad version of "Operation Vittles" was co-ordinated by the army-group Don and the lufttransportfuehrer Stalingrad, from airfields (Rostow, Morosowskaja, Tazinskaja, etc.) some 200-300 kilometres away from the city.

Weather conditions worried the pilots. Heavy snowstorms raged in the southern desert, and de-icers were not available at that time in the Luftwaffe—nor, of course, were the other modern flying aids. Fuel supplies arrived slowly, and the camouflaged depots were discovered by Russian reconnaissance and heavily bombed. Many of the German planes were destroyed on account of the lack of fighter escort.

Notwithstanding all this, during a short period before Christmas up to 100 aircraft per day managed, by dint of desperate efforts, to bring in supplies. On the other hand, sometimes no planes at all got through. The maximum number of aircraft that ever landed in one day is believed to have been between 150 and 170. In December 1942 the maximum lift reaching Stalingrad was approximately 250 German tons. What a difference from the 5000 U.S. tons brought in daily to Tempelhof and Gatow during the Berlin air lift—with its record of 11,786 tons on April 15th, 1949!

Gumrak airfield was taken by the Russians shortly after the encirclement of von Paulus' army, and Pilomnik was surrendered in the middle of January 1943. Even prior to its surrender, however, it had been a constant 'headache' to our pilots, as the Russians had harassed them by means of false lights and radio.

Almost incredible stories were told by the crews of aircraft returning from Stalingrad . . . of how, as each plane was about to take off, terrified soldiers tried to take hold of its wings . . . of wounded men storming the planes and being of necessity held off by the doctors at pistol-point . . . of the shooting down of planeloads of wounded by Russian fighters . . .

And so the tragedy of Stalingrad—a tragedy (though perhaps a necessary one) for the German people—neared its end. The approaching 4th Tank Army of General Hoth was wiped out by Russian tank divisions attacking it from east, west, and north. After that, even the supply bombs that had been dropped since the surrender of Pitomnik airfield almost all fell on the Russian side. The last horses had been eaten. No ammunition for tanks or heavy guns remained. No movement of any kind of motorized vehicle was possible, because all fuel was exhausted. Medical aid had ceased to exist: men died, often by slow freezing. The Germans were helpless against the Russian fire—including that of the dreaded "Stalinorgel."

On February 3rd, von Paulus (who had been promoted to Field Marshal during the last days of his stand) surrendered to the Red Army with the 90,000 men that remained to him.

May the battle of Stalingrad be a warning to mankind.

★ ★ ★

'Sh ! - The Clams . . .

Private pilots out near Hoquiam, Wash., have a new worry. Sheriff Mike Ilgore warns lightplane owners they'd better stop landing on nearby ocean beaches because they'll disturb the clams. It seems clams are a big business around Mike's diggin's and the natives don't want those clams disturbed. Research proves that the little clams, in particular, get panicky when planes go bouncing around above them. Future violations may be reported to CAA, says the sheriff.

("*Aviation Week*")

The ROYAL CANADIAN AIR CADETS

by Arthur Macdonald

Director of Publicity, Air Cadet League of Canada

Sixteen-year-old Jimmie Dawson of No. 161 (Saint John) Squadron, N.B., may only have one leg but most people who know him are betting that he will soon realize his ambition to learn to dance.

Jimmie travelled to Montreal recently to be fitted for a new artificial leg. While there, he paid a visit to the RCAF's famous No. 426 Squadron where he was tracked down by a number of newspapermen. A blond, slim boy, he told them that his hobby had been collecting stamps but once the leg was fitted he intended to take up dancing.

"My sister will teach me," he said. "After all, that's what sisters are for."

Ten years ago Jimmie was hit by a car. The accident forced amputation of his right leg just above the knee. His father, a disabled war veteran who is unable to work, could do little for him, but Jimmie continued his schooling and is now in Grade Nine. He got around on an artificial leg he received in 1945, but according to Jimmie it was, "a little small as I have grown a lot in the past four years. Also it was a bit clumsy."

Last year Jimmie joined No. 161 Air Cadet Squadron. His perseverance and determination not to let the injury handicap him, impressed his officers.

The squadron CO, Flt. Lt. E. Frye and his two assistants, Flt. Lt. Jack Bardsley and F/O A. MacKie, put their heads together to see what could be done. The Fundy Flying Club offered to help and later flew Jimmie to Moncton. There an RCAF North Star, piloted by Flt. Lt. G. Shea, brought him to Montreal. Within a few days he was fitted with a new artificial limb—courtesy of the New Brunswick Provincial Committee of the Air Cadet League, headed by chairman C. K. Beveridge.

As he walked on his new leg for the first time, the young Air Cadet was already making plans for the future. "Now I'll be able to get a job in the summer to help out the family," he said.

* * *

As this issue of "The Roundel" goes to press, plans are being completed for an event to take place at the Canadian National Exhibition in Toronto, on Tuesday, August 30th.

On that afternoon, on the imposing outdoor stage of the C.N.E., a prize drill team of Royal Canadian Air Cadets meets a similar group from the U.S. Civil Air Patrol in a second-year competition for the Major General Lucas V. Beau International Challenge Trophy. The Trophy is currently held by Canada, having been won at New York by an Air Cadet team selected from squadrons in the Montreal and Ottawa areas.

General Beau, who is National Commander of the Civil Air Patrol, established the award in 1948 with the idea of stimulating friendly competition between Canadian and American youth. This is the second in an annual programme of drill contests scheduled to last for a period of ten years. The competitions will be staged in Canada on alternate years.

The 1949 Canadian team comprises outstanding Air Cadets chosen from squadrons throughout Ontario. They will vie with a highly-regarded

American squad from the New Jersey Wing of Civil Air Patrol. This team recently survived a gruelling series of zone and regional competitions to establish itself as America's best.

Both groups will perform against an impressive backdrop of Toronto Air Cadets who will march on-stage to the music of the famous U.S. Air Force Band. A panel of four Air Force judges—two from each country represented—will have the difficult task of selecting a winner.

A complete report on the Beau Trophy competition will appear in a future issue of "The Roundel."

* * *

As this is written, the third annual Air Cadet exchange programme is in full swing. In future issues, the widely-travelled Canadian Cadets will give a first-hand report on their experiences. Meantime, however, the following details of the entertainment arranged for the visiting U.S. and British lads will no doubt be of interest.

The programme got underway on July the 29th when U.S.A.F. aircraft landed at Ottawa and Calgary bringing a total of 25 U.S. Civil Air Patrol Cadets to Canada. Next day the same planes made return flights across the border carrying 26 Canadian cadets on a thrilling two-weeks' tour of the United States.

Six days later the centre of operations switched to Dorval Airport, Montreal. There, at noon, Aug. 4th, a four-engined RCAF North Star took off on the first leg of a trans-Atlantic flight to Britain. Comfortably seated inside were 24 cadets bound for three weeks of sightseeing in the United Kingdom. The North Star set down at Northolt Airport, London, on Aug. 5th, and on a turnabout flight brought a reciprocal party of Air Training Cadets to Canada for an enjoyable and educational holiday.

Following an official reception by the C.A.S., the eastern group of U.S. Cadets flew to the Air Cadet camp, Summerside, P.E.I., first stop on an extensive jaunt through the Maritimes. On Aug. 3rd, they travelled to St. John's, Newfoundland, for deep-sea fishing and sightseeing in Canada's tenth province. By Aug. 5th, they were back in Halifax for a week-end of yachting and relaxed entertainment, and three days later flew to Saint John, N.B. From this point they headed west, stopping off for a day in Fort William. They left the Lakehead on Aug. 12th for the long flight to Edmonton, arriving in time to meet the western U.S. Cadets as well as the Canadian party returning from the States.

Meanwhile the western C.A.P. Group flew over the Rockies from Calgary to spend the early portion of their stay in British Columbia. From their Sea Island base they toured points of interest on Canada's scenic west coast, visiting logging camps, lumber mills and other centres of industry and commerce as guests of the British Columbia Provincial Committee. Informal receptions and parties rounded out the west coast programme before the Cadets departed for Edmonton on August 10th. From Edmonton they made a swing through the great Canadian north, stopping off at Whitehorse in the Yukon. After observing the Arctic phenomenon of twenty-four hours of daylight they flew back to Edmonton.

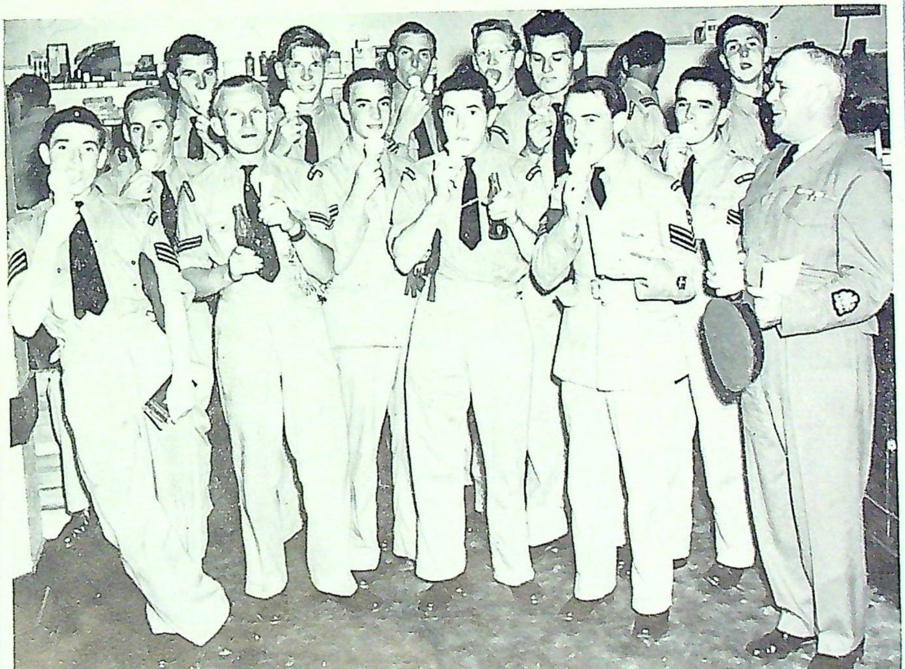
The massed party of fifty-two U.S. and Canadian Cadets took part in a final gala "get together" at Edmonton before heading for their respective homes on August 14th.

During the first phase of their stay in Canada, the British A.T.C. Cadets were based at the Air Cadet summer camp, Aylmer, Ont.

Under the auspices of the Ontario Provincial Committee of the Air Cadet League they enjoyed visits to Timmins, North Bay, Toronto and Niagara Falls as well as a day's outing on the scenic Lakes of Muskoka.

On August 18th they proceeded to Ottawa for official receptions and sightseeing in the nation's capital. The next stop was Montreal, where several relaxing days of entertainment were arranged by the Quebec Provincial Committee. An enjoyable day at the Laurentian home of Mr. and Mrs. C. Douglas Taylor highlighted this period. The return flight across the Atlantic left Montreal Airport on August 23rd.

The C.A.S. welcomes Lt. Col. W. G. Johnson, in charge of 13 visiting members of the U.S. Civil Air Patrol, on his arrival in Canada at R.C.A.F. Station, Rockcliffe.



25 visiting British Air Training Cadets lap up ice cream cones in the Trenton canteen. Right: W.O.1 John Silver, S.W.O. of R. C. A. F. Station, Trenton, who accompanied the Canadian Cadets to the U.K. last year.

Canada's N.R.C.

(Though most people are aware that the initials N.R.C. stand for National Research Council, it is questionable whether many of them realize the variety and importance of the services that the Council performs for Canada. In its eight main Divisions (Chemistry, Physics, Radio and Electrical Engineering, Medical Research, Building Research, Information Services, and Applied Biology) some of Canada's leading men of science are constantly carrying out research into practically all those scientific problems which affect, or may affect, our national life.

In this article we are concerned with giving our readers a broad idea of only one aspect of the Council's multifarious activities, namely, the work of the Aeronautical Laboratories. Mr. J. H. Parkin, C.B.E., Director of the Division of Mechanical Engineering (which includes the Aeronautical Laboratories) has very kindly given us permission to piece our account together from various issues of the Division's "Quarterly Bulletin."—Editor)

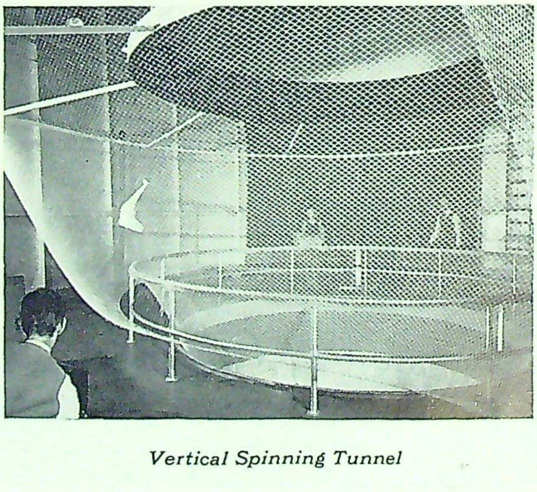
THE FACILITIES of the Aeronautical Laboratories are generally of a character and capacity not elsewhere available in Canada. In this way the Laboratories fulfil their main function to provide the Canadian aviation industry, both contractors and operators, with research, development and testing facilities and also function as the research organization of the Royal Canadian Air Force. Almost all phases of aeronautics are covered, and the facilities include atmospheric and spinning wind tunnels, model testing basin, water tunnel, equipment for testing full scale internal combustion engines and gas turbines, aircraft wings and components, and for work on vibration, fatigue, photoelasticity, gasolines, turbine fuels, lubricants and aircraft and allied instruments.

The Aerodynamics Laboratory

The performance of newly designed aircraft and the effects of modifications to existing aircraft are studied in the wind tunnels in the Aerodynamics Laboratory.

