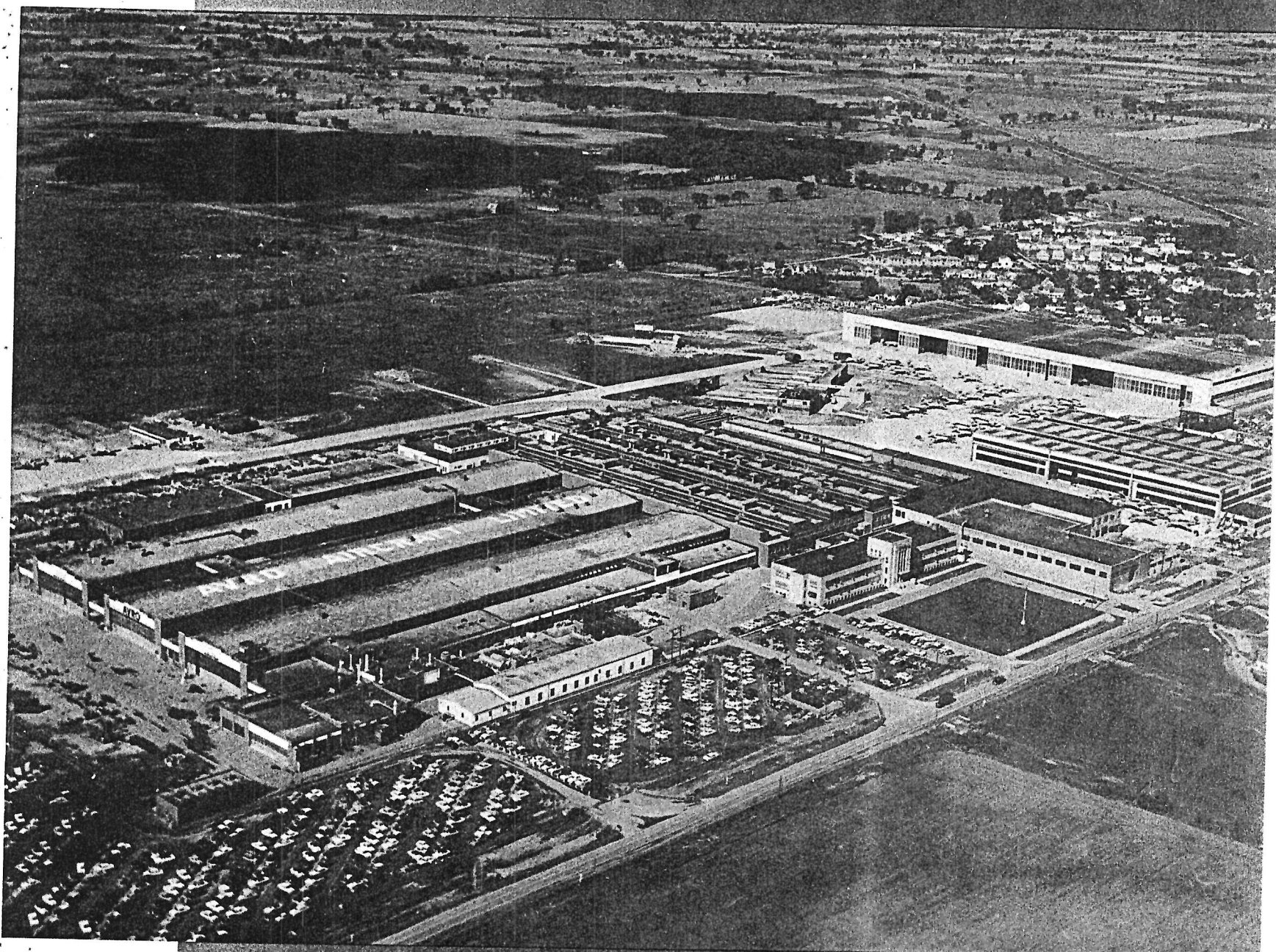




THE **AVRO** ORGANIZATION



#22

PRODUCED BY THE PUBLIC RELATIONS DEPARTMENT - AVRO AIRCRAFT LIMITED

RL 821-1955

AVRO AIRCRAFT LIMITED

Directors and Officers

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 J. C. Floyd — Vice-President Engineering
 H. R. Smith — Vice-President Manufacturing
 J. A. Morley — Vice-President Sales and Service

A. A. Bailie — Director
 J. Turner — Secretary and Treasurer
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J. Fairbairn — Quality Control and Inspection Manager
 D. H. Rogers — Chief Test Pilot
 E. F. Alderton — Industrial Relations Manager



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E. F. Alderton, Industrial Relations Manager



D. H. Rogers, Chief Test Pilot



J. Turner, Secretary and Treasurer



J. Fairbairn, Quality Control and Inspection Manager

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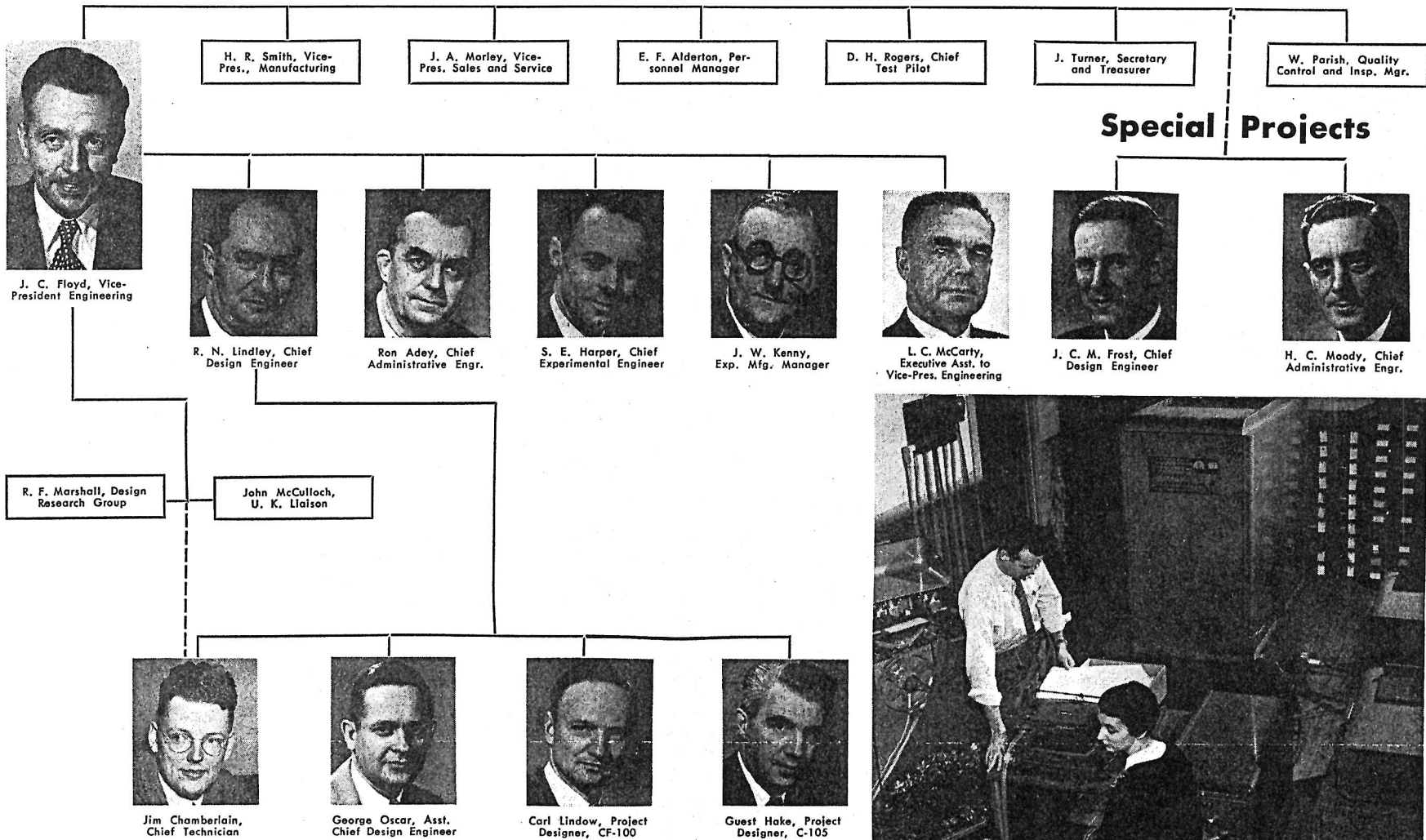
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This booklet is compiled from reprints of a series published by "Avro Aircraft News". Each chapter of the series contained descriptions of the internal organization of each Avro Aircraft Division and the relationship of each to the other.

Additional copies of this booklet are available from the Public Relations Department, Avro Aircraft Limited, Box 4004, Terminal "A", Toronto, Ontario.

MANAGEMENT COMMITTEE



First Comes Original Design So First Comes Engineering

How does a big aircraft corporation like Avro Aircraft operate so smoothly?

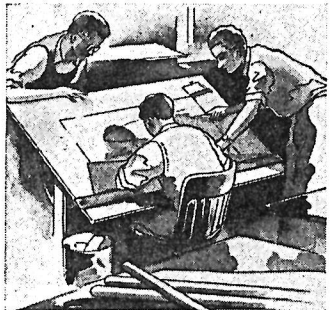
How come that people aren't falling over each other, with so much going on at so many places at the same time, over such a big area?

The answer is in organization and efficiency. There's management and an alert, efficient work force. There's the latest in modern equipment and techniques. Then there are intangibles . . . like loyalty, pride and ambition.

Through it all, first things come first. So let's start with the Engineering Division, where the original design is born . . . where the shape of things to come first take shape.

All set? Well, we go back a step . . . back to Ottawa . . . where RCAF specialists have analyzed Canada's basic defensive needs to combat bombing attacks by a potential enemy some five years from now.

It takes approximately that long to create and produce a jet interceptor; so the Air Force must always be thinking well ahead.



When the details of the defensive need are finalized, specifications for a suitable defensive aircraft are presented to a manufacturer, stating exactly what range, altitude, speed, armament and the like are required for the airplane's desired operational efficiency.

Avro Aircraft is the only builder of high-performance jet aircraft in Canada whose basic policy is to manufacture products of its own design, and is more than capable of undertaking such a project.

So Avro Aircraft takes over and the specifications go to its Engineering Division headed by J. C. (Jim) Floyd, Vice-President Engineering. From this creative source stems the research and development operations to come.

The specifications are converted by the Engineering Division into the configuration best suited to requirements. Wing geometry, fuselage size and shape, number and type of engines, fuel capacity, radar and armament installation, and a thousand-and-one other technicalities are considered in

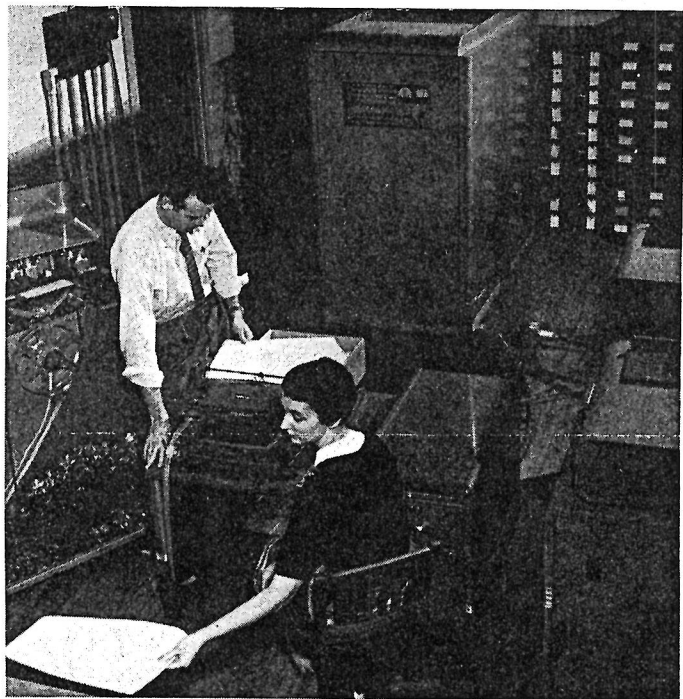
order to best meet Air Force needs.

Accumulated drawings and data are assembled as rapidly as possible, and a "Design Proposal" — based on findings — is prepared and submitted to the RCAF for approval. Some modifications may be required, but when accepted by Air Force, the Design Proposal is the basis on which the Department of Defence Production issues a "Design and Development Contract" to Avro Aircraft. At this point, every department of the company's vast Engineering Division gets into the act.

Four major departments contribute to the over-all high degree of effectiveness of the Engineering Division — Design; Research and Development; Experimental Manufacturing; and Administrative. In addition, there is the Special Projects Group which is allied to the Engineering Division, but reports directly to F. T. Smye, Vice-President and General Manager.

The operations of the Design Department are in the hands of Bob Lindley, Chief Design Engineer. This department is responsible for the creation of design in the initial "design proposal" stage and carries right through to the final production design. Reporting directly to Bob Lindley are Jim Chamberlain, Chief Technician; Guest Hake and Carl Lindow, Project Designers, CF-100; and George Oscar, Assistant Chief Design Engineer.

The Research and Development Department, directed by Stan Harper, Chief Experimental Engineer, conducts all physical tests on parts, assemblies, and completed aircraft. R&D



TWENTY-FIVE different arithmetic problems solved in less than a thousandth of a second! Art Downing, Senior Computer Specialist and Bev Burkhardt, Computer Operator are shown with Avro Aircraft's NCR Model 102-A high-speed general purpose electronic computer. "Brains" like this are essential to keep pace with the terrific engineering developments of the modern aircraft industry.

also undertakes basic research in order to assist the Design Department.

All parts of new aircraft needed for development testing are fabricated by the Experimental Manufacturing Department, managed by Jim Kenny. This department also developed the CF-100 wingtip rocket pods; and manufactures all test rigs, and does development evaluation modifications to existing aircraft.

Under the direction of Ron Adey, Chief Administrative Engineer, the Administration Department is the Engineering Division's business management function. Financial forecasts, budgets, planning, standards, personnel, wage administration and all such services to the Division are the responsibility of the Administrative Dept.

In a class by itself, the Special Projects Group under the technical and administrative juris-

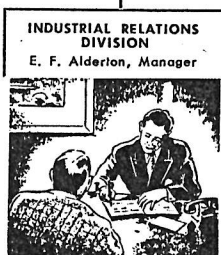
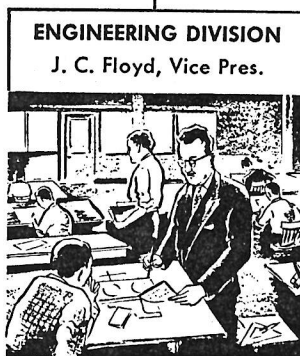
diction of John Frost and Hal Moody respectively is engaged in research of a very special nature.

Technological advances in modern aircraft have brought about many rapid changes in design technique. Engineering problems encountered today are often so tedious, detailed or complex that high-speed automatic computing methods have become a necessity.

In order to keep pace in a constantly-changing world market, and keeping in mind the long period of time required from initial design to the production of modern air weapons, a continuous study of "things to come" has become a necessity. Looking after this aspect of engineering is Rolf Marshall's Design Research Group, which is associated directly with Jim Floyd's office. Design Research is constantly analyzing potential future products.

IN THE NEXT ISSUE, the series will go into more detail about the departments sketched above . . . where do the test rigs and mock-ups come from? . . . who decides what materials should be used in design work? . . . how about ballistics of guns and rockets? . . . who prepares drawings of a new design? . . . who checks the stresses and strains of parts and components?

MANAGEMENT COMMITTEE



Designers First To Tackle Aircraft Creation Problems

So we've had a good look at the setup of Avro Aircraft at the top management level . . . who's who and what's what at the top, where the company's programs and policies and so on are attended to. And we saw how the various Divisions of the company fitted into the pattern. And we noted that the Engineering Division went into action first . . . getting the first, operational look at the RCAF basic requirement specifications for a new airplane.

This we noted. Now, let's take a good look at the first department in Engineering to go into action . . . Design.

Converting the specifications into a fully-developed airplane involves the co-ordinated efforts of a wide variety of design specialists.

Take the fuel system. It's one of the thousands of such problems facing designers. Its capacity must be considered in terms of distribution within the space available—without loss of efficiency, structural strength, or addition of unnecessary weight. Fuel pipe layout, numbers and types of valves and controls, access for service and maintenance, must all be considered. Simplicity is a prime aim. The system must be easily understood, and control manipulation must present no problem to a pilot making split-second decisions.

Add to this the similar problems facing designers of such "systems" as electrical, hydraulic, air conditioning, engine controls and installation, radar and radio, navigation, fire control—to mention only a few—plus the aerodynamic problems of the airplane silhouette, and

some idea of the enormous task of the Design Department may be appreciated.

Anyone who has tried to assemble a 1,000-piece jig-saw puzzle would have a better appreciation of Design's problem if they get 1,000 blank pieces all jumbled up in a box with orders to paint the complete picture, one piece at a time, before assembling the puzzle—then deliver the finished picture, completely stuck together—in a hurry.

These are the services specialists. Then there are the people who must produce the design drawings of the airframe in which the services will be applied. The frame is usually geared to available powerplant alternatives, which gives the designers a concrete starting point. From then on it's check and double-check, trial and error, accept and reject.

Three key sections of the Design Department bear the brunt of the problems of aircraft crea-

tion: Aerodynamics Section, Stress Office and Design Office. Here is how they work:

Aerodynamics

An aerodynamicist's chief concern is with what the airplane will do in the air. Sixty engineers in the aerodynamics section use all types of calculating aids from pocket slide rules to electronic "brains" to ensure maximum control of the proposed aircraft under all conditions of flight (climb, dives, tight turns, aerobatics, inverted flight, and so on) while meeting all required performance specifications such as operational ceiling, range, Mach limit, rate of climb, fire-power and the like. And all this must be done before even a mockup is built.

The aerodynamics section also eases the headaches of the stress office by calculating the magnitude of the loads imposed on the aircraft as a result of its passage through the air. For instance, they may say: "... after checking the aerodynamics of, and stress in the proposed wing design for this particular aircraft, bearing in mind all operational requirements, the wing will twist anticlockwise and shake off at an airspeed over 'so-&-so' mph, if the proposed wingtip tank is installed and loaded. With the tip tank empty, the wing will twist clockwise with safety between points A and B at 'so-&-so' mph. At 'so-&-so plus' mph it will twist beyond repair, and any increase in speed will result in complete structural failure."

Aerodynamics calculates G-loads on the proposed silhouette at all speeds, turn rates and pull-outs, at all stages between the minimum flying weight and the all-up weight in full long-range fighting trim.

Advent of the transonic and supersonic era has created a tremendous increase in the amount of engineering work needed to cover all conditions of flight. Electronic computers are used to cope with these added complexities. They do everything but think—replacing an unavailably enormous staff of human calculators while utilizing a fraction of the time. A "brain" will handle in minutes problems whose solution would shatter the endurance of the most patient and efficient human being.

Stress

A chain is only as strong as its weakest link—so is a modern aircraft. The stress and strain imposed on a chain can be easily calculated, bearing in mind the type of material and the ultimate use for the chain. The breaking and resistance points can be determined by jerking it, or gradually making



PUTTING IDEAS and problems solutions into readable drawing form is the job of the design office. Here, left to right, Frank Graham, Alan Buley, Bill Bates and Dan Cook consider the redesign of equipment at the wooden mockup stage.

it taut to the desired weight or load limit.

This same principle applied to the complex modern airplane, coupled with the variety of forces acting upon each one of a million points on, and within, the aircraft may give some inkling of the daily problems facing a stressman.

He must calculate the stresses in the structure evolved by the design engineers in order to determine the minimum material required in terms of form, type, weight, size, and so forth, necessary to support the various loads and maintain the shape established by Aerodynamics.

Again, the complexity of such undertakings requires the aid of automatic calculators. Since uppermost in the minds of stressmen is the necessity of keeping weight to a minimum, a subsection of Stress is the Weights Office, where an up-to-date record of the aircraft's weight at any phase of development is maintained. Stress and Weights utilize 80 engineers.

Design Office

In a sense, the design office is the communication between thought and action. Like the mechanism that initiates physical motion in the hands as a result of mental motion in the brain, it is the link between creation and production.

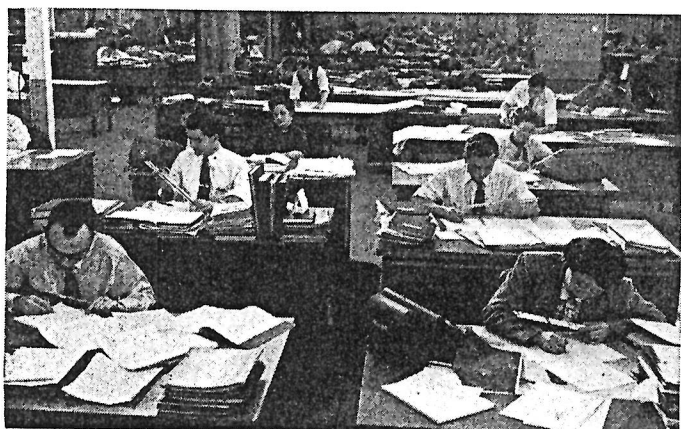
Designers describe on paper the structure and equipment evolved by the project-designers, aerodynamics and stress offices. These are comprehensive instructions to the manufacturing division, detailing the amounts, types, shapes, sizes, materials, and so on, needed to be shaped into an airplane. The actual assembly process requires close collaboration between the Engineering and Manufacturing Divisions, and will be dealt with in detail at a later date.

At this stage, design phases into manufacturing. It is done in two stages. First—structure and equipment installations are designed and redesigned in broad outline (with the help of aerodynamics, stress and manufacturing) until a satisfactory and economical compromise of the solutions to the many problems facing the design team is reached. Secondly—the general schemes are converted into specific subassemblies and details. Close liaison is maintained with the Production Department so that manufacturing requirements are met, and any new process required by the design can be developed in time to meet the manufacturing schedule.

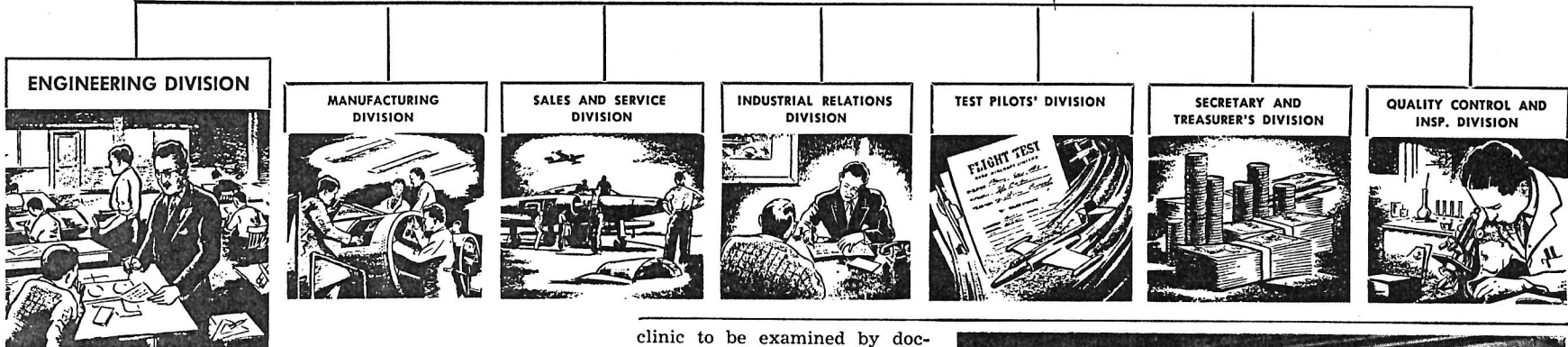
Designers, draughtsmen, lofts-men, checkers, liaison engineers and clerical help, constitute a design office staff of over 500. Co-ordination of the entire effort of the Design Department in the creation and development of an aircraft is maintained by the Project Designer, who is a member of a design committee, and reviews the multitude of problems which appear as the project slowly takes shape.

