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METEOROLOGY AND AVIATION IN CANADA

by

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Presidential Address delivered to the
Royal Meteorological Society, Canadian
Branch, at the Annual Meeting held in
Toronto, Canada, on January 31, 1952.

PRESIDENTIAL ADDRESS
FOR
ROYAL METEOROLOGICAL SOCIETY
CANADIAN BRANCH
January 31, 1952

METEOROLOGY AND AVIATION IN CANADA

It is my privilege this evening to follow the excellent precedents set by Mr. P. D. McTaggart-Cowan while he held the office of President of the Canadian Branch. The first, which you have just witnessed, is the award of the annual President's Prize, won this year by Mr. G. W. Robertson. To compensate the President for his out-of-pocket expenses in connection with the award, he is given the privilege to deliver the annual Presidential Address. I welcome this opportunity of speaking to the members of the Canadian Branch on a subject of my own choice. I have selected the topic "Meteorology and Aviation in Canada".

In selecting this topic, I had no intention of trying to emulate our good friend Sir Robert Watson-Watt, past-President of the Parent Society. I decided to speak on this subject quite sometime ago. This was before I had an opportunity to read the complete account of Sir Robert's Presidential Address,⁽¹⁾ entitled "Meteorology and Aviation", delivered before the Royal Meteorological Society last May. I would like to say, however, that I agree wholeheartedly with the views expressed by Sir Robert and that I feel that his remarks about meteorology in the United Kingdom apply equally well to Canada. To those of you who have not read it, I recommend it most highly.

In selecting my topic, I was guided by several factors:

First, it is a field in which I have some familiarity and a great deal of interest.

Second, the meteorological requirements of aviation and many other industries in Canada are increasing and changing at a very rapid rate.

Third, the Meteorological Division is on the threshold of major changes which will revolutionize the methods of providing weather service in Canada.

Fourth, there are a variety of ideas and what appears to me as misconceptions, both within and outside of the Meteorological Division, about the role of meteorology in Canada, the basic principles of the Meteorological Division organization and its operations. I too have views on these matters and I am glad to have this opportunity of offering a few of my own thoughts.

Before proceeding any further, I would like to state that the views I express are my own. Many of these coincide with the views held by others. A few, however, may not. They are not, therefore, to be construed as reflecting the official policies of the Meteorological Division or of the Canadian Branch.

I would have liked to entitled my address "The Philosophy of MANAIR". However, I refrained from doing so for two reasons: first, not everyone is familiar with the manual entitled MANAIR, and secondly, it may be a bit presumptuous on my part to assume that MANAIR embodies the whole philosophy of providing weather service to all of Canada. Nevertheless, MANAIR, the Manual of Standard Procedures and Practices for Meteorological Service to Domestic Aviation, is the embodiment of the bulk of our experience in Canada in providing weather service.

I would like to give you some idea of what I mean by the philosophy of MANAIR. As William James once put it, philosophy is a "peculiarly stubborn effort to think clearly". I won't vouch for the clarity but I shall try to state the basic policies and principles and show how the organization and procedures resulting therefrom are the best for providing weather services in Canada at present and what modifications, I feel, must be made to ensure that we continue to have the best possible weather service for aviation, and for everyone else in Canada. I am not going to try to deal with any abstruse ideas or thought processes, nor attempt to cover the scope of Canadian meteorological ideas and thinking. Rather, I shall try to portray the basic policies and principles of the Single Service System, such as we have in Canada, for providing weather service to the present and the foreseeable requirements.

The Meteorological Division is primarily a scientific enterprise. It is in this way that it differs quite considerably from most agencies of the government. It is also the servant of the people and of other departments of the government. For these reasons, I feel that the Meteorological Division should be considered as being different from most other departments and divisions and the normal bureaucratic red tape should not apply.

As a scientific enterprise, the Meteorological Division has two functions. One is the timeless quest for more understanding

of the nature of the atmosphere - the urge to expand the frontiers of knowledge regardless of whether the new information to be found is immediately useful or not. This has always been the primary meaning of the scientist's calling. Scientists took pride in keeping their curiosity and pursuit of knowledge as "pure" as possible. But in an industrial civilization, the scientist is called upon more and more to perform another important function: namely, to apply his knowledge and methods of investigation to the complex technical problems of our civilization. Meteorology, and like many other sciences, has, therefore, become a large profession and the demands for its services are growing at a rapid rate. The most effective and insistent demand comes from aviation. There is also a steadily increasing demand and a large potential demand from the general public, agriculture, forestry and many other industries. The Meteorological Division is responsible for two functions: meteorological research and professional service. Both these functions should be recognized as distinct and it should be realized that they are equally important. Without research, we will just exist; if we don't provide good service, we will be a "dead duck". Although MANAIR is primarily concerned with the second function, it does take full cognizance of the first. Research and service, although recognized as distinct functions, must be co-ordinated to ensure that we advance scientifically and give Canada the best possible weather service at the least possible cost. This requires good organization, teamwork, flexibility and progressiveness. These are the basic principles of MANAIR.

