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Contents

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Precipitable Water Over Canada: II Distribution

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ABSTRACT

The mean monthly distributions of total precipitable water over Canada, based on values computed for 168 locations, are presented and discussed.

Attention is drawn to the existence of such quasi-permanent features as the primary and secondary minima over the Canadian Arctic Archipelago and the Western Cordillera, respectively, and the strong zonal gradient in the precipitable water field over the west coast of Canada. As a consequence of the greater spatial sampling density (relative to that if only upper air data had been used in the calculation of precipitable water) mesoscale features, such as those associated with the influence of large water bodies, are illustrated.

Finally, avenues for the application of the results obtained in this study and areas worthy of further research are reviewed.

1 Introduction

Previous studies of the time averaged distribution of the total depth of precipitable water over Canada fall into two categories. Either the study has been made on a continental or larger scale (e.g., Tuller, 1968) or on a much smaller scale (e.g., Barry and Fogarasi, 1968). All of these have lacked in either spatial coverage or spatial detail.

The methods used in the present study and described in Part I of this paper (Hay, 1970c), enabled the spatial distributions of the mean monthly total atmospheric precipitable water for the whole of Canada to be mapped with considerable detail, since the fields were derived from values for 168 locations rather than the 34 Canadian upper air stations which had been available for earlier studies.

In this paper maps of these distributions for the period, 1957–1964 inclusive, are presented as Figs. 1–12.

2 Mean monthly distributions

a *Quasi-permanent Features*

Three features in the distribution of precipitable water over Canada which persist throughout the year, at least in the time averaged fields, are: the secondary minimum over at least part of the Western Cordillera; the strong zonal gradient over the west coast of Canada; and the primary minimum covering a broad area of the Canadian Arctic Archipelago.

The first of these quasi-permanent features is the result of the influence of the Western Cordillera itself, a large portion of which is above 1500 m and thus, at these latitudes, above the 850-mb surface. The effect of altitude results from two factors: (1) a reduction in the effective depth of the atmosphere through which the water vapour is dispersed; and (2) the influence of the elevated land mass on the dominant zonal atmospheric flow. Though Pacific air is not completely excluded from central and eastern Canada by the Western Cordillera (for example, Bryson (1966) shows that in July Pacific air occurs for approximately 50 per cent of the time as far east as the Saskatchewan-Manitoba border) the air which does cross the windward mountain barriers is generally from higher elevations. This fact along with any loss of moisture due to the orographically enhanced precipitation, also produces the lower values of water vapour content.

The strong zonal gradient over the western coast of Canada is similarly a result of the barrier effect of the Western Cordillera, the gradient on the western flank being strengthened as a result of the prevailing onshore (on-continent) upper air flow across this ocean-mountain boundary. By way of contrast, the distribution over eastern Canada is more complex in that there are seasonal variations in both the intensity and orientation of the gradient. The absence for the entire year of a comparable strong zonal gradient coincident with and parallel to the eastern coastline is in itself significant. This absence may be attributed to the combined effects of: (1) the prevailing flow at all levels being offshore (Bryson (1966) shows only one month (May) when the surface flow over Labrador is predominantly onshore); and (2) the less abrupt nature of the land-ocean transition (both in terms of the complexity of the coastline due to the presence of the Island of Newfoundland, Nova Scotia and the Gulf of St. Lawrence and altitudinally). The result is that, in terms of the scale of this study, modifications induced by the land-ocean transition will be diffused over a large horizontal area downwind from the surface change in an area where the precipitable water distribution has not been mapped in this study. The seasonal changes in the orientation of the isolines over southeastern Canada, with a tendency towards a more zonal orientation between April and July (Figs. 4–7) is almost certainly linked to the summertime strengthening of the moist airflow over the eastern United States.

The distributions also indicate that the core of relatively dry air over the Canadian Arctic Archipelago is best developed in January through March (Figs. 1–3) when the depth of precipitable water over the area is generally less than 0.20 cm; however, even in July (Fig. 7) when values are at their maximum (and at least 2.00 cm in southern Canada), the Canadian Arctic still has depths below 1.60 cm. The low atmospheric temperatures are an obvious reason for this permanent primary minimum, but the absence of significant water vapour fluxes (both in the vertical – from the underlying surface; and in the horizontal – from such source areas as the Pacific Ocean and the Gulf of Mexico) for the greater part of the year is also a significant causal factor.

b *Seasonal Variations*

Another characteristic of the Canadian precipitable water regime is the change from the relatively uniformly dry air over most of the country in winter (the exceptions are the western and southeastern coastal margins) to the considerably moister air with strong horizontal precipitable water gradients in summer.

In the winter months (November through March) the uniformly dry air is a consequence of the Arctic air which dominates almost all the country. Only on the western coast, and to a lesser extent over the Atlantic Provinces, are the moister air streams (Pacific and Tropical maritime) experienced with sufficient frequency to increase the average total water vapour content of the atmosphere in those areas. Where the demarcation between the contrasting air streams is both strong and locationally stable (as is frequently the case with the topographic "tying" of the Arctic front along the Western Cordillera in mid-winter) the horizontal gradient of mean precipitable water is also well developed.

Associated with the northward movement of the Arctic front between April and July (as discussed by Bryson (1966) and Barry (1967)) an increasingly larger portion of Canada comes under the influence of moister Pacific and Tropical air flows while a correspondingly decreasing area is covered by the drier Arctic air. The zone of strong horizontal gradient in precipitable water, which represents the area separating these two moisture regimes, thus moves northwards from its winter position predominantly south of Canada to a summer position over the northern areas of contiguous Canada. For example, in July (Fig. 7), the axis of the strong gradient trends southeastwards from Barrow (Alaska) through Churchill and Normandin to Goose Bay.

From June through October (Figs. 6–10) all of mainland Canada east of 80°W has a strong meridional gradient. This relatively rapid southward increase in the atmospheric water vapour content may be related to the decreasing frequency of Arctic air and to the increasing amount of air with maritime characteristics, while the broad meridional extent of the transition may be associated with a variety of interrelated factors. There is a considerable day-to-day variation in the location of the front which is in any case normally relatively weak as a result of the horizontal diffusing effect produced by perturbations within the frontal system and also as a consequence of the summertime weakening of meridional temperature gradients. Moreover, the moisture contrast is in effect between three air streams: the relatively dry Arctic air in the north; the intervening Pacific air which has undergone considerable modification during its transcontinental trajectory; and the moisture laden Tropical maritime air in the south, which has had a relatively recent oceanic history and short land trajectory.

Between May (Fig. 5) and September (Fig. 9) the similarity in precipitable water values between the southwest coast and locations in southern Canada east of the Rocky Mountains indicates the significance of the last-mentioned air stream in supplying moisture to the Canadian atmosphere in the summer half of the year. Indeed, in July (Fig. 7), values as high as those over the western coastline (2.00 cm) are found as far north as Fort Good Hope (almost on the Arctic Circle), though in this case the influx of moisture into the Mackenzie Valley to achieve this high value cannot be attributed solely to the horizontal flux of water vapour associated with the Tropical maritime air.

c *Mesoscale Features*

One consequence of the methods used in the present study to compute this precipitable water field is the possibility of detecting features in this field which normally would not be indicated with sufficient detail if the study were based solely on upper air data. Hence, not only is the influence of the Western Cordillera on the field shown in greater detail than has previously been possible, but the influences of large water bodies (notably the Great Lakes, Hudson and James Bays and the Gulf of St. Lawrence) are also demonstrated.