The co-ordinated functions of the Design Department described here cannot lead to the design and development of an effective aircraft without the help of the other departments of the Engineering Division, or outside facilities.

IN THE NEXT ISSUE, the series will describe Engineering's Research & Development, Experimental Manufacturing, and Administrative activities. Where do test rigs and mockups come from? ... How about armament? How is a design proven acceptable?



THIS VIEW of Avro Aircraft's Aerodynamics Section shows engineers dealing with their specialized problems with the aid of electric desk calculators and a variety of slide rules. In front, left to right, are Tex Roberts and Daisey Pon. Second row: Joe Stein and Bob Skulsky. Third row: Irene Paige, Sheila Bura and Monica Wardley.



Designers Say: This Is 'It' R&D Go Out And Prove It

So we have an aircraft designed . . . into the "shape of things to come."

Now follows the work of the Research and Development Department of the Engineering Division. Or call it: R&D.

When an airplane was a relatively simple machine, it was possible to develop the whole thing on paper and make a prototype with very little happening in between. In this Jet Age, this is almost impossible and definitely inadvisable.

It is now necessary to prove each idea as it develops in the minds of the designers. Strength and efficiency of structures, working of mechanisms and systems, use of new types of materials, or flying the complete airplane, are typical design phases which must be proved.

And proving them is the main function of R&D.

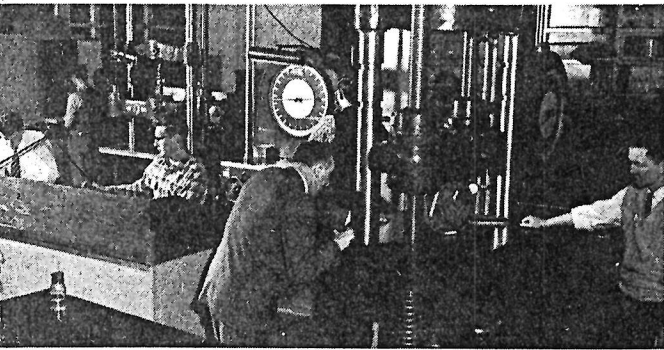
As the name implies, Research and Development is mainly a laboratory type of activity — which does not always stay on the ground. Reducing the risk of failure of any part of an aircraft (both in flight and on the ground) involves a considerable amount of testing. This starts immediately after the first scheme or portion of design is put on paper, and continues until the aircraft is obsolescent.

R&D's first phases include subjecting a typical portion of the wing or fuselage—called a shear panel — to the load and temperature conditions encountered in flight. In addition, small scale development of manufacturing techniques required to make such a structure are explored. Years later, the newest in radar or armament may come under a development program involving considerable ground and flight testing.

Timing is an important factor! Results of testing panels must be available before the final design gets too far along, and whether or not the fuel system works must be known before the aircraft assembly stage. Responsibility for this variety of testing activity falls on four main sections of Research & Development.

Metallurgy

A chain, it has been said, is only as strong as its weakest



VIEW OF A SECTION of Avro Aircraft Metallurgical Department shows (on the left) testing the tensile strength of materials and (at right) the proof testing of a production casting. Left to right are: Tom Bowden, Cy Sayce, Len Harris, George Funston (front), Bill Ganther (rear), and Bob Raymont.

link. Engineers are constantly searching for materials which will make the link stronger without increasing size or bulk, and it is the metallurgist's job to search out this material and provide all information necessary for its use.

Until recently, aircraft structural steel components of 200,000 psi (lb. per sq. in.) were considered at maximum tensile strength. Metallurgical research has produced heat treat methods and alloys making steel 30% stronger with no increase in weight. Use of Titanium, "the glamor girl of metallurgy", is another project with similar objectives.

R&D metallurgy investigates applications both design-wise and production-wise involving alloys of this wonder metal whose strength properties do not deteriorate with greatly increased temperatures.

Avro Aircraft metallurgists have produced a corrosion-resisting protective treatment for magnesium alloy which also forms an excellent paint base that can be applied in half the time required by previous methods.

The Metallurgical Section also has a functional role which is not unlike that of a medical clinic. Human beings with broken limbs, internal disorders and skin trouble, go to a medical

clinic to be examined by doctors, surgeons, dentists and specialists like radiologists. Aircraft materials which become cracked, broken, corroded, or are found to have internal defects, at any stage of their lives, are submitted to the metallurgists for examination.

Structural, Mechanical and Systems Testing

It is not easy to simulate on the ground the various loads, temperatures, modes of vibrations, and so on, encountered in the air—but Avro Aircraft engineers and technicians are doing just that. For instance, in a structural test, a typical aircraft wing and centre section will be forced down on a rig at points like the undercarriage, engine mounts, and heavy fuselage frames, while uploads of about 10-times the aircraft's weight are applied in various places to reproduce effects of wing lift. Internal pressures are applied to fuel tanks and cockpit sections to reproduce in-flight conditions. Arrangements of loads may be altered a dozen times to cover all anticipated critical loading conditions.

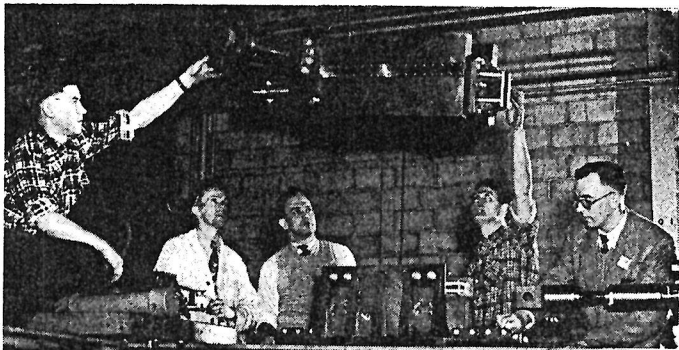
Such work takes months, even years, to complete; continuing with development beyond the initial flight to the point where structures fail at exactly the load estimated by the designers or perhaps, slightly more.

In the mechanical testing field, the simplest-looking jobs often turn into the most complicated. Testing of control surface bearings under heavy loads at relatively low speeds merely requires the bearing to be rotated while a certain amount of offset loading is applied. What happens? A nine-month development job and a machine which looks like an oversize diesel engine, and costs many thousands of dollars is the result. After several months' operation, the machine is earning its keep by proving that some types of bearings are not what they were thought to be. Knowledge like this can save millions of dollars and prevent possible loss of life.

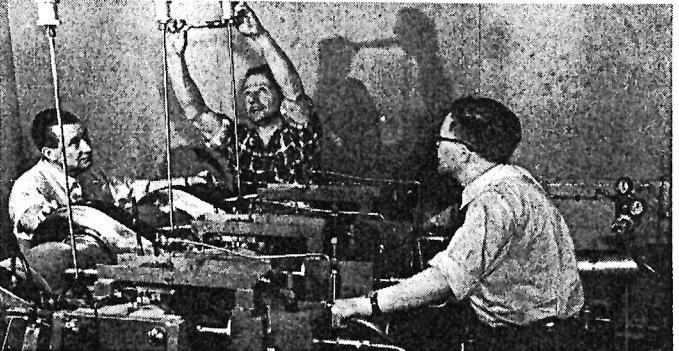
Near this machine is an area large enough to lay out every system of an aircraft. Starting with the smallest items such as valves, hydraulic jacks and the like, each part of each system is submitted to the type of loading and temperature conditions it will meet in flight.

Some problems, such as conditions causing metal fatigue, can only be solved on the aircraft itself. To do this the airplane must be instrumented and set up for ground engine running with recorders and other instruments housed nearby in a soundproof and heated hut. With engines blasting at take-off power, enough facts are gathered in a few seconds to make assessment possible and determine the next step.

So it goes. When canopies have been jettisoned, control



SHOWN REMOVING the inertia block from a test specimen of a hydraulic jack test rig are Bill Bridle, Jack Turban, Al Schnuck, Bert Berry, and Roy Tanner. Jack, Al and Roy are in R & D's structural test department.



DESIGNED SPECIFICALLY for the testing of offset loadings of bearings used in the aircraft, this machine saves many thousands of dollars. Here (left to right) are Wilf Hankey, Bill Hedge and Henry Jones of Research & Development's mechanical test department setting the machine up for a run.

surfaces vibrated, fuel systems checked and calibrated, the aircraft can then be handed over for flight testing.

Flight Testing

From a nice quiet office to the rear cockpit of a bucking, gyrating airplane is often the lot of a flight engineer observer in R&D's flight test section. Sitting in the rear seat of a CF-100 with the canopy off, allowing the wind to tear at face, arms and helmet just to prove the designers' theories on crew ejection from the aircraft, is just one such job for test engineers.

R&D Flight Test's prime function is to check, in flight, everything from an electrical gadget which may not operate in rare atmosphere to a complete aircraft with similar problems. Test flying requires considerable preparation on the ground. Remote and automatic recording instruments are employed, sometimes having as many as 50 channels. Electronics engineers and technicians are the brains behind this necessary supporting task.

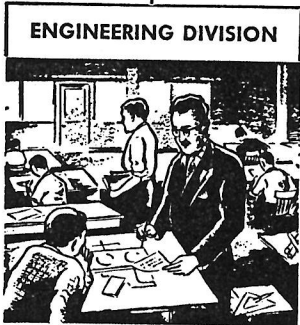
A "show piece" built by R&D is the Telemetry Trailer — another instrumentation and electronic engineer's dream. This is a large mobile receiving station that collects signals from test aircraft which are turned into indicated and recorded data required by the test engineer. Airspeed, control surface angles, accelerations, vibrations, stick

Armament and Electronics Testing

Armament projects are like hot potatoes. They are handled carefully. It goes without saying that in order to be effective, the armament installation must work properly. Projectiles, whether they be bullets, rockets, or guided missiles, must fire on demand and clear the aircraft with maximum safety. Problems such as: effect on aircraft flight characteristics, methods of jettison, and many others are among those solved through the co-ordinated test efforts of R&D's armament and flight and ground test sections.

Ultimate objective of the tests is to subject the armament and radar installations to a series of simulated combat conditions. The instrumentation specialists go "all-out" during this phase and it is a credit to their ingenuity that so much invaluable data is obtained.

IN THE NEXT ISSUE, the series will round out the Engineering Division's story with highlights of Experimental Manufacturing and Administrative activities, then move on to the Manufacturing Division story.



When All Is Said And Done— Flight Test Tells the Tale

In the past chapters, we traced an aircraft project from the laying down of its specifications, through Design and Research and Development.

Now, the Experimental Manufacturing Department puts all these ideas of Design, Research and Development into practical "hardware" which acts as the final proving ground for the aims of the designers, and provides the prototype aircraft and modifications for quality production.

The Experimental Manufacturing Department puts all these ideas of Design, Research and Development into practical "hardware" which acts as the final proving ground for the aims of the designers, and provide the prototype aircraft and modifications for quantity production.

Whether the design calls for a rig which will stimulate the fuel system on an aircraft flying at supersonic speeds, or a 1/80th scale model (accurate to 1/1000th of an inch), both receive the same painstaking care and attention to detail which is a prerequisite of experimental work.

As soon as Design Instructions are issued, they pass straight into the Experimental Planning Section. Here, expert planners (mainly ex-shopmen) decide the best and cheapest methods of manufacturing the parts, and devise how they will be subsequently installed in the aircraft. It is here that any queries on the drawings are raised, such as variations in manufacturing techniques, non-availability of materials or other problems. At this stage, it is also decided whether a jig or fixture will be required for the manufacture and assembly of the job.

Upon ensuring that materials are available and non-standard items have been ordered, the job is then handed over to Experimental's Manufacturing Section, which is, in effect, a self-contained factory with the following facilities: machine shop, jigs & tools, sub-assembly, sheet metal details, woodshop, model shop, and plastics and paint shop.

Details of most of the projects at present are covered by the security wraps associated with experimental work. It can be said, however, that one of experimental's biggest undertakings at the moment is the construction of fullsize mockups of Avro Aircraft's new all-weather jet fighter. Mockups are very accurately manufactured, and contain all the controls, electric and hydraulic systems, and thousands of other items which make up the modern aircraft. Designers can inspect any area of the mockups, and at a glance see the problems of fitting further equipment.

Major portion of the work in the Experimental shops at present is on huge rigs required by the Research & Development Department. Two of these rigs will take up practically the full

width of the Experimental Hangar. One is capable of testing every possible combination of fuel loading on the proposed aircraft; the other is for testing the variety of components which, when assembled in their proper places, comprise the new airplane. The components are tested to show durability and utility during their useful life—which is discovered when they are tested to destruction.

There was a time when people were intrigued with the external appearance of airplanes; today, the "looks" are practically secondary. Far more interesting are the little black boxes which are the nerve centres of modern fighter aircraft. Experimental's Electronics and Radio Section, as the name implies, is responsible for the wiring and correct functioning of all electrical services in the airplane. Whether a project is on an unveiled newcomer, or modifying a production veteran, the work involved in setting up a radar system has to be seen to be believed.

Finding a fault in an electrical system (whether new or modified) can sometimes take days of meticulous work. To avoid checking the faulty items while still on the airplane, the units are removed and tested on very elaborate test benches. One represents the autopilot system, another the fuel contents system, and so on. This method of bench checking saves much valuable time.

If a change in the requirements of an aircraft currently in production is specified, or some part or system of a production model proves unsatisfactory in service, the designers draw up a modification (which is manufactured in the Experimental Department) and request a trial installation be made. This is fitted to one of the production aircraft permanently based in the department. When the mod is flight-tested and results are satisfactory, it is cleared to the Production Division for incorporation in production aircraft.

and planning personnel, progress is reviewed against schedules.

STANDARDS—is the sorting house for engineering information. This section's task is the development, preparation and publication of material and equipment data. The information is aimed at the engineers, technicians, draftsmen and shop personnel who utilize the collected knowledge in the progress of a project.

Design Office Manuals, Equipment and Model Specifications are also produced by Standards. These form the reference "Bible" for the technical requirements of the aircraft.

PHOTOGRAPHIC—Due to the broad nature of its work, this section serves the entire company in one form or another. Increased use of photography in all phases of engineering and, lately, precision manufacturing, gives it a unique position in the Engineering Division. Photographic's operations include: production of precision templates for wind tunnel models and full-scale tooling and manufacturing; technical movies, often with high-speed cameras, for structural, flight and armament analysis; documentary movies for sales tools and public information; industrial still photos to illustrate technical reports and for public relations; wall chart reproduction for group information and instruction; making of lithograph plates for company-produced technical (classified) publications, parts lists and so forth.

PERSONNEL ADMIN—looks after personnel records, salaries and placement. A major undertaking at the present time by this section is the development of education and training programs for professional and technical employees.

ENGINEERING SERVICES—provides the Division's reproduction services such as blue-printing, multilith and xerography. This section also maintains a master file of all records as well as a reference library and reading area. Services is also responsible for the IBM section which provides tabulating facilities for the engineering and production divisions.



PLANNING AND SCHEDULING SECTION of Administrative Engineering is shown above. In first row on left (front to rear) are: Art Dunn, John Brook, Beryl Mashinter. Middle row (front to rear): Ron Gray and Frank Harrison, Bill Dale, George Ament, Wilda Huson, Marie Campbell. Third on right (front to rear): Norm Watt, Bill Wright, Jim Reid, Joyce Keeling.



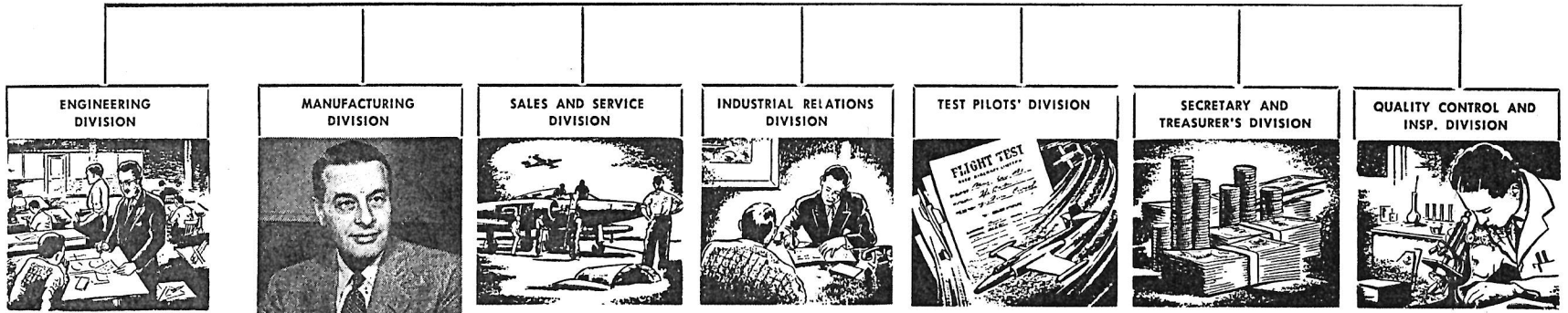
STUDENT TECHNICIANS and draughting trainees sponsored by Engineering Admin's education program are seen above on a tour of the plant with Tom Addison, Toolroom General Foreman (second from left), and Gerry Devries, Draughting Instructor (fourth from right). Here students watch operations in plastics section of the Tool Fabricating Dept.

Administrative Engineering

The Engineering Division's Administrative Department is made up of five sections which perform a variety of basic services geared to keeping the division's creative departments in a balanced state of productivity.

PLANNING—is where a new aircraft project hits its first major compromise—the one between engineering enthusiasm and elementary economics. Planning is where the engineering budget is considered in all its aspects. Estimating the engineering cost of each project, and forecasting the total annual expenditures are responsibilities of this section.

All engineering work is authorized from Planning by "work assignments", advising jobs to be done and cost account numbers. Each component of a project is covered by a drawing release and test program schedule, detailing completion dates of the operations of departments concerned. At regular meetings of department representatives



Harvey R. Smith, Vice-President Manufacturing



S. L. H. Wilson, Ind'l Engineering Mgr.



F. C. Richardson, Plant Engineer



H. F. Young, Chief Prodn. Engineer



C. N. Lucas, Procurement Mgr.



Norman Parsons, Prod. Control Mgr.



W. H. Riggs, Prod. Shop Mgr.



D. R. Wagner, Flight Test Gen. Supt.

Aircraft Is Designed Manufacturing Takes Over

From paper to planes. That's the job of Avro Aircraft's Manufacturing Division.

Through Manufacturing's front door flow Engineering's blueprints and precision drawings by the hundredweight. Out the back go ready-for-service aircraft.

In between, a work force nearly 6,000 strong is scheduling, planning, obtaining supplies, fabricating parts, assembling, preparing and testing. Like the tributaries of a river, scores of different departments send a constant flow of materials and directions to feed the main stream—the production line.

With such a vast number of operations going on at the same time, co-ordination and timing are of paramount importance. When a stage is reached the next part has to be there. Not two days early to clutter up the work area—and never late. The rivets, nuts, bolts or anything else that goes with the part must be there, too.

Because a small bottleneck in one minor department can hinder the whole scheme, Manufacturing must place the accent on this co-ordination and streamlining. Time is valuable. That is why a production meeting of all Manufacturing departmental heads is held every day at 8 a.m. to immediately iron out day-to-day problems and plan future work.

When you consider that obtaining the finest piece of copper wire to the eventual prepa-

ration of the 17-ton CF-100 for flight is all included in Manufacturing's job, the planning involved is tremendous.

Actual operations of the Division begin with the release of preliminary information on a new project by Engineering Division. This information, generally in the form of model specifications, performance data and preliminary sketches, is the basis of the earliest planning by the production departments until more detailed drawings are available.

A good example of this is taking place at the present time. Manufacturing is engaged on the CF-100 contract and is also approaching the stage of Engineering release on the C-105 program.

At this point must be determined what alterations in



TOOLS FOR THE JOB. This is Tool Design Section where Production Engineering produces drawings for the new tools which will be required to make parts. In foreground (at right) Reg Whittington, Tool Room Supt., whose section makes the tools, goes over design drawing with (from left): Joe Stringer, Tool Design; Earl Boeckner, Planning, and Don Waring, Tool Design.

manufacturing facilities will be necessary, additional machines and floor space, development of new sources of supply for materials and equipment, sub-contract facilities and many other new needs.

Planning the future program involves Industrial Engineering Department which is responsible for preparing an over-all production schedule in line with the number of aircraft to be produced. This schedule is based on a number of factors such as delivery requirements; manufacturing hours based on man-hours per pound related to the aircraft to be produced; as well as increased efficiency and methods improvement as personnel become more familiar with the job. Another is how readily manpower can be released from its present contract to begin work on the new project.

By this time Plant Engineering is analyzing changes in floor layout and determining with other Manufacturing departments the type and quantity of additional machines required. Re-location of equipment is helped greatly by the use of three-dimensional planning in miniature, in which scale models are used to produce the most efficient layout and at the same time provide more information at a glance than several volumes of drawings and directions.

As the program on the new project progresses and Engi-

neering begins to release drawings in volume, Production Engineering Department — the pivot of the whole production program—steps more into the picture. Having already assisted initial planning, they now provide tools and manufacturing techniques.

This key link between Engineering and actual production is comprised of four main sections — Process Engineering which plans the jobs; Tool Design; Toolroom where the tools are made; and representation on the Change Control Board through which design changes are processed and timed to enter the production line.

During this time Procurement Department has been analyzing requirements and arranging the purchase and supply of materials through its various departments — Material Assessment, Material Control, Purchasing, Sub-Contract and Stores, including Shipping and Receiving.

Now that drawings have been released and tools and materials are on hand, Production Control — as its name implies — takes over control of the flow of all manufactured parts and determines whether a part is to be made in the plant or sub-contracted.

As Production Control begins to release work orders in various levels of priority, fabrication and assembly of the parts begins. Production Shops, com-

prising 60 per cent of Manufacturing's personnel strength, swing into action.

In a wide variety of groups, parts are being fabricated, collected and made up into sub-assemblies, and fed into the production line through Production Control Stores along with similar parts and assemblies provided by sub-contractors.

Gradually the aircraft begins to take shape and moves along the production line, through the component marry-up stages, picking up engines, instruments and radar on the way.

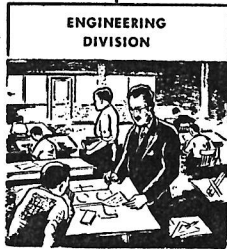
From here it moves to Production Flight Test Department for fuel flow checks, ground engine run, compass swing, installation of additional equipment and initial test flights.

After engine and airframe testing followed by radar flight test clearance, it is given a final inspection and cleanliness check. Then markings are added and another CF-100 is handed over to the RCAF.



FROM SMALLEST parts to the completed 17-ton CF-100 — it's all in the hands of Manufacturing Division. Nearly 6,000 Avroites are employed in this Division, and 60 per cent of these are in the Production Shops, which are centred on the Bays.

IN THE NEXT ISSUE the series will go into more detail about the Manufacturing Division, starting with Industrial Engineering Department, which maps out the overall production schedule.



Figures And Graphs Tell Story Of Production For Years Ahead

Just like the title of this series is "What's What? ... How? ... Who? In Avro Aircraft Organization," the first job of Industrial Engineering is to find out the who, what, where, when, how many, how fast, how much and similar answers relating to manufacture of a new aircraft before a hand touches a machine.

In other words, through many thousands of subsidiary calculations estimated from Engineering Division's drawings and blueprints of a new project, this department gives a date when the first aircraft will come off the production line, the cost, and future rate of flow of finished aircraft.

That's a lot of calculating, and it follows logically therefore that Industrial Engineering—in making all these calculations—establishes the master program covering the whole production schedule and its cost.

Program Planning Section of the department is responsible for setting up the master schedules and estimates, which also enable supervision to be constantly aware of schedule dates that have been committed by the Company.

On receipt of a request for tender from the customer or a request to estimate, a complete manhour estimate must be made of the required product. The estimate is produced by the use of learning curves (increased production from experience), past performance and information gathered from other sources; or by estimates based on standard data which has previously been established in the Company by the section.

This manhour data is converted into manpower required for all manufacturing functions. Completion dates of details, sub-assembly, components, final assembly, and flight test are set down.