In most fields of science, the application of ideas and new methods follow closely upon the heels of their discovery and development. Research must be continuous, but the application, of necessity, must be on a step-by-step "project" basis. In many fields, the application is only a step behind research. In meteorology, I feel that the application of new methods, new techniques and new ideas in everyday work is lagging behind the advances in theory. This does not mean that the theoreticians are going too fast. Far from it. It means that for some reason the meteorologists in the field are not able to introduce new methods into their everyday work as fast as it would be desirable.

What are the reasons?

First and foremost, there is the lack of time. The forecaster in the field is so busy handling the routine work and meeting schedules, he has to use the methods he knows, even though they are not 100% perfect, rather than experiment with new methods which have been untried and with which he is not familiar.

Second, the complexities of new ideas and methods. Much of the new theory in meteorology and the proposed methods of application are too complicated for the average office to incorporate them.

Third, inertia. The forecaster, like any other human being, is reluctant to disturb a familiar routine for an unfamiliar one.

It is, therefore, incumbent on us at this time to take stock. What changes must be made in the organization, in our methods and in our thinking to bring the practical application of meteorology up-to-date with theoretical researches.

I will come back to this matter later. Right now, I think I should go back and begin at the beginning.

To understand the organization of the Meteorological Division, one has but to look back over its history.

In the year 1839, when the Toronto Observatory was established, there was a shortage of staff and accommodation. This condition remains almost unchanged. Moving a portion of the Head Office staff to Richmond Street can hardly be considered as a satisfactory solution to the space problem. Nevertheless, a great deal of progress has been made in other regards.

During its early history, meteorology was only one of several scientific activities of the Toronto Observatory. Thus, from its beginnings, meteorology has been closely associated with scientific endeavour in Canada and this has carried on to the present time. During the 1870's the Observatory began issuing marine storm warnings followed closely by general forecasts for all parts of civilized Canada. Therefore, by tradition, the Meteorological Service of Canada is intended to serve all of Canada. But then came aviation in the 30's and then World War II. The rapid expansion and demands of civil and military aviation almost completely monopolized the facilities of the Meteorological Division and has almost completely dominated the rapid development of the past 20 years.

As a result of this close relation, a large number of the weather reporting stations lie along main air routes and in strategic locations relative to such routes and many older stations have fallen by the wayside. Forecast Offices are located mainly at military and civil aviation centres. With every major change in aviation, there has been a simultaneous change in the Meteorological Division.

Aviation owes a great deal to meteorology. On the otherhand, meteorology in Canada, as almost everywhere else, owes a very great deal to aviation. Many other interests and even the meteorologist at times look askance at the special consideration given to aviation. This I do not feel is justified. As Sir Robert said in his address,

"The aviators are to be congratulated on their persistence and their success in obtaining these facilities; the non-aviators are to be condemned rather than commiserated with on having been less successful because less demanding".

"They would not, in fact, have had even the fractional service they now enjoy had the aviators not been exacting."

Similarly in Canada, where would meteorology be today had it not been for the insistent and persistent demands of aviation? Yes, meteorology and all non-aviators owe a great deal to aviation and will continue to do so for some time to come. The new demands of the jet age are posing new problems which, when they are solved, will result in a better knowledge of the atmosphere and a better weather service for everyone.

We can be justly proud of Canada's participation and early lead in the manufacturing field of jet propulsion. Canada is also playing a leading role in the operation of jet aircraft. There is as a result, a need for specialized meteorological service to meet these new requirements. The problems are quite different from those of the past and will require a great deal of attention from the meteorologist.

The handling of jet aircraft operating at high speeds requires improved knowledge of winds, temperatures and turbulence at high levels as well as icing, cloud heights, visibilities, etc., for take-offs and landings, ascents and descents. The operation of jet aircraft requires detailed flight planning and calculated despatch. Navigation must be accurate. Climbs and descents must be planned and executed in as split second fashion as possible.