Using models in the wind tunnel, the effect of variations in attitude, control surface setting, and of modifications on the stability and control of an aircraft, can be determined and its performance predicted. The vertical spinning tunnel provides a safe medium for studying the spinning characteristics of an aircraft. Motion pictures are taken of the freely spinning model, and from the study and analysis of the films the spinning characteristics of the full scale aircraft can be predicted.

At the present time correlation tests are being carried out in this tunnel to determine how results here compare with results in other spinning tunnels, i.e. the R.A.E. tunnel at Farnborough and the N.A.C.A. tunnel at Langley Field.



Vertical Spinning Tunnel

Recent and current projects include—

the development of apparatus for studying the flow and pressure distribution over an aerofoil; further tests on the N.R.C.'s tailless glider; development of a chronophotographic camera for the absolute measurement of air speed; wind tunnel tests on three new Canadian aircraft; and tests on radar scanning antennae under conditions of high wind.

The Structures Laboratory

In addition to the aerodynamic qualities of aircraft designs, the properties of the structures must also be examined. The Structures Laboratory is equipped with a variety of testing apparatus and instrumentation for indicating the effects of loading on various components of an aircraft under different flight conditions. The most recent addition to the facilities of the Laboratory is the equipment for the static testing of full scale aircraft components snch as wings and tailplanes.

Recent and current projects include—

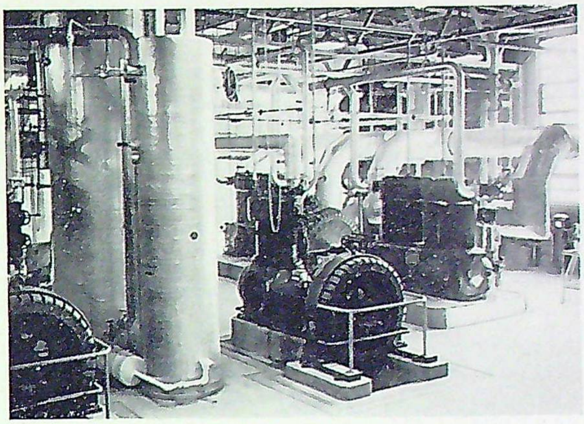
experimental study of curved plates subjected to endwise compressive loading; research on wing flutter; tests on the strength of a new type of prefabricated army hut; study of the vibration of box beams of various tapers, mass and stiffness distributions, and degrees of freedom; and vibration tests on a Canadian-built aircraft.

The Low Temperature Laboratory

Problems peculiar to Canadian aviation are associated with cold weather, and consequently a large amount of the work done in the Laboratories is concentrated on the improvement of the low temperature operation of aircraft. The recently completed Low Temperature Laboratory, equipped with large cold chambers and an icing wind tunnel, permits work on aircraft components, engines, fuels, structures and many items of equipment. Icing, one of the great flying hazards, is also studied in flight by laboratory crews using a specially equipped aircraft provided and flown by the R.C.A.F.

Recent and current projects include—

layout of the alternating current de-icing system of the R.C.A.F. North Star which is to be used for icing research; service trials of a complete N.R.C. electro-thermal propeller de-icing system on an R.C.A.F. Lancaster; experimental investigation of electro-thermal surface protection for the intake components and stator and rotor blades of a gas turbine; analysis of the results of all Canadian experiments in induced precipitation; and the fundamental study of the physical properties of supercooled water.



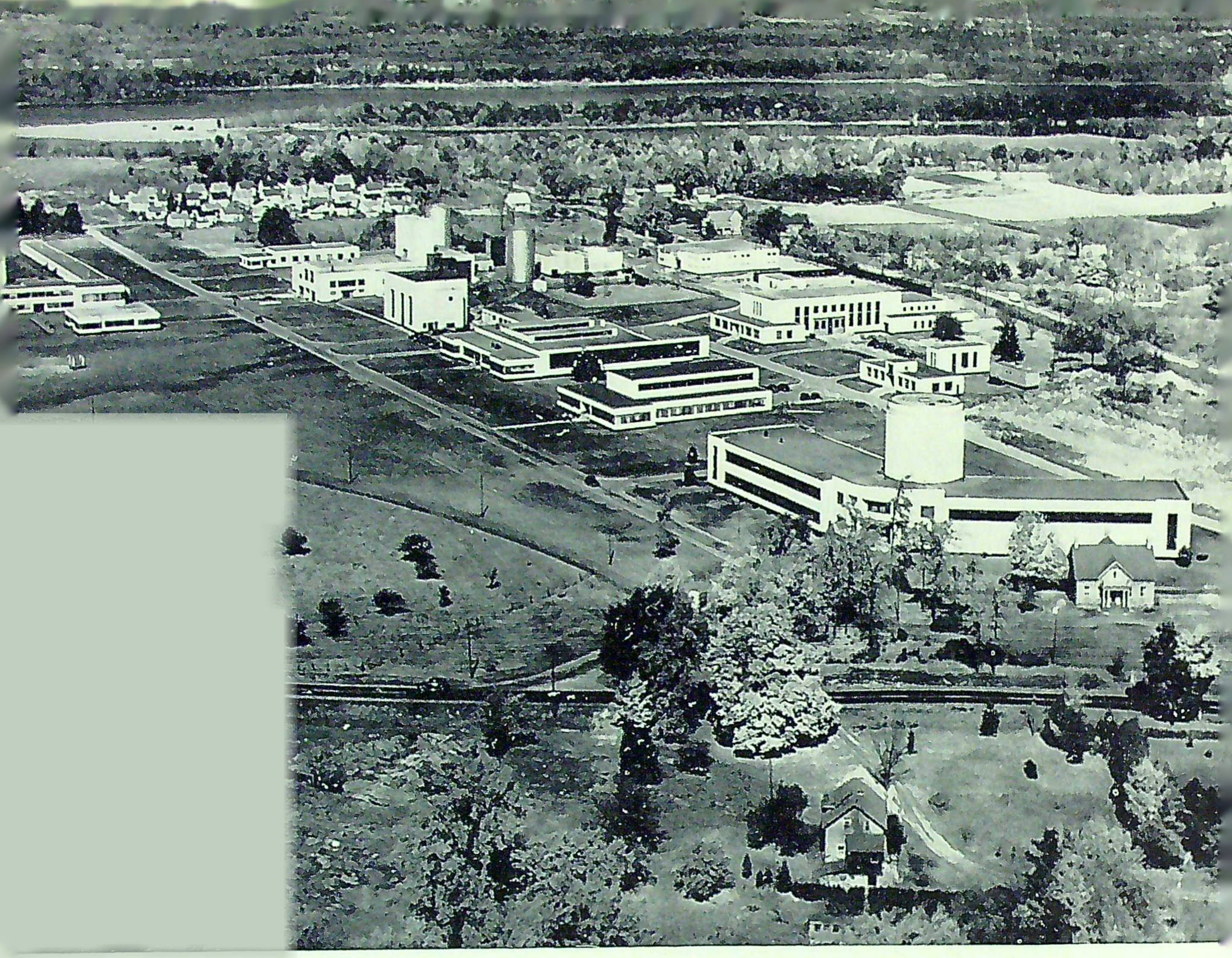
Low Temperature Laboratory

The Engine Laboratory

The Engine Laboratory was originally designed and built for the full scale testing of reciprocating aircraft engines. Since late in 1946 the test cells have been redesigned and converted for the testing of turbo-jet engines, with the exception of one 5000 H.P. Dynamometer Room and the Single Cylinder Laboratory which have been reserved for piston engine work.

There are at present four full-scale jet engine test beds in the Laboratory, three for simple jets while the fourth is designed for either simple jets or turbo-prop units.

Advantage has been taken of the lowest prevailing winter temperatures at the Laboratories to carry out low temperature endurance tests on engines and components under these conditions of high load, and to study the effect of a simulated icing cloud condition on turbo-jet engines.



Aeronautical Laboratories, N.R.C.

Tests have also been run to compare the performance of a number of wide boiling-range turbo-jet fuel cuts in low temperature operation.

The Flight Research Section

A Flight Research Section is operated at Arnprior, in co-operation with the R.C.A.F., for the investigation, in free flight, of problems in aircraft control and stability, transonic aerodynamics, ski undercarriages, and artificial precipitation. The National Research Laboratories' Tailless Glider, designed and constructed in the Structures Laboratory and examined in the atmospheric and spinning tunnels, is now based at the Flight Research Section and will be utilized for the investigation of the control and stability of tailless aircraft.

Recent and current projects include—

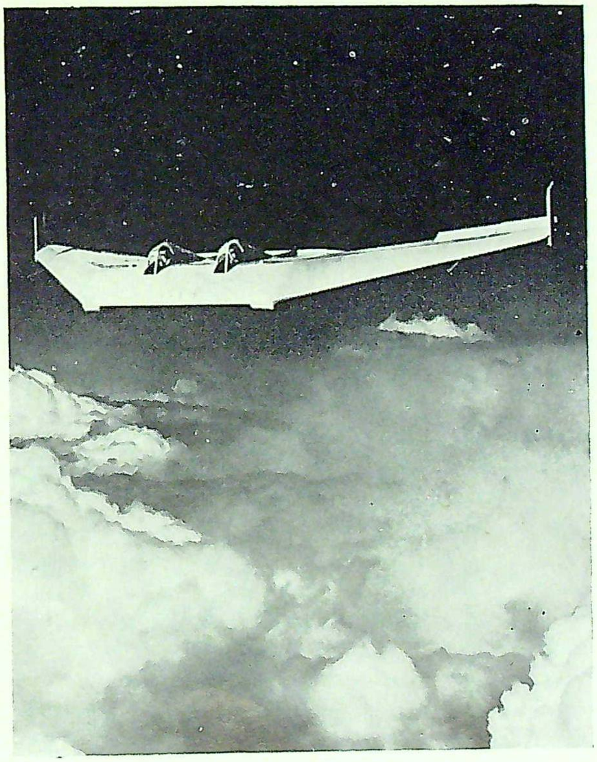
transonic research, using small models in the transonic region lying above prepared test sections on the wings of a Mustang; Tailless Glider flight tests; Norseman ski test; experiments in induced precipitation (with dry ice); and North Star performance and stability testing.

The Instrument Laboratory

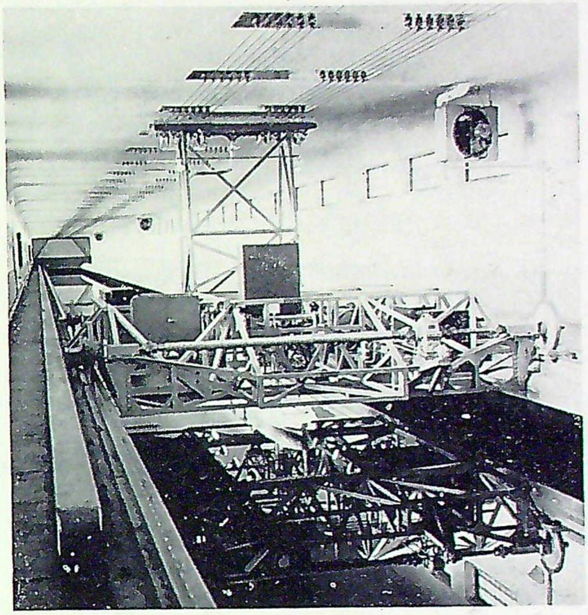
The development, calibration and maintenance of the instrumental equipment required for the research projects in the Aeronautical Laboratories is the function of the Instrument Laboratory. The complete instrumentation of the National Research Laboratories' Tailless Glider was developed in the Instrument Laboratory, as well as many instruments for the study of the meteorological conditions associated with the icing of aircraft. The Instrument Laboratory is also equipped to undertake the calibration of air speed indicators, altimeters, tachometers, pressure gauges, gyro attitude direction and rate of turn indicators and many electric type instruments. These calibrations can be made at normal and low temperatures. The behaviour under vibration can also be investigated.

Recent and current projects include—

the design and manufacture of the instrument equipment required for installation in the North Star aircraft which is being fitted for aircraft de-icing research; and, at the request of the R.C.A.F., the designing and building of an instrument to record the rate of firing of machine guns.



Tailless Glider



Model Testing Basin

The Model Testing Basin

The Model Testing Basin undertakes work for naval architects and ship builders as well as for the aircraft industry. Facilities are available in the Hydraulics Laboratory for work with river and harbour models and models of hydraulic structures.

* * *

The facilities of the Laboratories are continuously under review and modification in order to keep abreast of the ever-changing requirements in the field of aviation. The current emphasis on high-speed flight has resulted in a need for supersonic wind tunnels and equipment for work on combustion, compressors and turbines; and the design of a supersonic laboratory to provide such facilities has begun.

Promising the moon brings results only in the electoral world.

Commandant J. Block
(*"Forces Aériennes Françaises"*)

ROYAL CANADIAN AIR FORCE Association

"The Roundel'

By this time all members of the Association should be receiving "The Roundel" each month. Anyone who is not getting it has only to drop a line to:

The General Secretary,
RCAF Association,
424 Metcalfe St.,
Ottawa, Ont.

The editor of "The Roundel" tells us that quite a number of our members have written to him, asking if back issues of the magazine are obtainable. At present, unfortunately, they aren't; but it is hoped that a limited number of copies will be available later on. If and when it becomes possible to supply back issues, an announcement to that effect will be made.

Don't overlook the fact that the RCAF Association's section of "The Roundel" offers you the best imaginable means of exchanging your views, news of your activities, etc. Don't leave it to us to fill. Chairbound here in Ottawa, we can't give it the vital and personal touch that you can. It is suggested that every Wing appoint a publicity member to its executive—someone who can keep us posted as to your doings, send us photographs, articles, and anything that may be of interest to other Wings or members-at-large. The editor assures us that all contributions will be welcome, in any form. Send your material to the General Secretary of the Association. Contributions received by the 20th of any month will be used in the issue of the second following month—for example, a contribution received prior to September 20th would appear in the November issue.