When an order for aircraft is received, based on the estimate, this section must define the man-

power required by the various direct labour departments throughout the manufacturing organization.

This information then becomes the basis of direct manpower control. In turn, the manhour and manpower figures become the basis of a direct labour budget or target which appears on reports issued by the **Operating Control Section** of Industrial Engineering Department.

In addition, Operating Control Section receives a complete tabulation of actual direct manhours expended each week and can compare actual expenditures against the estimate. Thus the Company can always assess its position weekly.

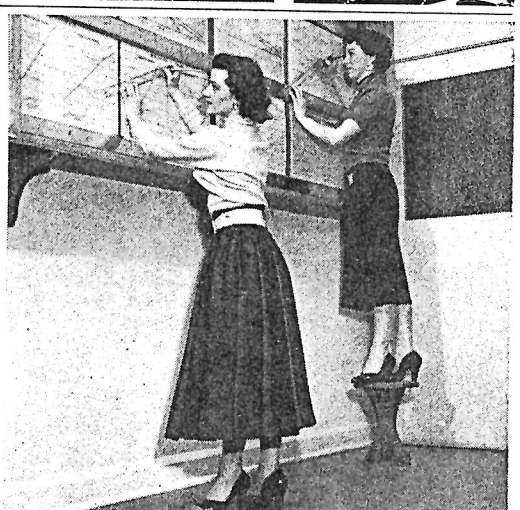
Operating Control is also responsible for issuing comparison reports like actual manhours expended against target for individual aircraft; actual manhours versus target for batch lots by detail, sub-assembly, component, sub-contract, final assembly, flight test; actual manhours versus target for all modification kits and installations; actual percentage of direct labour against departments; and physical position of output of components and aircraft.

With this information available, the **Budget Control Section** can now develop the Manufacturing indirect budget—control point for all indirect expenditure against direct manpower.

Prepared and submitted by each separate individual department, indirect budgets deal with all miscellaneous and indirect expenditures such as, indirect personnel (personnel who sup-



TIME STUDY of job on nose wheel installation is made by Claude McMaster, Time Study Section. Carrying out the work are Leslie Perkins (left) and George Durance, both of Bay II. Section is responsible for all master schedules and estimates.



BRINGING GRAPHS up to date with latest production figures are Program Planning's June Orr (left) and Rheta Schmidt. Section is responsible for all master schedules and estimates.

port direct manufacturing personnel), heat, light, stationery, telephone, and similar items. Here again, the Operating Control section produces weekly comparison reports and charts.

All this information and other data produced in the Department is under constant review by **Estimating and Analytical Section**, which analyzes data for any revisions that may be required, or to advise the department concerned if the actual performance is deviating from the estimate.

One of the most important links in the operation of Industrial Engineering is the **Time Study Section**. This section initiates from actual time studies all the operational data that is required by Industrial Engineering.

The work is performed in close liaison with operators and shop supervision, to enable the formation of standard assessment of the time required to perform all the various operations for fabricating parts, sub-assemblies, component assemblies, fuselage, marry-up, equip-

ping, final assembly operations and flight test.

As an indication of the magnitude of this work, there are over 200,000 separate and distinct operations performed in the manufacture of the CF-100, each one with its standard time developed. This section also suggests methods improvements.

Estimating Section, made up of personnel familiar with all information obtained, develops estimates on spares, ground handling equipment, and many miscellaneous items. Tooling estimates from Production Engineering Department are checked for any changes that may be necessary to assure a satisfactory estimate.

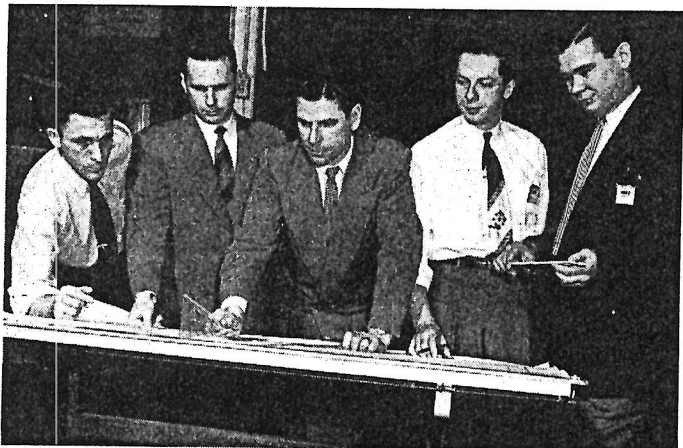
Another function of the Estimating Section is the Engineering change proposals. An estimator is a member of the Change Control Board and his responsibility is to estimate the effect on cost of all modifications that are to be introduced into the aircraft, and also estimate the cost of redundant and deleted parts made surplus as a result of modifications.

Estimating personnel in this section also assist the Sub-Contract Department by supplying any required estimated prices so that a fair assessment of their purchase prices may be made.

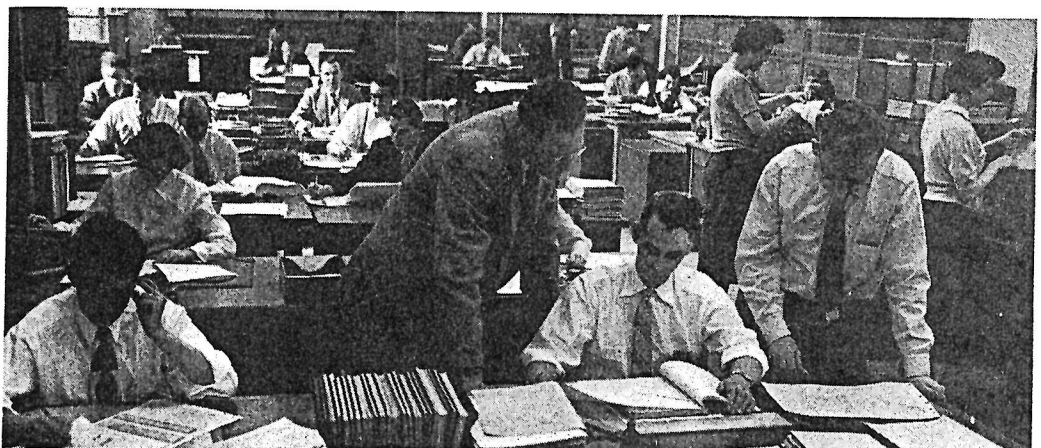
Another section is **Standard Practices and Procedures** which reproduces, writes or has written all Manufacturing standard practices and procedures. In most cases this involves investigation and the correlating of information from all Manufacturing departments.

Industrial Engineering's **Long Range Planning Group** is familiar with the current programs and records and graphs any or all anticipated future programs, so management can fully assess its position for some years ahead.

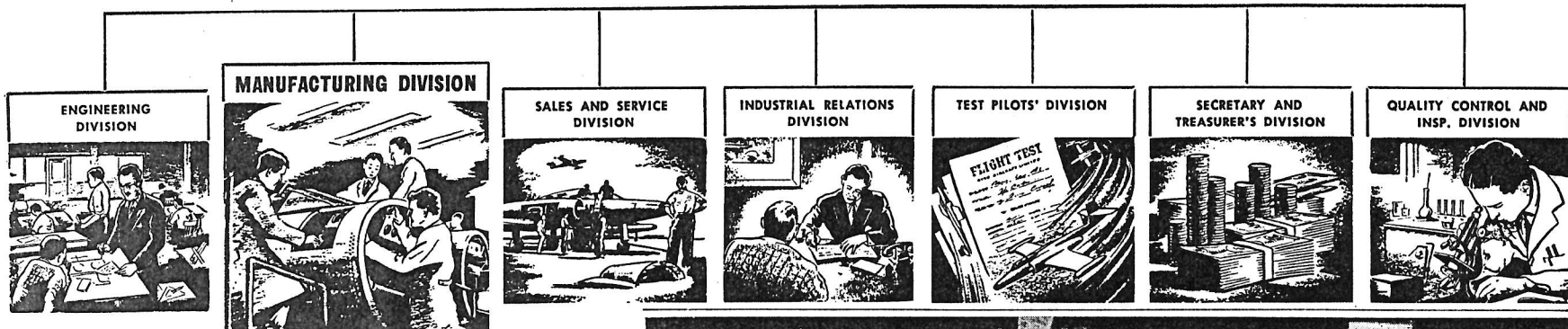
IN THE NEXT ISSUE the series will highlight the operations of Plant Engineering and describe the part this department plays in the manufacturing program and the operation of the plant as a whole.



PROGRAM PLANNING SESSION shows from left: Bill Wilson, analyst; John Thompson, scheduler; Supervisor Art Pincombe, and analysts Les Payne and Frank Ward.



CLOSE CO-ORDINATION is maintained between Estimating Section (in background) and Time Study Department. In foreground from left are Time Study's Harvey Judd, Jack Holt (Project Supervisor), Gerry Rutledge and George McDonald.



They Tee-Up Production Line Or Replace Your Light Bulb

From Engineering Division the drawings of the new aircraft have passed through the first stage in Manufacturing Division — that is through Industrial Engineering which has planned the overall schedule.

Now, fresh production lines must be set up and any new machines required to make tools and parts have to be obtained and installed. Perhaps additional buildings are required to house extra equipment.

This is where Plant Engineering with its multi-service subsidiaries takes over. Within this department comes Plant Engineering itself, Maintenance, Utilities and Fire Protection.

All work together as a closely-knit team serving a small city known as Avro Aircraft Plant, and provide that city with specialists and skilled trades in many broad fields. Cost of these operations is approximately \$10,000 a day, seven days a week.

Plant Engineering

Plant Engineering itself is in turn divided into different specialized sections. Its **Layout and Equipment Handling Section** utilizes floor area for efficient and economic manufacture of the aircraft from the detailed components through to final assembly. And here the "Toy Shop" Layout is used extensively.

In this layout every square foot of buildings and facilities is duplicated in model form to scale, greatly simplifying problems of overall planning.

Closely associated with this group is **Mechanical Section** specializing in plant and equipment services such as air conditioning, heating, air and water supplies, fuel storage, pumping facilities and ventilation.

Electrical Section of Plant Engineering supervises electrical power consumption of 2-3 million kilowatt hours per month, sufficient power to light a city of 20,000. This section is set up and operated much the same as

any public power utility. It supplies all its own engineering design services and lends electrical assistance where required.

Architectural Section deals with building design and construction, foundations for machines, partitions and floors, fire and water mains, drains and sanitary facilities, roadways, parking lots, landscaping and special structures associated with equipment.

Equipment Section is responsible for any equipment from the time of its initial conception to its final disposal at the end of its useful life with the Company. This section checks condition of machines and sets up the necessary preventive maintenance. It works in close harmony with the Safety Department and the requirements of the Ontario Department of Labour in maintaining machine safety as well as supervising the condition of cranes and lifting tackle.

Function of the Works Progress Section is chiefly administrative, keeping track of Plant Engineering work both cost and schedule-wise from the start to completion of the job. It also looks after the disposal of surplus production tooling and arranges movement of large jigs and fixtures at the request of Production.

Maintenance Department

Maintenance Department has a two fold job. In addition to maintaining production machines, plant equipment and all



AVRO IN MINIATURE is seen here in the three-dimensional layout used to plan changes in production lines and facilities. A look at a new layout produces fast, clear picture for supervisors in shops where changes are to be made. From left: John Boardman, Dave Outram, Wally Walsh, Layout and Equipment Handling Supervisor, Len Morgan (rear) and Bob Martingell.

utilities including fire protection, this department carries out building alterations, equipment fabrication and machine installation.

It is a closely integrated group of skilled tradesmen, including machinists, mechanics, plumbers, steam fitters, electricians, tinsmiths, carpenters, riggers, painters, assisting personnel and a large housekeeping staff.

Their work concerns the many miles of steam pipes, water and air lines and at least 100 miles of electrical distribution feeders and lighting systems not to mention the drains, sewers, roads and many other items which are often taken for granted such as repair of a desk or the light overhead.

The **Janitor Service** and house-keeping department, an essential part of Maintenance, has the task of keeping plant and grounds in a clean and tidy condition. The scrap and garbage removal from the premises per day is equivalent to that of a city of 12,000.

Maintenance Department has its own **Fabrication Shop**. Cab-

inets, work stands and all types of wooden structures and equipment are made in the **Carpenters' Shop**. Work stands, racks and custom built equipment is fabricated by Maintenance millwrights and welders.

Utilities Department

The **Utilities Department** maintains the essential services. These services demand a round-the-clock operation regardless of the number of people in the plant.

This all-important department generates and distributes the high and low pressure steam for the various processes and domestic services, all compressed air, the operation of all heating, ventilation and air conditioning equipment, hot air heating and installation, Company water works system, sewage disposal system and the operation of the stationary fire pumps and sprinkler pressure installations.

To give some idea of the magnitude of services provided during the last year, 275,000,000 pounds of steam were generated, representing a volume of 300

tons per day. To generate this steam 2,000,000 gallons of oil were used in addition to 2,500 tons of coal.

To satisfy compressed air demand more than 4,000 cu. ft. are necessary to meet normal requirements. Purchased water reached a peak of 15,250,000 gallons last December, exclusive of another six million supplied by the Company system and used in the plant air conditioning units.

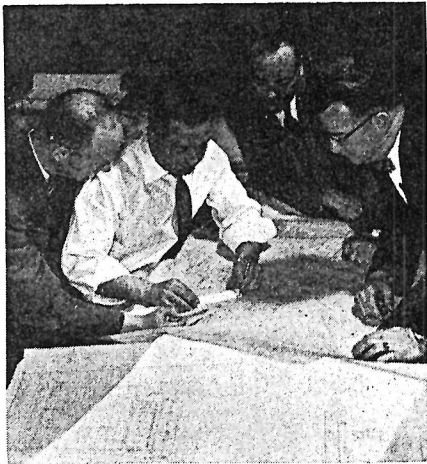
Fire Protection

The **Fire Protection Department** at Avro is on the alert twenty-four hours a day, 365 days a year. This important department maintains a constant vigil over all fire protection and warning system installations throughout the plant.

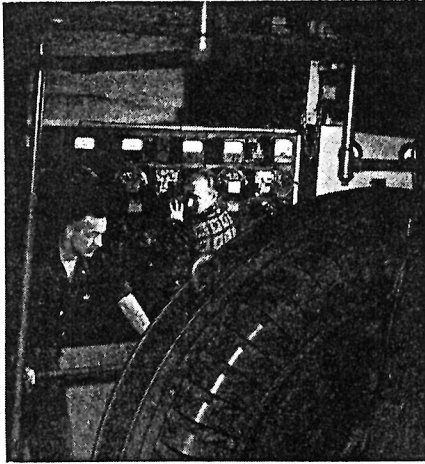
IN THE NEXT ISSUE the series will describe the work of Production Engineering in which metal first begins to take shape — the tools for the job.



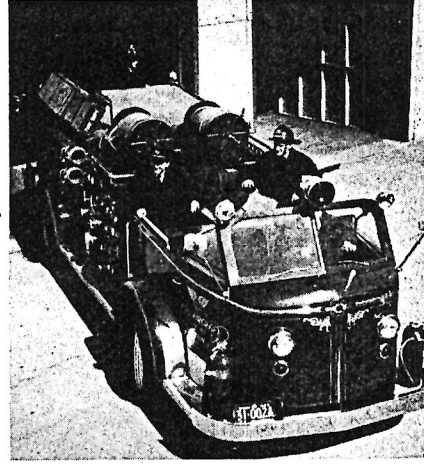
INSTALLING tensile machine in new Metallurgical laboratory are (from left): Bob Edwards, Ivan Daddson (kneeling) and Lee Morrison. Machine tests strength of metals under heat by tearing metal apart.



FOUR-WAY PLANNING session on new installations for the C-105 program. From left: Gord Brown (Mechanical), John Shields (Building Construction), Fred Hunter (Electrical), Frank Harrington (Equip'l.).



BIG COMPRESSORS providing 4,000 cubic feet of compressed air for rivet guns and many other outlets in plant are checked here by Third Class Engineers Harold Kennedy (left) and George Porter.



FIRE TRUCK moving through plant on standby calls is familiar sight. Crew leaving on call here are: Tom Thompson (rear), Capt. Don Linger (centre, left), Al Bennett, and behind wheel, Elwin Moore.



Now Come Tools, Know-How From Production Engineering

The program for the new aircraft has been planned, new machines have been installed — and now, for the first time, metal begins to take shape as Production Engineering takes over to make the tools for the job and plan the work.

As the key link between Engineering Division and Production, the Production Engineering Department operates in four sections — Tool Engineering, Tool Manufacture, Tool Inspection and Change Control.

Dealing first with Tool Engineering, this section is again divided into five subsidiary groups, Planning, Methods and Processes, Tool Design, Production Engineering Services, and Production Engineering Lofting.

The **Planning Group** is the focal point of the overall Department, since it is the first to receive the Engineering data and determines exactly how the part is to be made and the type of tooling needed.

Even before the actual drawing is released by Engineering Division, the Planning representatives are in the picture with the design engineer determining details as to how the airplane is to be put together, what effect the basic geometry and design schemes will have on production techniques, and preparing preliminary tool cost forecasts and capital equipment requirements.

In the main, all the other groups receive their instructions from the Planning Group. Details as to how the part is to be made are recorded on the process master, originated by this group.

In the case of a machine part, for example, this card includes instructions for operations required on the mills, drills, lathes or bench. In the case of a sheet metal part, it includes operations required on the brake, presses, stretch presses and routing with related heat treat and materials required.

The **Tool Design Group**, with preliminary information from Planning as to Tooling requirements, designs the tooling in detail. This may be in the form of drill fixture, milling fixture, or the larger assembly fixtures seen on the assembly floor where the small details parts are brought together into the component stages. Having completed the design, the tool drawing is released to the Tool Room for actual manufacture.

Methods and Processes Group investigates manufacturing techniques to find improved methods and establishes tool engineering standards. The **Services Group** takes care of receiving,

recording and distributing the flow of Engineering information in the form of blueprints or engineering change instructions, to the many departments concerned. All the blueprint cribs through the shops are controlled by this group. The **Lofting Group** is responsible for the transfer of instructions received from Planning onto the master glass cloths from which templates are re-produced for the fabrication of detail sheet metal parts.

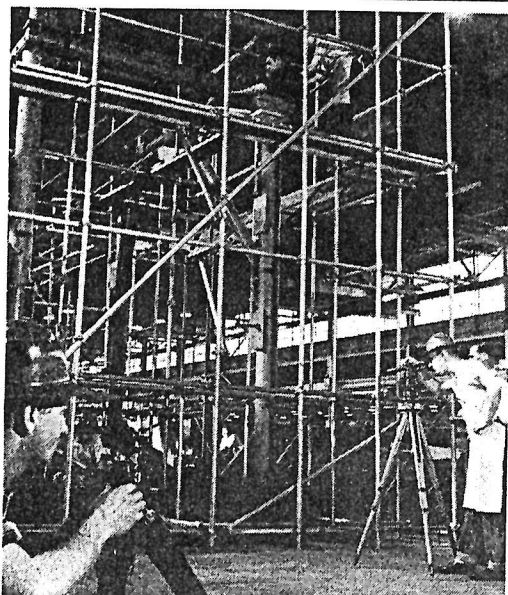
Tool Manufacture — from tool design's detail instructions makes the tools. This work is to very close tolerances, because the tool may be used to reproduce several hundred parts to exacting standards. Examples here are drill and router templates for sheet metal parts, machine shop fixtures, master models or assembly fixtures.

Tool Inspection as the name implies ensures top standard of tooling manufacture. This section is a part of the Production Engineering Department rather than the overall Inspection Division in order to be in close liaison with tooling.

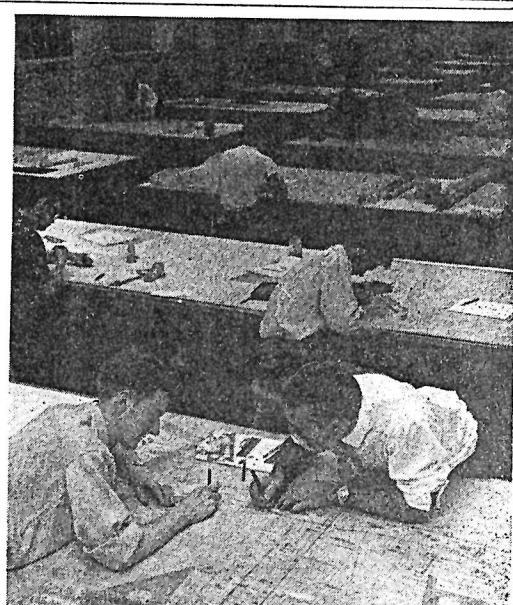
When Tooling Engineering completes its many jobs, Production receives — in addition to the Engineering Division drawing of the part — an operation card outlining the sequence of fabricating operations, the required tools and all technical data for production of parts and assemblies.

The **Change Control Board** consists of representatives of all departments concerned with the design and manufacture of the product. This board handles the requests for changes to the aircraft, and decides at what stage such changes can best be introduced into the production line. It also estimates the cost.

IN THE NEXT ISSUE the series will describe the work of the Procurement Department which obtains the materials required.



NEW JIG for assembly of components goes up in Bay 1. In foreground (from left) are Tool Manufacturer's Red Kelly, Al Homan and Frank Watts, Tool Inspection. Above, working on top of the jig, are Nelson Cronin (left) and Des Poulter.



LOFTING SECTION transfers processing instructions onto master glass cloth for reproduction of parts. In foreground here are Loftsmen Fred Fleming (left) and Jim Rowe, while at the second table over are Dennis Doherty (left) and Jim Burton.



PLANNING SECTION determines way a part will be made. Seen here in foreground working with model of a part are (from left): Tom Simpson, Cy Harris and Joe Cribar, Project Sup. On right is Roy Rickman and general office in background.



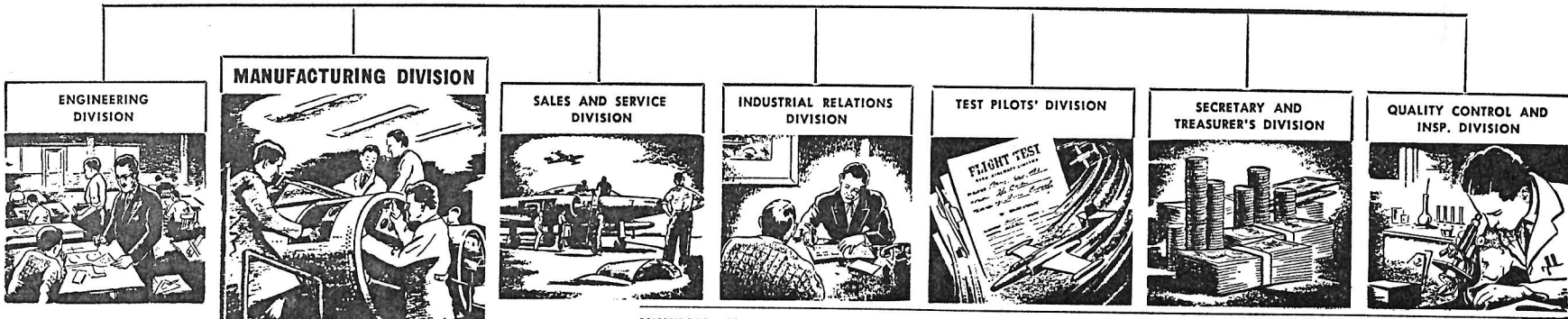
REG STANLEY, Tool Inspector, checking dimensions of a tool on an angle computer. Tool may make many parts.



TOOL DESIGN'S Rene March designing tool from which production line parts will be made. From here the detailed drawing and instructions go to the Toolroom for manufacture and then the tool is passed over to Tool Inspection.



CHANGE CONTROL BOARD seen here in session. From left around table: Horace Hally, Sales and Service; Jack Slater, Production; Bris Halliday, Production Control; Harry Wilby, Engineering Division; Frank Fry, Production Engineering (chairman); Dennis Lawler, Procurement; Paul Kennedy, Production Engineering (secretary); Charlie Hughes, Production Engineering; Art Prescott, Sales and Service; Fred Funnell, Quality Control. Change Control also estimates cost of any modifications.