In June through August (Figs. 6–8) the influence of the relatively cool water surface of the Great Lakes may be seen in a depression of precipitable water values in the vicinity. On the other hand the northward inflexion of the 0.60 cm isoline in the same area in November (Fig. 11) may be attributed to the relatively warm lake acting as a significant energy and water vapour source. Similar factors are apparently operating in the areas of Hudson and James Bays and the Gulf of St. Lawrence from August to at least October.

3 Application of results

This study was primarily intended to provide information required in a study of Canada's radiation climate. To this end the analyses described in Part I were performed and monthly mean values of precipitable water (with and without a pressure correction) were calculated for 165 selected locations (see Fig. 1, Part I).

In the case of the pressure corrected precipitable water, a linear pressure correction, adapted on the basis of a study by McDonald (1960), was applied in the regular way during the analysis of the upper air data. A new set of regression coefficients expressing the relationship between the total depth of pressure corrected precipitable water and screen-height vapour pressure was calculated for the 62 upper air stations. In this way it was possible to determine both of the required values of precipitable water at all 165 locations for subsequent use in the radiation study. The results of the radiation climatology study have been discussed briefly by Hay (1970b), but are described in detail by Hay (1970a).

Another application, not yet attempted, is to undertake an investigation similar to that of Bruce (1964) who studied the correlation between total precipitable water and precipitation. A spatial analysis of this association on the scale made possible by the methods described in this study could lead to a designation of areas where atmospheric precipitation-producing mechanisms are operating most effectively.

The strength of the relationship between surface vapour pressure and the total atmospheric water vapour content suggests two other lines for research. Both the temporal and spatial (horizontal and vertical) variations in the correlation and regression coefficients deserve further study. Obviously the strong correlations found in the present study are a consequence of the concentration of water vapour in the lower layers of the atmosphere. How the strength of the relationship varies both with the atmospheric depth over which the precipitable water is integrated and with the length of time over which averages are computed are two points which must be considered before any further application of the method to atmospheric studies (e.g., radiation and water vapour flux calculations) is contemplated. The extent of the spatial variations in the coefficients of determination and standard errors derived in this study (see Table 1, Part I) suggest that further study *is* warranted. In Part I (Hay, 1970c) some tentative explanations for the spatial variations in the regression coefficients were advanced. The suggested interrelationships between these variations and aspects of the dynamical and physical climatologies of Canada are again an indication that further investigation is necessary in order to fully evaluate the method used here.

4 Summary and conclusions

On the basis of the computations described in Part I of this paper it has been possible to present in this part, maps of the mean monthly distributions of total atmospheric precipitable water over Canada for the period 1957–1964. The distributions reflect the influence of both topography and the characteristics of the atmospheric circulation, these factors operating on a variety of time and space scales.

Acknowledgements

Grateful thanks are due to Miss M. Horner who typed the final draft of Part II of this paper.

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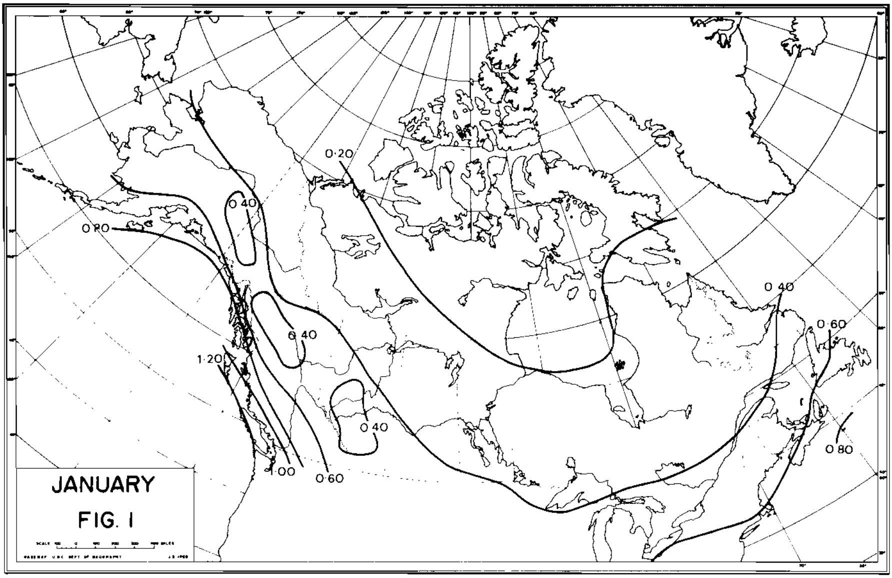
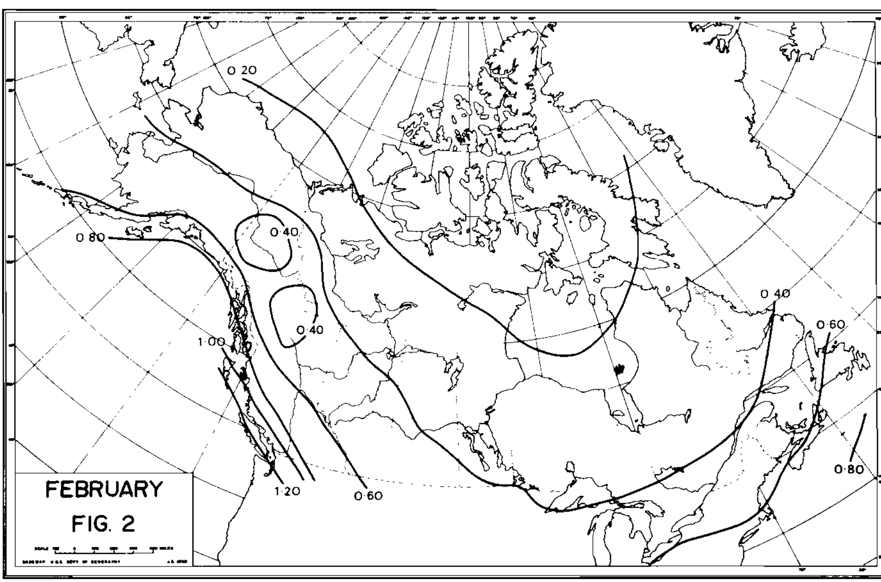
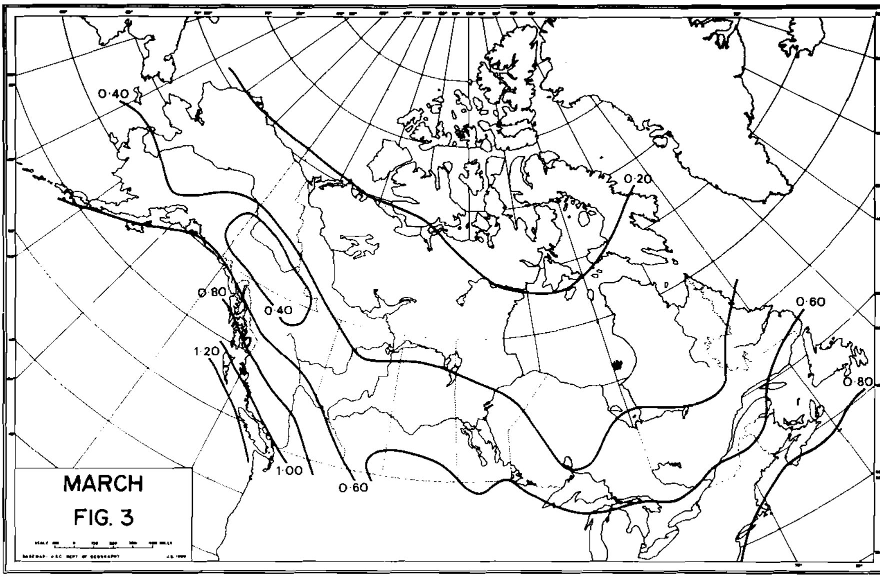


Distribution of mean monthly precipitable water (cm) for Canada and Alaska.