No. 702 (Lethbridge) Wing

What does an Air Cadet Squadron do when it has no money to pay for three Air Cadets' summer board at a Flying Club? This problem dropped into the lap of Flt. Lieut. George Watson, C.O. of 11 Sqn. (RCAC), and a member of No. 702 (Lethbridge) Wing, RCAF Association.

Walter Reich, Vice-president of the Lethbridge Flying Club and a patron of No. 702 Wing, solved the problem. He approached three patrons of 702 Wing, and each assumed the responsibility for boarding one Air Cadet with the Lethbridge Flying Club.

Mr. E. R. McFarland, President of the Lethbridge Flying Club, and Messrs. P. O. Emerson and F. King, both active members of the Club, are enthusiastic over the training of Air Cadets towards obtaining their private licenses. Mr. McFarland, who is also a member of the provisional executive of the RCAF Association for Alberta, made history on May 31 when he offered one hour's dual to every Air Cadet bringing in a new recruit, and a half hour in one of the Club's Fleet Canucks to each new recruit.

At the regular July meeting of No. 702 Wing, the members resolved to create a scholarship of $25 to help a meritorious Air Cadet pay for his advanced training for his private license.

No. 405 (Porcupine) Wing

From Mr. Jack Pringle, Publicity Chairman of No. 405 Wing, we learn that the Association in Timmins is considering the possibility of taking over, or assisting in, the sponsorship of the local Air Cadet Squadron. Present sponsors are the

Kiwanis Club. At No. 405 Wing's first regular dinner meeting in July, a motion was passed to request a joint meeting with the Kiwanis executive for the purpose of discussing the matter. Great tribute was paid to the members of the Kiwanis Club, who have spent much money and effort on the Squadron; but, as an Air Force Group, the Wing is naturally anxious to lend its support to the Timmins Air Cadets.

The dinner was such a success that it has been decided to hold a similar function every third Wednesday, beginning on August 20th. This arrangement would, it was felt, enable miners or other shift-workers to attend a majority of the meetings.

Cpl. W. S. Tennyson, of RCAF Station Aylmer, was a guest at the first dinner. He told the members that "The Roundel" was being very well received by the men in the Air Force and that he and his "buddies" hoped that the Association would get lots of space in the magazine, as they were all interested in their activities.

Something for Shatterproof. Miss Muriel Keith, sponsored as "Miss Air Force—1948" by the Air Force Club of Kirkland Lake.

No. 405 Wing is starting a membership campaign, with the objective set at several hundred. The Porcupine area contains some 350 ex-Air Force men.

The Association To-day

The Association now has more than 6,000 members. Of these, 3853 are members-at-large, many of whom it is hoped to bring together in Wings before this present year is out.

We give below a list of all the existing Wings, showing the names of their respective executives, and the number of their members.

No. 100 (Bluenose) Wing, Halifax

This is the only hundred percent W.D. Wing of the Association. It has 38 members.

President:	Miss Ruth E. M. Vogler
1st Vice-president:	Miss Hilda Thompson
Secretary:	Miss Mildred Rogers
Treasurer:	Miss Eleanor S. Cameron
Chairman Dramatics Committee:	Miss Patricia A. Smith
Catering Committee:	Miss Rhoda Wilkie
Dramatics Committee:	Miss Clare I. Webber

No. 101 (Atlantic) Wing, Halifax

Membership: 99

President:	Mr. William Gordon Jr.
1st Vice-president:	Mr. Lloyd Allen
2nd Vice-president:	Mr. Donald Farnell
Secretary:	Mr. Paul Emmerson
Treasurer:	Mr. Gerlad Godfrey
Additional Member:	Mr. William Scott
Additional Member:	Mr. Frederick Power
Additional Member:	Mr. Angelo Casagrande

No. 102 (Colchester) Wing, Truro

Membership: 36

President:	Mr. F. W. Young
1st Vice-president:	Mr. J. E. Comeau
2nd Vice-president:	Mr. J. Kendrick
Secretary:	Mr. G. M. Gillespie
Treasurer:	Mr. D. T. O'Brien
Additional Member:	Mr. F. L. Wilson
Additional Member:	Mr. R. E. Chisholm
Additional Member:	Mr. H. P. Roode

No. 250 (Saint John, N.B.) Wing

Membership: 74

President:	Mr. Charles Swanton
Secretary:	Mr. E. B. Fitzgerald

No. 251 (Madawaska) Wing, Edmundston

Membership: 42

President:	Mr. W. K. Scott
1st Vice-president:	Mr. J. L. A. Pelletier
2nd Vice-president:	Mr. J. Z. E. Clavette
Secretary:	Miss Roberta Richards
Treasurer:	Mr. P. A. Charest
Additional Member:	Mr. R. Dube
Additional Member:	Mr. R. Castonguay

Additional Member:	Mr. A. P. Stothart
Additional Member:	Mr. M. Louden
Additional Member:	Mr. J. H. Cyr
Additional Member:	Mr. R. V. McCabe

No. 300 (Remembrance) Wing, Granby

Membership: 27

President:	Mr. Rean Meyer
1st Vice-president:	Mr. Edward Ossington
2nd Vice-president:	Mr. Robert Shanks
Secretary:	Mr. Robert Costley
Treasurer:	Mr. Jacob Katchergensky
Additional Member:	Mr. John Bergeron
Additional Member:	Mr. Stuart Armstrong
Additional Member:	Mr. Marcel Barre

No. 301 (Air Force Veteran's Association) Wing, Montreal

Exact membership figure is not at the moment available. It is, however, extremely large.

President:	Mr. Roy H. Foss
1st Vice-president:	Mr. T. Cecil Davis
2nd Vice-president:	Mr. Joseph M. St. Pierre
Secretary:	Mr. Albert E. Roodhouse
Treasurer:	Mr. Gerard R. Monty
Additional Member:	Mr. Jack G. Ireland
Additional Member:	Mr. Charles H. Link
Additional Member:	Mr. Clifford M. McEwen

No. 400 Wing (Guelph Wings Club)

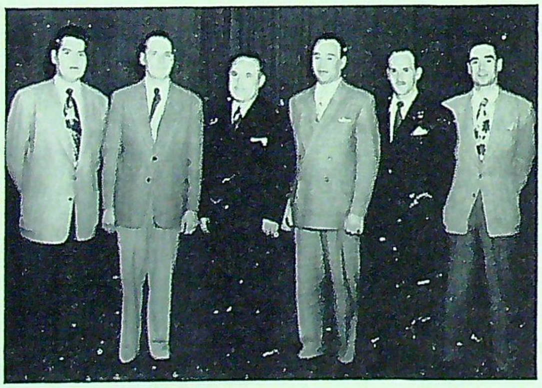
Membership: 93

President:	Mr. John Spence, D.F.C.
1st Vice-president:	Mr. John Florence
2nd Vice-president:	Mr. Kenneth Jeans
Secretary:	Mr. Harold Gillespie
Treasurer:	Mr. John Shoemaker
Additional Member:	Mr. William Maxwell, D.F.C.
Additional Member:	Mr. Thomas Olsen
Additional Member:	Mr. Jim Marsland

No. 401 Wing (Air Force Club of Kirkland Lake)

Membership: 35

President:	Mr. Stanley Johnston
1st Vice-president:	Mr. Wilfred Nubel
Secretary:	Mr. Joseph Audet
Treasurer:	Mr. Mandle Gurevitch
Additional Member:	Mr. Howard Robinson
Additional Member:	Mr. Paul Scanlon, D.F.C.
Additional Member:	Mr. George Baker



No. 401 Wing. Left to right: Messrs. G. Charbonneau, W. Nubel, S. Johnston, M. Gurevitch, D. Scanlan, H. Robinson.

No. 402 (Sudbury District Air Force Association)

Membership: 80

President:	Mr. Alan Sangster
1st Vice-president:	Mr. Russell Blain
2nd Vice-president	Mr. Denis Thyne
Secretary:	Mr. William Couch
Treasurer:	Mr. Omar Boucher

No. 403 (City of Sarnia) Wing

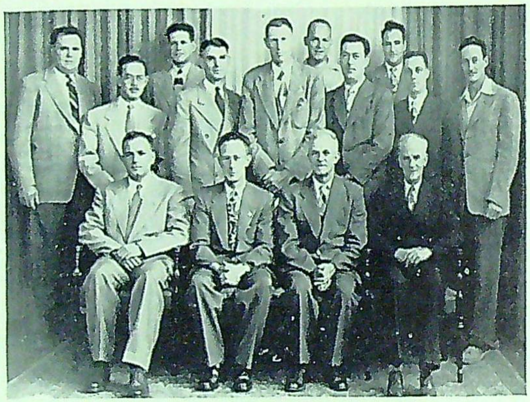
Membership: 42

President:	Mr. John P. James
1st Vice-president:	Mr. Harry B. Turnbull, D.F.C.
2nd Vice-president:	Mr. Richard T. Gates
Secretary:	Mr. William G. Keelan
Treasurer:	Mr. Frederick E. Miller
Additional Member:	Mr. David A. Harding, O.B.E., A.F.C.
Additional Member:	Mr. Douglas I. Macklin, A.F.C.
Additional Member:	Mr. David P. Jamieson, B.M.E.

No. 404 (Kitchener-Waterloo) Win g

Membership: 117

President:	Mr. Charles Stover
Vice-president:	Mr. Arnold Rothschild
Secretary:	Mr. George Douglas
Treasurer:	Mr. Thomas Hetherington
Assistant Secretary:	Mr. Harold Beaupre
Assistant Treasurer:	Mr. Jack Playford



No. 405 Wing. Front row (left to right): Messrs. E. Finchen, G. Gedge, E. A. Cain, T. E. Ashton. Rear (left to right): Messrs. Monahan, Hardy, Carswell, Farrow, Verity, Van Rassel, Goodman, Lafranier, Richer, Tennyson.

No. 405 (Porcupine) Wing, Timmins

Membership: 40

President:	Mr. E. A. Cain
1st Vice-president:	Mr. G. Gedge
Secretary-Treasurer:	Mr. E. Finchen
Additional Member:	Mr. T. E. Ashton
Additional Member:	Mr. D. Hardy
Additional Member:	Mr. H. Shuttleworth

No. 406 (North Bay and District) Wing

Membership: 110

President:	Mr. Reginald Lehman
1st Vice-president:	Mr. Allan Larden

2nd Vice-president:	Mr. Clifford Alger
Secretary:	Mr. Frank Sider
Treasurer:	Mr. Bruce McCubbin
Additional Member:	Mr. John Halliday
Additional Member:	Mr. Robert Harris
Additional Member:	Mrs. Dorothy Saya

No. 407 (Grey-Wellington Border) Wing

Membership: 20

President:	Mr. Thomas Beck
1st Vice-president:	Mr. William J. Renwick
2nd Vice-president:	Mr. William Watson
Secretary:	Mr. Burritt Brooks
Treasurer:	Mr. George Prew
Additional Member:	Mr. Kenneth Brown
Additional Member:	Mr. Orville Lee
Additional Member:	Mr. Patrick O'Donnell

No. 408 (Toronto) Wing

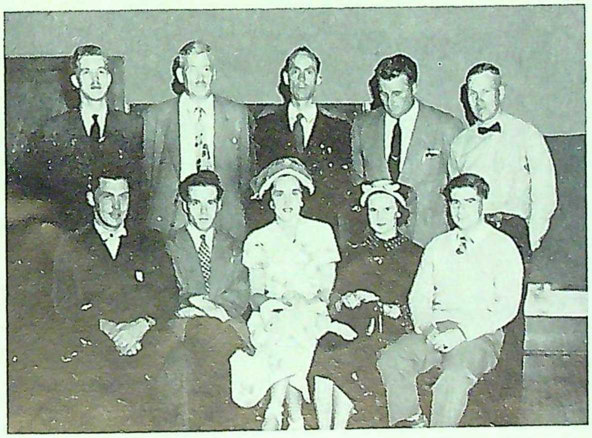
As in the case of No. 301 (Montreal) Wing, exact membership figures are not to hand.

President:	Mr. Brenton Ross
1st Vice-president:	Mr. Frank Ellis
2nd Vice-president:	Mr. Frank Smith
Secretary:	Mr. Gene Villeneuve
Treasurer:	Mr. George Dawber
Additional Member:	Mr. John Collyer
Additional Member:	Mr. Edmund Eberts
Additional Member:	Mr. Sidney Harris

No. 500 (City of Winnipeg) Wing

Membership: 232

President:	Mr. Ernest Hall, A.F.C.
1st Vice-president:	Mr. Dufferin Roblin
2nd Vice-president:	Mr. Thomas Farenhurst
Secretary:	Mr. John Thornton
Treasurer:	Mr. Clarence Atchison
Additional Member:	Miss Jessie Joscelyn
Additional Member:	Mr. Oscar Olson
Additional Member:	Mr. James McDiarmid
Additional Member:	Mr. Hugh Anderson
Additional Member:	Mr. Eric Coy



No. 501 Wing. Front row (left to right): Mr. J. Ferguson, Mr. J. W. Friday, Mrs. Dorothy Chambers, Miss Valma Maki, Mr. K. G. Adams. Back row (left to right): Messrs. W. K. McGregor, C. H. Moss, R. Arnold, G. Thornes.