From Pins To Big Machines Procurement Does Shopping

Providing production materials, ranging from the smallest rivet to complete pre-fabricated sections of the aircraft, is the basic function of Avro's Procurement Department.

Almost as important however, is its provision of the non-productive materials, which include mill, or plant operative supplies and capital equipment, or the machines, furnishings, tooling, without which the plant could not operate.

Procurement's operations include such diverse activities as the expediting of deliveries, receiving and storing under suitable conditions of materials at the plant, and operation of the company transport.

Also, co-ordinating services analyze requirements, provide statistical records, deal with customs and traffic procedures, and facilitate liaison between Procurement functions and those of other manufacturing units and company divisions.

Operations of these different activities are arranged into three main groups — Material Assessment, Purchasing, and Storekeeping.

Material Assessment

Material Assessment may be termed Procurement's "connecting link" as its operations are chiefly concerned with analyzing material requirements from information supplied by other units and divisions.

Bills of material are drawn up on all major contracts, which are immediately amended as the various process changes take place. Much of this information is received from Procurement's Change Control Board member, who in turn informs the Board of current material available when proposals for modifications are under consideration.

Design components are frequently manufactured by sub-contractors, using raw materials drawn from Avro stores. In such

cases assessments are made of all requirements, schedules drawn up, shipping orders raised to despatch the materials and records maintained to indicate the position relative to a given part of any time. Disposal of scrap and surplus materials is also arranged by this section.

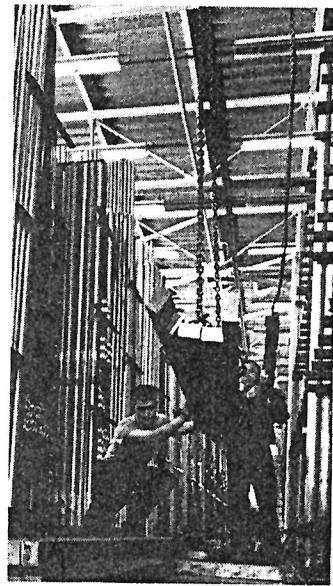
A **Material Costing Group** calculates material prices for the estimating section of Industrial Engineering; another section deals with **Material Sales**, and the **Inventory Group** is continually checking inventory items with actual stock.

Purchasing Department

Due to the tremendous variety of material involved, Purchasing Department operations are spread between several groups. In every case the procedure calls for "invitations to tender" being issued to several competitive sources, the best price offered almost always governing selection. However, transportation and handling charges, delivery and the consideration of the Canadian as opposed to foreign material source are sometimes determining factors.

The Production Group is concerned with material that not only has to comply with rigid government and military specifications, but must be obtained from a recognized source of supply approved by both Avro and R.C.A.F.

Specialist sections, each a self contained unit under a senior



ALADDIN'S CAVE of metals is Raw Materials Store where supplies are kept until needed in shops or by sub-contractor. Moving in aluminum bars are George Davison (left), Roger Salvian.

buyer, deal with the various types of materials. **Raw Materials Section** includes aluminum and other metals in sheet, bar and tube forms, for use both in the plant and also in sub-contractors' shops. **Standard Parts** are the nuts, bolts, rivets, connectors etc., used in each phase of production. **Equipment Parts** ranging from navigation lights to ejector seats, also include all hydraulic apparatus, radar and electronic instruments. **Sub-Contract Parts**, as previously mentioned, are components manufactured to Avro design.

The non-production group is less restricted — dealing with standard commercial materials — although their purchases may frequently be far removed from the "off-the-shelf" variety.

Capital Equipment and Plant Services cover all forms of plant equipment, machinery, or constructional requirements, ranging from heavy presses to file cabinets. **Mill Supply Section** purchases operative supplies — anything and everything from pencils to lamps, including electrical, steel, hardware, lumber, tools, stationery, and automotive requirements to mention just a few items.

The service group is made up of sections concerned with records, filing, typing and multi-lith services, whilst **Statistics** maintain records of quantity and value of all purchase orders issued against each contract.

After the purchase order has been issued, it is vital to ensure that the materials are received in accordance with the agreed delivery schedule. This is the responsibility of the **Expediting Department**, whose activities are divided between internal and external groups.

Internal expeditors provide liaison between the production floor and Procurement's receiv-



SOME IDEA of vast number of suppliers can be gained from Multilith Section's master file seen here. Front to rear checking and compiling are: Mary Snow, Mary Swan, Joyce Pollard.

ing and purchasing departments. The external expediter visits suppliers to determine the cause of any delay, and if possible, to correct it.

Customs and Traffic section prepares documents for import and export shipments for Customs purposes, and also determines routings so that shipments and personnel take advantage of the most convenient air, rail, and road transport services.

Storekeeping

Storekeeping comprises, in addition to the various stores functions, receiving and shipping and operation of the company transport.

Largest section is the **Production Material Store** which caters for the storing, under suitable conditions, of materials of almost every imaginable size, shape and weight. Certain materials require special storage facilities, and all must meet with Avro and R.C.A.F. inspection approval.

These requirements together with the fact that requisitions are frequently "cashed" in an irregular flow, make storekeeping a major undertaking. There are occasions when more materials are coming in than going out as suppliers meet their quotas. In many cases these incoming materials may be of a wide variety of shapes and sizes. At times like these every inch of space is valuable, yet all materials must be stored correctly and still be available for shipping at short notice.

Quantities of materials in **Mill Supply Stores** are kept as small as possible for efficient maintenance of services. The stores also operate a **Reclamation Section** where used materials of all types are either made serviceable, or else are disposed of at the best price.



INTERVIEWING BOOTHS where salesmen show their latest products and discuss arrangements for supplies is busy section. In foreground Buyer Archie Myles (right) talks to salesman.

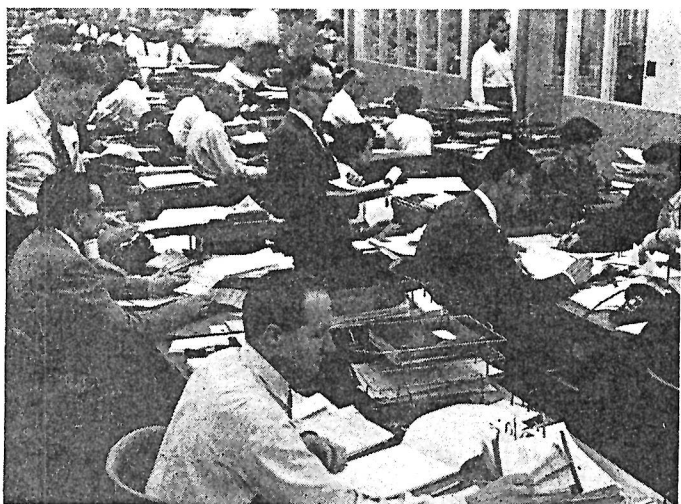
Tool Stores Section includes the Master Tool Crib, service cribs, repair crib and **Employee Re-Sale Stores**. The first maintains a full supply of tooling, which it feeds to the appropriate service cribs located at strategic points throughout the plant areas; the repair crib services air lines and pneumatic equipment, and the Re-Sale Stores operate for the benefit of employees, offering a wide range of tools and equipment at cost prices.

Transport Section moves equipment, materials and personnel wherever and whenever required, both within and outside the plant. These operations are controlled by a despatcher service, and are maintained by mechanics in the company's own **Garage**. Car service is provided for special services, such as delivery of important documents, and to supply mail and ambulance service.

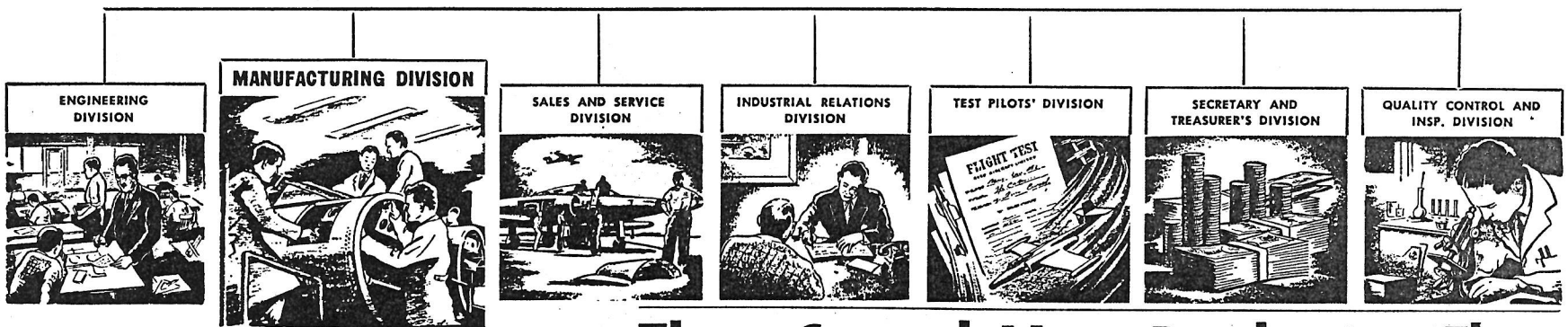
Receiving and Shipping's functions are self-explanatory, dealing with incoming and outgoing materials of every description. Well over 100,000 different items are handled each year.

The Company's procurement programme has done much to stimulate the growth of the supporting Canadian aircraft materials industry. By Avro Aircraft's continuing search for new and different materials, both established and new manufacturers have been encouraged to enter the aircraft field, to the mutual advantage of all.

IN THE NEXT ISSUE the series will describe the part played by Production Control in the Manufacturing Division program.



GENERAL VIEW of Purchasing Department where a thousand-and-one items of supply to keep the plant and sub-contractors operating are ordered and arrangements made for delivery and storing. In foreground is the Equipment Parts Group.



They Control Vast Production Flow To Meet Manufacturing Deadlines

Production Control, as the name implies, controls the flow of production through the manufacturing and assembly stages, ensuring that all phases of fabrication from the small part to the larger assembly meet a pre-determined date of completion.

To do this the Department operates in two main groups—Order Issue and Scheduling, and Progress.

In these sections there are first the people who schedule and issue orders to the shops, and secondly, the group that follows through—staffs the Finished Parts, Component and Kit Marshalling Stores, expedites shortages, clears bottlenecks and provides liaison with all departments so that deliveries are maintained on time.

Before any order is released, the **Scheduling Group** must break down the over-all production schedule provided by Industrial Engineering into smaller schedules for parts and sub-assemblies. This is required to determine, for example, on what day a part should go into work, in order to be finished in time to meet the flow for the finished aircraft.

Another factor concerned with scheduling comes under the heading of Shop Loading which takes into account the types and capacities of machines so that each section in the shop is released orders consistent with capacity.

In following a sequence through Production Control we find that the **Order Issue and Scheduling Section** has been supplied with a sales order from the Sales & Service Division, which in effect is the order from the customer for a particular batch of parts or assemblies.

This order number, to which all work carried out on the part will be charged, is inserted on the Process Card which follows each batch of parts through the shops. To this is added the priority work date set down by the Scheduling Group.

Then to complete the package

there is the Engineering Division blueprint of the part, and a material requisition which will be "cashed" at material stores to supply raw material from which the part will be made.

A progress control station in the shop having received the release from Order Issue and Scheduling, procures the material from stores and also draws out the tools required for the first operation.

When the first machine operation is completed the package is returned to the Progress control station where a record is made of its status and then the second operation follows in similar fashion.

This sequence of events follows through all the fabricating sections in line with the type of work required to produce the particular part, and could involve any of the fabricating groups such as Machine Shop, Sheet Metal Shops, Presses, Processing, Heat Treat and Inspection and so on until the part reaches the Production Control **Finished Part Stores** in the area adjacent to where it will be required for assembly. Here it is recorded and issued in normal stores procedure.

Throughout all the fabricating stages a day-to-day record has been maintained on the status of the part and its location in work, as well as progress comparison reports against the schedule—from which management is provided a picture of where we stand in relation to the schedule.

Where production rates on parts drop behind the priority schedule, it is the responsibility

of **Progress** to instigate the necessary action to recover the schedule position. This could involve liaison with Procurement for outside supplied parts, clearance of technical information from departments concerned, or expediting tools and fixtures required to put the parts into work.

In addition to these two groups, other sections provide a similar operation for other than the main production programme. **Modification Progress** provides production control functions on aircraft returned for modification. **Overhaul and Repair Section** has its own self-contained Production Control Group looking after the issue of orders covering parts required for damaged components returned for repair.

A **Spares Progress** section maintains records and provides progress on all parts and assemblies for the Company's spares operations. **Sub-Contract Progress** is responsible for expediting sub-contracted parts and assemblies in accordance with the manufacturing schedule.

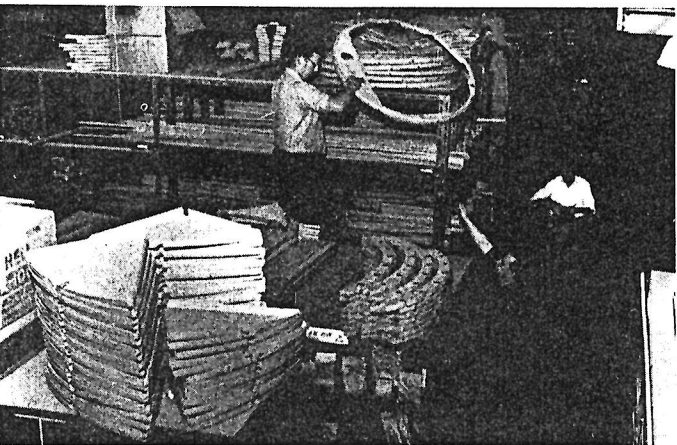
In addition to all of these groups there is the **Tool Control Section** that takes care of all tools after manufacture in the Tool Room and also operates the tool cribs throughout the plant where small tools are stored and issued.

From this it can be appreciated that the functions of Production Control are plant-wide.

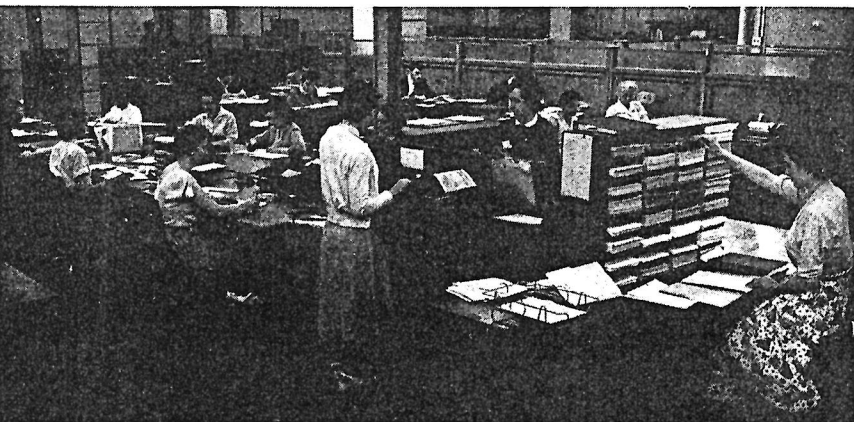
IN THE NEXT ISSUE the series will tell the production line story where some 60 per cent of Manufacturing Division personnel are employed.



MACHINE SHOP Control Station where flow of parts through the Machine Shop is controlled. In foreground is John Mosey, Sub-Foreman, with Ferna Ash (left), and Hazel Blackburn seen checking an order with Al Guardhouse, Expediter, in rear.



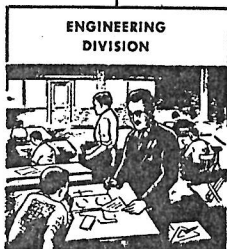
FINISHED PARTS STORES of nose section, showing Al South, Storekeeper, handing parts to Tom Adair, Expediter, for distribution to the assembly floor. In background Storekeeper Ed Prestidge loads truck with other parts needed for production line.



REPRODUCING PROCESS CARDS for release to the shops at Order Issue Group. From extreme right clockwise around tables: Mary White, Ann Macpherson, Nellie Van Leest, Joan Squirrell, Mae English, Alice Bentley, Helen Taylor, Alma Payne, Blanche Facer and Anne Brownson, all of Order Issue Group.



TOOL CONTROL where tools are held for release with the "package" as the parts go into work. From left: Robert Rennie, Tool Crib Attendant, locates tools, while George Sullivan, Progressman, and Charles Tighe, Dispatcher, load up a truck with tooling being released to the shop for production of parts.



ENGINEERING DIVISION



MANUFACTURING DIVISION



SALES AND SERVICE DIVISION



INDUSTRIAL RELATIONS DIVISION



TEST PILOTS' DIVISION



SECRETARY AND TREASURER'S DIVISION



QUALITY CONTROL AND INSP. DIVISION

Raw Materials To Aircraft Is Production Shops' Job

Amid the hustle and bustle of the production line and in the adjacent shops where the hum of machines and the thump of the presses add to the clamour of the rivet guns, some 60 per cent of Manufacturing Division's total strength is employed.

The Production Shops cover a total of 1½ million square feet and include the three Assembly Bays, Details Shop, Modification and Repair centres and the Pre-Flight line.

Their job: To turn raw materials into finished aircraft.

The process begins with the making of the individual parts. Production Control releases an "order" to the Production Shops, which now have available the following:

—A blueprint of the part from Engineering Division.

—A production program from Industrial Engineering.

—Additional machines and equipment installed by Plant Engineering.

—Process card and tooling from Production Engineering.

—Materials from Procurement Department.

Initial fabrication of parts involves two main areas — the Sheet Metal and Machine Shops. Mainly, Sheet Metal produces parts from the familiar aluminum alloy sheet material such as the major outer skin panels of the aircraft. Machine Shop processes parts from raw materials like extrusions, bar stock and forgings which require machining operations.

In following a part in the machine shop we find the "package" consisting of raw material, blueprint, operation card and tooling is placed in the section where the first operation is to be performed. This could be on lathes, mills, drills or layout, and the sub-foreman allocates the work to an operator who will complete the first operation.

After the first phase is completed the operator initials the operation card and the "package" is re-allocated for the second operation. This movement is repeated as the part travels along its production sequence and into the Inspection centre.

In the case of sheet metal parts, a similar pattern is followed. However, different operations and machines are involved, such as the Presses, Brake, Routers, Drop Hammer, and again into the Inspection centre.

From Inspection, in both cases, parts go through the Process Room to receive finishes like anodize, plating and paint. From here they are delivered to a finished parts store adjacent to where they will be required for assembly.

Following into the assembly sections, the detail or single parts are issued to the floor from finished part stores and the sub-assembly operations begin.

These sub-assemblies, which could be made up of 25 individual parts are then passed to the component assembly, which

in simple terms is a collection of sub-assemblies. These in turn move into the major assembly stage where the sections are "married-up" and where the basic configuration of the aircraft takes shape.

Along with the many assembly operations, hundreds of pieces of equipment such as hydraulics, cockpit instruments and control systems are being installed, as well as miles of electrical wiring and tubing for fueling systems.

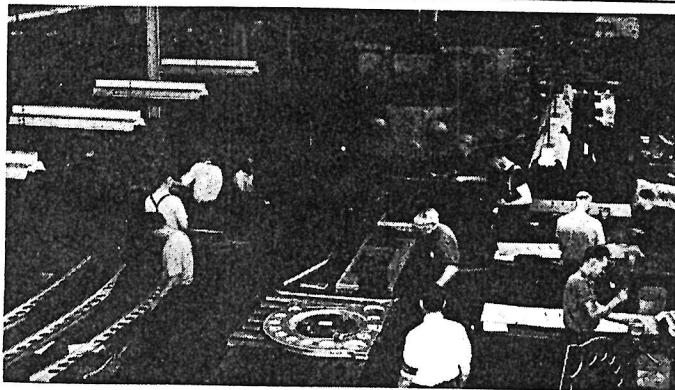
After primary test, markings are added to the fuselage and the aircraft is delivered as a finished unit ready for pre-flight testing.

Pre-Flight includes a complete check of the fuel system plus preliminary engine runs, and a full check of all functions of the aircraft.

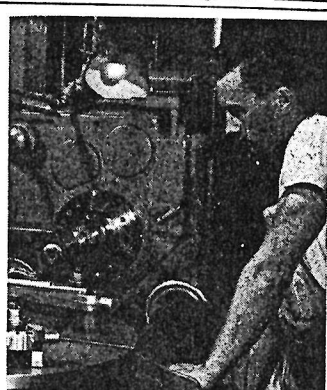
Along with these main production functions, the Production Shops operate the Modifications Section which is responsible for installing those modifications which cannot be conveniently entered on the production line.

There is also Repair and Overhaul Group carrying out major repairs on aircraft returned from RCAF bases. This particular section also makes all the ground handling equipment.

IN THE NEXT ISSUE the series will conclude the Manufacturing Division story with Production Flight Test.



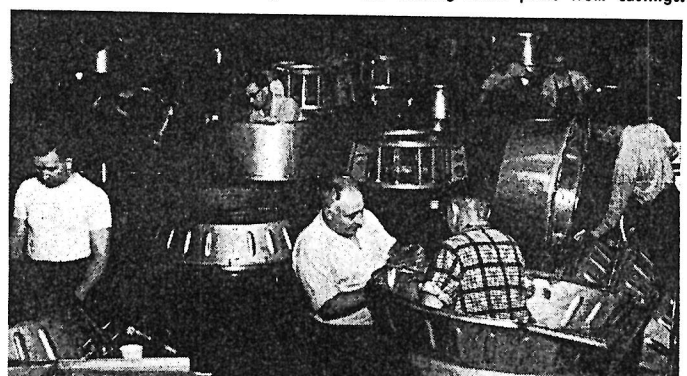
MAKING THE PARTS is the first stage in the production program. Here sheet metal sections are being stamped out by the big press which can be seen in background.



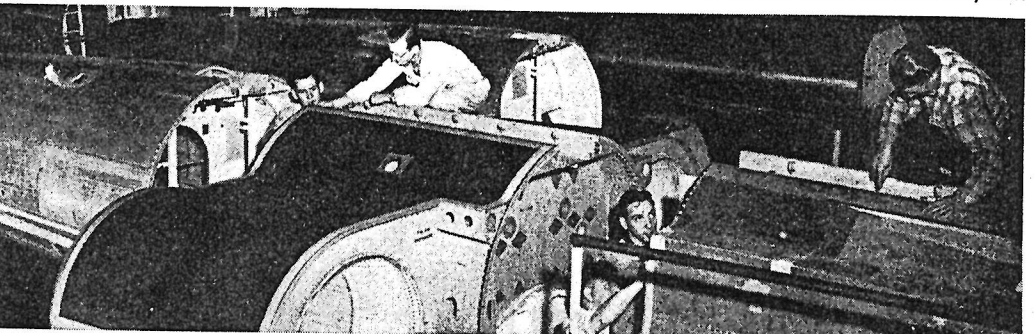
MACHINE SHOP men like Bill Oltrosina are making other parts from castings.



FINISHING-OFF WORK at bench is Lockland Trumbley's job in Production.



THEN ASSEMBLY BEGINS and parts grow into components. This cowling assembly view shows in foreground, from left: Tom Lowry, Fred Pellet, Lawrence Jollymore.