Mr. Merewether, in speaking to the Canadian Branch last November, stated that the influence of weather on airline operation is in fact a comparatively minor one today. That may be quite true, but I believe that the meteorologist will continue to play an important role in aviation and become more important as time goes on. This is not "whistling in the dark" on my part as I am sure that even without aviation, meteorology has sufficient scope in Canada to keep us all busy for the rest of our lives. I am making this statement because I fully believe that aviation needs and will continue to need weather service for a long time to come; perhaps, indefinitely. The information they will require and the means of incorporating the weather data into their operations will undoubtedly change, but the need will remain and I think that the demand on the forecaster's time will be greater than it is now.

The meteorological problems of Jet operations include both climatological and current weather information. Accurate and detailed climatological data of winds, temperatures, humidities, pressures, etc., are required for development and design and operational planning purposes.

In operations, accurate upper air information will be required, necessitating complete and reliable networks of radiosonde and rawinsonde reports.

Jet operations will necessitate research on more accurate instruments for use at high levels, accurate in-flight reporting and accurate landing forecasts. Radar will probably have to be used to catch rapid and local changes.

The traffic control problems associated with jet aircraft operations are very complicated. The altitude of operations will vary during flight owing to both the characteristics of the aircraft and the existing weather. On approach, an aircraft will have to begin its descent about 200 miles from point of landing, necessitating an accurate knowledge of its position and an accurate forecast of the ceiling and visibility at the terminal. Problems of temperature accountability will probably necessitate hourly temperature forecasts to enable operations personnel to plan loads for departures which will depend upon the time of day as well as conditions aloft.

All this indicates the importance of meteorology to aviation in the future. It also indicates that the forecaster will have to become more thoroughly familiar than ever with the operations of the aircraft and be ready to give full attention to meeting requirements immediately. When an aircraft travels at the speed of sound, the pilot won't have time to do much thinking. Although the man on the ground will also be pressed for time, he will, nevertheless, have to do much of the work and thinking for the pilot. To be successful, jet aircraft operations will entail a considerable advance in detailed local forecasting, and the closest co-operation between the operator, the air-traffic controller and the forecaster.

In addition to the developments in aircraft types, there is and there will continue to be, a rapid increase in the number of uses to which aircraft are being put. The multitude of uses has resulted in creating a demand for different types of forecast each designed to meet the requirements of a specific type of problem. It is expected that the utilization of aircraft in a greater variety of projects and over more widespread areas of activity will continue to increase and will require specialized weather services.

Thus far, I have dealt mainly with the increased demands of aviation. Actually, this is only a small part of the overall picture of weather requirements in Canada. There is an increasing and insistent demand by industry and the general public for more and more specialized weather services and greater accuracy. Many of the large industries are just awakening to the fact that meteorological advice is of value to them.

So far, we have just scratched the surface of the potential demands of this large body of consumers. As Sir Robert said in his talk, "We shall not have that public weather service which is justified by the potential economic value of timely weather forecasts until there is a weather salesman at a public 'counter", behind an attractive and arresting shop front in as many market places, agricultural and commercial, as there now are airfields. And we shall not have that until a force of well-informed uncommercial travellers in meteorology have "sold" the economics of weather to the major industries of the country, beginning with agriculture".

What will these increased demands for weather services involve? I believe that it will necessitate a great deal more individual attention. Even the pilot, who gets more attention than anyone else, is going to need more. The actual direct contact between the pilot and the forecaster may some day not be necessary, but the pilot will nevertheless be putting more and more reliance on the work of the "weather-man" even though the information may be integrated into his operation by new operational procedures and techniques.

The need for more individual attention by other industries and individuals is obvious. Many do not know what they need or want. It is becoming increasingly necessary for the meteorologist to become thoroughly familiar with the user's operations and help him to determine his requirements as well as meet them. There will be an increasing need for familiarization tours of factories and farms and close co-ordination with their supervisory personnel just as there is a constant need for familiarization flights in order to learn and keep up to date on airline operating procedures. The meteorologist will have to be a "Jack of all trades, and a master of meteorology".

I am willing to bet that those who pressed so hard for the Hamilton Public Weather Office did not fully realize how such an office would be of benefit to them. They knew they needed more personalized and individual attention. They got it and I feel certain that they have not only been pleased but astounded at the value of the services provided by one man and his assistant. Although a great deal of credit is owing to the outstanding ability demonstrated by Mr. D. G. McCormick, it should actually be attributed mainly to the excellent co-operation of the Malton DPWO and the sound organization behind Mr. McCormick. By this I am not in any way discrediting the top notch job being done by Mr. McCormick. In fact, with someone else, the Hamilton Public Weather Office might have been just a very ordinary office or even a failure. The reason I have selected the Hamilton case is because I feel that it clearly demonstrates the point I wish to make. Put a sound organization behind a good weather salesman and the result is top notch weather service. There is a great need in Canada for a large number of outlets of this kind.