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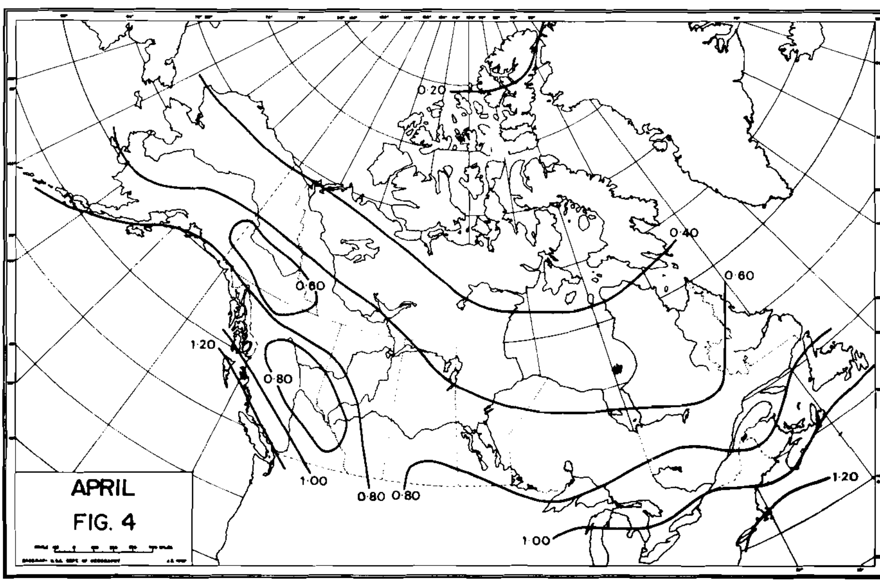

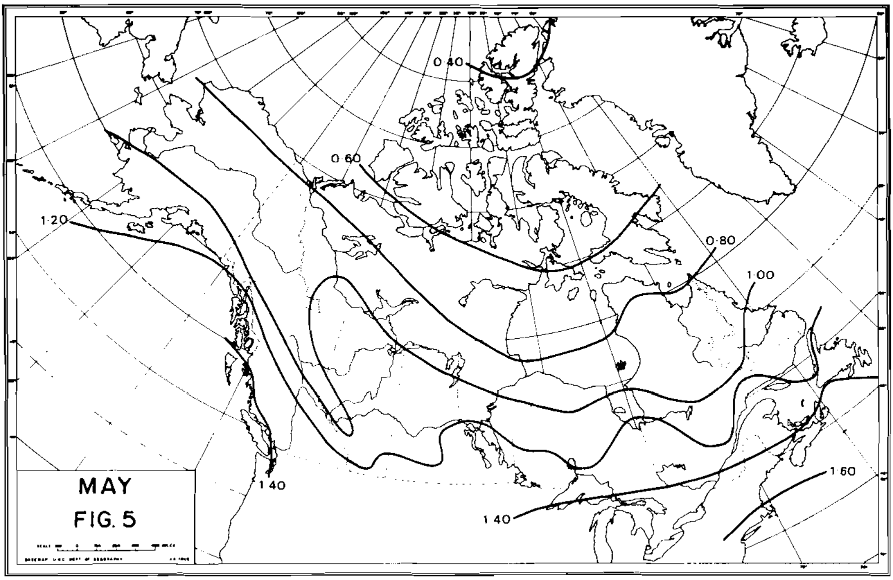

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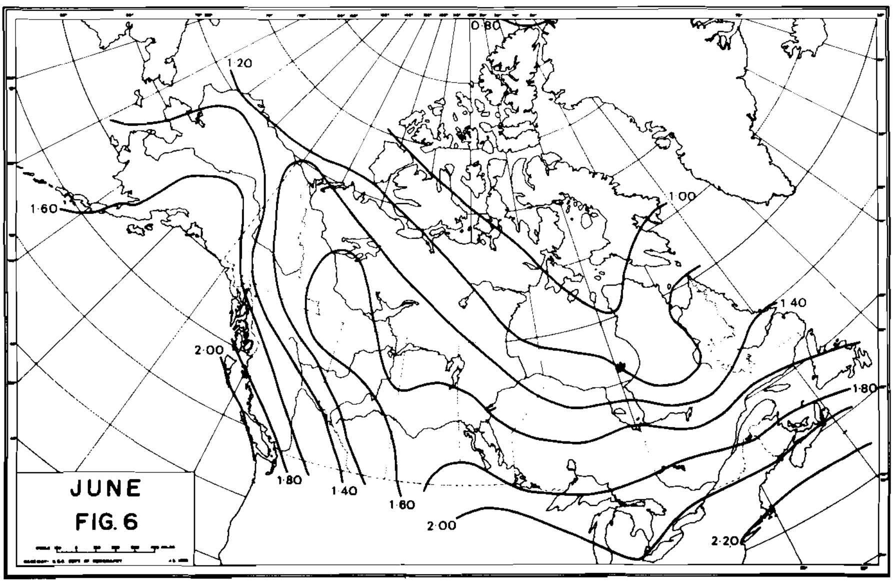