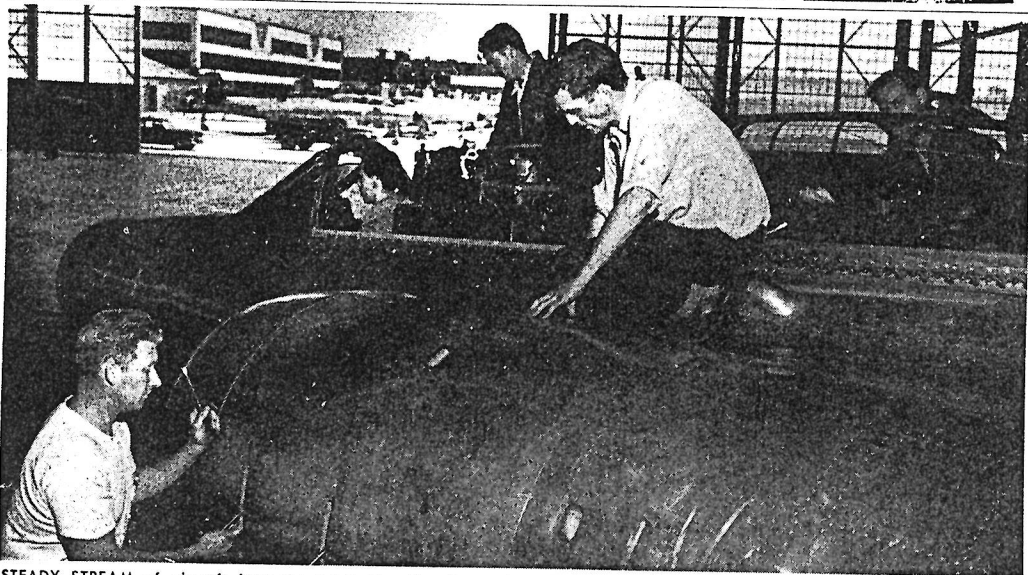
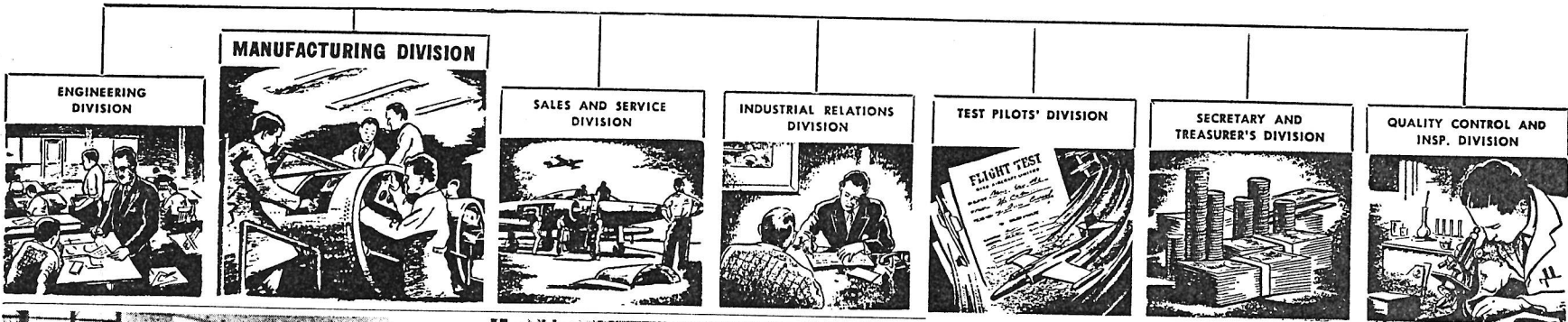
NOW ASSEMBLIES have grown to the marry-up stage of nose, centre and rear sections. Marrying-up and checking sections as aircraft takes shape are (from left): Wally Steel, Dick Hutchinson, Jack Power (Inspection), Harold Hill and Vaughn Card.



THEN electrical units go in. Clockwise from left are: John Duane, Harold Ball, Doug Beattie, Kathie Nixon, Irene Ash, Kay Gamble, Eleanor Stuttle, Arnold Clancy and Stew Snyder.



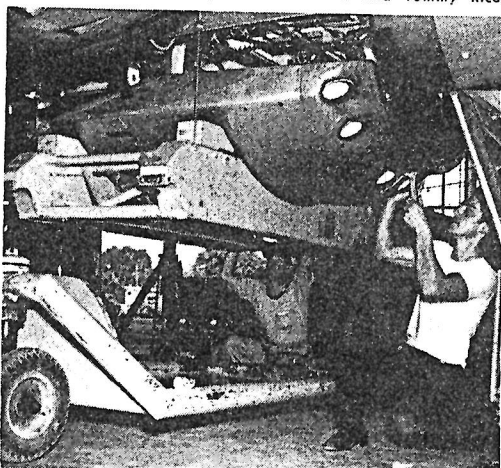
THE BIG MOMENT is when the doors of Bay 3 open and out goes another CF-100 to the flight line for engine and control tests.



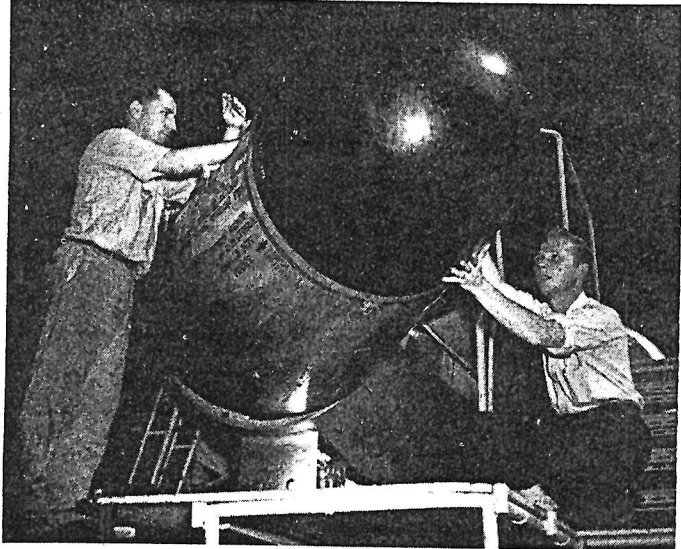
STEADY STREAM of aircraft from the production line flows through the Flight Test hangars. Checking and servicing aircraft between routine flight testing are (from left): Mac Ranson, Bob Walker, Joe White, Stan McMullen and Tommy Rice.



IN AVRO CONTROL TOWER on top of Boys, Al Smith (right) talks to pilot, while Ken Brown "tape" records conversation.



INSERTING CF-100's STING in Armament Section. Working on gun-pack are Norm Duddleston (left) and John Case.



CF-100's "NOSE FOR TROUBLE" is kept under security wraps so the intricate "innards" of radar and computing equipment cannot be shown. John Warwick (left) and Bob Hooper obligingly "close up shop" just temporarily for this picture.



ON THE FIELD Avro Aircraft's mobile radio truck keeps up liaison with flight line, pilots, the Avro Control Tower and Malton Airport Tower. Here George McKee talks to airborne CF-100 while RCAF pilot climbs into aircraft ready for takeoff.

Flight Test Proves Aircraft And Adds Finishing Touches

Production Flight Test follows through with Manufacturing Division's final job — that of ensuring the aircraft meets the flight requirements for which it was designed. From the time the aircraft leaves the shops ready for its initial flight, until it is finally accepted by the RCAF, it is under their close check.

The department is divided into two main groups, Radio, Radar and Armament and Flight Test.

As the aircraft is received from the shops ready for first flight, it is assigned a Flight Test ground crew who take over fueling and the loading of ejection seats and parachutes. It is at this point that the "log book" comes into existence, in which is recorded all information pertaining to flying time and maintenance or modification work on the aircraft.

Each aircraft is tested first from the point of view of its engine and airframe performance which includes flying control, pressurization equipment, speeds and general flying characteristics.

After the initial flight by an Avro Aircraft test pilot the aircraft is returned to the Flight Test Hangar where the mechanics make a checkover, rectifying any points reported by the pilot, and readying the aircraft for its next flight.

When the aircraft completes this first stage of acceptance it is handed over to the RCAF flight crew who again check performance of the aircraft — still from the aspects of airframe and engine, or "A. and E." as is the common phrase.

Having been proven "A. and E.-wise" by both the Company and RCAF pilots, the aircraft passes its first stage of acceptance and now undergoes similar flight tests covering the radar equipment.

The Radio, Radar and Armament Group first co-ordinate the aircraft to a ground target, harmonizing the radar, gunsight, gun package and wing-tip rockets into a completely integrated fire control system. After this the various "black boxes" which make up the radar system are adjusted and calibrated.

Due to the security nature of the radar equipment it is not possible to give any of its most interesting aspects. One thing that can be said is that it is complicated. Just multiply the complications of the home TV set by about 100 and you are somewhere in the area of the radar system.

This ground checking work having been completed, the aircraft again takes to the air for its radar acceptance flights by the RCAF crew. On these flights the aircraft usually fly in pairs — one being the target and the other the attacker. As one system is proved, the positions are reversed and the second aircraft is similarly tested. Again any snags encountered by the flight crews are rectified by the radar mechanics assigned to the particular aircraft.

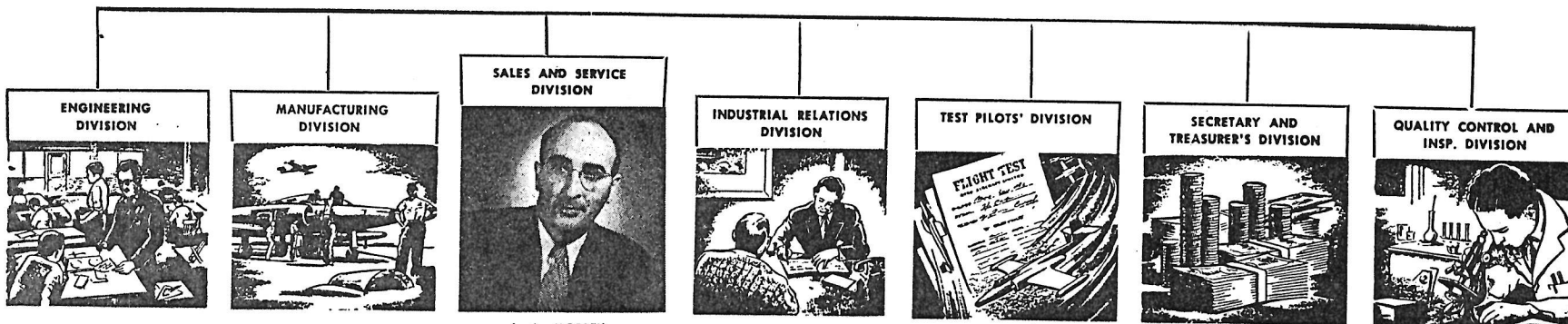
Having completed all its tests the aircraft enters the delivery line where any additional modifications are completed prior to delivery. It is also cleaned and receives its registration number and RCAF insignia.

The log book is then signed off by the RCAF acceptance pilot and the aircraft has its final inspection before a ferry crew delivers it to one of the RCAF bases.

In providing all the ground services for this testing program, the Production Flight Test Department has other functions under its direction, such as the Control Tower where Avro operators maintain constant contact with the aircraft, and make a tape recording of all flight contacts for test analysis.

Another is the mobile radio truck which keeps a ground crew in contact with all air activity and permits immediate preparation for any circumstance requiring their assistance. Yet another is the daily inspection of all aircraft on Avro premises known as the "D.I."

IN THE NEXT ISSUE the series moves another stage to describe the operations and organization of Avro Aircraft's Sales and Service Division.



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Sales and Service.



M. D. WILLER
Asst. Sales &
Service Mgr.



F. C. PLUMB
Service Manager



E. G. MAHONEY
Ottawa Liaison
Office Rep.



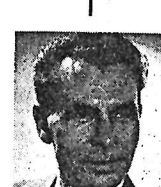
G. L. HUMPHREY
U.K. Liaison
Office Rep.



DAVE MELDRUM
Parts Manager



R. M. HAWLEY
Military Sales
Manager



J. R. DOUGLAS
Contracts
Administrator

Sales And Service Follows Aircraft Through Its Life

We have followed the progress of the CF-100 through all its stages — from the initial Design through the Production Departments, to Production Flight Test and finally to the RCAF. The story, however, really begins with the Sales and Service Division, for right from the very beginning when the aircraft is nothing more than a gleam in the designer's eye, they have an interest in it.

Few people realize what a far-reaching organization comes under the heading of Sales and Service. The Sales and Service Division is in fact the essential link between the Company and the customer.

The Division consists of four main departments which work together as a unit. They are the Military Sales Department, the Contract Administration Department, the Part Department and the Service Department.

The Military Sales Department initiates discussions with the customer, reviewing possible requirements, carrying out market analyses, and advising the Company on future trends.

The Contracts Administration Department is responsible for the negotiation and administration of all contracts between the Company and the customer. When a contract has been signed, the Contracts Administration Department issues Sales Orders and other instructions for work to proceed. In other words it is the fountainhead from which flows the authority to initiate all work performed in the plant.

Never Ending

Due to the continually changing requirements of our business, this work is not a "one shot" effort but a never-ending process which begins when the preliminary negotiations commence and continues for as long as the aircraft is in service. The Contracts Administration Department is the coordinating agency which ensures that the RCAF requirements are carried out and that the work performed is done under the correct

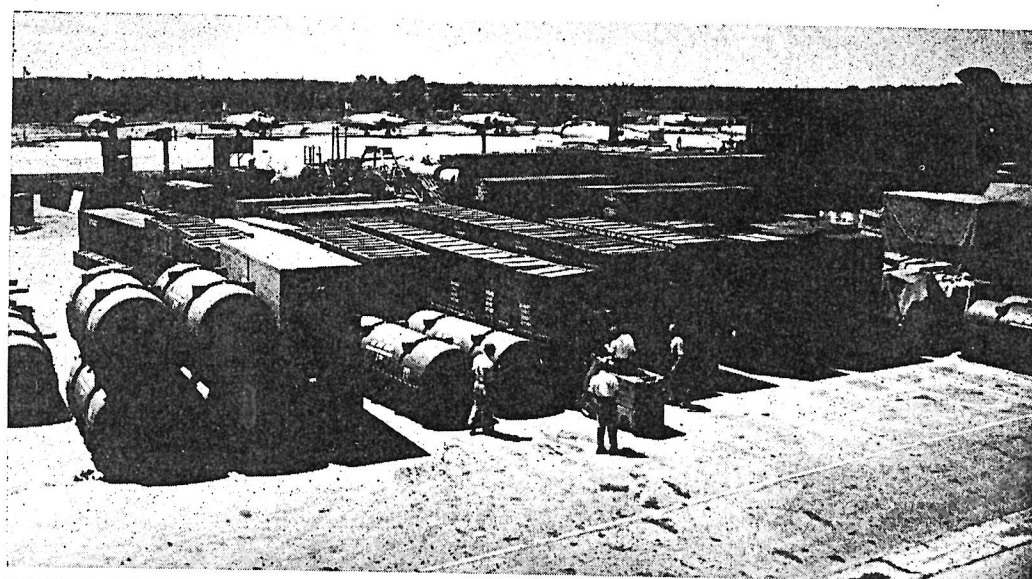
financial and contractual authority.

The third of these four main Departments, the Parts Department, performs the very important function of provisioning, ordering and supplying spare parts to the RCAF for the maintenance of aircraft in Service. Provisioning conferences are held at regular intervals to ensure that the customer is kept adequately supplied with the proper spares. Another function of this Department is to supply the Experimental Flight Test Department with maintenance spares for their development flying and testing programmes.

Has Watching Brief

The largest of the four Departments is the Service Department. From the time a CF-100 is delivered to the RCAF the Service Department has a watching brief to ensure that the Air Force is able to make the maximum use of the aircraft during its operational life. Specially trained Field Service Representatives are stationed with the Air Force squadrons using our aircraft. These representatives are fully conversant with all aspects of the aircraft, and advise on the correct maintenance and operating techniques to be used. To support the Company representatives a team of Service Analysts forming part of the Headquarters Staff sends out a constant flow of technical information — Modification and Service Bulletins, etc. to the Company representatives and to the RCAF.

An important part of the Service Department is the Technical

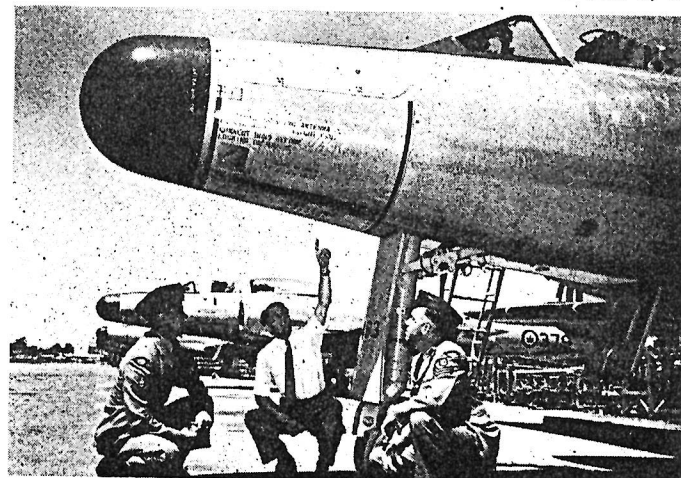


PREPARING AND SHIPPING of parts to the various RCAF units where CF-100s are in service is a major undertaking. Every unit must have a complete supply of spares on hand in case of emergency. As squadrons become more widespread, fast supply of parts becomes increasingly important, and on some occasions Sales and Service has delivered parts by air.

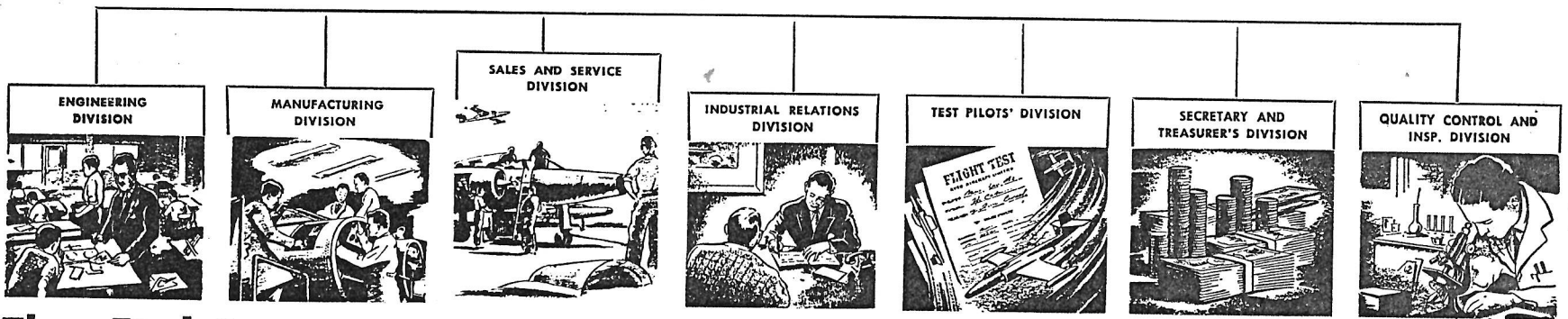
Writing section which is responsible for producing publications covering all aspects of the servicing, maintenance, overhaul and repair of the aircraft. Working in close cooperation with the Technical Writing section is the Technical Illustrating section where a large staff of trained technical artists produce the illustrations for the many publications which are necessary for the maintenance and operation of the aircraft. A separate section prepares the manuscripts and illustrations for printing and distributes the completed publications.

In addition to the four main departments, the Sales and Service Division maintains liaison officers in London, England and in Ottawa.

IN THE NEXT ISSUE
— details of departments.



LATEST CF-100 information is explained by Service Representative Ted Clark to F/Sgt. Jim Upham and F/Sgt. Al Calvert during their visit to the plant from the 409 CF-100 squadron at Comox, B.C. Ted Clark is Service Representative at Comox.



They Find Customer—Set Out Contract—And Supply Spares

Operations of the Sales and Service Division begin with the Military Sales Department where the main task is to obtain the type of business best suited for the Company's operation. It is in constant touch with Management and Engineering, advising them of market trends and determining what our Engineering Department can do to meet known or anticipated requirements. This Department also establishes a continuing liaison with the Air Force in order to keep abreast of the latest requirements.

In finding a buyer for the Company's products the problems of defence must be studied, and it must be established that the required product can be developed and manufactured at a reasonable cost and to meet the needs of the customer at the right time.

The formal starting point of a new project or program is usually the issuing of a "Requirement" by the Air Force. Such a requirement outlines the need for the new product and shows in some detail what it will be required to do.

From this point and from discussions with the customer, the Engineering Division prepares a design study outlining generally what the new product will look like and what its performance will be. The design study is eventually embodied into a proposal which is submitted formally to the customer. The proposal is prepared jointly by the Engineering Division, Military Sales, and the Contracts Administration Departments.

In addition to selling current and proposed products as well as helping to maintain good customer relations, Military Sales are constantly investigating new items which the Company could develop and produce.

There are 16 foreign representatives representing Avro Aircraft in 21 countries and an important duty of the Military

Sales Department is maintaining continuous liaison with these representatives.

Contracts Administration
When the customer's actual requirements are known, Contracts Administration obtains Cost Estimates from the divisions concerned. A proposal is then prepared setting out in detail the work to be performed and the time and cost involved. This proposal is submitted to the customer for study and approval. After lengthy negotiations, frequent meetings and the exchange of much correspondence a contract is signed.

Even though the contract is satisfactory at the time of signing it must be supplemented and amended from time to time to meet changing needs and circumstances.

The contract sometimes runs to over thirty pages and sets out in detail the scope of the work to be carried out, the standard of workmanship required, the materials to be used, and the aircraft performance to be achieved.

After the contract is signed, sales orders are issued to all departments who are concerned in the work, setting out in simple terms the requirements of the contract.

Apart from the negotiation of Prime Contracts, the work of the Contracts Administration



IN CONTRACTS OFFICE W/O Ed Hymes discusses production of Air Service Trainers with Fred Patterson, Contracts Officer, and Roger Cooper and Derek Miller, Contracts Coordinators. In background (from left to right) are: Shirley Arbor, Ruby Flint, Reg Bayliss and Lyn McLure. Contract sometimes runs to over 30 pages in setting out requirements in detail.

Department is carried out by five sections; Development Contracts, Tooling Contracts, Production Contracts, Repair and Overhaul Contracts and Miscellaneous Contracts.

Parts Department
Another section of Sales and Service is the Parts Department. Supply of aircraft spares to the RCAF is extremely important, and is a considerable undertaking.

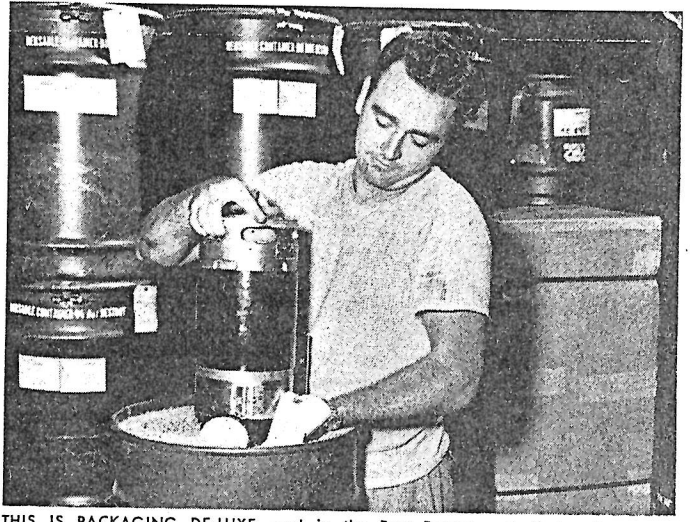
The weight of spares shipped monthly from the Parts Department totals many thousands of pounds. Over a million and a half pounds of CF-100 parts have been despatched to date.

The first step is the provisioning of spare parts required for the maintenance and overhaul of the aircraft. Provisioning conferences are held at regular intervals, and RCAF and Company experts review every part of the airframe.

Parts are examined to determine the length of their operating life under various conditions. The number of hours the aircraft to which the part is to be fitted will be flown; the susceptibility of the part to deterioration in storage and many other factors which may affect the life of a particular component are all considered.

When all factors have been studied, the various parts are ordered by the RCAF from the Company and from component manufacturers.

Spare parts are grouped under two main headings; Maintenance spares which are shipped directly to RCAF supply depots across Canada, and Overhaul spares which are used by contractors carrying out overhaul for the RCAF or are despatched as required to the Service Department's mobile repair parties at various RCAF squadrons.



THIS IS PACKAGING DE-LUXE, and in the Part Departments it has become a science. Stowing an alternator in a specially designed canister for dry damage-free travel is Don Van Wyck. Parts are shipped wherever CF-100s are in service.