No. 501 (Lakehead) Wing (Port Arthur and Fort William)

Membership: 153

President:	Mr. Clifford Leaney
1st Vice-president:	Mr. Robert Arnold
2nd Vice-president:	Mr. George Thornes
Secretary:	Mr. Charles Moss
Treasurer:	Mr. Allan McDevitt
Additional Member:	Mrs. J. Chambers
Additional Member:	Mr. Kenneth Adams
Additional Member:	Mr. Walter McGregor

No. 600 (Regina) Wing

Membership: 104

President:	Mr. Keith Malcolm
1st Vice-president:	Mr. Alastair Nicol
2nd Vice-president:	Mr. Thomas Baggaley
Secretary-Treasurer:	Mr. William Fyles
Additional Member:	Mrs. D. Johnston
Additional Member:	Mr. James MacKenzie

No. 601 Wing, Moose Jaw

Membership: 37

President:	Mr. Norman Currell
1st Vice-president:	Miss Margaret Mathieson
2nd Vice-president:	Mr. James de-Rosenroll
Secretary:	Mr. Gordon Fraser
Treasurer:	Miss Mary Reyke

No. 602 Wing, Saskatoon

Membership: 36

President:	Mr. Thomas Cowan
1st Vice-president:	Miss Marion Graham
2nd Vice-president:	Mr. Basil Boyce
Secretary:	Miss Elizabeth Raeside
Treasurer:	Mr. Roy Burnham
Additional Member:	Mr. Frank Lovell
Additional Member:	Mr. Edgar Mather
Additional Member:	Mr. Cecil Bradwell

No. 603 (Yorkton) Wing

Membership: 26

President:	Mr. J. N. Park
1st Vice-president:	Mr. W. B. Dean
Secretary-Treasurer	Mr. C. L. Vokes
Additional Member:	Mr. T. Kozachenko
Additional Member:	Mr. D. J. Cook

No. 700 (City of Edmonton) Wing

Membership: 186

President:	Mr. Don "Tiny" Ferris
1st Vice-president:	Mr. Murray Cooke
2nd Vice-president:	Mr. Dave Roberts
Secretary:	Mr. Jim Rowand
Assistant Secretary:	Mr. Chester Wallace
Treasurer:	Mr. Ross Gould
Additional Member:	Mr. Jim Cox
Additional Member:	Mrs. Ishbel Ferris

No. 701 (Calgary) Wing

Membership: 89

President:	Mr. Allan Insley
1st Vice-president:	Mr. William Stillwell
2nd Vice-president:	Miss Katherine McDonald
Secretary:	Mr. James Taylor
Treasurer:	Mr. George Bennett
Additional Member:	Mr. Jack Patriquin
Additional Member:	Mr. Ralph Scott
Additional Member:	Mr. Harry Oborne

No. 702 (Lethbridge) Wing

Membership: 46

President:	Mr. Theodore C. Segsworth
Vice-president:	Mr. Fred Sutherland
Secretary:	Mr. Everett Borgal
Treasurer:	Mr. Alvin Dunn

No. 702 Wing. Back row (left to right): Mr. T. C. Segsworth, Cadet LAC B. Horlacher, Cadet F/Sgt. A. Marthaller, Mr. J. Jenkins. Front row (left to right): Cadet Cpl. C. Hoult, Cadet Cpl. G. Lindsay, Cadet Cpl. J. Smedsted.

No. 800 (Forbidden Plateau) Wing (Courtenay, B.C.)

Membership: 26

President:	Mr. William McKerrall
1st Vice-president:	Mr. Herbert McRae
2nd Vice-president:	Mr. Norman Faulafer
Secretary:	Mrs. Catherine Blackmore
Treasurer:	Mr. David Garman
Mdditional Member:	Mr. Sidney Cannings
Additional Member:	Miss Edna Gear
Additional Member:	Mr. Howard Fullard

No. 801 (City of Victoria) Wing

Membership: 108

President:	Dr. W. Douglas Marshall
1st Vice-president:	Mr. William King
2nd Vice-president:	Mrs. Winsome Blenkinsop
Secretary:	Mr. Albert Meek
Treasurer:	Mr. George Lee-Warner
Additional Member:	Mr. Tom Bell
Additional Member:	Miss June Snyder
Additional Member:	Mr. David Carmichael Jr.
Additional Member:	Miss Ruth Sharpe

No. 802 (Greater Vancouver) Wing

Membership: 144

President:	Mr. A. W. Carter, O.B.E., M.B.E., D.S.C.
Vice-president:	Mr. Donald McLarty
Treasurer:	Mr. William McKay, D.F.C.
Secretary:	Mrs. W. L. Miller
Additional Member:	Mr. Mark Robinson
Additional Member:	Miss Densie Leigh
Additional Member:	Mr. Urwin Finch
Additional Member:	Mr. Robert Little
Additional Member:	Mr. Ernest Tennant, O.B.E.
Additional Member:	Mr. R. W. Ferguson

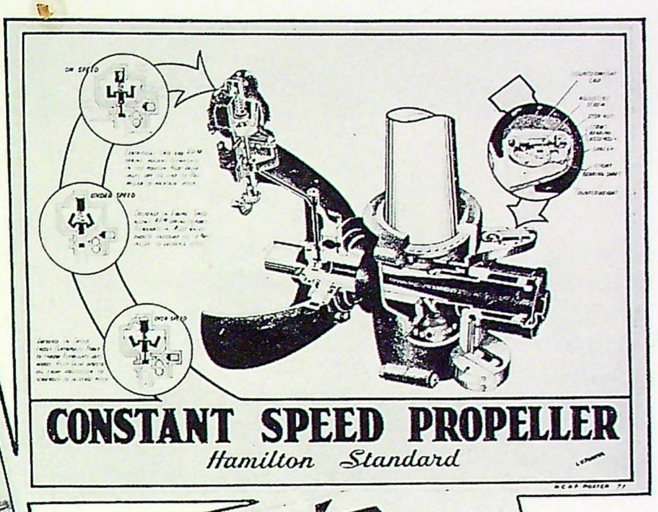
IMPORTANT

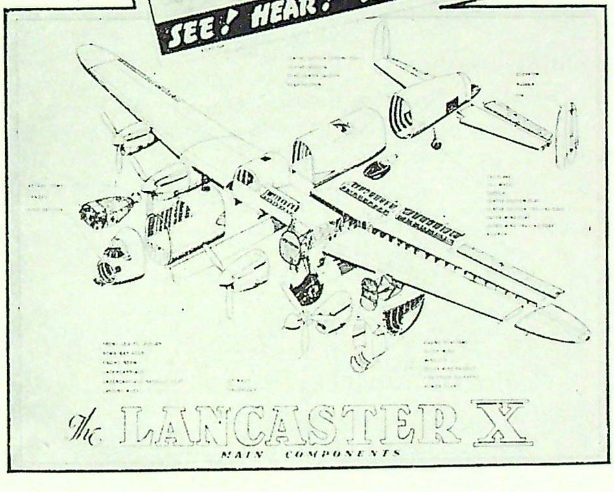
RCAF Association members are asked to address all communications concerning "The Roundel" to:

The General Secretary,
RCAF Association,
424 Metcalfe St.,
Ottawa, Ont.

This procedure will save two days in mailing time, as the Association, and not the RCAF, is responsible for the accuracy and conformity with Association policy of all contributions, mailing addresses, etc.

Have You Seen these Posters?





RCAF Poster No. 70: Don't Mutilate Costly Equipment

RCAF Poster No. 71: Constant Speed Propeller

RCAF Poster No. 72: Causes of Accidents

RCAF Poster No. 73: The Lancaster X—Main Components

ORDER WHAT YOU WANT FROM YOUR SUPPLY SECTION

RTCA Plans Complete Air Traffic Control

Excerpts from a Paper by D. W. Rentzel and F. B. Lee, Civil Aeronautics Administration.

(Reprinted by courtesy of the "SAE Journal")

Special Committee 31 of the Radio Technical Commission for Aeronautics has drawn up an air traffic control plan—on which the country has already embarked—to make all-weather flying a reality within a few years.

The size and scope of the plan is such that RTCA's most economical estimates reveal that the plan will cost more than $1,100,000,000 and will take until 1963 to complete.

The plan is set up in two parts: the Transition Program and the Ultimate Program.

The Transition Program should do much to relieve present congestion and increase schedule reliability. It incorporates items like omnidirectional VHF ranges, VHF voice communication, and CGA which are part of a program started earlier by the CAA. The Transition Program should be completed in 1953.

The Ultimate Program aims to cradle our civilian and military aircraft with certainty and safety from take-off to landing. All the ground and air devices of the Transition Program will be fitted into the Ultimate System, which will be almost completely automatic.

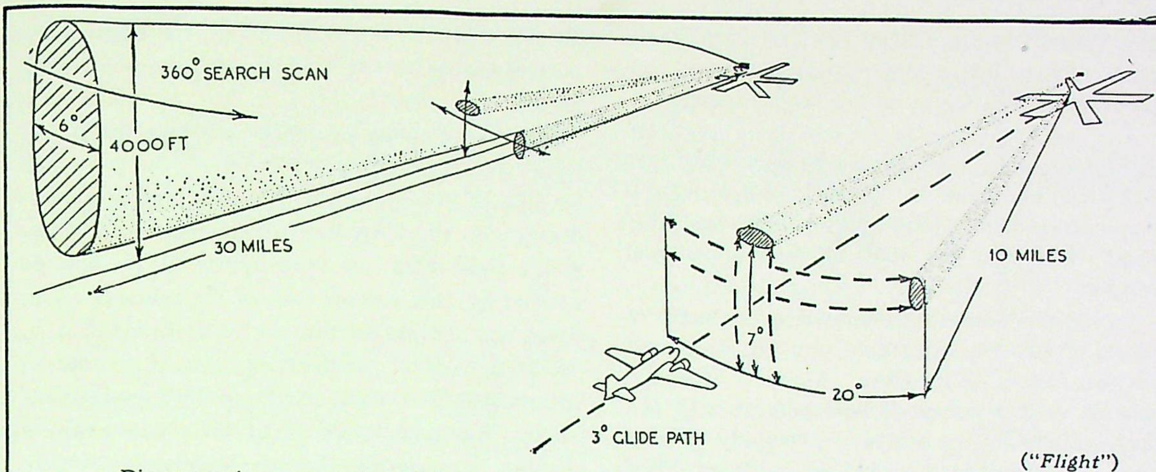
Actual devices to carry out much of the plan for the Ultimate Program have not been devised. But the requirements have been carefully outlined by the RTCA, and the general principles on which the devices will operate are known. There is little doubt that the needed equipment can be produced.

Here are some of the functions which the combined systems aim to accomplish, according to an RTCA report:

- Provide safe separation of aircraft by automatic means without impeding the flow of traffic.
- Reserve a prescribed airspace for the next intended move, whether this be straight ahead, reverse course, up, down, right, or left.
- Establish separate but adjoining units of airspace at all the various levels above the ground—in other words, vertical and horizontal block systems.
- Arrange the flow of traffic automatically to obtain maximum use of the runways at the airfields along the route, causing a minimum delay to the aircraft.
- Indicate when and where aircraft can be inserted into the traffic flow so that they can be sequenced by lane and time. At the same time, the system must permit rearrangement of the traffic flow to handle emergencies, special priorities, and other operational irregularities.
- Provide a means to control aircraft experiencing equipment failure.
- Control aircraft flying on courses other than ordinary routes.
- Readjust the flow or sequence of aircraft when conditions such as severe thunderstorms require a change in the flight track.
- Transmit to the aircraft, and display to the pilot, such traffic control clearances as "go up," "go down," "go right," "go left," "hold," or "proceed."
- Segregate aircraft which have different speed characteristics whenever necessary but not preclude aircraft of different speeds from using the same lane when this is desirable.
- Collect, transmit, store, and display information on the operation of every aircraft in the system. While information on every aircraft need not be displayed at the same time, provision must be made to display readily the information for any area desired. Automatic warning of conflicts and emergencies must be provided.

The system must be designed so that mechanical or electrical failure cannot give a dangerously false indication.

These are only a few of the requirements. The system's task is fantastically complex. Before the



("*Flight*")

Diagrammatic representations of the sections of the radar beams used in the G.C.A. system. Above is the search "lobe," for which two plan position indicator tubes are used to give a 360 degree picture of the area within thirty miles of the airfield. On the right is a detail diagram of the "precision" part of the system, which is used to bring the aircraft in on to the runway.

war, such a system could not have been established. But new developments, such as radar and other electronic devices using extremely high frequencies, have given us the tools which make such a system possible.

Transition Program Started

A considerable portion of the equipment needed to fulfil the aims of the Transition Program is already available. Some is already operating.

One important piece of ground equipment is the omnidirectional, very-high-frequency range which provides courses in any direction chosen by the pilot. More than 300 of these ranges were scheduled to be put in operation in 1948 by the CAA. We expect them to be in general use by the airlines and non-scheduled operators before the end of 1949. Very-high-frequency voice communication is in operation along the CAA airways today and its use is increasing rapidly. These items, like many others in the Transition Program, were part of a program which was started by the CAA long before the RTCA report incorporated them into the all-weather system.

The Transition Program calls for primary surveillance radar. Operational tests of this type of radar are now going on, and procurement contracts probably will be let during this fiscal year.

The Air Navigation and Development Board, which is responsible for carrying out the details of the all-weather program, is studying the requirements for secondary radar coverage and expects to have development specifications ready by July, 1949. Both types of radar should be in general use by 1953 or 1954.

Distance-measuring equipment, which will give the pilot continuous information of his position, is now being developed by the Air Force and the CAA. We expect this equipment to reach the stage of limited procurement and operational trials by July, 1951.

The first test model of a mechanical interlock system, designed to replace the laborious hand posting of aircraft movements, is now being installed at Washington National Airport. Procurement specifications will be ready some time this year, and the equipment can go into general use soon thereafter.