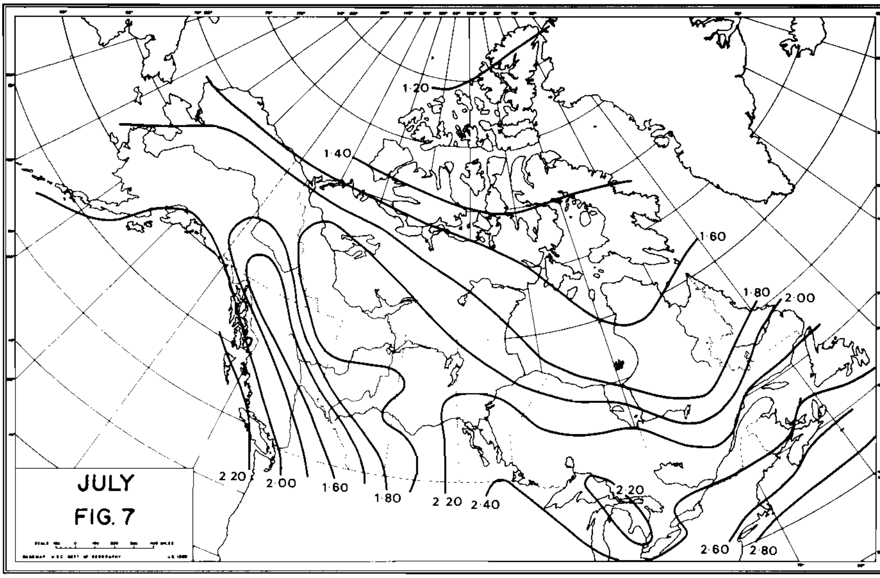

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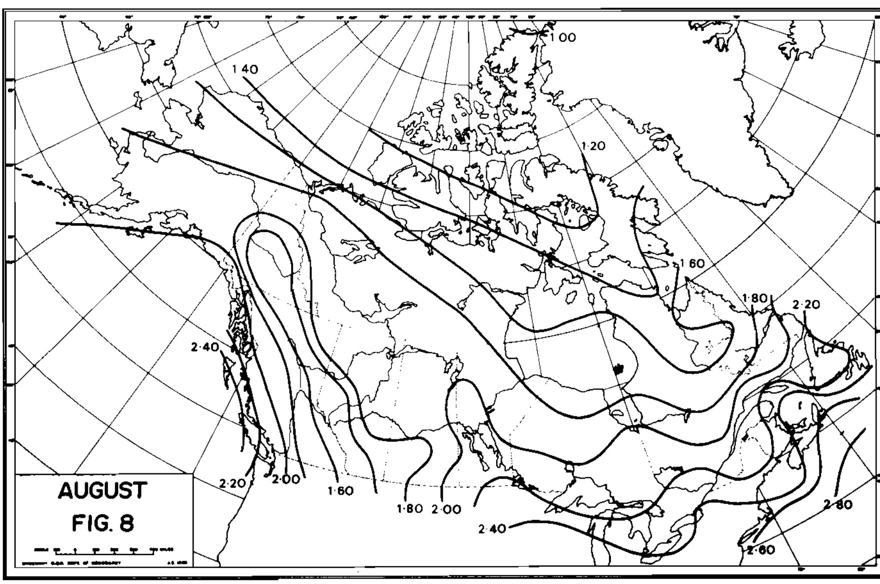

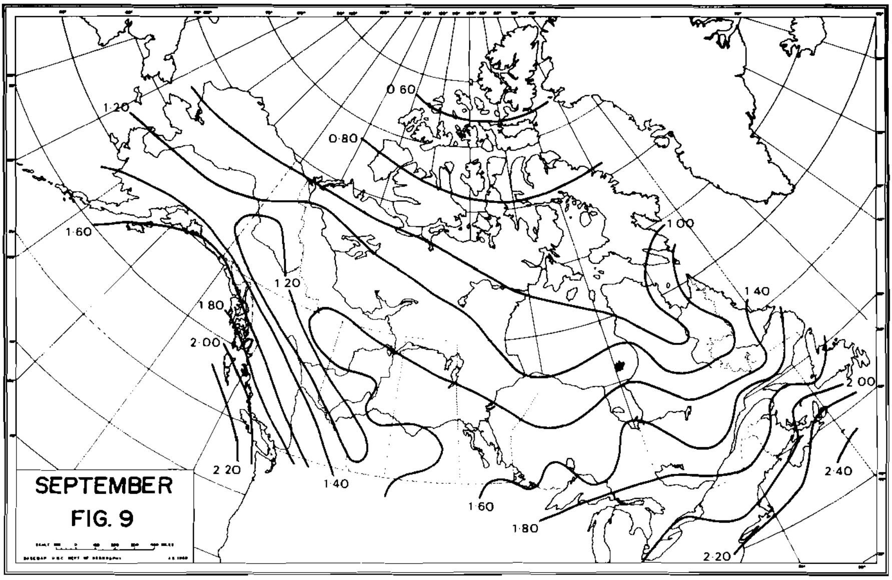

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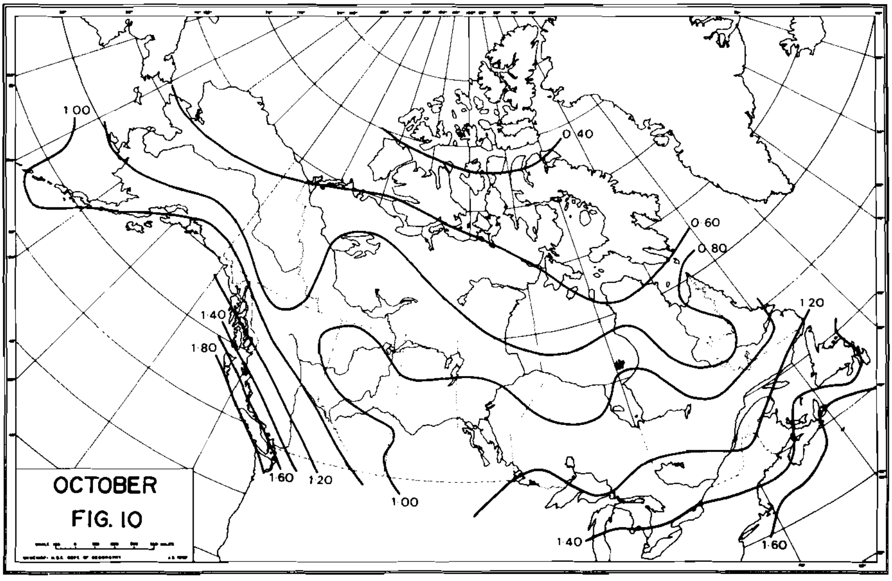