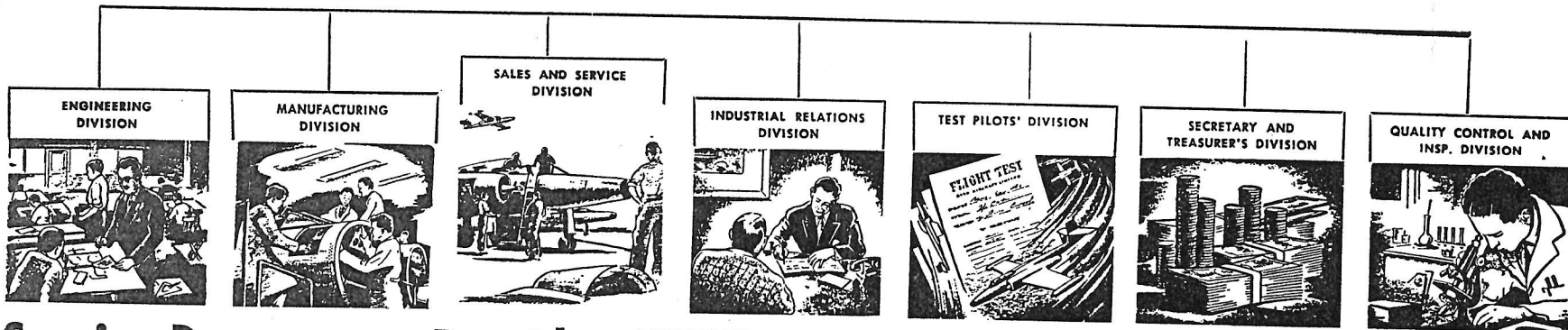


MOISTURE PLAYS HAVOC with stored parts unless they are well protected. To keep package free from moisture, Doreen Virtue dips it into bath of liquid wax which will harden into protective covering. Spares despatched: over 1,500,000 lbs to date.



CF-100s ARE SCHEDULED for squadron strength in Europe next year, which will mean increased European operations for Sales and Service Division. Seen during his visit to plant is H. G. Bloss, head of the Aircraft Section of NATO, with Military Sales Mgr. Bob Hawley (right), Vice-President, Manufacturing, Harvey Smith.

IN THE NEXT ISSUE the final article on Sales and Service will describe other departments within the Division.



Service Department Provides Liaison And The Know-How

The Service Department is the largest unit within the Sales and Service Division and is responsible for all matters relating to the aircraft after it has been delivered to the Air Force. This Department consists of four major sections—the Service Section, Technical Writing Section, Illustrating Section, and Publications Production Section.

Service Section is composed of an external staff of Field Service Representatives and internal or headquarters staff of Service Engineers and Service Analysts.

Field Service Representatives are stationed at R.C.A.F. bases across Canada and in Europe, and their main task is to ensure that all Avro aircraft are maintained at peak efficiency and that the correct operating and maintenance techniques are used.

They are provided with the latest technical information and have at their command the complete service facilities of the Avro organization.

In addition, the Field Service Representatives are recalled periodically to headquarters where they undergo refresher courses to bring them up to date on the latest servicing and maintenance techniques.

The Service Engineers are supported by a group of Service Analysts and form the headquarters staff whose main function is to analyse Field Service and other reports and initiate remedial action for any problems that arise. Headquarters group also issues Modification Bulletins which set out in detail methods of incorporating the various modifications.

When it becomes necessary to carry out modifications on our aircraft at R.C.A.F. bases, a modification program is drawn up defining which aircraft are to be modified, and the bases at which they are located. Modification kits are then shipped out by the Spares Department to the bases affected, and mobile repair parties responsible to the

Service Department are despatched to carry out the work.

Regular lecture programs are conducted by the headquarters staff, for the benefit of R.C.A.F. personnel and the Service Representatives.

Technical Writers

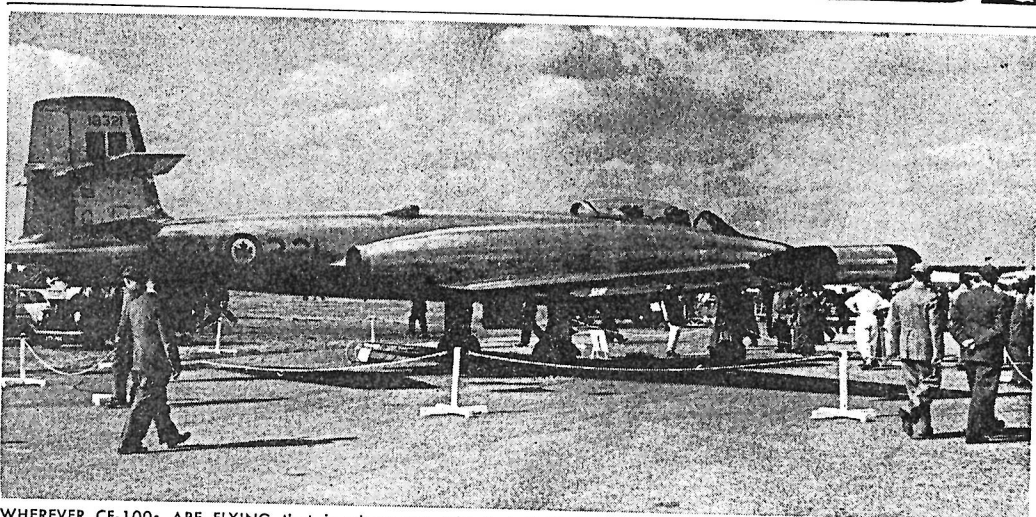
Technical literature is vital to efficient aircraft maintenance, and in the Technical Writing Section a staff of technical writers prepares the text for the many publications required to keep a modern aircraft flying. The writers maintain a close liaison with all other departments within the Company to ensure that the information which is published is comprehensive and accurate.

The manuals prepared by this section cover every phase of servicing, maintenance, repair and overhaul. Many months of painstaking work go into the preparation of the manuals which are commenced long before the aircraft is delivered. The information is gathered from a variety of sources—from blueprints, from personal contact with the designers and from the aircraft on the assembly lines. All the publications are constantly being revised and brought up to date.

Apart from writing technical manuals, the Technical Writing Section assists in producing Sales Brochures and other Sales literature publicising the Company's products.

Illustrating Section

Working in close co-operation with the Technical Writing Section is the Illustrating Section which is divided into two groups.



WHEREVER CF-100s ARE FLYING that is where you will find Field Service Representatives of Sales and Service Division. Typical example is this picture taken at last week's Farnborough display in Britain. Field Service Reps here were smartly turned out in white coveralls and answered questions about the CF-100, which was making its first appearance at Farnborough.

The Manuals group produces all illustrations required for the Service Manuals, Bulletins and Training Aids. There are several thousand perspective illustrations and wiring diagrams on active file in the section and a large proportion of these are subject to frequent amendment.

A separate General Illustrating Group handles a wide range of art work. Sales promotional brochures, reports, animated charts, film titling, slides, model work and many other assignments are handled by this group. The artists are very often called upon to produce scaled perspective drawings of structures for study by Engineering Division.

The Publication Production Section prepares the copy and illustration for plate-making and also arranges for the printing and distribution of all the literature published by the Sales and Service Division.

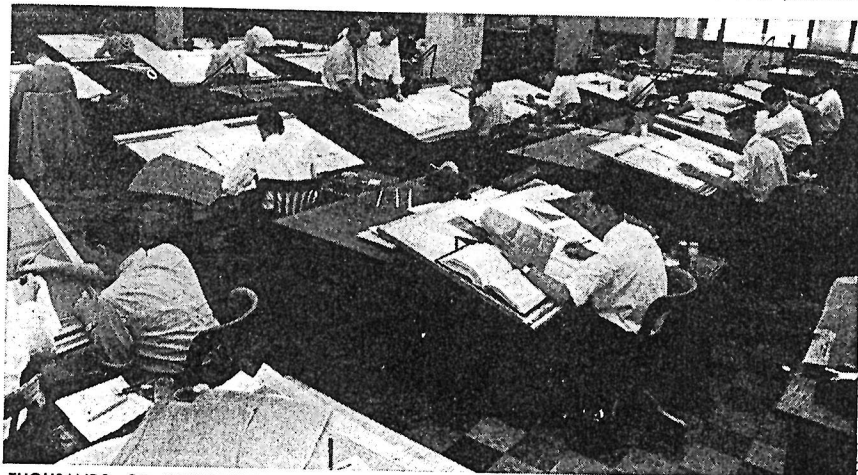
IN THE NEXT ISSUE the series moves on to describe Quality Control and Inspection Division.



COPY LAYOUT MAN Ted Harmsworth discusses the preparation of copy for reproduction with proportional typists June Thompson (left) and Dorothy Henry. This year some 5,000 separate pages of text and illustrations have been processed.



TECHNICAL WRITING SECTION produces all the copy for the many manuals which cover servicing, overhaul, maintenance and spare parts. These manuals are used by both Avro Aircraft and RCAF personnel. In foreground are (from left): Yvonne Vaughan, Charlie Quinn and typist Marilyn Hazel.



THOUSANDS OF ILLUSTRATIONS for the technical publications are produced by the Illustrating Section's Manuals group seen here. Yet another group within this section specializes in reports, animated charts, sales brochures, film titling, slides, model work and a variety of other assignments.



Frank Hems, Chief Administrator



W. E. Fairfield, Supt. Quality Control Co-ordination



Joe King, Supt. Production Inspection



C. G. Meilton, Supt. Production Inspection Bldg. "A"



W. J. Hutton, Supt. Experimental Flight Test Inspection



R. L. McCallum, Supt. Production Flight Test Inspection



A. S. Howland, Supt. Mod. Centre & Repair & Overhaul Inspection

Quality Control Aims High To Get Best In Production

In this jet era of "sound and heat barriers" and of still greater speeds ahead, the quality of workmanship in the building of today's aircraft must be exceptionally high.

In the "baling wire and string" days an inch or two here and there didn't matter. Today a few thousandths of an inch can mean complete failure. That is why Quality Control and Inspection Division plays such an important part in checking the work of the Manufacturing Division to ensure that each part built into an aircraft meets the designers' specifications.

At Avro Aircraft the inspection responsibilities are headed by the Quality Control and Inspection Manager, Chief Inspector and Superintendent Inspectors covering each main manufacturing area.

To simplify explanation and operation, this first article deals with the work of Quality Control.

As implied by the name, the object in life of Quality Control is to devise means and methods of ensuring that Manufacturing, and Works Inspection give and ask for the best in quality.

Scrap and rejection percentages for Avro production and the production of subcontractors is logged so that it is always possible to tell if a fall off is taking place and corrective action taken.

Sampling inspection data is issued to Receiving Inspection based on the difficulties of holding the various elements of different parts. It is an economy move but requires careful control and means that instead of carrying out 100% inspection of parts received here from an outside supplier, perhaps only a 10% check inspection will be

needed. This is always safeguarded by judging the results of the percentage that is checked and rules for this are laid down.

Avro Aircraft will always need sub-contractors and it is very desirable that such firms have their own approved inspection organization. Many firms are approved by the RCAF but the Company is empowered through Quality Control to make its own approvals. Some 50 sub-contractors operate under Avro Aircraft Quality Control approval although not all are necessarily active. Each active firm has to be visited regularly and its facilities and organization reviewed to make certain that the standard of approval set is not allowed to fall off. Scrap and rejection figures of work done provides a good measuring stick for this purpose.

Trouble reports from Service Department's field representatives are channeled to Quality Control for action to prevent recurrences.

Quality Control keeps a check on the vast number of gauges and other items of equipment used for



CHECKING WORK of Avro Aircraft's many sub-contractors is another Quality Control job. Here Bill Dinan (right) discusses manufacture of a part with sub-contractor's representative.



MATERIALS REVIEW receives all parts rejected by Works Inspection and examines them for possible rework and use. Check is being made by Ted Shirley (left) and Fred Routley.

electrical and radar testing; also that for hydraulic and pneumatic systems. It would be a dangerous practice if equipment was put into use and then neglected, so it is essential that such items are regularly checked and re-calibrated.

An important facet of Quality Control work is Check Inspection and Materials Review. Check Inspection has become more necessary as the RCAF Quality Control has increasingly delegated the responsibilities of inspection to the Company. Works Inspection checks the work of the Manufacturing Division and is guided by the instructions issued by Quality Control, in addition to what is laid down by Engineering. To make certain that instructions are understood, and are being worked to, and that individual inspectors are not permitting a fall-off in quality, Check Inspectors periodically examine the accepted work of inspectors and also make checks on the workings of the various processes carried out in the plant.

The functioning of all processes is governed by specifications and it is important to check regularly that specification conditions are being met. Materials Review receives all parts which have been rejected by Works Inspection and examines them in collaboration with RCAF Quality Control and Stress representatives to determine if the part is safe for use in its existing condition or if it can be made serviceable. By these means it is possible to salvage a lot of parts which would be expensive to replace.

One branch of Quality Control carries out checks on drawings and lofts for the aircraft. The bulk of drawings examined comprise those which appear as Production Drawings, i.e. those which have been processed by Production Engineering and are endorsed with their requirements.

The drawings are examined so that Production Engineering's requirements in no way upset the requirements of Engineering. At one and the same time, an overall check is made and this frequently results in changes and improvements being made to drawings by both Engineering and Production.

Value of this check on drawings and lofts will be shown up when production commences, by a big reduction in queries and reduced scrap and rejection of parts.

The Quality Control check does not stop at "productionized" drawings, it also includes interchangeability data drawings, "GA's," forgings and castings drawings etc. Tool Design drawings for jigs, fixtures, match plates etc. that will control interchangeability are also checked.

A valuable aspect of the check made on tool design is, that Quality Tool Inspection no longer needs to inspect interchangeability tooling against both Tool Design and Engineering requirements.

Quality Tool Inspection functions as a branch of Quality Control and checks that all assembly tooling controlling the interchangeable aspects of the aircraft is in agreement with the tool design.

The tooling covered comprises assembly jigs and fixtures, drill jigs, match plates, rigging boards and other ground equipment, and the references whereby the various jigs are controlled.

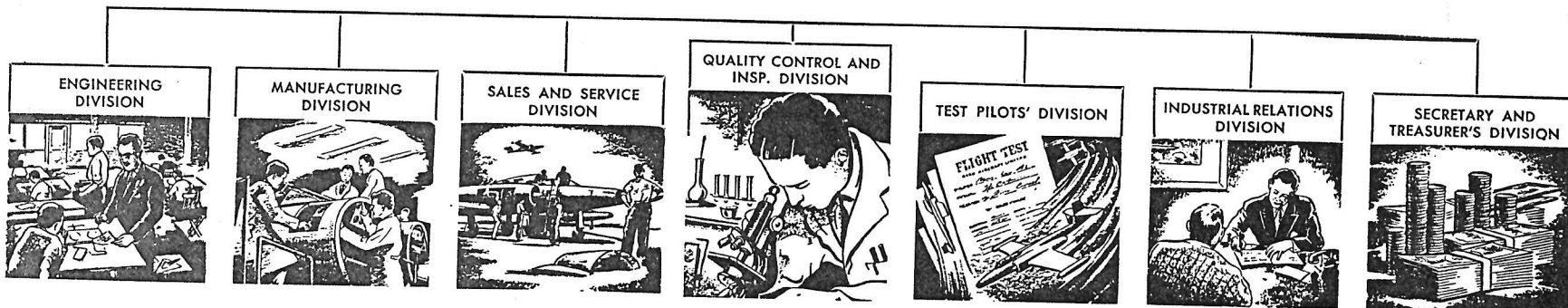
Yet another branch of Quality Control is the Standards Room, the arbiters of accuracy who work in a temperature closely regulated at 68° F. Here measurements and comparisons are made to minute fractions of a thousandth part of an inch—the accuracy necessary when it comes to the checking of gauges used in our own shops or let out to sub-contractors. Here again it is essential to check and keep on checking because as soon as a gauge is put into use, it will begin to wear and there comes a time when a gauge will be telling a false story with consequent expensive scrap, unless the wear rate is noted so that the gauge can be removed from active use in time for replacement or adjustment.

Interchangeability has been mentioned several times in this article, and it is one of the tasks of Quality Control to compile and issue an interchangeability report for each aircraft. These reports serve as a guide to the RCAF and form the basis of instruction to Quality Tool Inspection.

IN THE NEXT ISSUE the series will describe the many different jobs of Inspection Department.



IN STANDARDS ROOM gauges used in the plant or let out to sub-contractors are checked to fractions of a thousandth part of an inch. In foreground working on surface plates are Howard Derouin (left), Cyril Moore. Room is kept at 68 deg.



From Materials To Aircraft Inspection Keeps Checking

Wherever manufacturing processes are being undertaken in Avro Aircraft, there you will find men of Inspection, their familiarity with the many different aspects of aircraft production combining to provide a sound knowledge and skill for the department as a whole.

Those in Receiving and Machine Shop Inspection must be capable of checking close limit machined parts to drawing dimensions and be able to make use of the variety of fine measuring equipment available.

Assembly and Installation inspectors, apart from their ability to interpret drawing requirements, must have that necessary background of experience which tells them where to look for trouble. A broken split pin in a flying control mechanism is far from obvious, but could be the cause of a fatal accident. So could a blocked vent pipe. Experience seems to instinctively lead a good inspector to just that place where trouble lies.

Inspectors have no shelter behind a cloak of anonymity, each has a set of identifying stamps, and when a part, large or small has been found satisfactory, then the inspector's stamp goes on it, signifying that the part is correct to all requirements and airworthy.

Even the act of stamping is not free from danger. Some materials have been brought to such a high degree of strength that it is sometimes unsafe to make an impression upon them with the usual steel stamps, rubber stamps only are permitted.

Receiving Department can be considered as the first stage of inspection in the plant. This department is primarily responsible for inspecting and testing where necessary, all parts and materials used in the manufacture of the aircraft. The inspection checks made are to see that parts or materials are correct to approved specifications or drawings; that they agree with the requirements of the Purchasing Department, and are correctly batched for storage until required.

Special Requirements

When parts are received from sub-contractors, either as forgings, castings, components or machined parts, they are checked for special requirements such as heat treatment, crack detection etc. and that they are dimensionally correct before proceeding to the next stage of operation.

After clearance from the Receiving Department, the parts are then carefully stored and issued for manufacture as required. It is the responsibility of the inspector to see that storage shelf life of goods is maintained in good order and to certify that the material required for Production is correctly batched and to the required specifications to make the parts.

Material drawn from Stores is manufactured via three main sections; Machine Shop, Sheet Metal and Processes. Machined parts are controlled by Inspector for Tool Proving Orders, First Off Stages and then to the Final View Room where they are checked to the drawing requirements and forwarded to the next stage of assembly.

Sheet metal parts are similarly controlled through the methods of manufacture such as Routing, Press Forming and Stretch Forming until the final part is checked in the View Room.

Parts that require various forms of protective treatments, crack detection or heat treatment are also controlled by Inspection, and inspectors check the cleaning and painting of parts. They also cover the various stages of sub-assembly work carried out prior to the final assembly.

Keep Records

As the major sections of the aircraft are assembled, inspections are carried out and records are kept as all the various stages are completed such as flying controls, oxygen, low pressure pneumatic system, hydraulics, electrical installations, fairings, etc. All rigging dimensions and readings are checked, landing gear retraction tests, cabin pressure tests, serial numbers of the various components installed are recorded.

The inspector covering these stages must therefore have had considerable aircraft experience, as he may be called upon to check any one of these stages as the work is completed and put up for inspection.

During the course of engine runs, prior to the aircraft's preparation for flight test, various instrument readings are taken and are recorded in the aircraft log book, these may be necessary for comparison while the aircraft is in service.

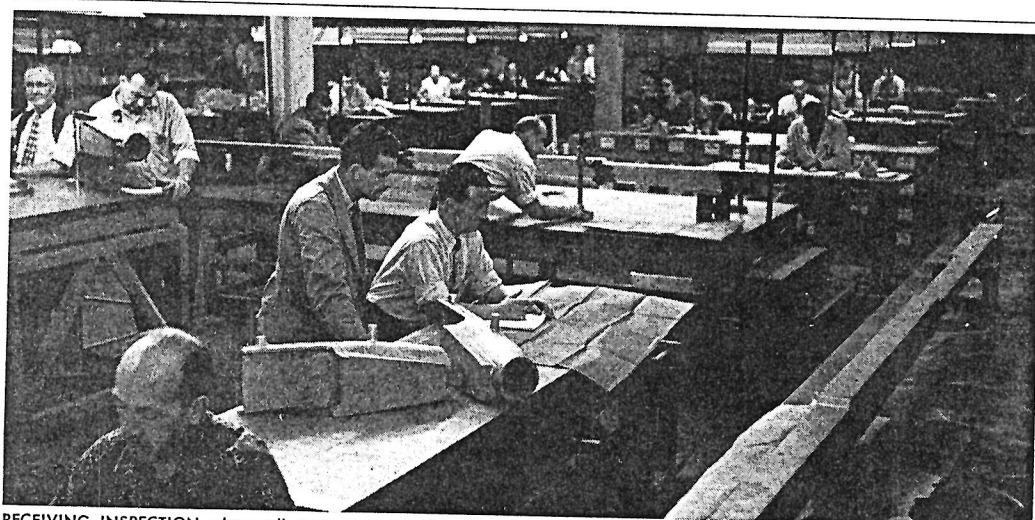
Flight Test Inspection covers the work carried out during the preparation of the aircraft for its initial flight test and checks all the various stages until the aircraft is finally delivered.

Lots of Experience

All inspection personnel covering the many aspects of flight test work have had considerable aircraft experience. They also are familiar with the many other inspection standard requirements throughout the plant, whether it be structure, components, systems, electrical, radio, radar etc.

First stage of Flight Test Inspection is termed Pre-Flight Inspection. This stage covers the functioning and proving of Fuel System, Engine Installation etc. and a check of the other various systems.

A Final Inspection is carried out prior to the aircraft's first flight to ensure that the aircraft is complete; that all installations and services have been checked, and the aircraft is airworthy. This stage is therefore very important as it is the last check



RECEIVING INSPECTION where all parts and materials used in the manufacture of the aircraft are inspected and tested. In foreground (from left): Chris Hansen, Dave McKane and Jim Irvine. Left rear: Charlie Jenkins and Andy Bell. Checks made here ensure that all parts and materials which have been supplied by sub-contractors are correct to specifications or drawings.

before the aircraft carries out its initial flight.

The next stage covers the actual period of Acceptance Test Flights by the Company, and R.C.A.F. pilots. Inspection is required to ensure that all aircraft are satisfactorily prepared for each flight, and this is covered by a Daily Inspection. Inspection also covers flight defects reported by the pilot, such as trim adjustment, landing gear operation, cabin pressure, radio and electrical.

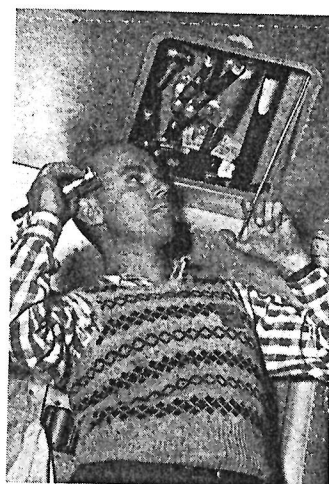
When the aircraft is satisfactory, a Contractor Inspector's Test Pilots and Acceptance Certificate is drawn up, and when completed, constitutes the formal acceptance of the aircraft by the Department of National Defence. All aircraft log books and records are then completed during the third and final stage which is termed Delivery Inspection and Final Painting.

Ready for Delivery

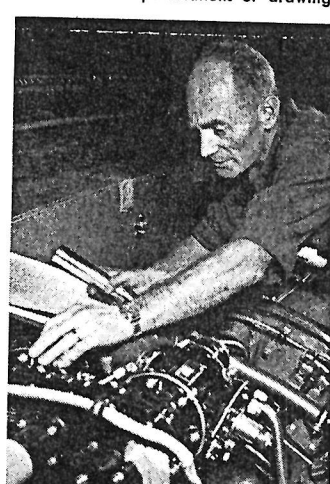
Another section, Experimental Manufacturing Inspection, covers the inspection of machine parts, sheet metal details, sub-assembly, component, welding—both gas and resistance, mock-up parts for future aircraft, and also the wind tunnel and free flight models. Included in the Manufacturing Section is the building of special structures required by the Structures Test Laboratory which also has inspection coverage.