Hamilton, Victoria, Lakehead and a few others I could mention are the forerunners of a most promising venture- "one-man weather offices". Some day, I expect to see such an office in almost every city and larger town, in major industries and, in fact, in every place where the weather services provided will be justified by the economic values derived. However, large numbers of such offices cannot be established until certain basic changes in our organization and procedures have been made. The reason why the existing few "one-man weather offices" are working so well is because they are still very few. If they were increased substantially in numbers, as they should be, the system would bog down.

And then we need better salesmanship. As a public service there is no need to use high pressure methods or quackery. But the public has to be "sold" weather services. The effect of weather on an industry can, to some extent, be taken out of the "Act of God" category and placed in the "calculated risks" category. But many do not realize this and that the weather services are free. When I say "free", I mean that they are free in the same sense as "old age pensions" and "children's allowances" are free. It may seem a paradox that a forecaster should have to sell to the citizen the service the citizen is already paying for. However, that is the case. This is not a reflection on the product of the weather service, but is owing to a lack of appreciation by the average individual of the effect of weather on his day-to-day work and how some of the effects may be overcome by intelligent use of weather services. It is, therefore, up to the meteorologist to "sell" the service.

The question of salesmanship in meteorology has generally been overlooked. I do not feel that it is enough to teach a man everything there is to know about theoretical meteorology and preparing a "prog" and then turn him loose to issue forecasts, brief pilots and answer the telephone. Although there are a number of outstanding salesman meteorologists in Canada, the quality of salesmanship is not general and where it does exist, it is only fortuitous.

Training of meteorologists should include sales techniques and methods, consumer psychology, public relations and the many varied facets of salesmanship. Although this might mean extending the training courses in scope and duration, it will have to be considered. A successful industrial organization would not expect a person having only a thorough technical knowledge to be a successful salesman, without training. Why should meteorology?

In summary, to meet the meteorological needs of aviation, industry and the general public we need in Canada, more outlets, more forecasts, more accurate forecasts, more individual attention and better salesmanship. What is the Meteorological Division doing and what do the meteorologists have to do to achieve this goal?

In his address, Sir Robert made some interim suggestions, one of which was a slogan the Meteorological Office might use: "Meteorology in the service of productivity". Sir Robert also mentioned the need for more money. We too need more money. In a country such as Canada with its large area and small population, the strategic importance of its location and the vast economic potential of its resources, more money per capita will have to be spent on weather services. More money will probably be provided. However, there is an economic upper limit to the amount of money and particularly the manpower which can be allotted to providing weather services. Increased expenditures and more personnel is not the only answer to the problem. Money will have to be spent on aids such as Central Analysis Office and Facsimile. Without these, progress would be very slow and uncertain. But even with them, progress will be uncertain unless everyone takes advantage of these new facilities to increase his own productivity. The successful development of the Weather Service of Canada will require the utmost co-operation and understanding of everyone connected with the Meteorological Division ranging from highest echelons of Government to the lowliest positions in the organization. Increased productivity per man is the only real answer to handling the rapidly increasing civil and military weather needs. To do this, the CAO and Fax are needed as tools but the success achieved depends on the meteorologist.

To venture into future prediction is a tricky business. The purpose of what follows is to inspire argument, thought and ambitious enterprise. To appraise the future, the first thing to do is to look the problem straight in the face and with realism determine our faults and shortcomings. We must learn the lessons from the past and give proper weight to those factors shown to be correct.

Let us look at how we are handling weather requirements.

Back at the beginning of the last war, the forecaster did a great deal of the plotting, drew all his own maps and charts, stood outside with the airline dispatcher while he was bringing in the one or two flights during each shift and wrote a "tailor-made" forecast for each flight. Suddenly the number of flights increased substantially to such an extent that the forecasters developed writer's cramp and the teletype circuits were jammed so full of forecasts there was hardly time to send the raw data. Then someone suggested a simple solution. Why not write one set of forecasts every six hours to serve the needs of all flights instead of one forecast for each flight? Ten years ago, that was revolutionary. Now it seems very elementary.

With this in mind, let us look at our present day operations.