Precision beam radar, known commonly as GCA, has been service tested by the CAA for civilian use at Washington, New York, and Chicago. Contracts for additional equipment have been let, and other contracts will follow. It will be used to supplement and double-check operation of the CAA Instrument Landing System. If desired, it can be used as an independent landing aid. The scheduled airlines are now reaching the point where Instrument Landing System approaches are routine at all our large airports.

Devices for helping to get maximum use from airport runways must be developed. They probably will not come into general use before 1954. Approach-control timing equipment, on the other hand, is now at the stage of final operational testing.

In addition to these ground devices, a number of pieces of airborne equipment must be developed for the Transition Program. Many of these are now in various stages of development, and the specifications for the others will be ready by next year. National operational adoption of these devices is scheduled for 1953 and 1954, although some, like the light-weight VHF communication and navigation receiver being developed with CAA funds, will be in production in 1949.

Entire Flight Guided

The Ultimate System will be the greatest development in aviation since the invention of the airplane itself, we believe. A double system of position determination will guide each airplane from take-off to landing. Although completion of the program is 10 to 15 years away and most of the equipment for it is yet to be constructed, procedures and plans for bringing it about are already established, and the program is under way.

In somewhat simplified form, here is how this Ultimate System will work:

At each General Control Area, present and expected traffic densities and information about the capacities of airports and routes will be fed into a complex calculating machine called an Airport Time Utilization Device.

The pilots at the various airports in each area, meanwhile, will file proposed flight plans, which will be transmitted to the General Control Area Office. At this office, they will be fed into the Time Utilization Device, which will determine whether the proposed routes and timings are free from conflicts. If so, each pilot will be notified. If the device detects a conflict, it will offer an alternate time and route for the pilot's approval. Once the flight plan is approved, the device will automatically reserve the time and space for each flight.

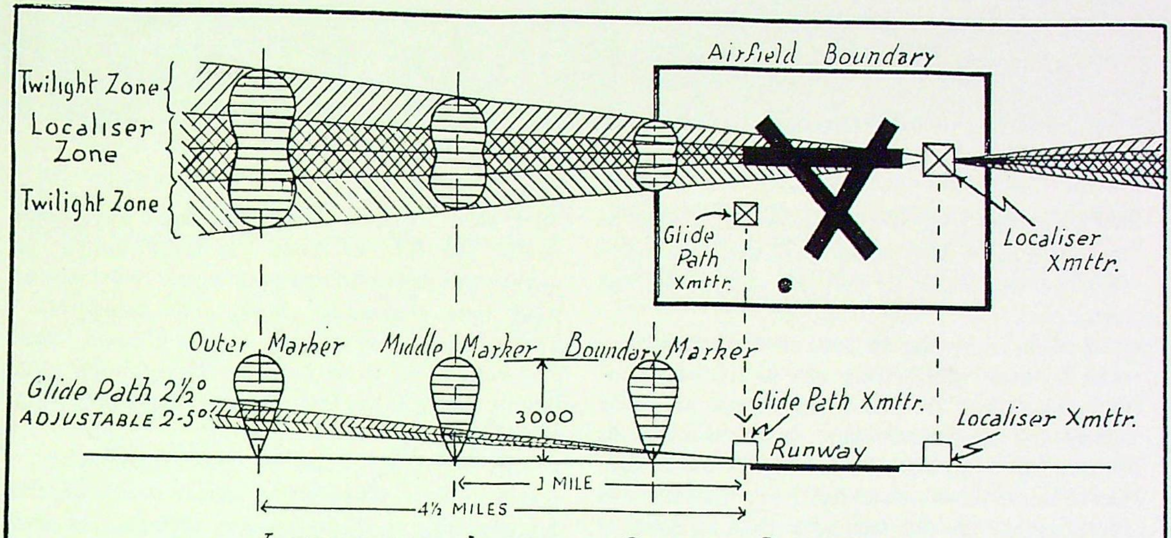
Each plane using this phase of the system will have a private communication line—the pilot will be able to communicate privately and independently with the CAA traffic controllers. After the pilot's flight plan has been approved, he will be notified by this private line of his take-off time, route, and acceptance time at his destination.

During take-off the pilot may use, if necessary, electronic aids to establish his proper course and climb. When he levels off at his predetermined altitude, instruments before him will provide constant information about his distance and bearing to known points. By means of a computer, he will be able to fly whichever parallel track has been assigned him. Meanwhile, his identity and position, as established by the equipment in the plane, will be reported automatically to traffic-control offices on the ground.

At the same time, however, his position is being determined constantly by entirely independent equipment—a secondary radar network along his route. The information from the radar and the data derived from the plane's equipment will be checked continually against each other. This will provide a complete double check against both pilot error and malfunctioning of equipment. If any significant discrepancy appears between the two systems, the controller will notify the pilot and take whatever action is necessary.

Specialized air-space separation equipment and air-traffic control equipment will automatically watch over the air space at all times to prevent collisions, both between aircraft and with fixed obstacles such as mountains. If two aircraft desire to enter the same block of air space, one will be permitted to enter and the other automatically warned to stay out.

At any time during the flight, the pilot can request minor changes in his traffic-control clearances. To do so, he will merely push appropriate buttons, and the request will be automatically transmitted through the aircraft's private-line



INSTRUMENT LANDING SYSTEM DIAGRAM

system. Depending on circumstances, the request either will be displayed to a controller or enter automatic equipment which will give the pilot an answer without human intervention.

As the pilot approaches his destination, automatic flow-control equipment will begin making periodic comparison of the aircraft's actual position with its originally scheduled landing time. The pilot will be informed automatically of the number of minutes and seconds he is ahead or behind his schedule so that he can adjust his speed accordingly.

Each aircraft approaching the field will be automatically channeled and sequenced into the final glide path to the runway so that the best possible use is made of each runway. Coming in for a landing, the plane will be flown either by the pilot or by automatic equipment in precise time relationship to the aircraft ahead. Radar equipment will provide a separate check on this time-space relationship.

Once on the ground, the private line will continue to give the pilot instant and complete information on where and how to taxi in order to clear the runway immediately and avoid traffic hazards on the ground. During bad weather condition, as special radar will keep watch over ground traffic which cannot be seen from the control tower.

(*The Radio Technical Commission for Aeronautics is an organization of governmental and industrial agencies concerned with development, application, and use of radio in aeronautical operations, formed in 1935 upon invitation of the Assistant Director of Air Commerce of the U. S. Department of Commerce.*

Special Committee 31 was appointed in June, 1947, to develop basic air traffic control principles and to outline equipment and procedures required to implement air traffic control principles.)

★ ★ ★

(It should be noted that Canadian Civil Aviation is not governed by RTCA, and therefore does not necessarily conform to RTCA policies.—Editor)

The Old Historian Speaks—
On Navigation Generally

(Reprinted by courtesy of "Air Clues")

WE DECIDED TO START the series with a word or two about navigation generally, so with this end in view we set course to find our old friend, the historian.

We didn't have far to look: no further, in fact, than his usual stool at the end of the bar. But then, historians are like that. There he sat, a bowed and aged little figure, his face lined, his moustaches drooping, and the cares of the navigational world on his shoulders. His tankard was nearly empty and his studies of the properties of near-alcoholic fluids were thus at a very low ebb. The significance was not lost on us.

Both our tankards filled, we came straight to the point.

"We'd like to know something about this old-time navigation," we said, "you know, who or what started it and why, and all that sort of stuff. Something that will give our readers an idea of the way people did things in the old days and why they did them. What they used and why, and how things developed through the years. In that way we might get a better idea of what we are doing at the moment: work things out logically, in fact."

The historian looked at us pityingly, but the twinkle in his eye was unmistakable.

Zeno Upsets the Apple Cart

"If you're looking for logic in navigation," he said, "you'll get a surprise, because the first bit of logic that was introduced into the navigation world promptly proved that navigation in itself was an impossibility."

"How come?" we queried politely.

"Well," said the Old Man, "navigation is generally accepted as the art of conducting a moving vessel, or in these days an aircraft, in an orderly manner from place to place; on the assumption, of course, that things can move in the first place. And to give people their due, until about 495 B.C. everyone was quite happy to accept this definition and assumption. Now about that time a character called Zeno appeared—metaphorically, as it were, on the horizon—and he was one of those horribly brainy boys who aren't happy unless they are upsetting everybody else's ideas.

"In about 445 B.C. he upset them with a vengeance by producing a logical proof of the impossibility of all motion and therefore of any type of navigation. It ran something like this. 'An object,' he said, 'is either in the place you think it is, or in the place in which you think it is not!'"

We assured ourselves that our beer was in the place we thought it was, but made no comment.

"'Further,' reasoned Zeno, 'how can the body move where it is? For if it is there, then it *is* there. And it quite obviously cannot move where it is not,' he concluded, 'for it is not there to move or do anything at all. All motion is therefore logically impossible.' Well, of course, people were literally halted in their tracks by this pronouncement. And what made them more annoyed was the fact that they couldn't find any logical argument to refute him. So they did the only thing possible in the circumstances. They implicated him in a plot against the government of the day and lopped off his head, and everyone moved around quite freely once more."

The Old Man sighed and looked at his near-empty glass. We hastened to replenish it.

Confounding Euclid

"Mind you," he continued, in his stride once more, "Zeno wasn't the only fellow to try and upset the apple cart. Oh! dear me, no. Our friend Euclid had a pretty good go, too. And some of his mistakes exist and are believed even to this day."

He paused, dipped his finger into his beer, and drew two triangles on the counter. We copied them neatly into our notebook and labelled them Figure 1.

"Now here," resumed the Old Man, "we have two triangles, in each of which two sides and an included angle are equal. According to friend Euclid these two triangles are equal in all respects.

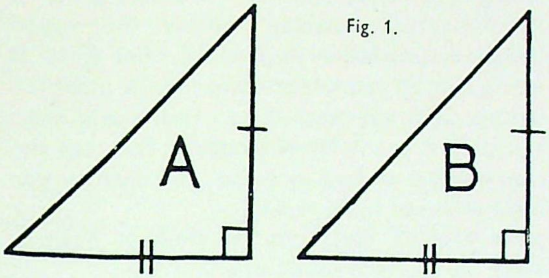


Fig. 1.

But are they? Let us suppose that the two triangles are islands, A and B, identical in shape and size and spaced a distance of 100 miles apart. Then we should invoke the name of Euclid in vain in trying to explain to the appropriate authorities just why we arrived at A instead of B or vice versa. And moreover, these authorities would be perfectly justified in expressing in quite forcible terms their opinions of our technical ability in such a case. So the triangles are not equal in all respects. Time and position would have to be considered also before this could be so."

Needless to say, we couldn't have agreed more with this attack on Euclid. Our disagreements with him started on about our first day at school. However the little man hadn't finished with us yet, as we were to discover.

The Columbus Legend

"Well," he said with a beaming smile, "that makes you think, doesn't it?"

We had to admit that it did indeed make us think.

"And talking of thinking," he went on, "I suppose you belong to those people who still think that Columbus discovered the world was round."

We grudgingly admitted that we did.

"And there again you would be wrong," was the disconcerting reply, "because the circumference of the world had been measured by the Chaldeans 2,000 years before Columbus was even heard of. The Chaldeans said that if a man walked for a whole year covering 3 miles an hour he would just get round it, and though nobody to our knowledge ever accomplished that remarkable feat, the distance this represented—26,000 odd miles—was undoubtedly not far from right.

"Later on there was an Egyptian by the name of Eratosthenes who put in quite a lot of spare time on this problem. It had to be spare time because he was then librarian of the Alexandrian Library, and with 14,000 students on the books he was kept pretty busy during the day. However, though he knew this Chaldean formula, it was a bit too vague for him. He thought he would work out the distance for himself.

"Being an observant sort of character, Eratosthenes had noted that at a certain time of the year—the summer solstice on June 21st—the reflection of the sun could be seen in a deep well at a place near what we now call Assuan. It was then in the zenith or right overhead at that place. About 500 miles north he found the angle of the sun from the zenith at the same instant to be 7½ degrees. Euclid, despite his obvious shortcomings and the fact that he was long dead, helped him here. Eratosthenes was satisfied that sunbeams, to observers on the Earth, were parallel, and he was also convinced that the Earth was round. So taking the figures he had already obtained, he decided that 7½ degrees went into 360 degrees about 50 times—they weren't too fussy in those days—and that 50 times 500 miles was 25,000 miles, the circumference of the Earth. And he wasn't far wrong either.

"However," the Old Man remarked, "all the old-timers weren't as near the mark as Eratosthenes. There were, for instance, our twaddle-talking friend Plato who thought and taught that the Mediterranean and Greece were on top of a cube, and Socrates who said of astronomy what many students have since expressed of navigation in rather less elegant language—that it was 'impossible to understand and madness to investigate'; but despite this, people pressed on, literally regardless, and managed somehow to get from place to place and back again.

"Since the first abortive aerial sortie by Icarus in about 1100 B.C., people had re-adopted for their slogans 'It's safer by sea.' And, in spite of their primitive instruments and ideas, they did, in fact, manage to get a surprisingly long way on that uncharted element. The Phoenicians, for instance, were trading with Britain as early as 1500 B.C., using a method of navigation which we now call 'rock-scratching'."

"What might that be?" we asked.

"Well, all it means really," said the Old Man, "is hugging the coastline. However, this wasn't entirely satisfactory, as you can well imagine. Slave-power was rapidly being replaced by sail-power, so the danger was always present of being caught out and driven aground on a lee shore. Besides, hugging a coastline was obviously no way to earn a name as an intrepid mariner, or, for that matter, to foster the export trade, and very soon people began to look for some other way of getting around. And, as always when people are dead keen, they found it, but not before some bright person invented a reasonably accurate method of taking latitude sights—which didn't happen until some time between 200 B.C. and A.D. 700."