Experimental Flight Test have in their section many aircraft which carry extensive instrumentation together with the necessary additional wiring for recording purposes. Among the various projects of Experimental Flight Test are gun firing tests, fuel venting, braking, de-icing and anti-icing tests and many others that are necessary in the development of the modern airplane. Every new installation is checked by inspection.

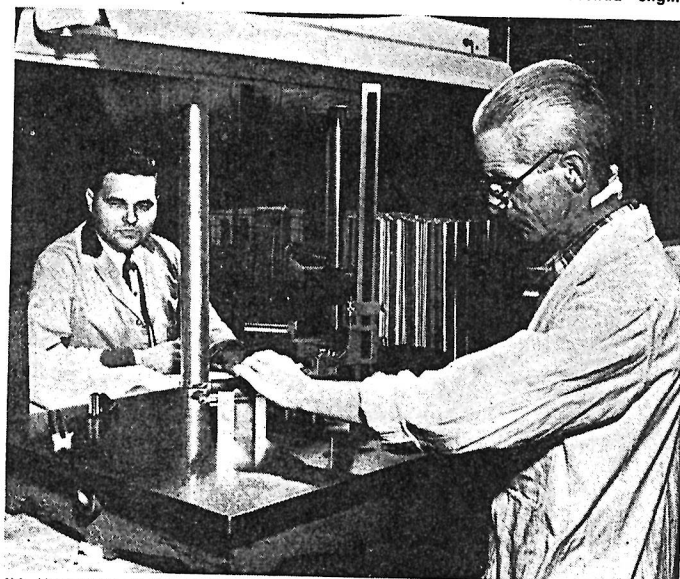
IN THE NEXT ISSUE the series will describe the operation of the Test Pilots' Division.



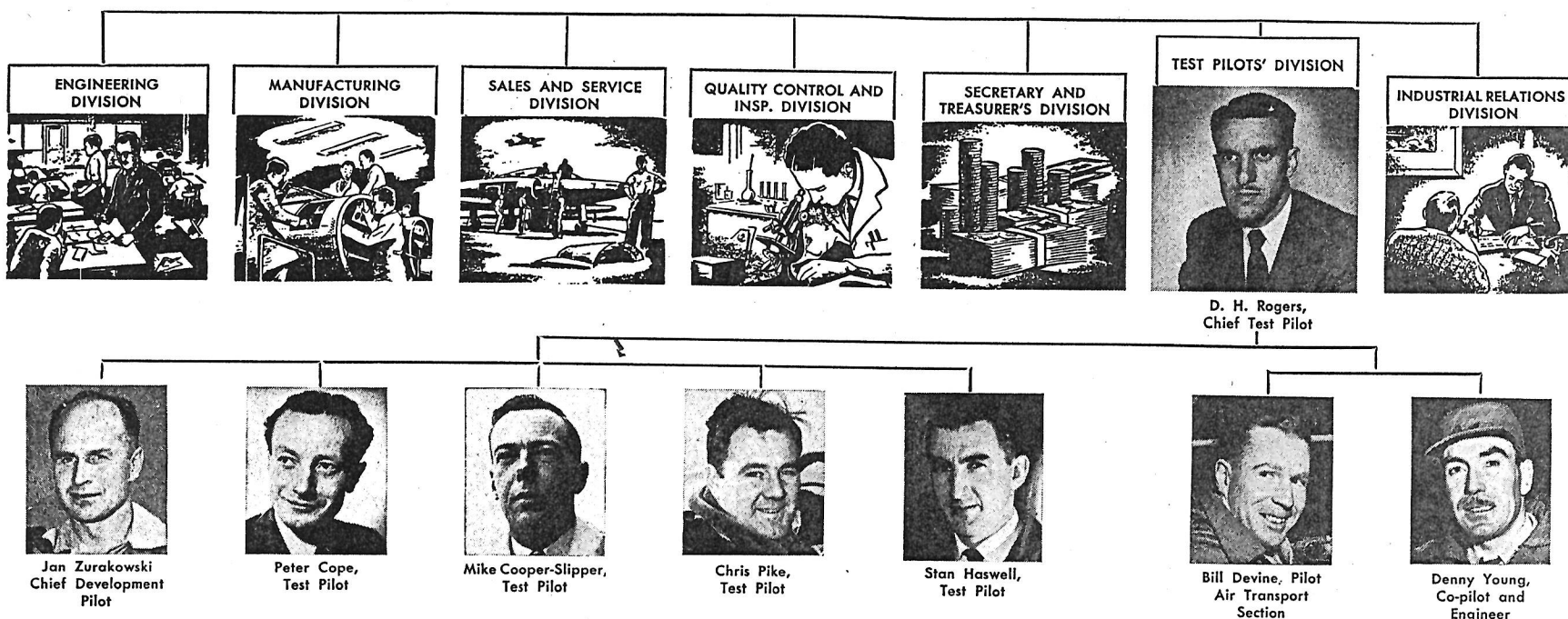
SYSTEM inside aircraft is checked by Jim Kentell, Production Flight Test Insp.



ON PRODUCTION LINE Harry Priestly inspects installation of Orenda engine.



IN MACHINE PARTS INSPECTION George Miller (left) and John Weir carefully examine parts which they check to the drawing requirements before forwarding to the next stage of manufacture or assembly. Inspections are carried out all along line.



There's No Hollywood Touch In Real Job Of Test Flying

Hollywood and novels portray the test pilot as a nerveless daredevil who has little or no regard for authority, convention or his own neck. But in real life, he is seldom the glamorous superman of fiction. Rather, the proving of a modern high performance aeroplane demands a man with a serious approach to scientific research with some of the qualifications of an aeronautical engineer and an aircraft inspector as well as being a competent and experienced pilot.

When a new aircraft is being conceived, the test pilot's duties actually commence long before the first flight. During the many months or even years of planning, designing and building a prototype, the test pilot works closely with the Engineering Division to study in detail every feature of cockpit, controls, systems, emergency procedures and the many other items which will affect the operation of the aircraft. His wealth of practical flying experience is utilized to evaluate all items from the pilot's viewpoint and to consider their suitability under all conditions of flight in both normal and emergency operation.

In the last few hectic weeks before the first flight, the test pilot lives with the aircraft almost constantly preparing himself for the flight by becoming as familiar as possible with the cockpit and controls until, on the day all is ready, he can commence the actual testing with confidence born of careful and detailed planning.

Following the excitement and thrill of the initial flight, which is usually a conservative investigation of the general handling characteristics at relatively low airspeed, there begins the complete and exhaustive program of performance and handling trials under all possible conditions of airspeed, altitude and loading. Many hours of flying are also required for the development and proving of systems, powerplants, navigation and de-icing equipment, armament and all the other installations necessary to enable an aircraft to fulfill its designed role.

When sufficient flying has been accumulated on the prototype to ensure that the aircraft is satisfactory for delivery in all important details and that any refinements which may be desirable in the light of experience can be incorporated subsequently or retro-fitted if required, the testing of the production aircraft begins in quantity.



PRACTICAL EXPERIENCE of pilots is drawn on greatly when new piece of equipment is to be installed in aircraft cockpit. Discussing new equipment here are (from left): Fred Mathews, Flight Test Engineering; Chief Test Pilot Don Rogers, and Jan Zurakowski, Chief Development Pilot. Next step on program: Extensive testing.



PASSENGERS AND CARGO bound for Cold Lake, Alberta, going aboard Avro Aircraft's DC 3 last week. From left: Al Haworth, Stanley Barnes, Maxwell Say, Harry Keeling, Bill Beattie, Bob Anderson and Walter Massey all of Flight Test, with Al Rankin, licensed engineer and Denny Young, co-pilot engineer. In the last year the DC 3 has carried total of 600 passengers.

Each must be put through a detailed routine of tests to ensure that, in all respects, they are up to a uniform high standard and that every item is functioning correctly within the narrow limits established for acceptability.

Here at Avro Aircraft, as in most large aircraft manufacturing companies, the experimental and production test flying is carried out by two groups of pilots located in different buildings.

Jan Zurakowski, Senior Development pilot, and Peter Cope have their office with the Chief Test Pilot in the experimental hangar where they are close to the Flight Test Engineering Section, under Mario Pesando, and to the aircraft they fly on development work.

Production testing by Chris Pike and Stan Haswell is carried out from the Flight Line building at the run-up base. Grouped together in this office and shop area with the Company Test Pilots are the production, inspection and A.I.D. personnel who are directly engaged in flight service work on aircraft undergoing production testing. Also located here are the R.C.A.F. Acceptance Pilots under F/L Kersey.

Flight Test Orendas

The Test Pilots Division of Avro Aircraft also supplies a pilot for the flying required by Orenda Engines Limited for the flight development of their products. This flying is carried out for the most part by Mike Cooper-Slipper, operating from the Genaire Hangar.

In addition to their normal flying duties, the test pilots receive numerous assignments for demonstration flights and Avro Aircraft is particularly fortunate in having Jan

Zurakowski, with his world-wide reputation for outstanding aerobatic displays, as a member of the staff. His spectacular flying at the S.B.A.C. show at Farnborough this year resulted in much favourable comment regarding the handling characteristics and manoeuvrability of the CF-100.

The allocation of flight duties among the pilots, as outlined above, represents the normal functions of the Sections but each individual pilot is competent to carry out tests in all sections. Circumstances often arise which result in an experimental pilot being assigned a production aircraft to test or a production pilot may carry out test flights for Orenda Engines and so forth.

Air Transport Section

Another flight operation which is the responsibility of the Chief Test Pilot is the Air Transport Section operating a specially refitted D.C. 3 from the Genaire Hangar for the rapid movement of Company executives and Procurement and Field Service personnel to distant meetings or to R.C.A.F. squadrons as required for expediting Company business. The rear portion of the cabin can quickly be converted from a comfortable passenger arrangement to a large cargo compartment capable of transporting aircraft parts, modification kits or even a complete jet engine. The D.C. 3 is also used by all Company pilots for instrument flying practice.

Most of the transport flying is done by Bill Devine as captain and Denny Young as co-pilot/engineer. These pilots have both had years of experience in D.C. 3 type aircraft—Bill in Air Transport Command of the R.C.A.F. and Denny in com-

mercial operations in many parts of Canada.

A further responsibility of the Test Pilots Division is the Flight Safety Section. Max Keller, as Flight Safety Technician, maintains the necessary supply—in first-class condition—of all parachutes, helmets, flying clothes and personal emergency equipment. He also conducts a review of emergency procedures at regular intervals with all flight crews to ensure their full knowledge of vital actions which must be carried out without a moment's delay in the event of sudden difficulties in flight. Max works closely with the Institute of Aviation Medicine of the R.C.A.F. in the procurement and application of new safety equipment for our flight operations at Avro Aircraft.

Finally, while a test pilot's life is more strenuous than glamorous and he has many duties to perform in addition to flying there is no intention to minimize the tremendous interest which the work holds for him.

Experimental testing provides the thrill and adventure of penetrating formerly unexplored areas of flight and production testing, which is largely repetitive routine, is seldom boring. Each aircraft has its individual quirks and idiosyncrasies to challenge the test pilot and all test flying has occasional moments of excitement and sometimes of rare beauty of nature never visible to those who always live "with one foot on the ground".

IN THE NEXT ISSUE—the Industrial Relations Division.



E. F. Alderton, Industrial Relations Manager



T. W. Shaw, Professional and Staff Employment Supervisor



E. V. Nield, Employment Supervisor



D. G. Lingwood, Employee Services Supervisor



Mike Syron, Chief, Plant Protection



S. M. Jenkyns, Security Officer



Reg. Robinson, Assistant Industrial Relations Manager



R. I. Smylie, Recreation Supervisor



R. P. Attwood, Food Services Supervisor



Dr. S. G. Jackson, Medical Director



K. R. Berry, Senior Job Analyst (Staff)



J. W. Storr, Senior Job Analyst (Plant)



Walter Smith, Personnel Records Supervisor

Employment Interviews 2,000 Job Applicants Every Month

The Industrial Relations Division, as the name implies, plays a large part in the maintenance of management-personnel relationships at Avro Aircraft.

As the first step in this relationship comes when a prospective employee applies for a job, this first article will deal with the functions of the Employment Department. Details of other sections within the Division will be given in following issues.

Employment Department is divided into two sub-departments both with specialized functions. They are hourly employment, and professional and technical employment.

The Hourly Employment office is responsible for the interviewing, hiring and induction of all hourly paid employees.

An average of 2,000 persons a month make enquiries for jobs at the employment office, either in person, by telephone or by mail. A percentage of these applicants are selected for positions by merit and in the light of labor requirements.

Another operation of this office is the processing of transfers of all types. On an average 200 transfers a month are expedited.

Professional and Technical Employment is responsible for the recruiting, selection and placement of professional and technical personnel. Employment officers range as far afield as the United Kingdom in their search for highly skilled people.

Travel 25,000 Miles

In 1955 Professional Employment officers travelled 25,000 miles and visited six countries in an all out recruiting drive for highly skilled professional personnel. An intensive advertising campaign has been carried on in newspapers, magazines, professional publications, and university papers.

The advertising has been done in North America as well as abroad, and when it is considered that advertising and availability for interviewing have been synchronized successfully some idea can be obtained of the intensive organiza-

tion that has gone into the project.

The postage stamps on the correspondence received daily by this department also bear witness to the fact that people all over the world are well aware of Avro Aircraft and are keen to join the Avro team.

Both sub-departments are responsible for their own induction procedure. This is simply a matter of familiarizing the new employee with the benefits to which he or she is entitled on joining the Company. These include Company-paid Group Insurance plan, complete in-plant hospital service, special services to arrange for transportation, accommodation, employee counselling and the pension plan. All are explained and questions answered at the time of induction.

Take Oath Of Secrecy

Another important part of induction is the administering of the oath of secrecy wherein an employee swears to keep secret all matters concerning the production of special equipment built by the Company for Canadian and allied governments.

Although there is a set routine to be followed in the hiring of a new employee the procedure is not as simple as it would appear.

Every applicant is an individual and is received as such. That is why a team of qualified and experienced interviewers and placement officers is constantly engaged in the interview booths, discussing with applicants the present and future possibilities of employment in the tremendous number of different positions within the Company.

The Employment Office in con-



BACK from Ireland after receiving recall notice, Charlie Hourigan (right) discusses his return to production Bays with Employment Officer Harry Wickett in one of interview booths.



APPLICATIONS for jobs at Avro Aircraft come from all over the world. Here Jean Kilby checks one of the many hundreds of dockets of correspondence and information in current files.

junction with the hospital at the time of the pre-employment medical is responsible for ensuring that persons are engaged for work for which they are medically and physically fit.

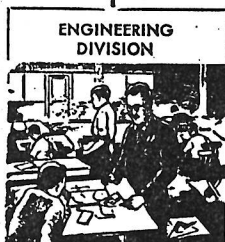
Employment Office also works in close liaison with such organizations as the Canadian Institute for the Blind, D.V.A. and other rehabilitation centres to help in placing those who, due to illness or injury, have become partially incapacitated, but whose other highly developed skills can be used.

Many handicapped people who formerly would have been passed by are now contributing greatly to the growth of the industry.

IN THE NEXT ISSUE the series moves on to describe three more sections of this division—Industrial Relations, the Plant Protection Corps and the Security Department.



A COMMISSIONER OF OATHS, Joyce Fyfe of Employment Office administers oath of secrecy to a group of recalled and new employees during induction program at the Employment Office. All Avroites are required to keep secret matters concerning production of special equipment built by the Company for Canada or allies.



Records, Security And Safety Are Industrial Relations Jobs

The Assistant Industrial Relations Manager supervises the coordination of the various functions which come within the field of labour relations.

Within the group is the Wage and Salary Administration Department whose chief function—as the name implies—is to administer wages and salaries within the current wage and salary structure.

The analytical work of the department is carried out by the Area Job Analysts for both staff and hourly employees.

These Analysts write up and rate job descriptions of the many different jobs being done throughout the Company. Their work is carried on within a specified area to insure that they will have the maximum opportunity of familiarizing themselves with specific conditions.

Yet another unit, Personnel Records is responsible for maintaining a complete history of everyone within the Company. Every individual change in location or status is recorded so that it is immediately available.

Keeping up to date records on 8,000 employees is a big job indeed. For example: over 56,000 changes are made in records in one year and in the same period the Records Department sends out over 8,000 personal and business reference letters.

Approximately 150,000 telephone enquiries are handled in a year. The vast majority of these calls requiring research in order to supply accurate and up to date information. Some 2,000 dockets a week are handled by the filing section.

Although the foregoing figures may seem impressive they only give part of the picture. Records is also

responsible for maintaining an I.B.M. card system and for producing accurate reports and statistical data.

A good system of Records is basic to the proper functioning of any large organization. Avro Aircraft's is second to none.

SECURITY

Security of the plant and personnel through the Security Department and the Plant Protection Corps is another Industrial Relations Division responsibility.

The Security Department itself would be the first to say they are not responsible for Security. "Security is everybody's business".

The department is, however, responsible for the maintenance of security requirements and for implementing the changes in these requirements which may from time to time become necessary.

It is also the responsibility of this department to see that, contractors, sub-contractors and visitors are properly cleared to enter restricted areas and the plant itself.

Authorization of Avro Aircraft employees for movement into restricted areas is also a Department function.

On many occasions personnel from the Company are required to travel to the United States, abroad or to restricted installations in other parts of Canada. Security arranges "trip clearances" for such personnel so that their business is expedited with maximum efficiency.



SPECIAL MEASURES guard restricted areas to which a minimum of personnel are admitted. Here Guard Herb Hale examines pass of Art Newburg before he enters restricted area.



PREPARING trip clearance for an Avro Aircraft employee to visit another security-guarded plant outside Canada are Moira Dorsey (left) and Ellen Downey of Security Department.

A full description of the functions of security at Avro Aircraft is the last thing the department would want. The only applause the "silent service" gets is in the satisfaction of having achieved its ends quietly and without fuss.

A more tangible example of security is seen coming to and going from work and inside the plant in the form of the Corps of Plant Protection Guards.

On duty in every kind of weather from 100 in the shade to below zero, these men check and patrol 24 hours a day every day of the year for the protection of Avro Aircraft people and property.

Guards cover between 500-600 miles per week on patrols and direct the coming and going of over 5,000 automobiles daily.

The force itself is as large as that in many small cities in Canada and their duties are no less diverse. All officers of the Plant Protection Corps are duly sworn in constables of Peel County and are constantly being called to duties outside the confines of Company property.

The memory of the excellent job done by the Corps during Hurricane Hazel, directing traffic, guarding against looting and funneling information is still vivid in the memories of many in the community.

The manual control of the traffic lights at Highway 27 and the Malton Road by the Corps is a boon to Avroites as well as others passing this corner during rush hours. Whenever an emergency arises in the community surrounding the Company the Corps of Guards is on hand to help out and maintain order.

Another fact not generally known about the guards is their responsibility for first aid in the plant during periods when the hospital is closed.

IN THE NEXT ISSUE — Employee Services, which covers Hospital, Recreation, Food Services, Group Insurance and other services.



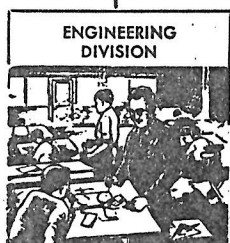
ALL VISITORS must be checked on entering plant and must be accompanied by an escort when moving around plant. Here Sgt. Joe Best and Ruth Strangways confirm identity of visitor before admitting him through the Plant Protection Corps Office.



YOU CAN'T PLACE too much emphasis on safety, says Safety Inspector Doug Dunn, fixing reminder to one of the plant noticeboards. Safety is of primary importance at all times and is another facet of Industrial Relations Division at Avro Aircraft.



COMPLETE HISTORY of everyone within the plant is maintained by Personnel Records which is constantly at work bringing individual files up to date. Checking records (front to rear) are: Ruth Martin, Fern Small, Ken Rowntree, Audrey Watson.



Variety Of Special Services Available To Avro Employees

The purely service functions of the Industrial Relations Division which cover a broad field of service-to-employees are carried out by the Employee Services Department.

Perhaps it would be more accurate to say the Employee Services Departments, because two departments and several groups are involved in administering the various functions.

Among other things Employee Services is responsible for the administration of the Company-paid Group Insurance scheme, the Pension Plan; transportation, housing, Recreation Club, Food Services and the counselling of employees.

Group Insurance

All applications, addition of new members and changes of beneficiaries are made by Group Insurance. In 1955, 10,777 claims were received and 4,159 policies distributed. In addition, 6,316 claims forms were issued and instructions as to their use given by Employee Services Officers.

Pension Plan

After two years with the Company all staff members of Avro Aircraft are given the opportunity of applying for the Pension Plan. Membership in the plan numbered 1,493 in 1955 and will in all likelihood increase in 1956. Notification of eligibility for the plan is automatically sent out by the group along with pertinent literature about the benefits that may be derived from subscribing to it.

Transportation

A list of rides available and rides wanted is kept in a coded file by Employee Services at their Transportation counter. When matched with a master map of the area this code instantly gives the answer to transportation available and required in any specific spot up to 80 miles from the plant.

Accommodation

In a good number of cases new Avro employees come from out of town or even from abroad, arriving at Malton with only baggage. One of their first problems is accommodation. Employee Services has a list of two hundred houses, apartments, flats and rooms—furnished and unfurnished. Generally the problem of accommodation is well under control before the employee leaves the plant immediately after being hired.

Recreation

The Recreation Supervisor and staff work in conjunction with the Recreation Club Committee (composed of elected representatives) in helping to organize and direct some 30 recreational activities for employees. Members of the club contribute 25 cents a month through payroll deductions and their total contributions are matched by a similar amount from the Company.

Among the many groups are those participating in basketball, skiing, hockey, bowling, tennis, softball, badminton, golf and many hobbies such as model aircraft building and photography.

The Avro-Orenda Choir and the Avro-Orenda Pipe Band are joint activities of the two recreation clubs. Both groups perform gratis at many charity drives throughout the community.

Dances, Christmas parties and picnics are organized by the club,

and the large attendance of employees at all these functions is a clear indication of the Recreation Club Committee's enterprise.

Food Services

The Food Services branch of Employee Services is responsible for the administration of the in-plant feeding operation.

Day and night lunches and dinners are prepared in a central commissary and delivered by mobile units to various areas throughout the plant.

Counselling

Many employees have benefited by Employee Services counselling. Subjects on which advice can be obtained in personal interviews with members of a qualified group of Employee Services officers cover some 17 broad categories ranging from personal matters to business and educational problems.

Hospital

The health of the employees at Avro Aircraft is protected by the plant hospital from the time of their pre-induction medical through the duration of their stay with the Company. Minor injuries are treated on the spot and medical examinations and advice are provided by the Medical Director and the staff of nurses.

Over 63,000 occupational and non occupational treatments were given in 1955 alone.

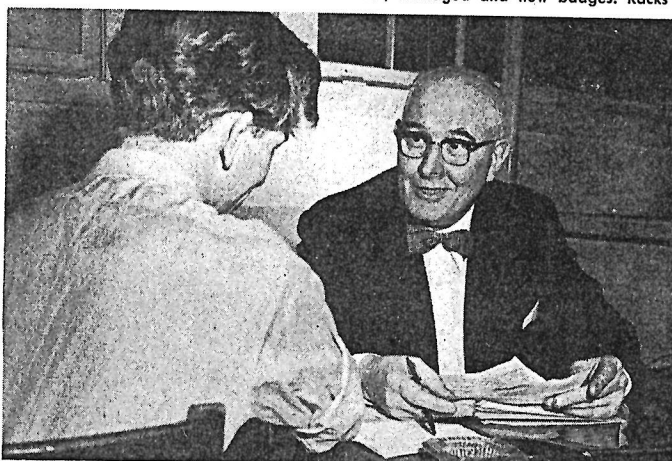
IN THE NEXT ISSUE, the Secretary and Treasurer's Division.