The forecaster today is much more productive than he was ten years ago. But is he as productive as he should be? The unit cost per forecast has gone down substantially but has it gone down enough?

The forecast today is better than it was 10 years ago. But is the improvement owing mainly to the very large increase in amount of observational data. I feel that the forecast issued 10 years ago was quite good considering the lack of data.

The forecaster today still does most of his own analysis and proggng. In some offices the work is shared between two or more forecasters. The introduction of Ozalid reproduction of maps has done much to cut down on the duplication of chart work. The sharing of work and the use of Ozalid reproduction have increased production substantially but these improvements are far from being enough.

We are still drawing too many charts. The forecaster at the DAFO spends so much of his time on detailed analysis and proggng, he has very little time left for actual forecasting.

Everytime a new weather requirement arises, there is a need for additional staff. Every time the meteorologist staff is increased, there is a need for more plotting staff. Even when there are two offices on the same airport, duplicate maps may be plotted and drawn. The point is, there is far too much duplication.

As I was fortunate enough to become closely associated with meteorology and aviation in 1937, just at the stage when both started to expand rapidly, I am in a position to consider myself as a bit of an old timer. I was among the first few who worked the first graveyard shift when the present 24-hour routine got underway. As I recall, I was the only one awake that night during the winter of 1937-38, out at Stevenson Field in Winnipeg. A year and a half later, I qualified as a meteorologist and started forecasting. In looking back, I can say we did a very good job. As an old timer, I am a bit reluctant to see the old individualistic method of operation die out. It was a simple system. Each forecaster was a complete forecast organization in himself. When he was on duty, he helped with the plotting, often doing it himself, analyzed all the maps and charts, and issued the forecasts. At the time, the demands for forecasts seemed quite heavy. However, compared to the present, the number of enquiries were insignificant. The method of handling was eminently satisfactory. But this method is no longer good enough. Admittedly, it is difficult to change from methods of operation developed and found successful over a period of years. However, we have to change. The demands on the forecaster make it imperative to develop new methods and use them. Although there are a few "die hards", it is still noticeable that many of the more experienced fore-

casters are adopting the new methods and are pressing hardest for further changes. This may be an indication of increased wisdom with age or a weakening of the flesh. Why try to do the whole job alone when assistance is available and more and better service will result?

I feel that the biggest disadvantage of our present method of operation is that there is far too much duplication of effort and that the emphasis in both training and practice is placed almost entirely on what is considered as the scientific aspect of forecasting and too little on the actual weather and weather service. Solve these problems, and we will not only have one of the best weather services in the world - but the best! Meteorology in Canada is making a big contribution to Canada's economy. With some modifications, it can be a tremendous contribution.

In Canada, we operate on what might be called the Single Service principle.

There are a number of systems which might be used to provide meteorological service to meet all requirements, civil and military. In principle, these systems fall into two categories:⁽²⁾

The first is the Single Service System. Under this system, the state meteorological service is responsible for providing weather service to all consumers, civil and military. This system allows for a maximum of economy and ensures centralization where centralization is desired. It allows the best of the meteorologists in the country to be posted to those positions where they can be of greatest service. It also ensures that the shortage of trained meteorologists, which is almost inevitable in the event of war, hot or cold, will be offset by a centralized and co-ordinated training program and that in the interim, until new men are available, the existing staff will be distributed to those points that require greatest service.

The other system may be called the Multiple Service System. This system consists of the setting up of separate meteorological organizations to serve specialized groups. This has the advantage of providing each group with a specialized meteorological organization, but is very wasteful of the available meteorological talent.

During wartime, the multiple service system has many advantages. The organization attached to each military unit is designed and trained to meet the specialized requirements of the unit. This to some extent justifies the duplication of service involved. However, in combined operations, this system is at a disadvantage in determining the question of responsibility. This is an inherent difficulty in the multiple service system as each service is likely to consider itself in the best position to provide the best information.

In the United States, the multiple service system is perhaps a necessity. The immensity of its population and its military organizations, its airlines and its industries are such as to make it almost inconceivable to consider the possibility of one organization handling all the requirements. Perhaps, it could be done but the administrative problems would be almost insuperable.

In Canada, we have a large country but a small population. We also have a large variety of activities requiring weather services. If each of these groups were to employ its own meteorologists and ancillary staff, provide its own facilities and communications, etc., the number of personnel employed in meteorology would have to be increased tremendously or the quality and quantity of services would be decreased. It is quite likely that both events would occur. Although we have had very limited experience in Canada with independent meteorologists, and none with separate groups of meteorologists, I still believe that the Single Service System is the only answer.