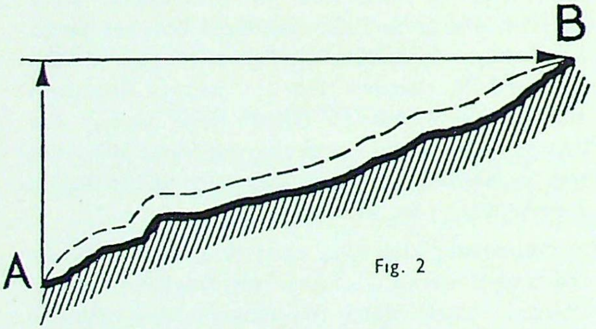


Fig. 2

Once again the Old Man's finger explored his beer. One again he drew on the counter. And once again we copied down the result, this time marking it Figure 2.

Meridian and Parallel Sailing

"Suppose in this diagram," he said, "a ship had to be navigated from A to B. In the old days they would have taken it round coastwise, on the dotted line so to speak; and a very long-winded and unsafe procedure it was, too. But now that reasonably accurate latitude sights could be taken, the fashion changed and meridian and parallel sailing—still, mark you, combined with a bit of judicious 'rock-scratching'—became the vogue. Using this method a ship sailing from A to B would first set course due north from A until the latitude of B was reached, and then would steer east until it got to B. Although in this case the trip was just as long as before, the method was much safer and easier to sail."

We couldn't resist just the trace of a smile which the Old Man wasn't slow to notice.

Intrepid Polynesians

"Oh, yes, you can smile," he said, "but they didn't do too badly even at that. When you consider that their sextants consisted of coconut shells with holes in, their compasses, if any, of bits of lodestone hung on string, and their knowledge of blatherings like the bits I've quoted from Zeno and Plato, then you must admit they didn't do at all badly.

"In fact, between the eleventh and fourteenth centuries the Polynesians thought nothing of voyages of over two thousand miles and they sailed all over the Pacific—to Samoa, Tahiti, and New Zealand. Nor did they carry any expensive apparatus or maps and charts. Their maps, constructed first from strips of wood and shells, were then drawn out on the sands and memorized before any long trips. Navigation must have been rather fascinating in those days, but a bit hazardous for the absent-minded.

"By this time the compass had been developed in a rather primitive form—though that's more or less a story by itself—and men's minds turned to the question of sailing across the meridians. Since they did not travel very great distances in this manner they were able to do so with a fair degree of success. So the system of traversing the meridians, or 'traverse sailing', reared its ugly head and our present-day Traverse Tables are relics of those days. Now things were really getting to the stage when a ship could set course from A to B direct with a reasonable chance of getting there within a day or two of E.T.A.

"The next development was, as might be expected, the navigation of long distances by estimates based on mathematics. In those days it was called deduced reckoning, a term which we have since corrupted to dead reckoning. And hand in hand with this deduced reckoning went an increased knowledge of maps and charts."

Ptolemy's Best-seller

"Now, maps and charts," he went on, "are probably the beginning of real navigation as we know it today, and for their introduction into England we are almost certainly indebted to one, Bartholomew Columbus, who was said to have brought the first one into the country in 1489. This was most probably one of Ptolemy's maps which had been best-sellers ever since A.D. 150. Using the theories of the Alexandrians he had employed latitude and longitude co-ordinates on his maps but not in a very clever way. However, they were, until about the beginning of the seventeenth century, all that were available; and Christopher Columbus on his epoch-making discovery trip certainly used one.

"These charts of Ptolemy's had one big disadvantage—they treated the Earth as though it were a flat surface. By this time most people had some idea that the Earth was round, but spherical trigonometry had not yet been developed sufficiently to be of help to them in this respect. In low latitudes, of course, this 'plane sailing'—hence the expression—didn't matter very much, but unfortunately in higher latitudes it mattered a great deal. The navigator of that time would measure off his track angle from the chart, set course along the desired track line from A, and, only too frequently, fail to arrive at B. Naturally, there was a distinct lack of future in this proceeding, although the same thing is often done even today, but not quite under the same conditions or for the same reasons. However, be that as it may,

Mercator (Gerard Kremer)

their 'plane charts' almost always let them down; neither the beautiful embellishments of the artist nor the mermaids encountered *en route* could help them out.

"This obviously came under the heading of a very bad thing, and when, in 1556, a Belgian by the name of Gerard Kremer, a name which he afterwards changed to Mercator, suggested the famous projection which now bears his name, everyone breathed quite a sizable sigh of relief, although the first projection was a purely mathematical one and not particularly accurate. However, this chart of Mercator's set people thinking, among them being an Englishman named Edward Wright, who thought so hard that in 1594—incidentally, the year Mercator died—he produced a table of meridional parts and a correct Mercator projection.

"From then on," said the Old Man, "navigation proceeded apace. The navigators of the eighteenth century gained particular distinction for their profession and did much to advance it and to explore hitherto unknown territory. Among the more famous of these was Captain James Cook who started life as a ship's boy on a collier. He didn't waste his time among the coals, however, as is evident from the fact that he passed his examination in the navy as a master's mate at the quite youthful age of twenty-nine. His journey to New Zealand and the maps he made during it are still looked on with wonder even to this day."

The Old Man paused and we could see that his thoughts were far away. Perhaps he was thinking of Christopher Columbus quelling his mutinous men with talk of the pole-star's orbit. Perhaps of Jonathan Swift, who, in *Gulliver's Travels,* imagined himself to be in a condition in which he could see "the discovery of the longitude, the perpetual motion, the universal medicine and many other great inventions brought to perfection." Or was the Old Man paying mental tribute to the thousands of gallant seamen who gave their lives for the furtherance of navigation, or to the countless others who laboured year in and year out, often without reward or encouragement of any kind, to bring it to the pitch of perfection which it has reached today, both in the air and on the sea? We waited a few minutes and then leaned towards him.

Defining a Navigator

"As it's getting late," we suggested gently, "perhaps you'd like to end by giving us your definition of what constitutes a navigator."

Reluctantly he forwent his reverie.

"My definition of what constitutes a navigator?" he repeated. "Well, first let me tell you a story. I much prefer stories to definitions. And this one takes place in a chart room aboard ship on a particularly dirty night. The skipper, a mature second officer, and a very, very junior officer are poring over the chart, and, as usual, none of them knows for certain where they are. The junior officer points to a spot on the chart and says confidently: 'We're there, Sir.' The second officer thoughtfully draws a fair sized circle. 'I think we are very probably inside that, Sir,' he ventures. The skipper sighs and turns away. 'Ah! well, gentlemen,' he comments, 'I am satisfied that we are on the chart.'

"And that," concluded the Old Man, "was the voice of one in whom suspicion was coupled with a confidence bred of great experience. In short, a navigator."

As we drank up and bade him goodnight we couldn't help thinking that he was right.

The WOG's Reply

(Last month we printed Sqdn. Ldr. Ingram's poem, "Dis Ting Wot's Call Rajio", written in bygone Gander days. We gather from the poet that it evoked the following anonymous reply. —Editor)

I'm jus' operator, wot's call B-group WOG;
I sit on de groun' while de peelot he fly.
'E sometime go up—'e go *plenty* way up—
But sometime I go jus' as 'igh!

I'm get—'ow you say it?—"de call from op dere,"
From dese fellow wit' stripe on de sleeves;
I'm sometime get call from de bonch all at once—
More noise dan a moose wit' de heaves.

I'm have to look after my log books galore,
An' dese "Operations" dey cry in my ear,
"Wot's de 'old-op?—de trawble? You 'urry lak 'ell!"
—An' me? I'm jus' trying to 'ear.

Den someone walk off wit' de pencil, of course,
An' de book, she is fall on de floor;
I try for to copy two damn t'ings at once,—
An' dey ax, "Don't you know dere's a war?"

De corporal, de sergeant, and maybe de flight,
Dey all have de question to say;
All time people bodder . . . de room mus' be swep . . .
. . . In between time, I copy away.

Den dat fellow in hairplane, he's land wit' is log,
An' 'e show it to young SSO;
She's so neat, she's so pretty, he's look up at me
An' say, "Why is it YOU can't do so?"

Well, some day, by gar, I'm goin' to blow op,
As 'igh as de plane, I believe;
I'm goin' to say, "I make log jus' as nice,
Give me *peace* . . . an' de *stripes* on my sleeve!"

Pistons to Rockets

(Reprinted by courtesy of "Canadian Aviation")

THE VARIOUS TYPES OF POWER PLANTS, from reciprocating engines to rockets, were discussed by Peter G. Masefield, Director-General of Long Term Planning, England, in an analysis of civil aviation trends. Each type has its sphere of usefulness, he said.

"**The standard piston engine** is suitable for operations over all but the very long ranges. In the present state of the art, its most economic performance is gained at heights of up to 25,000 ft., at speeds up to about 350 mph, and in present aircraft sizes, for stage lengths not exceeding 2,000 miles. One of its great advantages is its flexibility of performance within its economic speeds and heights.

"**The compound piston engine** is most suitable for very long range operation at moderate speeds and at greater heights than the piston engine. In contemporary sizes of aircraft it has advantages over the piston engine for stage lengths of more than 2,000 miles. For long ranges the compound piston engine gives promise of being even more flexible than the standard piston engine, for heights up to about 35,000 ft. and speeds up to about 400 mph.

"**The propeller-turbine engine** is at present most suitable for medium range operations at moderate speeds and heights—up to about 425 mph and 35,000 ft. When more fully developed for civil purposes, eventually, in conjunction with improved air traffic control, **the propeller-turbine is likely to show advantages over the piston engine for all but very short or very long range operations and—in the largest sizes—for all operations.**

"The chief difficulty with the propeller-turbine engine today is that because of the small amount of interest in it for military purposes, almost all the development costs have to be spread over relatively few civil orders. The propeller-turbine is, in consequence, not receiving the amount of effort which it deserves and only a fraction of the development which is being concentrated on the turbo-jet.

"**The plain jet engine** is most suitable at present for moderate ranges at high subsonic speeds and at great heights—not less than 450 mph at not less than 30,000 ft. In the course of aeronautical development **the plain jet turbine will probably show improved commercial efficiency at supersonic speeds, up to about 1,500 m.p.h. at heights up to 75,000 ft.** Although at high speeds the jet is more efficient than any propeller-driving engine, such speeds must always be costly to provide, although not necessarily less economic in operation because additional revenue may be attracted.

"In the immediate future **the jet engine appears unlikely to be worth while for distances of less than 300 stage miles or greater than 2,000 stage miles.** Its development beyond these confines will depend on the development of air traffic control to permit rapid landings.

"**The plain jet with 'after burning'** is inefficient at subsonic speeds except as a take-off device. It is likely to prove suitable for cruising speeds of not less than 650 mph at 50,000 ft. and for supersonic cruising speeds of up to 2,000 mph at 80,000 ft. or more. The remarks on the plain jet apply with still greater force to the engine with 'after burning' added.

"**The ram-jet** takes us, necessarily, into the almost unexplored realms of supersonic speeds, about which, one day, enough will be known to permit economic commercial operation.

"When the time arrives **the most satisfactory operating speed of a ram-jet airplane would appear to be around 2,200 m.p.h. at 50,000 ft.** or more for stage lengths of around 1,000 miles.

"**The rocket power plant** applied to commercial aircraft is a further stage away. With it, speeds of up to 5,000 mph at not less than 100,000 ft. for stage lengths of some 500 miles appear possible. The economics at present look poor, but may improve materially as nuclear science advances.

"**The rocket projectile** is at the moment the ultimate peak of high speed transport to which we can look forward. With theoretical intra-terrestrial speeds of up to 18,000 mph and inter-planetary speeds of 25,000 mph, the rocket projectile may eventually bring any point of the earth's surface within an hour's block time of any other point—at an economic fare.

"Although such prospects may sound fantastic, the progression to a service "On the Hour to Anywhere in the Hour" is no greater than that from the stage coach of yesteryear to the 300 mph transport airplane of today.

"(I should add that my more detailed economic and performance explorations in this paper go no further than the plain jet.)

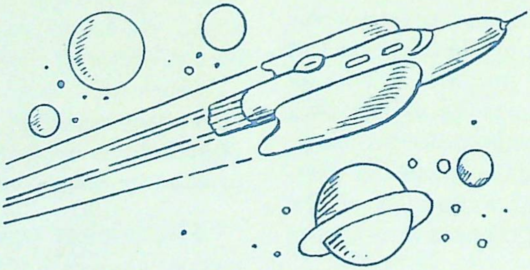
"**Types and sizes of aircraft have their own most suitable spheres of use.**

"**The commercial helicopter,** in sizes of not less than 10 seats, will find its most useful application in stages of from 50 to 200 miles, particularly for journeys involving short sea crossings. At present, helicopter costs are likely to be a good deal more than costs of fixed-wing aircraft. But the helicopter is still at an early stage. Its development is likely to be rapid during the next 10 years.

"**Short stage fixed-wing aircraft** are, in general, incapable of competing with efficient surface transport for distances of less than 200 miles except where sea crossings, mountains, or other geographical barriers intervene. From 200 miles onwards the airplane shows increasing advantages over surface transport—with the turbine offering possibilities of marked reductions in costs when the 'stacking' problems have been solved.

"**Medium and long stage fixed wing aircraft** represent the most advantageous developments in air transport vehicles. **Large aircraft are necessary for long stage routes.** But once the largest economic payload has been decided and allied to the longest route which requires to be operated, then every technical development will tend to reduce the size of airplane required for the job. At the present time aircraft of between 100,000 and 300,000 lb. represent the peak of development for long stages. We shall probably see bigger types still before evolution begins to reduce the size.