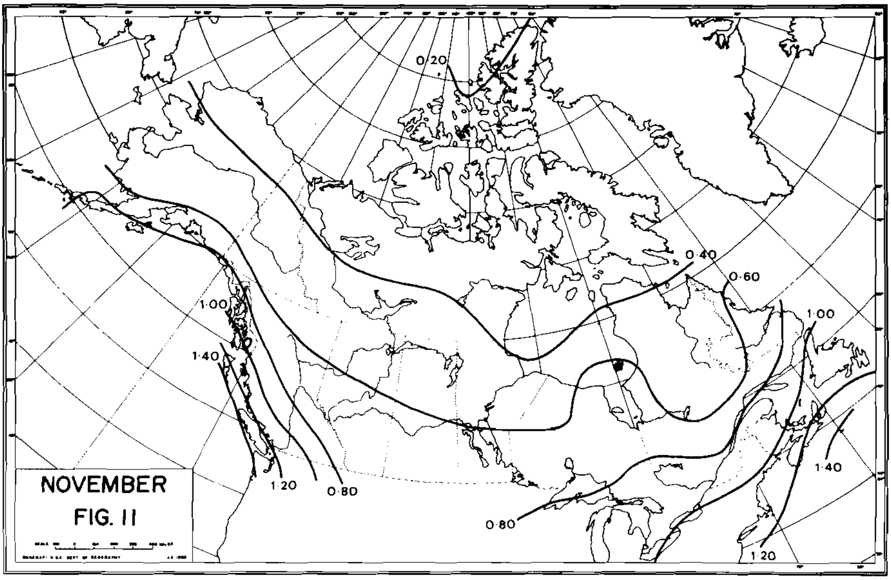

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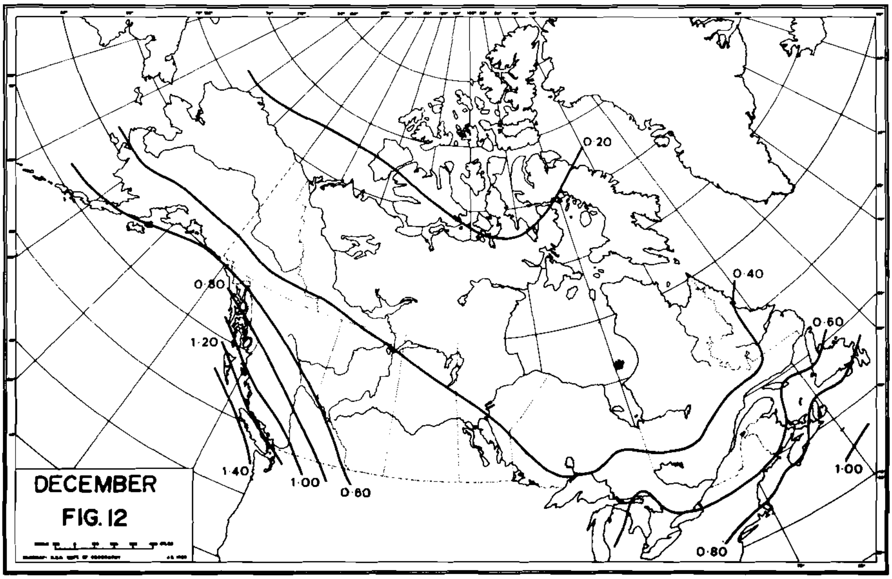

Chaleur Urbaine à Montréal

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[Manuscrit reçu le 2 June 1971]

SOMMAIRE

Par des sondages de température effectués en hélicoptère à 12 sites de l'île de Montréal, on a pu mesurer la chaleur générée par la ville en 37 jours assez bien distribués à travers l'année. Cette chaleur fut mise en relation avec deux fonctions exprimant l'intensité du chauffage, la première, selon le nombre de degrés sous 65°F de l'air ambiant, et la seconde fonction, selon la même variable multipliée par la vitesse du vent. Une relation linéaire fut établie dans l'un et l'autre cas entre la chaleur urbaine et l'intensité du chauffage, mais avec une dispersion minimale dans le second cas. Un calcul à partir de la meilleure droite de régression permet de déterminer la chaleur totale générée par la ville dans une année, soit 40.2×10^{16} calories-gramme. Cette quantité de chaleur est de beaucoup supérieure à la chaleur artificielle générée par les combustions, soit 8.40×10^{16} calories. On en conclut que la chaleur urbaine ne peut être expliquée sans faire appel au rayonnement solaire.

1 Introduction

L'île de chaleur urbaine peut se définir comme la zone tridimensionnelle dans laquelle l'atmosphère, à altitude égale, est plus chaude que l'atmosphère rurale environnante. Ce phénomène a été observé et mesuré en plusieurs villes de différentes dimensions. On peut résumer ces observations de la façon suivante : 1) la chaleur urbaine se manifeste surtout par les nuits de ciel clair et de vents légers; 2) le phénomène est surtout évident sur les écarts des températures minimales entre la ville et la campagne; moins, sur les températures maximales; 3) le phénomène est plus marqué en été qu'en hiver.

Les théories expliquant la formation de l'île de chaleur urbaine avancées jusqu'ici par différents auteurs, ont tenté de répondre à la fois à deux questions qui nous semblent très distinctes, à savoir : 1) d'où vient la chaleur urbaine ? et 2) par quels processus physiques cette chaleur est-elle transmise à l'atmosphère ? Pour répondre à la première question qui concerne l'origine de la chaleur urbaine on peut faire appel soit au rayonnement solaire seul, soit à la chaleur artificielle générée par les combustions de toutes sortes, ou soit à l'une et à l'autre source à la fois. Quant aux processus physiques réglant la transmission à l'atmosphère de la chaleur, solaire ou artificielle, il faut faire appel à l'un ou à

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plusieurs des régulateurs de température suivants : la capacité thermique plus élevée et l'albédo moins élevée des matériaux urbains; la rugosité plus grande qu'offrent au flot atmosphérique les structures urbaines; enfin, la présence des polluants atmosphériques qui peuvent réduire l'entrée du rayonnement solaire ou diminuer les pertes du rayonnement terrestre.

Le présent article s'intéresse à la première des deux questions évoquées qui concerne l'origine de la chaleur urbaine : est-elle principalement d'origine solaire ou artificielle ? La méthode consistera à comparer la chaleur urbaine mesurée directement dans l'atmosphère à la chaleur artificielle calculée à partir de la combustion.

2 Mesures

La chaleur urbaine fut évaluée à partir des enregistrements de température effectués en hélicoptère au-dessus de Montréal entre février 1968 et juillet 1969. La méthode consistait à sonder l'atmosphère en 12 sites préétablis (Fig. 1), dans une épaisseur de 900 mètres. Ces mesures furent toutes effectuées tôt le matin durant les deux ou trois heures suivant le lever du soleil. Il y eut en tout 73 mesures de ce genre, mais la moitié d'entre elles furent laissées de côté dans le calcul de la chaleur urbaine parce qu'elles ne rencontraient pas les exigences du modèle simple presenté ci-dessous.

3 Modèle

Le modèle utilisé se décrit ainsi (voir Fig. 2) :

1) Les sources de chaleur sont divisées en deux catégories selon qu'elles relèvent ou ne relèvent pas du chauffage. Soient H, le flux de chaleur émis par les sources indépendantes du chauffage (autos, industries, etc.) et $F\ (V,T)$, une fonction exprimant le flux de chaleur causé par le chauffage, et dépendant de la température ambiante T, prise seule ou associée à la vitesse du vent V. Le choix de la fonction F sera déterminé plus loin.

2) On considère les sources de chaleur comme distribuées de façon uniforme sur tout le territoire urbain.

3) L'atmosphère se déplace au-dessus du territoire avec une vitesse constante sans cisaillement vertical.

Ces hypothèses de base conduisent aux trois équations suivantes:

$$C = \int_0^{L/2V\cos\theta} \int_0^S \left\{ F(T,V) + H \right\} ds\, dt \tag{1}$$

$$C = (F + H)\ SL/2V \cos\theta \tag{2}$$

$$Y = 2CV \cos\theta / SL = F + H \tag{3}$$

où L représente la dimension du territoire dans une direction parallèle à la direction du vent; θ, l'angle entre la direction du vent et la dimension L; V, la vitesse du vent; $L/2V\ \cos\theta$, la durée moyenne du séjour de l'atmosphère au-dessus du territoire; et ds, la surface élémentaire du territoire.