VALERIE REED checks request card at Transportation Counter which provided some 2,500 rides for Avroites in 1955.



NEW BADGES are issued by Nadine Burgess of Employee Services. Last year well over 7,000 fresh badges were issued to employees in covering departmental changes, and lost, damaged and new badges. Racks of different badge cards are shown in rear.



EMPLOYEES IN NEED of advice on personal problems seek the counsel of Employee Services officers. Ray Simpson of Employee Services, seen here (at right) discussing problem with an Avroite in one of interview booths, is one of counselling officers.



RECREATION covers a wide field of sports, hobbies and entertainment. This is a flashback of the last Christmas Party.



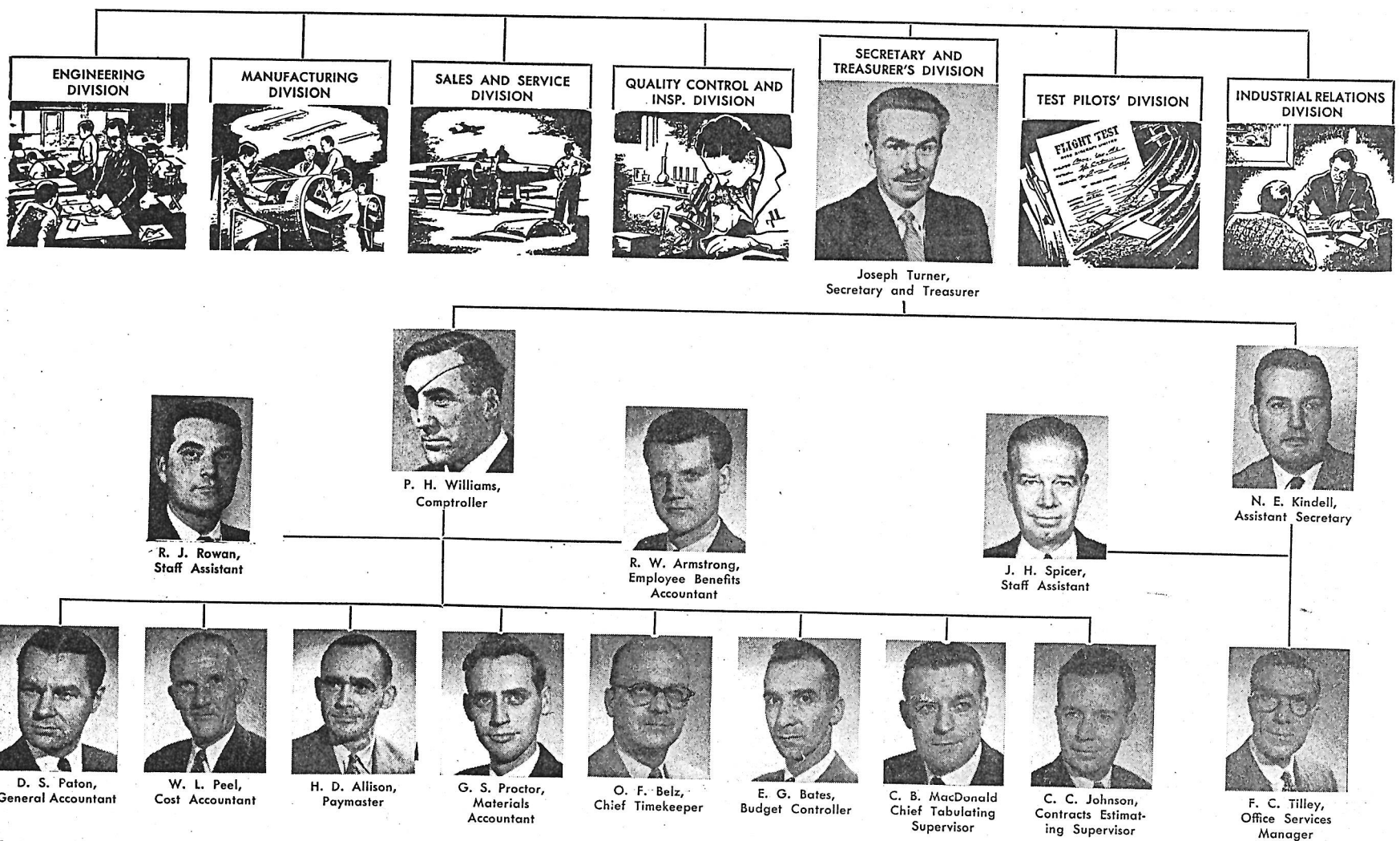
MIKE BENTLEY of Flight Test discusses medical items in his insurance claim with Jenny Wright of Group Insurance, following Mike's return after a month off work due to a nose operation.



NORENE WILSON shows one of the 1,700 TV dinners served each week as feature of the mobile food service.



CUT FINGER is dressed for Eddy Darlington of the Woodshop, by Nurse Bessie Wickham. Nearly half a million visits have been made by employees to plant Hospital in last five years.



Law, Insurance, Mail, Printing Just Parts Of Secretarial Job

The Secretary and Treasurer under whose jurisdiction all financial, secretarial and legal requirements of the company including related administrative matters are executed, has a dual responsibility.

As the title suggests, this Division possesses two distinct functional operations—and this first article deals with the operations which come under the heading of "Secretary".

Many duties of a company Secretary are prescribed by law. For example, the procedure and administration of the company in compliance with the requirements of the Dominion Companies Act such as filing of company returns to the Secretary of State, the keeping of statutory books and corporate seal, etc.

Other duties of the Secretary are to record and preserve the minutes of Shareholders, Directors and Management Committee meetings at which he attends; the preparation of notices and agendas for such meetings; ensuring that the resolutions of these meetings are conveyed to those responsible for implementing such decisions either by means of policy directives for company-wide communications or direct to officials where they affect individual Divisions or Departments.

Then there is the handling of corporate correspondence of legal or formal nature; preparation and collation of reports for Directors and Members of the Management Committee; act in an advisory capacity when called upon by other Divisions on legal matters and assist in drafting the form of legal contracts; to ensure proper insurance coverages carried by the company and file claims; liaison with parent company; the operation of office services departments, i.e. Mailing, Printing, Telephones, Office Furniture, Stationery, etc.

Just as the duties of the Secretary and Treasurer embrace two different

types of work, it is similarly so in the Assistant Secretary's unit where we find both Staff and Line functions, the former undertaken by the Staff Assistant and the latter by the Office Services Manager.

The Staff Assistant is responsible to the Assistant Secretary for general company secretarial matters such as insurance; contractual arrangements for such services as firefighting, ambulance, etc. with the federal Department of Transport; liaison with the Canadian Underwriters inspectors; obtaining of licenses and permits required by law; clearance of monies due families of deceased employees and many other duties common to secretarial practice.

The Office Services Manager is responsible for the operation and administration of the Office Services Departments which come under the following headings:

Mailing—The volume of work in Avro's Mailing Department exceeds that of many post offices in moderate sized communities with as many as 12,000 pieces of mail, internal and external, handled in an average day.

Telegraph and teletype services also are the responsibility of the Mailing Department.

Printing—The Printing Department compares favorably with many commercial printing houses in equipment, variety and volume of work. Equipped with four small and one large Multilith press and two Gordon presses, single, dupli-



MANY THOUSANDS of calls are handled each day, by Switchboard personnel who are the link between Avro Aircraft's 1,629 telephones and outside world. They handle more calls per day than the town of Brampton (pop. 11,000).

cate, triplicate and quadruplicate forms are normal production items, not to mention complete manuals and brochures in colour form.

In addition to printing a large percentage of all stationery requirements of the company binding, folding, padding, stapling, composition, punching and other functions common to the printing trade all contribute to making this department one of complete printing service.

Telephone Exchange—Telephone facilities serving Avro and Orenda Engines comprise 83 trunk lines. The number of instruments in use total 1,629—1,115 locals and 514 extensions—while internal, outgoing and incoming calls average 23,000 a day.

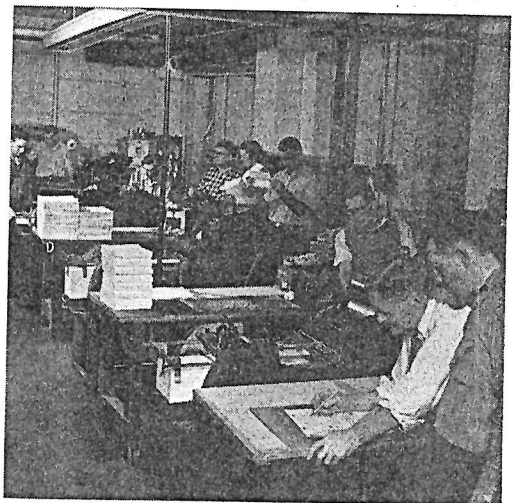
Stationery Stores—Altogether a total of 2,700 different forms and

supplies are carried in stock. Perpetual inventories are maintained from day to day to avoid "out of stock" conditions to exist.

Forms Service—This department in its studies of office forms is primarily intended to assist in the designing of new forms required from time to time by all divisions of the company.

Furniture, Equipment & Archives—Providing suitable furniture and equipment, maintenance of furniture and repair of equipment is the main responsibility of this department.

In all, 11,000 pieces of furniture and 1,000 pieces of equipment including typewriters, calculators, adding machines, etc., are being used in the day-to-day operations of the company. In addition, complete



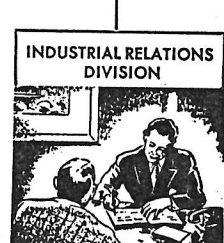
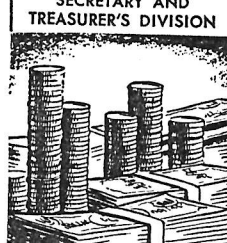
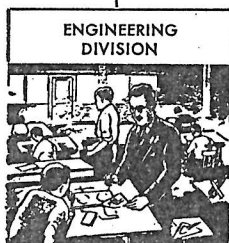
PRINTING DEPARTMENT consumes 12 tons of paper each month in making 1,500,000 impressions on a variety of presses. Equipment and volume compare favorably with many commercial printing houses. Some of presses are shown here.

inventory records maintained by Departments and Divisions.

Archives—The storage house for all non-current documents—handles approximately 82 tons of records dating back to the company's inception in 1945.

R.C.A.F. Stenographic Service—A staff of stenographic personnel is provided for all R.C.A.F. resident officers and their staffs.

IN THE NEXT ISSUE the series will describe the operations and organization of the other half of this Division which covers the financial responsibilities of the Company.



If It's A Question Of Finance They'll Be Providing Answers

In order to master the mass of accounting detail demanded by modern business in a firm of our size the Secretary and Treasurer, in his managerial capacity of administering and coordinating these activities, vests in the Comptroller the authority for direction of the processing and recording of all financial transactions as well as the prescribing and development of methods and systems to meet these requirements.

Nine departments exist within Accounting—eight of an operational nature and, the other, a mechanized service function to the other departments called Tabulating. Unique in its role of the "workhorse" in the company's accounting operations, it is of interest to know just how the tabulating equipment contributes so much in providing and arranging statistical data for a wide variety of purposes.

The basic element in tabulating is a card in which holes are punched in accordance with predetermined codes. Once punched, these cards become a permanent record from which statistics are developed in various forms to meet the requirements of specific applications such as plant labour distribution, accounts payable, staff and plant payroll records and envelopes, material quantities and values, etc.

The cards are processed through printing machines at a rate of 6,000 and 9,000 cards per hour.

By means of carefully timed electrical impulses combined with a series of mechanical devices, the punched holes are automatically interpreted and reproduced in printed form in single, duplicate, triplicate or quadruplicate copies and, when necessary, on ditto and multilith masters where considerable numbers are required.

1,500,000 Cards Weekly

Thus, through the medium of this equipment, can basic data in any derivative form be obtained much more rapidly and accurately than is possible by manual methods. A total of eight major accounting applications which entail the punching and processing of approximately 500,000 cards per week is an indication of the volume of work which is accomplished in the Tabulating Department.

The overall clerical functions and responsibilities within the Accounting Department are now departmentalized as follows:—

General Accounting—This department is subdivided into three sections—the General Ledger, Accounts Payable and Fixed Assets. The former, as the name implies, maintains the company's general ledger which constitutes the unit from which the company's financial position is determined in the form of financial statements. In addition, this section checks and approves travel expense claims for payment, is responsible for the cashier's function, payment of cheques and records all accounts receivable.

The Accounts Payable Section is responsible for checking all suppliers' invoices to purchase orders and receiving vouchers for materials purchased as well as suppliers' invoices for services rendered, approving same for payment and other numerous tasks common to accounts payable procedure. An average of

1,500 invoices are processed each week.

The Fixed Assets Section maintains a perpetual inventory, quantities and values, of all Crown and Capital Assets.

Cost Accounting—This department has the responsibility for collecting together all costs chargeable to a particular job or contract. This includes both costs chargeable direct to a contract—such as time spent by employees, material costs and payments for services supplied by outside concerns as well as indirect costs or overhead which must be apportioned fairly to the jobs or contracts concerned.

Their responsibilities also include publishing the cost accounting manual which establishes the code numbers necessary to allocate the costs to the various job orders and contracts, preparing billings to customers, financial statements and other cost data required for control purposes and government audit.

Payroll—Additional to ensuring that all hourly and weekly paid employees receive their proper pay each week in accordance with approved rates and procedures, timekeeping for staff employees, retroactive and holiday pays are also a responsibility of this department as are other functions common to payroll practice such as complete records of employees' earnings and deductions, distribution of income tax forms, distribution of paid up Canada Savings Bonds, etc.

Material Accounting—Records for some 30,000 material items, both production and mill supply, are maintained in this department. They prepare financial statements relating to the material position each month and reconcile book inventories with physical count. They are also responsible for seeing that unit prices for all material are maintained at the latest average price. The detailed calculations necessary for this are carried out on the tabulating equipment.

Timekeeping—On this department rests the responsibility each week for providing the source data for the plant payroll and plant labour costs and analysis. Working right on the floor in the immediate area of every time clock throughout the plant, timekeepers perform their dual function by recording on each employee's time card the number of hours worked for payroll purposes and, at the same time, show a breakdown of these hours according to jobs worked on by work order number on job cards.

The hours recorded on the time cards must be in balance with the hours entered on the job cards for the same period to ensure that payroll and labour figures are in agreement. Completed every Friday, this source data is submitted to Tabulating for processing each Monday morning, the time cards for the pre-



FROM time cards to complete payroll. Here Wilma Preston (foreground) and Cloris Cole of Tabulating check pay envelopes and receipts in finished form coming off machine.



TIMEKEEPER Russ Robbins (left) checks labour for a job on a Toolroom profiler with machine operator Ed Wright. About 10,000 such work order entries are recorded each week.

paration of the plant payroll and the job cards for the labour distribution.

In addition to the foregoing, Timekeeping personnel perform numerous other tasks such as handing out pay receipts each Thursday to all hourly paid employees, assist Brinks on each pay line every Friday and submit changes in address for plant employees through the proper channels.

Budget Control—In this department the all-important divisional forecasts of overhead, capital and manpower budgets are collected together and summarized for the company as a whole. Once set up, the task of reporting, comparing and analyzing actual performance each month against the budget figures provides a concrete basis for maintaining proper financial control over the various activities of the company and many other functions arising out of these responsibilities for administering the company's financial plans and policies.

Contracts Estimating—Responsibility for analysis of costs and other statistical data of an accounting nature relating to current and future operations rests with this department. Their personnel ensure that all costs have been foreseen in the preparation of estimates. They prepare financial analyses of these for Management and correlate such Estimate data in brochure form for presentation to customers.

The Employee Benefits Accountant is responsible for all accounting records pertaining to Group Health and Accident Insurance, Pension Plan and Canada Savings Bonds purchased by employees on the payroll deduction plan.

The Staff Assistant, directly responsible to the Comptroller, assists in numerous tasks common to the overall administration of the Accounting Department, such as scheduling of operations, distribution of financial statements, stationery requirements of a specialized nature, librarian for all accounting procedures in departmental files, etc.

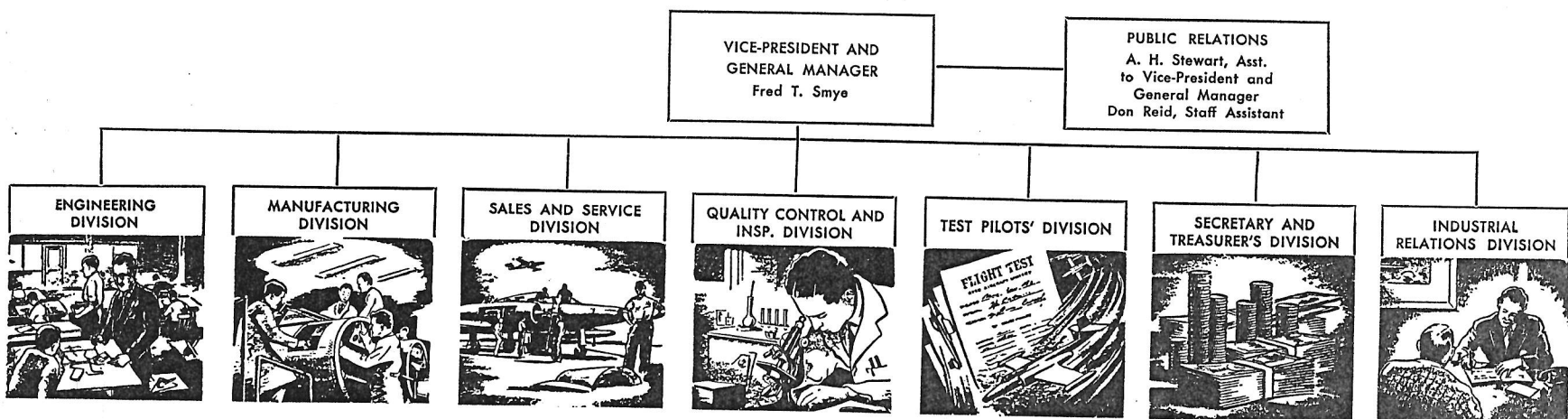
IN THE NEXT ISSUE—the Public Relations Department.



GENERAL VIEW of the Accounting area with Cost Accounting in the foreground. This is where all costs chargeable to particular jobs and contracts are collected, financial statements are prepared and where the Cost Accounting Manual is published.



THIS Sortergraf is a file of invoices and receiving vouchers in Accounts Payable. Operators Isabel Moody (foreground) and Gloria Rogers remain in a stationary position while racks glide back and forth to speed process of selection and matching.



They Help To Tell Your Story In Canada And Around World

So now you have taken a good look at the several and varied operations within Avro Aircraft . . . the who, what, why, where and when of how the Company is organized and how each group, section, department and division operates and co-operates, each with each other.

There remains one more operation . . . the planned, programmed and organized function of maintaining and extending public esteem, acceptance and approval of the Company, its people and its products.

The department charged with this responsibility is Public Relations. It is a function of the office of the operating head of the Company, the Vice-President and General Manager. And the direct responsibility for its operations is placed in the hands of the Assistant to the Vice-President and General Manager.

The members of Public Relations are especially trained and experienced in the varied tools and mechanics of Public Relations . . . photography, illustrating, the assaying of public opinion trends . . . the writing, editing and distribution of news releases, creating of advertisements, the creative production of internal and external plant brochures, pamphlets and booklets . . . international distribution of company documentary films . . . operation of a speakers' panel . . . writing, securing of photographs, editing, layout and direction of production of the internal employees' newspaper, Avro NEWS.

Sole Press Contact

Public Relations is the sole authorized contact of Avro Aircraft with the Press, Radio and Television and magazines, in the local community, across Canada and in the publishing centres of the world. All inquiries to Avro for publicity information are referred to Public Relations so that Company policy and Security regulations can be centrally controlled.

The department maintains the company's friendly relations with these communications media on a personal "first name" basis wherever practical to further the understanding of the world press as to Avro's progress and objectives.

The department is also responsible for handling requests and enquiries from the general public on such matters as general information, photographs, charitable appeals and the like.

Then there is the counselling and clearing from a public relations standpoint all speeches made by Company Personnel on Company subjects or where the speaker is identified with the Company . . . securing pictures, stories and facts for newspapers, technical publications, and suppliers who wish to show in advertisements their products in use here . . . acting in a liaison capacity for Avro Aircraft display booths, air shows, internal drives . . . handling of the sales of photographs that have been requested by employees . . . checking and filing under specific subjects the technical and news story clippings about Avro and other items related to the surrounding communities which have a bearing on employees in their homes or in the plant . . . and many other similar subjects.

Liaison between Avro Aircraft and the A. V. Roe Canada Group on public relations matters affecting the group as a whole is maintained by the Assistant to the Vice-President and General Manager of Avro and the Assistant to the President of the parent group.

Public Relations as a function of industry is as old as industry itself. But its operations as an "arm" of Senior Management is a relatively new development brought about by the constant growing complexities of life in this 20th Century.

In Grandpa's time, public relations communication was attained effectively in a community by the simple act of rolling out a cracker barrel in the village store to serve as a distribution centre for the exchange of information. Today, and specifically for Avro Aircraft, the "community" has grown to involve many millions of people of many nations.

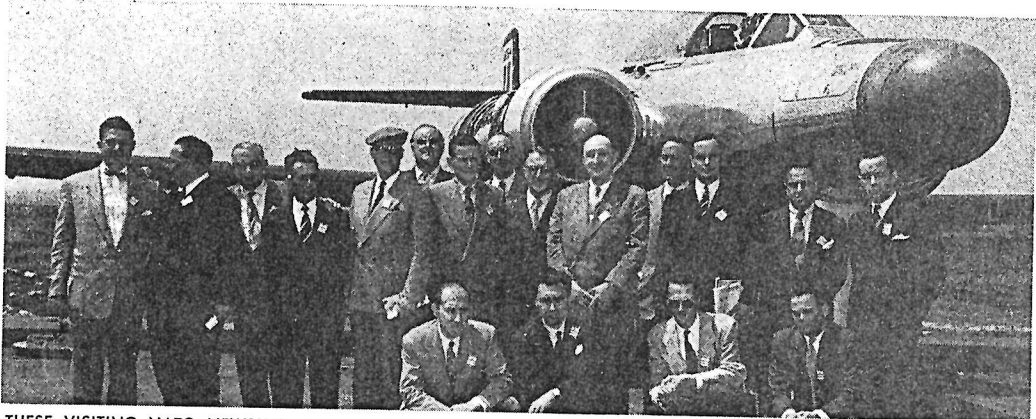
Neither Grandpa with his cracker barrel nor Avro Aircraft with its specialized Public Relations functions could hope to make and retain friends if their products couldn't stand up to public scrutiny. But with good products, the right people making those products and a sincerity of purpose and objective, public relations wins at a walk.



PLANNING advertising which appears in many countries and languages are A. H. Stewart (left) Asst. to the Vice-President and General Manager and Carroll W. McLeod of Cockfield Brown advertising agency. Avro ads are currently rated among top three of all aircraft companies in North America.



SPEAKERS from Avro are in constant demand by public organizations, so Public Relations operates a Speakers' Panel whose members give talks on various subjects. Here Doris Bridge, Public Relations, helps Chief Test Pilot Don Rogers select a short film to give with his address at a meeting.



THESE VISITING NATO NEWSMEN are a typical example of the many Press, radio, TV, newsreel and magazine writers in all parts of the world who are in constant contact with Public Relations for information and pictures of Avro activities.



PUBLISHED NEWS about Avro Aircraft is forwarded by international clipping services. Here Renee Whitley catches up on the filing of clippings received in the last two days. Items may range from a few paragraphs to a six-page illustrated feature.



MAKING LAYOUT of current issue of Avro News, Don Reid (right) discusses photographic assignments with Photographer Verne Morse. Press time is deliberately held back to absolute deadline to get as much last-minute news as possible into issue.



AVRO AIRCRAFT LIMITED

MALTON - ONTARIO

MEMBER

A. V. ROE CANADA LIMITED - HAWKER SIDDELEY GROUP