"One of the most important factors contributing towards economic operations is the *matching of aircraft size and types of aircraft to the routes and stage lengths over which they will be required to operate*. In the present state of the art a 100,000 lb. airplane is most suitable for stages of about 1,750 miles, whereas a 300,000 lb. airplane is most suitable for stages of about 3,000 miles. For the same most economic stage distances and the same payload, turbine aircraft will have to be larger than aircraft powered with conventional engines until turbine consumptions have been improved very much compared with present prospects."



Hydro-Electric Power

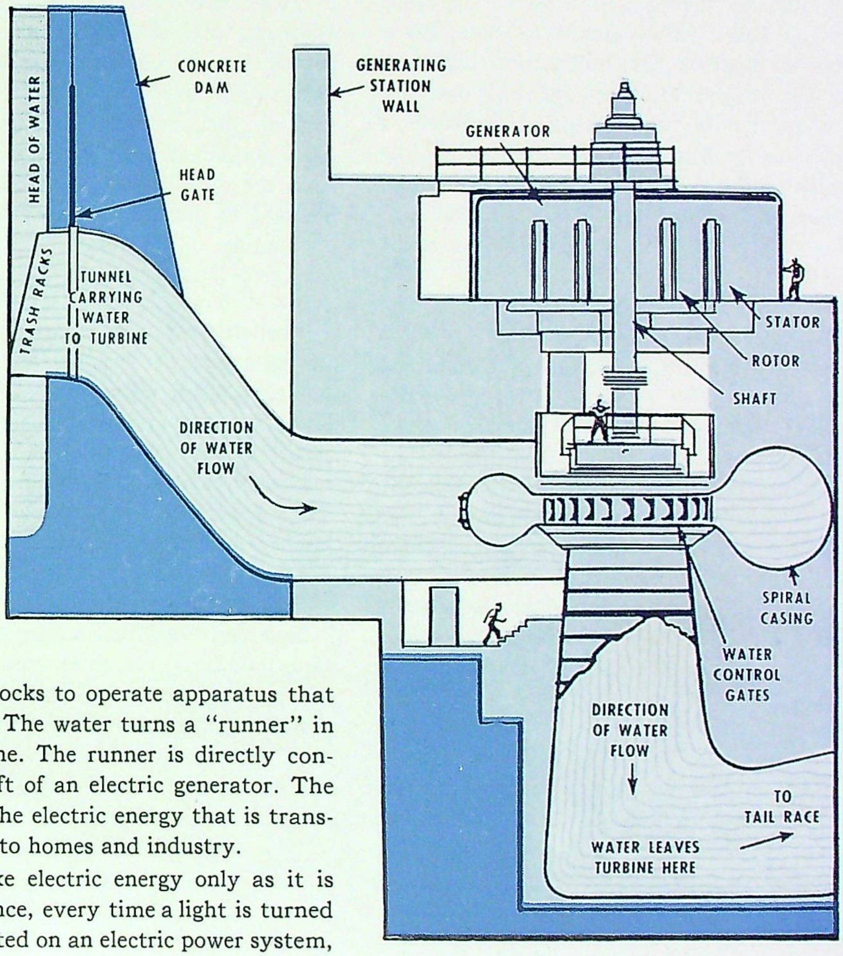
(Courtesy of Canadian General Electric Co., Ltd.)

THE OVERSHOT WATERWHEEL that turned the stones to mill flour a century ago used the energy developed by water flowing from one level to another. The amount of work the mill would do depended upon the quantity of water flowing and the height from which it fell.

Today in electric generating stations, water impounded by a dam to form a "head" falls through tunnels and penstocks to operate apparatus that makes electricity. The water turns a "runner" in a hydraulic turbine. The runner is directly connected to the shaft of an electric generator. The generator makes the electric energy that is transmitted over wires to homes and industry.

Generators make electric energy only as it is needed. For instance, every time a light is turned on or a motor started on an electric power system, the generator instantaneously generates the additional electric energy needed. Quickly, in a split second, the governor on a water turbine opens the gates just enough to allow the right amount of additional water to flow from the dam through the turbine to assume this new load. Thus water above the dam is in fact power stored for future use.

The hundreds of hydro-electric generators in operation in Canada vary widely in size, depending on the amount of water available and the height of the "head," The smallest waterwheel-driven generator in Canada is rated 25 kva and the largest are 75,000 kva driven by 100,000 hp turbines. The fall of the water, or the "head," on these different hydro-electric units ranges from about 5 feet to over 1100 feet.



Starter for Turbine Engines

(Condensed from an article by Robert McLarren in "Aviation Week")

Turbine Starting Factors

POWER REQUIRED to start a gas turbine engine has proved to be considerably greater than that for a reciprocating engine.

Two factors create this problem—(1) The gas turbine must be turned up to about one-third rated engine speed before enough compression is generated to operate the combustion chamber, whereas the reciprocating engine must only be turned a portion of one revolution to enable a single cylinder to fire, and (2) the "drag" of the gas turbine engine consists of air resistance within its blading and air passages, whereas the reciprocating engine "drag" is only that of a single cylinder on compression stroke.

Starters for reciprocating engines have an output of from 2 to 4 hp., while jet or turboprop engine starters require an output of from 10 to 250 hp.

This large power requirement cannot be solved by the use of battery capacity alone without increasing the weight of the battery and electric starter combination to impractical values.

One solution to this problem is the use of an external battery cart and, while this system is widely-used on large Air Force installations, its use aboard a carrier presents problems of space, weight and interference on the flight deck during operations.

Services Conduct Studies

It was to find solutions to this problem that the Navy Bureau of Aeronautics began a study of jet aircraft starter systems in 1945.

The programme has cost, thus far, an estimated $2,000,000. The Air Force has also been carrying out investigations.

Development on several types of starter is continuing, but the AiResearch pneumatic system is considered the best to date and is now ready for production installation.

Components

The system consists, basically, of two separate units: power source producing a supply of compressed air and a small air-operated starter.

The basic power unit may be used to supply air to two-, four-, six-, or eight-jet aircraft. In addition, after the start has been made the air supply may be used to drive air-operated alternators, generators or motors; engine accessories such as fuel, oil, vacuum or hydraulic pumps; and for cabin air conditioning. The exhaust gases from the turbojet section of the starter unit may be used to provide wing deicing, and ground or air heating.

Uses Miniature Jet

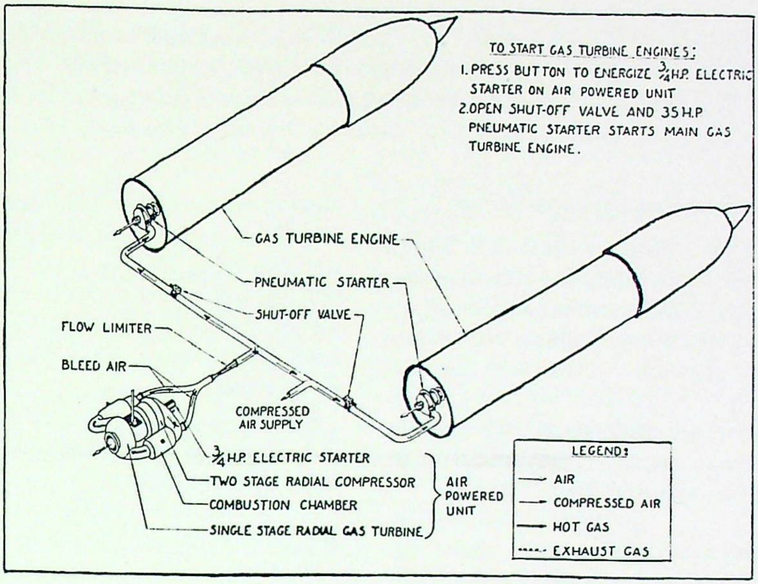
The basic power unit is, essentially, a miniature turbojet using the aircraft's regular fuel supply.

Air is taken aboard through a vertical inlet located in the middle of the engine and routed forward through a two-stage centrifugal compressor unit having a pressure ratio of 2.87 and delivering air at its outlet at 86 in. Hg (42 psi.) under standard conditions.

It is this air that is routed to the starter mounted on the aircraft's jet engine.

Remainder of the air is ducted rearward through two combustion chambers, mounted on either side of the unit, and thence into the toris of the turbine. This centripetal turbine was originally developed by Schmidt in Germany and features the flow of combustion gases from the outer rim inboard to the outlet at the turbine centre.

The Schmidt turbine was adopted after extensive tests had determined that axial-flow turbines demonstrate poor efficiency in small sizes. The high speeds associated with these small units create extensive losses to which the Schmidt turbine is not subject. However, as the size of the Schmidt turbine is increased it loses out in the efficiency race with the axial-flow.



Operation

The starter unit is energized by a 24-v., 100 amp., ¾-hp. electric starter (instead of the 20-hp. unit used for direct starting of present jet engines), which accelerates the unit to about 600 rpm., when its combustion chambers fire.

The unit is then accelerated to 40,000 rpm. by the miniature turbine, at which speed 66 hp. is developed. At this point, the valve to the starter is opened and high-pressure air energizes the air starter, which weighs 20 lb. and develops 35 hp. This air turbine turns the aircraft jet engine up to about one-third rated speed (2300 rpm. in the case of the Westinghouse J-34 used by the Navy) at which point the main turbine start is made.

The AiResearch unit is not intended for installation on presently operating aircraft but two different sizes are being used in two new Naval planes, as yet unannounced, with multi-jet units.

In addition, the same unit has been redesigned to deliver 85 hp. to a shaft for driving accessory units. This auxiliary powerplant version weighs only 95 lb. Still other units are being developed in various sizes to provide both starting and accessory drives for several different size and type Naval aircraft.

Shaggy-Bear Story

A PLEASANT, if slightly incredible, tale of U.S. Air Force wartime operations in the China-Burma-India area is told by United Aircraft Corporation in *The Beehive*. It seems that pilots in this theatre became accustomed to the practice of uncomfortably close formating by friendly patrolling fighters for positive identification. One such pilot, whose co-driver was asleep (illegally) on the cabin floor, spotted in the distance a Thunderbolt approaching for the usual "cockpit check."

Switching on his automatic pilot, he dashed to the rear of his Dakota and seized his pet Himalaya bear also asleep. After strapping the creature into his own seat, the pilot vanished into the cargo compartment. The amazement of the Thunderbolt pilot, and the reaction to his report at base, had an immediate result. Suffering from "extreme combat fatigue," the fighter pilot was given swift return passage to the U.S.A.

("*Flight*")

New Principles of War

(The "Strictly Personal" column of "Aviation Week" is almost invariably good for at least one hearty chuckle. The following extract from it strikes us as one of the best items in recent issues. It is a U.S. Admiral's reply to a good-humoured poem poking fun at the Navy. "Keep your tempers, you USAF gents," says the column's Editor—"the Navy Speaks . . . ")

General Reveals Existing Laws Vetoed

Washington, D.C., May 23 (NUTS)—In an exclusive interview at headquarters this morning, Gen. Perma Nently Chairborne presented details of new operating techniques which completely cancel all known principles of war and the law of gravity.

Q. General, what are your plans for the next war?

A. There won't be any next war.

Q. Why not?

A. When all the other nations hear about our plans they won't dare to start a war.

Q. What are the plans, General?

A. First of all, we will restrict our entire offensive to the air. By fabricating an overwhelming offense, we can ignore the defense. This can be achieved by dreadnaughts of the air. We refer to these as airnaughts.

Q. What will the airnaughts be like?

A. It will operate on the closed shuttle principle.

Q. What is the closed shuttle principle, General?

A. That is a procedure whereby an aircraft can bomb a target and keep on going to return to its starting point without turning around.

Q. Do you mean they will fly completely around the earth?

A. That's it exactly.

Q. General, how can we build planes that can go that far?

A. The details aren't worked out yet, but the idea is comparatively simple. If one plane can go 5,000 miles, two planes can go 10,000 miles. Now, if you double the fuel load of those two planes, you get 20,000 miles. Actually, we won't need as much fuel as that because the planes will go faster.

Q. How much faster?

A. Well, a plane that is standing on the ground is traveling about 1000 mph. because the earth rotates about 24,000 miles in 24 hr. We should be able to add another 1000 mph. to the plane's initial, or static, speed, and this get around the world in 12 hr. We can travel in such a direction that the last part of the flight will be down hill, or, we can pick a direction which will provide a tail-wind all the ways. That will give us optimum velocitation.

Q. Will the airnaught carry any payload?

A. Definitely, every single member of the flight crew will draw flight pay.

Q. I mean bomb load, General. With such a load of fuel, how do you propose to carry any bombs?

A. We have written specifications for bombs which will be absolutely devastating and must not exceed 1 lb. in weight. We refer to these as bombites. The control button console should not weigh over 30 lb. for full equipmentation

Q. Are you going to have any trouble getting enough fuel for your airfleet?

A. None at all. We are working on a fuel-recovery system by which each plane re-processes the exhaust products of the plane ahead, and thus manufactures most of its own fuel.

Q. How does the first plane in line gets its fuel?

A. There won't be any "first" plane. There will be a continuous ring of planes so that each one will have a plane ahead of it. This constitutes a sort of endless bomb-belt.

Q. General, that is remarkable. Does it mean that all your planes will have to stay in the air continuously?

A. Not necessarily, but that is a feature we are working toward. The thought is that if our planes won the last war by staying in the air only 6 hr. a day, they can win the next one four times as fast by staying in the air 24 hr. a day. Or, in the same length of time, the same job can be done by one-fourth the number of planes.

Q. That means you would refuel in the air?

A. We would go much farther than that. We expect to re-service the plane in all respects, and exchange flight crews while airborne. Thus we dispense with bases. When we ultimate this program you will find that all phases of warfare will be completely aerialized.

Q. How are we going to handle the enemy's defense against your bomb-belt?

A. He won't have any.

Q. Why not, General?

A. As I explained, we propose to devote all our potential to the offense. Practically all other powers will do likewise since they pattern their forces on our organization. Thus, any enemy is bound to get caught without any defense.