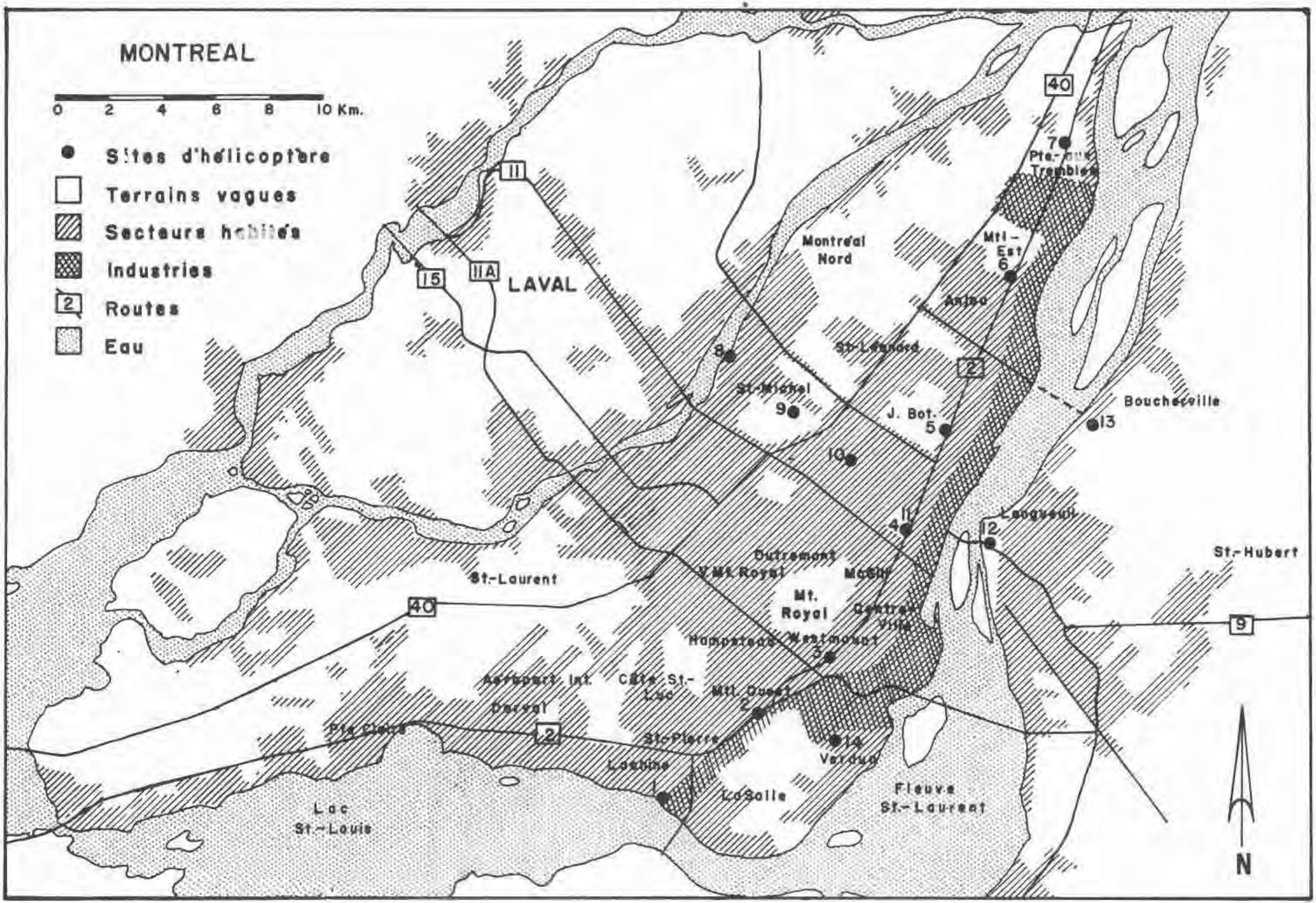


Fig. 1 Carte de Montréal métropolitain.

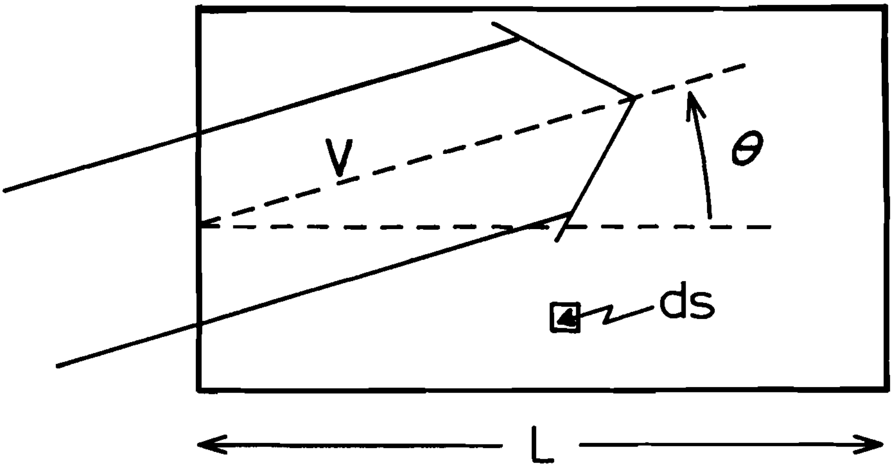


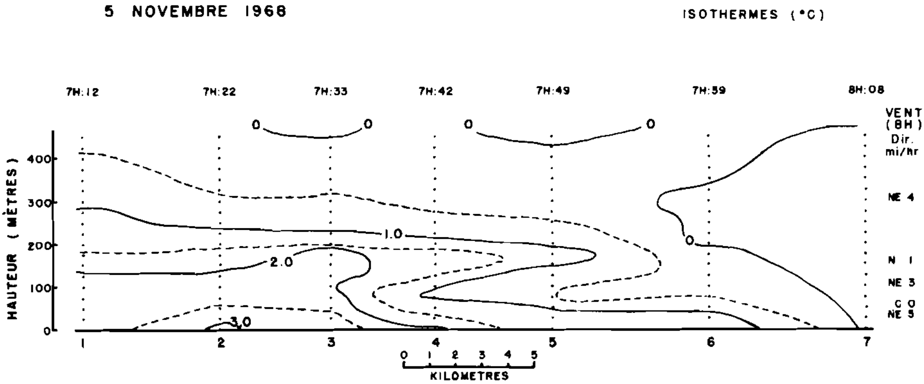
Fig. 2 Schéma du modèle mathématique utilisé pour le calcul de la chaleur urbaine. (Voir l'article pour les définitions.)

