The Field for Weather Forecasting in Forest Protection.

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The potential value of forecasting, as applied to weather conditions that are especially dangerous from the point of view of forest fires, is admitted on all hands. Such knowledge would be important in one way or another to everyone concerned with the business of forest protection. An inspector, for instance, charged with the supervision of settlers' "abatis" fires, might find both his own and the settlers' tasks enormously lightened if he possessed information regarding the weather for 48 hours ahead on which he could rely. And all protective routine - disposal of smoke-chasers, supply of labour and transport, handling of travellers and sportsmen, and so forth - would be simplified in a corresponding manner. Foremen, again, in charge of gangs working in the woods might well be able to avoid some risks if they were provided with forecasts and trained to make intelligent use of their own observations. (This would be particularly true in the case of work that was hazardous in itself, such as the burning of debris on a right-of-way.) Indeed even a government might find its hands considerably strengthened in this way for dealing with such questions as the closing of forested districts to travel during dangerous weather, particularly if the forecast which it possessed applied to a fairly long period ahead and at the same time commanded the confidence of the citizens at large.

It is therefore well worth while on several counts to try to obtain the highest possible efficiency in fire-weather forecasting; and an attempt will be made in the following notes to analyze our requirements and the field which they open up for the development of this work. (It may be remarked that the arguments used will refer in the main to conditions as they exist in the Province of Quebec).

The ideal to be arrived at in this matter is easy to define, for a fire inspector cannot be given too much or too accurate information regarding the weather conditions that are liable to affect his hazards. But the method of approaching this ideal does not admit of any such offhand statement, for our experience is still very limited and the whole of the work is still practically in its infancy. However, the considerations which follow may be of some value as suggesting the lines along which it seems likely that a solution should be looked for.

There is no question, in the first place, but that the foundation of the whole business is the normal process of general weather forecasting that is conducted by the Dominion Meteorological Service. This Service receives telegraphic weather reports twice a day from more than two hundred observing stations scattered across the northern hemisphere from the Pacific Ocean to the Ural Mountains, and this data, when plotted on special maps, gives a picture of the general state of atmospheric pressure, temperature, wind, and precipitation from which the experts are able to draw up the ordinary weather forecasts with which everyone is familiar in the daily press. There is thus no difference between the requirements of the forest-protective organizations and those of agriculturists, airmen, sailors, or ordinary citizens in general, and the existing machinery may so far at least be considered to be fulfilling our needs.

But it will readily be understood that facts shown by the "weather-map" are of a very general character, as the areas of high and low pressure may measure many hundreds of miles across, and the observing stations are sometimes very widely separated from one another, especially in the less populous regions. And as a consequence the forecasts themselves are in correspondingly general terms and apply to areas that are of very considerable extent - in the east of Canada for instance the areas that are generally distinguished for this purpose are the Ottawa Valley, Upper St. Lawrence, Lower St. Lawrence, Gulf and Maritime Provinces. This state of affairs is unavoidable in view of the nature of the work and of the conditions under which it has to be carried on; and though an increase in the number of the observing stations that report by telegram or radio, particularly in the far north and around Hudson's Bay, would be of great assistance to the forecasting staff, as the reliability of a forecast depends very much on the amount and accuracy of the information that is available, it is still probable that these forecasts would always continue to be of a somewhat general character. And as the ideal for forest protection purposes undoubtedly demands definite and well localized warnings, the next point to consider is whether the ordinary weather forecasts can be particularized in any way so as to correspond with the individual conditions met with by the protective organizations in the smaller units of area in which they operate.

In an article entitled "Intensive Studies of Local Conditions as an Aid to Forecasting Fire Weather" (Monthly Weather Review, November, 1923), Mr. G.W. Alexander of the U.S. Weather Bureau, puts the matter in a nutshell by stating that for the localization of a forecast "it is necessary that conditions in the actual area under consideration be known, and that by previous study such conditions be correlated with the effects of the general

distribution of the elements that control the weather". Since the date of this article the U.S. Weather Bureau has taken the matter up vigorously, and it is therefore worth while to see whether its experience could be made applicable to the situation in Eastern Canada.

The method adopted by the U.S. Weather Bureau has been to take trained forecasters from its staff and detail them solely to fire-weather duties in certain localities. There are now six such officers established respectively at Boston, (Mass.), Duluth, (Minn.), Spokane, (Wash.), Boise, (Idaho), Seattle, (Wash.) and Portland (Ore.). The author recently had an opportunity of studying the procedure followed in Oregon, and found that the fire-weather officer there based his forecasts on the data supplied by the daily weather-map (evening issue) supplemented by standard weather reports (embodying also air-humidity readings) from twelve stations distributed over Oregon, Washington, Idaho, and British Columbia, and special reports sent in once or twice daily during dangerous weather from eighteen "key" stations in Oregon. He made up seven different forecasts for the seven different districts into which he had divided the State on a basis of its topography, prevailing winds, and other special local conditions, and he intended to increase this number shortly by further subdivision. In addition to actual forecasting he also occupies a large part of his time in research and statistical work, (for which he receives other reports of various kinds), and in field work with the protective organizations, to which further allusion will be made later on.

Now on the face of it it would appear as if this system were a good one that could be copied with advantage for use in almost any locality. It might be argued that a meteorologist could well be installed at Quebec, Fredericton, or Halifax to interpret and expound the general weather forecasts in the light of such local experience as he was able to acquire through research and observations of all sorts carried out in the forests with which he was personally concerned. This is in fact the first conclusion which naturally suggests itself to one who observes the working of the system in the Pacific States. But there are several considerations nevertheless which forbid its hasty acceptance, and make it doubtful whether an opening for localized fire-weather forecasting of exactly this kind really exists or not.