In line with this policy, meteorologists are seconded to other government departments and the military forces. Generally, these personnel come under the jurisdiction of the agency to which ^{they are} assigned insofar as administration is concerned. But technical jurisdiction rests with the Meteorological Division.

Thus any agency obtaining the services of a meteorologist has first priority on his time and effort. And in addition, they have the advantage that the meteorologist is backed by the entire Meteorological Division organization. The Division is committed to giving the meteorologist every assistance in carrying out his duties. The meteorologist remains a member of the team. If he is not suitable for the particular job, he is replaced. A company would not necessarily be in a position to know whether the man is suitable or not. When the man has completed the task to which he has been assigned, he is withdrawn and absorbed into the organization. The company or agency need have no hesitation in cutting off the services when no longer required as the man is not thrown out of work or hurt in any way. The Meteorologist's outlook does not become stereotyped as he has all the advantages of constant contact with his fellow meteorologists in the organization and is free to apply for promotional competitions or change in positions should this be considered desirable.

The most important principle of the Single Service System is centralized technical control. Without this the most valuable characteristics of the Single Service System, i.e. concentration, flexibility and economy, would be lost. During the past few years, there has been a tendency to form "small packets" and even actual dismemberment of the Meteorological Division.

Although these actions have been motivated by efficiency of administration, the results are sometimes a bit disconcerting. It is very difficult in some cases to decide whether the matter in hand is to be considered as technical or administrative. Friction results. This is unfortunate as the Meteorological Division has a big job to do and it should be done as economically as possible. This can only be accomplished by a healthy, sound and whole Weather Service of Canada. When speaking to the Royal Meteorological Society, Sir Robert could refer to himself as a lesser bureaucrat in the past tense. If I continue on this subject much further, I too may end up as a lesser bureaucrat in the past tense. However, in justification of not pursuing this point further, I would like to say that the problems referred to are primarily administrative and, therefore, only hinder and do not prevent the application of the Single Service principle.

Next in importance to centralized technical control is the principle of co-ordination. It appears to have become my pet topic. Co-ordination is the central theme of MANAIR. Although many rules and regulations have been laid down to achieve co-ordination of effort, it should be realized that co-ordination is essentially a basic principle, or a philosophy if you like, which should be adopted and practised to ensure that the best possible service is always provided with a minimum of effort. Co-ordination is just another word for teamwork. Every person and every office has been assigned definite duties and responsibilities. Some may be more difficult than others to carry out, but they are all important. It is only by each person doing the job he has been assigned with the assistance of others and by assisting others where required, that a first-class weather service will always be provided.

Co-ordination is essential to the Single Service System. Under a multiple service system, it is quite in order to put in two or even more major forecast offices serving different agencies in the same area, city or even on the same airport. This is definitely contrary to the Single Service principle.

According to MANAIR, the whole of Canada is divided into Areas. Each Area has a principal forecast office responsible for all the weather services in the Area. Then depending on requirements, there may be several Aviation Forecast Offices which serve as outlets.

At present, the District Aviation Forecast Office is the nerve centre and co-ordinator within the Area. It co-ordinates with the other District Aviation Forecast Offices in producing the best possible analyses, prognoses, and weather forecasts. These are then passed on to the Aviation Forecast Offices which serve as outlets of weather services designed to meet the specialized requirements of the user.

By means of the Ozalid reproduction of weather maps, exchange of forecasts and coded analyses, and long distance telephone conferences, a high degree of co-ordination has been achieved. Duplication of effort has been cut down and consistency in the forecasts issued by the same and adjacent offices has improved considerably. But we still have a long way to go.

To achieve a complete co-ordination of effort, we will have to make basic changes. These have already been planned and considerable progress has been made towards implementation of the plans. Admittedly, progress has been slow and sometimes a bit frustrating. However, evolution is always slow and we have to be patient.

The three major physical steps to be taken are the establishment of the Central Analysis Office, the introduction of National Facsimile transmission of weather maps and Shift Supervisors in each major forecast office. Progress has been made in all three.

The establishment of the Central Analysis Office is probably the most important step. Unfortunately, its birth pains have been unduly protracted. It was to have been based at Ottawa but now it is being moved to Montreal. As a result, the original nucleus of able men has been broken up. However, where the Central Analysis Office has lost, agriculture and forestry have gained. Although the Central Analysis Office has lost very valuable men before it has even got started, the blow is certainly not fatal. I feel that we have in Canada a group of the best trained and capable meteorologists to be found anywhere. The success of the Central Analysis Office is not, therefore, in doubt. The problem is to get the Central Analysis Office operational as soon as possible.