4 Analyse

L'étude des données expérimentales ayant révélé que l'influence urbaine tombait en deçà de la précision des mesures quand on se trouvait au-dessus de 500 mètres d'altitude, l'analyse a été limitée à cette couche inférieure voisine du sol. Cette analyse a suivi les étapes suivantes :

1 – À chaque journée, le sondage le plus froid fut choisi comme le sondage de référence représentant les conditions rurales ou semi-rurales. Ce sondage était normalement celui situé en bordure du territoire, et du côté d'où venait le vent.
2 – Une carte des excès de température de chaque sondage par rapport au sondage de référence le plus froid fut dressée le long de chacune des deux lignes de sites de sondages. Un exemple est présenté aux figures 3a et 3b.
3 – Le territoire urbain fut divisé en petits quadrilatères de deux catégories, selon que le quadrilatère contenait ou ne contenait pas un site de sondage. Pour les quadrilatères avec un site de sondage, la chaleur urbaine fut calculée en utilisant tout simplement les excès de température obtenus à ce sondage. Quant à la chaleur des autres quadrilatères, elle fut obtenue par un jeu de proportions tel qu'illustré par la figure 4.
4 – La sommation de la chaleur urbaine propre à chaque quadrilatère donne la valeur C des équations (1) à (3), c'est-à-dire la chaleur urbaine totale sur le territoire considéré.
5 – La vitesse moyenne V du flot atmosphérique fut établie par interpolation linéaire dans le temps et l'espace entre les vents mesurés à 315 mètres d'altitude (à la tour de Radio-Canada sise près du site 3) et à 115 m (à la tour du Jardin Botanique, située près du sondage 5) (voir Fig. 1).

Plusieurs raisons ont amené le rejet de certaines mesures dans le calcul :
1) absence de mesures complètes de température pour quelques sondages;



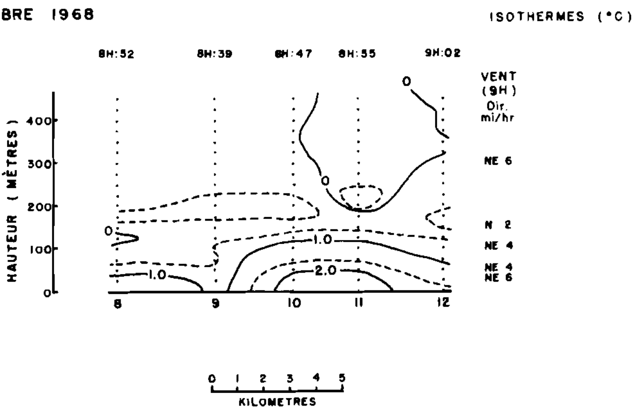


Fig. 3a Exemple d'excès de température (par rapport au sondage le plus froid) sur la coupe verticale de l'atmosphère formée par les sondages 1 à 7.

Fig. 3b Exemple d'excès de température sur la coupe verticale formée par les sondages 8 à 12.

2) flot atmosphérique insuffisamment défini, soit quant à la direction (direction du vent différente aux deux tours par plus que 45°), soit quant à la vitesse (cisaillement vertical marqué du vent ou changement soudain de la vitesse durant la prise des mesures);
3) absence d'un champ bien défini des excès de température;
4) absence d'une couche atmosphérique stable au-dessus de 500 mètres, qui puisse empêcher toute perte de chaleur par turbulence.
En conclusion, des 73 journées, 37 seulement furent retenues pour le calcul de la chaleur urbaine.

5 Choix de la fonction $F(V,T)$

Les ingénieurs utilisent, pour prédire la consommation par le chauffage, une relation simple sous la forme de $K(65 - T)$ où T est la température en °F et K, la constante de proportionalité. On peut, de la même façon, poser que la

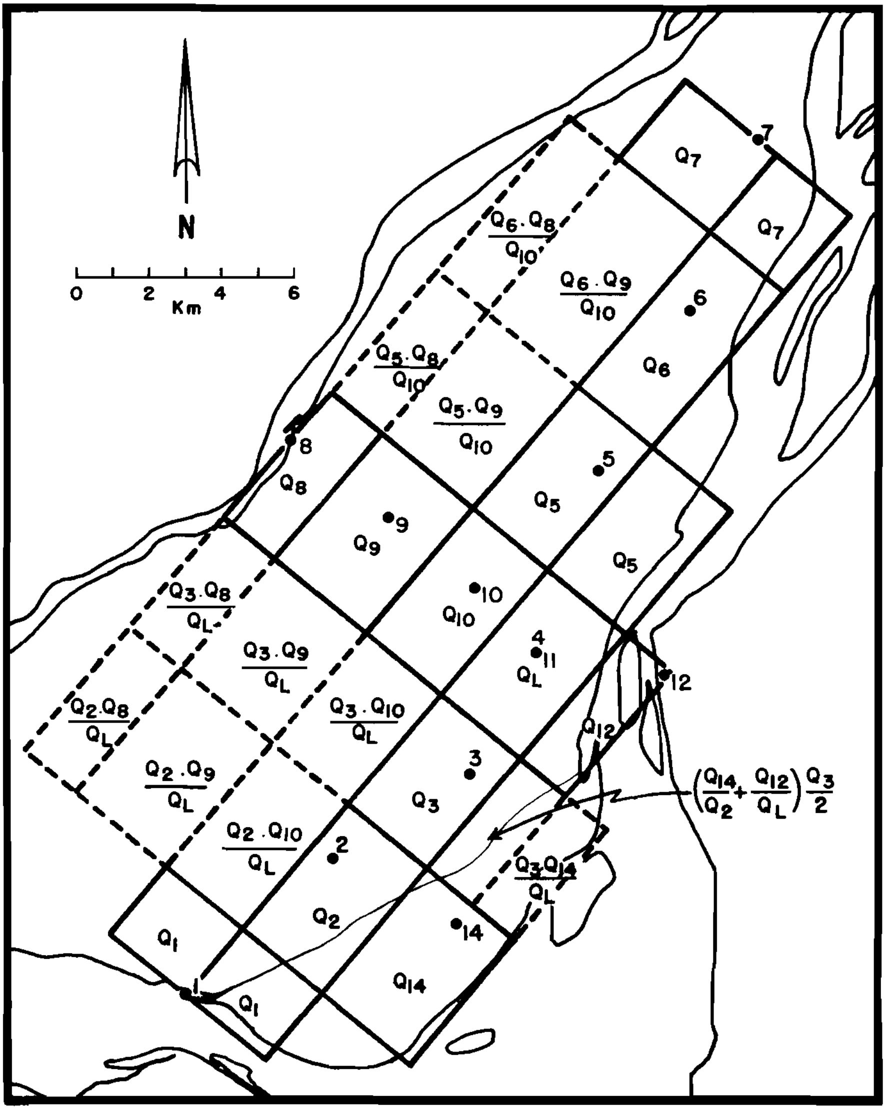


Fig. 4 Grille utilisée pour le calcul de la chaleur urbaine. Q_n = chaleur urbaine du quadrilatère avec site n. $Q_L = (Q_4 + Q_{11})/2$, où 2 sondages furent réalisés.

chaleur dégagée par le chauffage est en relation linéaire avec le nombre de degrés sous 65°F, soit $a(65 - T)$, où a est la nouvelle constante de proportionalité.