Q. Are there any other developments I can mention in connection with your publicity?

A. Well, under our directivation project enginairs are working up an interesting list of devices. These include projectile traps and the strato-mine. The new binocular electronics system also gives gives us some very valuable military implements. Among them are missile reversers, blind underway remote photography (BURP) and electronic camouflage (chamelenics). Ratro-radar will permit keeping the bomb sight on the ground. Thus the groundier will take over the bombardier's job, which will eventually be handled automatically. As you can see, we have just about eliminated the man from the problem. The next logical step is to eliminate the machine. We call this de-mechanization.

Q. General, are there any obstacles to your plan?

A. We are worried about de-objectivation.

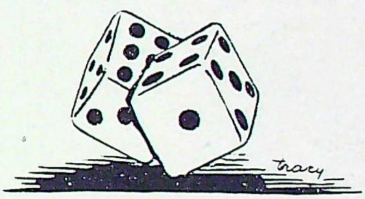
Q. What is that?

A. Target shortage.

Thank you, General.

R. H. W.

So You Want To Gamble?



By Flt. Lt. H. Fraser

Since the most reliable statistics available indicate that approximately 85% of all the accidents are traceable to unsafe acts of persons, it follows that many individuals do not consider the risks they take in terms of the law of averages.

If we take an unweighted coin and toss it into the air, there are two possible positions in which it may come to rest—heads or tails. Because there are only two possible positions, we say there is a fifty-fifty chance that the coin will show "Heads." In the long run, the frequency with which the coin would fall heads uppermost would be half the number of throws.

That the odds are not always the same, can be demonstrated with ordinary dice. Here we have cubes with faces numbered from one to six. If we throw them on a smooth surface, there are six possible positions in which either of them may come to rest. If we wanted a certain face of one of the dice uppermost, then we say there is one chance in six in our favor. Now, if we throw one of the dice six thousand times, we may expect to have the number one face uppermost one thousand times. The result may not be as we expect it to be, but the more times we throw the dice, the frequency in which a given face falls uppermost will closely approach one-sixth the number of throws made.

Just as the law of averages functions in tossing a coin, so does it operate with respect to accidents. The law of averages never fails to operate; and if we flout it by taking unnecessary risks, our names may be posted in the Vital Statistics Column prematurely.

("*Wings Over Greenwood*")

Smith-B's Last Flight

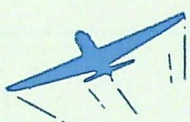
(In our last issue we reprinted from "The Aeroplane" an article on the late Robert Smith-Barry, originator of the famous Gosport System of flying instruction. The following letter to "The Aeroplane" provides a further note on this remarkable man.—Editor)

DURING THE WAR, I served with the R.A.F. on an O.T.U. at Risalpur, in the North-West Frontier province of India, and during that time the late Robert Smith-Barry was in charge of the air-training school. Many were the tales that circulated of his flying prowess and of the contrivances, made mostly from wrecked Hurricanes, which he designed for flight instruction.

While I was there he flew a Harvard, a Hurricane and a Vickers Valentia which was used for navigational training. When he entered the cabin of the last-named, all the "erks," who were ready seated waiting for a flip, beat a hasty retreat thinking perhaps that they had better be safe than sorry.

In due course his head appeared from the open cockpit and, much to the amusement of those assembled, he was wearing his Service cap, peak backwards, in the fashion of the pioneers. Instead of waving away the chocks in the customary manner, he roared out the order above the din of the open Jupiters. This was probably the last 'plane the great airman ever flew, for shortly afterwards he retired to live on a houseboat at Srinagar and devote his time to mathematical problems.

R. C. BONES.



Tire Temperatures

(Reprinted by courtesy of "Aviation Week")

IN-SERVICE TESTS, reported to be the first conducted by the U.S. Air Force or industry to record accurately the actual temperature of tires under flight condition, were made recently by the Mechanical Branch of the Aircraft Laboratory, Engineering division, Air Materiel Command.

Trials were run during takeoffs and landings with standard 47-in. tires. Thermocouple needles were inserted in the casings at two points of anticipated maximum temperatures—the first just above the bead overlap, the second as close as possible to the deflection line at the shoulder.

Penetration was to a depth of at least half the plies and the needles were laced to the casing. Thermocouple leads were connected to a newly developed commutator which operated a potentiometer in the cockpit.

Temperatures, measured prior to takeoff and every 5 sec. during takeoff run, rose 9°F. at the shoulder and 12°F. at the bead.

Cooling was accomplished by flying at 3000 ft. at 160 mph. with gear down for 30 min.

In landings at touchdown speeds of 115 mph., average temperature increase was 35°F. at the bead. Light to moderate braking was used during landing rolls and readings taken every 5 sec.

Additional taxi tests were made to determine the "equilibrium speed" at which tire temperature tends to stabilize—no build up or cool-off. At 30 mph. the temperature stabilized at 126°F.

Additional experimentation is planned at higher speeds and loads and on jet craft.


The DIMMER VIEW
by ray tracy
NOTICE
ALL BARRACK BLOCKS
STATION CLEAN-UP!
INSPECTION TOO!
LOOK SHARP! BE SHARP!
B BLOCK 9
WAX
WAX
NOTICE
ALL BARRACK BLOCKS
STATION CLEAN-UP!
AND
INSPECTION TOO!
POSTPONED
LOOK SHARP! BE SHARP!
9-49

LETTERS TO THE EDITOR

An Ex-W.D. Looks Back

Dear Sir:

It's good to receive "The Roundel" each month. . . stirs up the old nostalgia. As an H.Q. type, I find most of the technical talk over my head, but the rest is both interesting and informative. And hurray for Ray Tracy!

We have a small group of ex-W.D.'s in Montreal who get together once a month, mostly for gab—though we *do* send small gifts to girls who are recuperating from T.B. at St. Hyacinthe or who happen to be in the military hospital here, as well as food parcels to RAF girls in Britain in similar circumstances.

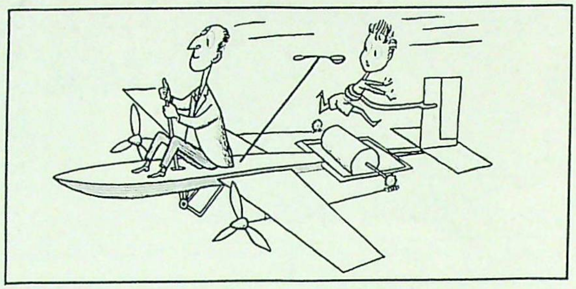
Incidentally, I think it would be most interesting to see letters in "The Roundel" from the guys and gals who kept on the move after they shed their blues. There's Ruth and Jean of B.C. who went to Australia and New Zealand to visit Edith, a Saskatchewan girl who married ex-POW Peter (he teaches the upper grades of a Northland school, and she the lower). Rumour has it that they're now on their way to England, where no doubt they'll go looking up D.R.O.'s at Knightsbridge or Lincoln's Inn Fields. Then there's Fern, last heard from in the Office of the High Commissioner for Canada at New Delhi, India. . . and Eileen, who journeyed from B.C. to France to marry her Frenchman, only to change her mind, get a job with a U.S. military organization, and then return to the West Coast.

Oh to be in England now that summer's here! If only I could have wrapped up that wee town of Cockington in Devon

and brought it home. What about agitating for reunion flips or tours at very minimum prices? What a chance that would be for those of us who have to stay at home about fifty weeks of the year!

Best wishes and good luck!

Lorna Norman (RCAFA)



Castor-oil-age aeroplane. One small-boy-power operated through treadmill and motivated by retractable caster-oil-spoon principle.

("*Aeronautics*")

The Speed of Sound

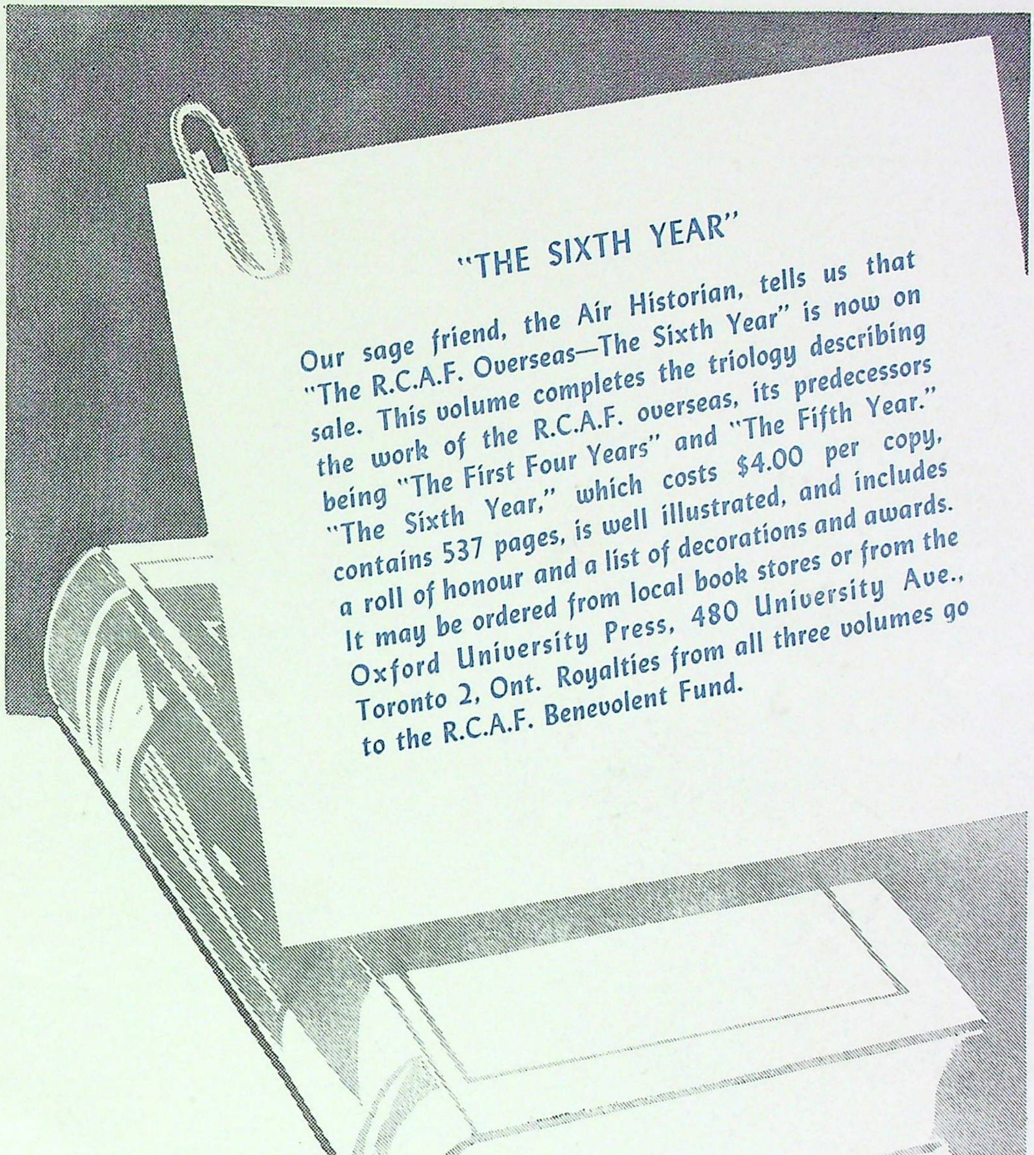
AS BRITISH AIRCRAFT attempt to overtake the speed of sound in air readers may be interested in comparing sound speeds in various other media with those attained in the atmosphere, where they vary from approximately 761.5 m.p.h. at 15°C. (58.99°F.) at sea level to approximately 640 m.p.h. at −57°C. (−70.6°F.) at 36,000 ft.

Speed of sound through:

Ice-cold vapour	3,209.91 m.p.h. (4,708 ft./sec.)
Ice-cold water	3,366.72 m.p.h. (4,938 ft./sec.).
Vapour at 60°	3,856.94 m.p.h. (5,657 ft./sec.).
Gold	3,897.85 to 4,697.6 m.p.h. (5,717 to 6,890 ft./sec.).
Silver	5,903,02 m.p.h. (8,658 ft./sec.).
Clay rock	7,786.15 m.p.h. (11,420 ft./sec.).
Brick	8,167.96 m.p.h. (11,980 ft./sec.).
Oak	8,604.31 m.p.h. (12,620 ft./sec.).
Granite	8,836.12 m.p.h. (12,960 ft./sec.).
Iron (hot)	10,554.26 to 11,856.50 m.p.h. (15,480 to 17,390 ft./sec.).
Steel (cast)	11,154.24 m.p.h. (16,360 ft./sec.).
Glass	11,188.33 to 13,424.6 m.p.h. (16,410 to 19,690 ft./sec.).

Sound waves in constant air temperature would travel at constant speed, but as the atmosphere's temperature fluctuates from hour to hour and decreases with height, sound waves and airspeeds vary accordingly. As far as is known, sound cannot be transmitted beyond the earth's atmosphere (some 200/250 miles height), as sound cannot travel in a vacuum.

("*Air Reserve Gazette*")


"THE SIXTH YEAR"
Our sage friend, the Air Historian, tells us that "The R.C.A.F. Overseas—The Sixth Year" is now on sale. This volume completes the triology describing the work of the R.C.A.F. overseas, its predecessors being "The First Four Years" and "The Fifth Year." "The Sixth Year," which costs $4.00 per copy, contains 537 pages, is well illustrated, and includes a roll of honour and a list of decorations and awards. It may be ordered from local book stores or from the Oxford University Press, 480 University Ave., Toronto 2, Ont. Royalties from all three volumes go to the R.C.A.F. Benevolent Fund.

The ROUNDEL