In the first place there is the question of expense. The maintenance of a weather office, counting the necessary personnel and the cost of receiving the large number of telegrams required for constructing a weather-map, is a costly undertaking, and it is obvious that to duplicate the process of making ordinary general forecasts, that is already being carried on for the whole Dominion

at Toronto, would be purposeless. The duplication of the staff would also entail a risk of contradictions occurring between the forecasts issued by the different offices; and there is no reason to suppose that in this event the general forecast made by a new man under strange conditions would be as reliable as that of the experts long established at headquarters. These drawbacks do not affect the western American forecasters, as the branch offices of the Weather Bureau to which they are attached are regularly in receipt of weather-map data and are authorized to issue general forecasts for their districts in any case. A further, though perhaps minor, difficulty is created by the fact that an eastern forecaster using the evening weather-map data would be forced to do his work during the night, while the same data reach the Pacific Coast by five o'clock p.m., as the whole of the service is co-ordinated on eastern time. Finally, it is necessary to bear in mind that Oregon is widely different from Quebec in its topography, seeing that the Coast Range, the Cascade Range, and the Rocky Mountains, with the intervening lowlands, make for great changes in elevation within short distances. Such sharp variations undoubtedly cause marked alterations in weather, and it is possible that where they do not exist localized forecasting in detail may be so much more difficult as not to be worth attempting. (This same argument however also implies that localized forecasting, if possible at all, is correspondingly more necessary.) A further difference between Quebec and Oregon will also arise through the influence on the former of the St. Lawrence and other large bodies of inland water.

But while these considerations may indicate that the western American system cannot be applied offhand and without modification, we are left with the unfortunate facts that the general forecasts do fail in some cases to give details to the extent that the protective organizations require, and that it is clearly impossible to expect the staff of a central office, who are prevented by the conditions of their work from paying more than a flying visit to the protective organizations from year to year, either to obtain the kind of specialized local knowledge which the fire-weather forecasters in Oregon and Washington possess or to fulfil the important function of educating the men in the field, the necessity for which will be alluded to below. It would therefore appear desirable to consider alternative methods whereby the advantages resulting from the existence of a local fire-weather expert could be secured without incurring the drawbacks and difficulties to which allusion has just been made. It might, for instance, be found possible for the central bureau to transmit the relevant features of the day's weather-map together with the general forecast based on it to a local expert by means of a special telegraphic code, and avoid in that way both the duplication

of staffs and the danger of contradictions in the basic forecasts made. In fact some compromise arrangement of this sort should certainly be tried out if the system of the U.S. Weather Bureau is found unsuitable for adoption as it stands. It is to be hoped that a good deal more light may be obtained on this question shortly, as a result of the work that is now being done in collaboration with the Meteorological Service.

There is however another aspect of weather forecasting for which a wide field undoubtedly lies open immediately and that is the very local work that falls to be done by each inspector in his own district and on the basis of his own personal observations. There is no question but that a person who is properly instructed and who is supplied with a more or less detailed forecast on which to base his deductions, can do very valuable work with a barometer and a recording hygrograph in connection with the weather probabilities of his own immediate neighbourhood. In fact such work must necessarily be considered as the concern of the man on the spot, as it affects him closely in connection with fire-fighting, slash-burning, and so forth, while an expert at a more central point, even though he were fully familiar with local conditions, could not be expected to advise on the probabilities for every parish. The importance of this kind of work is recognized very clearly in the West, and the instruction of the forest personnel in intelligent observation and deduction is an important part of the fire-weather experts' duties.

This does not imply, however, that a fire-inspector with a pocket aneroid can do good work entirely on his own, or indeed that he can ever hope to do it, for a forecast, the more detailed the better, is absolutely necessary to provide him with the proper setting for his own observations. And while a really detailed local forecast will probably not be available unless the difficulties mentioned above as attaching to decentralized forecasting work can be overcome, the forecasts that are now being sent out from Toronto to the protective organizations are certainly detailed enough to make it well worth while for all those concerned to occupy themselves with interpreting them in accordance with their experience of conditions in their own localities. It is just the records of success and failure in such attempts that will supply the information required for the organization of a service on the most efficient and economical lines.

A further field for fire-weather work is also undoubtedly opened up by the question of the connection between the inflammability of forest fuels and weather conditions. This question is really the most fundamental of all as weather is ultimately of importance only on account of its effect on the inflamm-

ability of the fuels. Air-humidity being much easier to measure than duff-humidity, we have so far advanced much farther in our study of the former than of the latter; but the relations existing between the two have got to be investigated nevertheless if we are to obtain from the air-humidity observations a true idea of what is going on in the duff. This question would therefore appear to call for research, of a kind that would probably require an expert investigator and proper laboratory equipment.

A final point that may be added here is the statistical examination of such observations and records as have already been made or that will be made in the future. Masses of figures are comparatively easy to collect, but lead nowhere unless they are submitted to careful analysis and statistical treatment; on the other hand if this is done they may well suggest problems that require solution and so open the door to further very valuable work.

And in fact it may truly be said that this last consideration applies with equal force to most of the foregoing discussion. It is as yet too early to attempt to lay down too exactly the field that this work may occupy in forest protection, and the most that can be done at present is to indicate the lines along which its first development should be directed. A truer idea of its scope and limitations can only be formed as further experience is gained.