The Central Analysis Office is a natural development of the Single Service principle. however, it is not exclusively a characteristic of this system. Witness the WBAN Center in the United States which is operated jointly by the Weather Bureau, and the military services and whose product is used not only by these agencies but by many others such as the airline companies. However, the Central Analysis Office is of particular importance to the Single Service System as it is the natural and normal development of the basic philosophy of the system.

The purpose of the Central Analysis Office is to make available to all forecast offices on a routine basis, the best current and prognostic weather maps and charts, thereby cutting duplication of effort to an absolute minimum and enabling forecasters to direct their full attention to preparing the detailed weather forecasts and applying these to practical problems.

Although it is difficult to try to visualize the Weather Service of Canada as it will be several years hence, I have no doubt that there will be substantial changes. As I see it, the Central Analysis Office will issue nearly all the basic weather maps and charts required. After some opposition, the forecast personnel in the field will learn to respect and rely on the Central Analysis Office. Although an individual will be able to beat the Central Analysis Office on the exact forecast position of a particular front on a particular occasion, it will be found that the Central Analysis Office will score consistently higher than any individual or the average forecast office can hope to. It will be found that it is safer to accept the Central Analysis Office "progs" than to do one's own. Once this is the case, the forecasters will have time to think. The fetish of having to do one's own analysis and progging will go by the board.

Plotting and analysis in the field will not disappear, but will decrease substantially. I feel sure that in the future, local area maps will be required and will be prepared, mainly for aviation and similar purposes where detailed forecasting will be required. However, the amount of work involved will be quite small compared to the present heavy map programs.

The Central Analysis Office will deal with the weather developments on an hemispherical scale and will pass on to the field the expected large scale features of synoptic developments and general weather.

The District Offices will then interpret the information in terms of expected weather over their areas of responsibility. The Aviation Forecast Offices, Dependent Forecast Offices and the shop fronts of the District Aviation Forecast Offices and Dominion Public Weather Offices will then interpret the weather for the consumer. The whole setup will be one large mass production and merchandizing organization. And the quality of the product should improve. Why?

First, because the Central Analysis Office will be able to come up with consistently better forecast maps than we are able to produce today. This will not be owing to the fact that the meteorologists at the Central Analysis Office will be any smarter than the meteorologists are to-day, but merely owing to the fact that they will be able to direct their full attention to this task and will have a large enough staff to handle the job. They won't have to brief pilots or answer telephone calls. Their task will be to produce the best possible analyses and prognoses.

Second, the forecaster, having the best possible current and prognostic charts available, will be free to specialize on the actual weather. The latter is a field that I feel has, to some extent, been

neglected, perhaps, because wind and snow, cloud and rain, cannot be easily glamourized into beautiful mathematical equations. I feel that there has been a tendency to consider weather as of secondary importance to the weather map.

When forecasters have more time to think about the weather, a great interest will develop in this field and a great deal more work will be done on correlating weather with the surface and upper air charts. The recent increase in the number and quality of Local Forecast Studies in Canada is an indication of the increased attention to these matters. Although such studies as recently published of work done at Vancouver on the flow of Polar Air into British Columbia and at Moncton on the effects of the Bore of the Petitcodiac on fog are certainly not world shaking nor particularly profound, I feel that they are extremely important to good forecasting, I also feel that these papers are just the forerunners of a deluge of this type of paper which will improve in quality and importance during the next few years and will contribute immensely to the improvement of weather services. The correlation of weather with surface and upper air maps and the studies of local weather are most important and will become increasingly so as the C.A.O. product is made available to the forecasters in the field.

Third, the forecaster will have more time for the consumer. As he gains better knowledge of the consumer's operations and his needs, he will be in a better position to serve him.

In the above, I have not mentioned such things as five-day forecasts and other products of the C.A.O. This is not owing to the fact that I do not think they are important. On the contrary, they will be very important. But the time allotted to me for this address does not enable me to deal with all facets of these new developments.

The establishment of the Central Analysis Office is only step one. Step two is to obtain a National Facsimile Circuit. Without facsimile, the output of the Central Analysis Office will be limited as coded analyses will have to be used and transmitted over already heavily loaded communication facilities. Coded analyses are certainly a poor substitute for the actual chart. The full value of the Central Analysis Office will not be realized until facsimile distribution of weather maps and charts is also a reality.

We already have facsimile in Canada. We have a link between Greenwood and Halifax, a radio link between Goose and Frobisher and a network consisting of several drops at Air Defence Command stations in eastern Canada. It is quite likely that the initial national network will be strictly for military purposes. Ultimately, it is hoped that the national network will be adopted for all civil as well as military purposes.

Last November, Mr. Merewether gave us a very complete and optimistic picture of the value of facsimile in airline operations. I have great hopes for the future of the Weather Service of Canada when we have both Central Analysis Office and Fax.

The implementation of these plans will not, in any way, decrease the importance of any other forecast office.

The Central Analysis Office will be the forecaster's forecast office. It will be a source of information and assistance and will exercise no control over the forecast organization but I hope will have a tremendous impact, nevertheless. The role of the District Aviation Forecast Office and Dominion Public Weather Office will remain the same, and if anything will increase in importance as the scope of weather services is broadened and increased. The problem of inter-district and intra-district co-ordination will become increasingly important. With this in mind, the Meteorological Division has planned for and will soon implement Shift Supervisor positions. This is the third step.

The Shift Supervisors might have been designated "Co-ordinators", because co-ordination will be their main responsibility. It will be their responsibility to co-ordinate with other District offices, co-ordinate the efforts of all personnel within their own offices and co-ordinate with all the outlets and consumers within the Areas. The Shift Supervisors will have a very important role to play.

The above changes will have a tremendous impact on the methods of providing weather service and necessitate a tremendous change in the training of meteorologists and on what might be called the meteorologist's psychology.

I feel that the training of meteorologists, both MA and BA types, should be reviewed in the light of pending changes. I have no specific suggestions to offer right now. However, it must be obvious that either meteorologists will have to be selected on their salesmanship ability or will have to be given training in this function. Meteorologists will also have to be trained to use maps prepared by the Central Analysis Office rather than relying on doing the analysis and prognosis themselves. I feel that all meteorologists will still have to have a solid grounding in theoretical meteorology and related subjects, but particular attention will have to be given to the practical application of preparing forecasts from processed data instead of the raw data. Being a bit of an old timer, I have to agree that this is going to be a bit hard to take. But experience has shown that it can be done and the increased demands will make it imperative that it be done. Fortunately, the changeover is not being made overnight. Those forecast personnel now using facsimilized maps found it a bit difficult at first but with every day's experience are finding that this method of operation makes very good sense. Other offices will be able to capitalize on this

experience as the facsimile circuits are extended. The training of meteorologists should take cognizance of this method of operation as soon as possible.

Similarly, the need for salesmanship training should be given immediate attention. Salesmanship cannot be learned from a few lectures. This too requires a great deal of practice as many new meteorologists find to their chagrin when called upon to do their first real briefings. Salesmanship should not be left up to the individual to learn by trial and error after he arrives at the forecast office. The presentation of weather information to the pilot, to the public, and to the industrialist requires correct techniques. A good presentation of the information available from the forecast and basic data promotes intelligent allowance for the limitations of meteorological science, and enables the consumer to make the most intelligent use of the information in his operations.

In some way training in use of processed data and salesmanship will have to be included in the training courses even if this necessitates increasing their duration. Training programs will have to broaden their scope to give the meteorologist also a wider knowledge of the organization of the Weather Service of Canada, his responsibilities as a member of it and knowledge of the operations and weather needs of all types of consumers.

Most important of all to the success of the new methods of operation will be the wholehearted co-operation of all forecast personnel. This will necessitate changes in the forecaster's thinking. The first effect of the Central Analysis Office and Facsimile will be a need for the forecaster to change his approach to his work and the success of these new facilities will depend upon the receptivity of the meteorologists to the new approach and ideas. All meteorologists should condition themselves now to these new developments. There will be a great need to work out fresh solutions for the completely new set of organizational and operating problems as they arise.

These new developments necessitated by the changing times and so carefully thought out by the Meteorological Division administration, will need imagination and willingness to experiment with new patterns of organization, communications and procedures.

It would be rather difficult and time does not permit going into detail in this matter. Suffice it to say, that all meteorologists in Canada should be thinking about these pending changes and preparing themselves mentally, and one might almost say spiritually, for them. Only by a thorough understanding of the organization, the plans, the requirements and the potentialities of the new methods, can the meteorologist do his fair share in making the new methods the success it is hoped they will be. The need is

for imagination, adaptability and breadth of vision. The meteorologists in Canada have the intelligence, the training and the experience necessary to meet this challenge. I have great expectations of the future of the Weather Service of Canada.

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