Par ailleurs, on peut prévoir que la vitesse du vent au-dessus des habitations doit aussi jouer un rôle. Le chauffage doit être d'autant plus élevé que le volume d'air se renouvelle plus rapidement; on peut poser que la production calorifique du chauffage est proportionnelle à la vitesse du vent V. Une façon de combiner la vitesse du vent avec le froid serait de poser $F = (1 + V)\ (65 - T)$. On voit

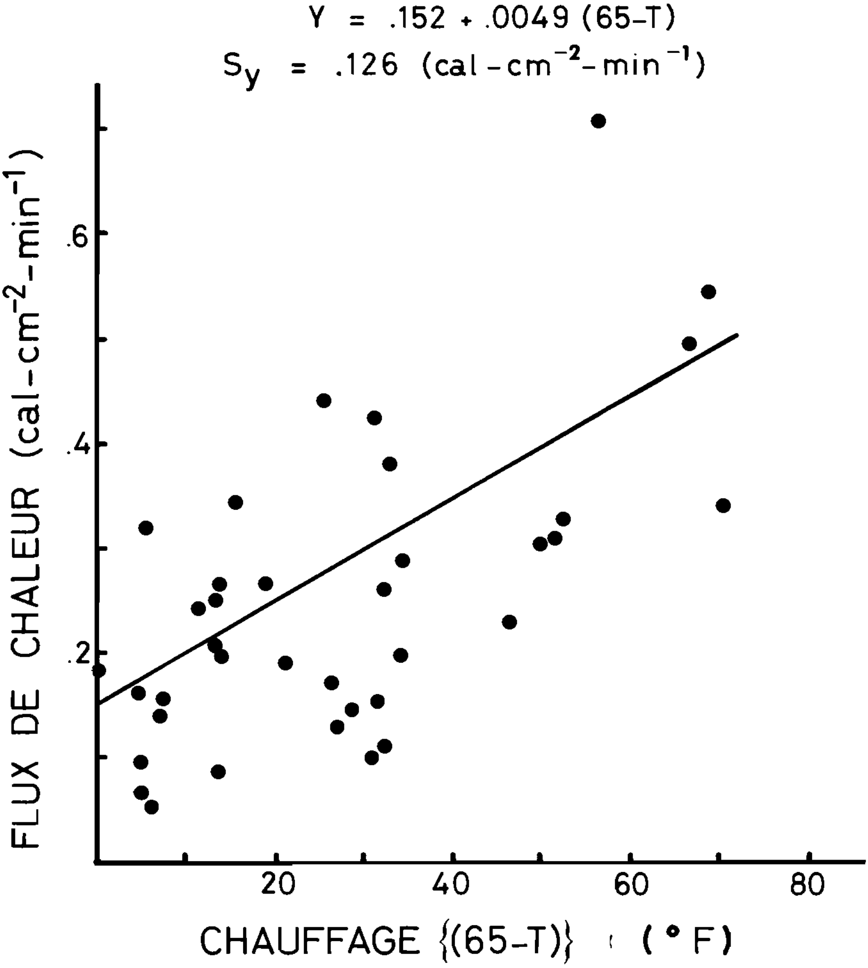


Fig. 5 Flux moyen de chaleur urbaine, Y, en fonction du chauffage, $(65 - T)$. S_y, écart type des points de part et d'autre de la droite de régression.

que la fonction s'annule pour T égal à 65, mais qu'elle demeure différente de zéro lorsque le vent disparaît.

L'une et l'autre fonction F, établies ci-haut, seront utilisées et jugées au mérite par la moindre dispersion qu'elles engendreront.

6 Resultats

Dans les figures 5, 6 et 7, respectivement, apparaissent les graphiques de Y, flux moyen d'émission de chaleur en fonction de la variable $(65 - T)$ (Fig. 5), de la variable $(1 + V)$ $(65 - T)$ (Fig. 6), enfin de la même variable $(1 + V)$ $(65 - T)$, mais pour les seules directions du vent venant des secteurs ouest, nord-ouest, est et sud-est, c'est-à-dire pour les vents soufflant latéralement (voir Fig. 1) au grand axe du territoire (Fig. 7). On comprend que cette dernière représentation constitue une tentative de minimiser l'effet de la distribution non-

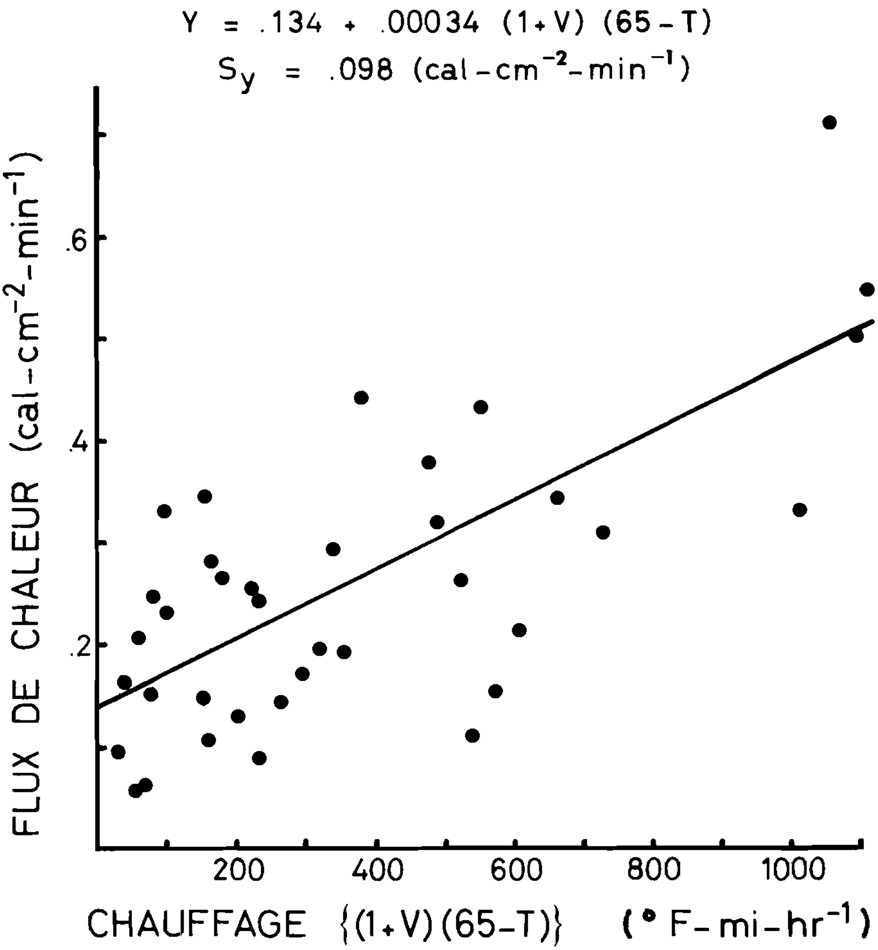


Fig. 6 Flux moyen de chaleur urbaine, Y, en fonction du chauffage, $(1 + V)$ $(65 - T)$, pour toutes les directions du vent. S_y, écart type des points de part et d'autre de la droite de régression.

uniforme des sources de chaleur. La droite et l'équation de chaque figure furent obtenues par la méthode des moindres carrés.

7 Discussion

On remarque que la dispersion des points, mesurée par l'écart type S_y des points de part et d'autre de la droite de régression, est maximale dans la figure 5 et minimale dans la figure 7. Ceci signifie que la contribution par le chauffage se traduit mieux par une fonction impliquant à la fois la température ambiante et la vitesse du vent plutôt que par la fonction simple de température, et qu'à cause de la distribution non uniforme des sources de chaleur, les vents latéraux se prêtent mieux à une évaluation de la chaleur urbaine. Ce qui reste de la dispersion dans la figure 7 peut être attribué en bonne partie à l'hypothèse de

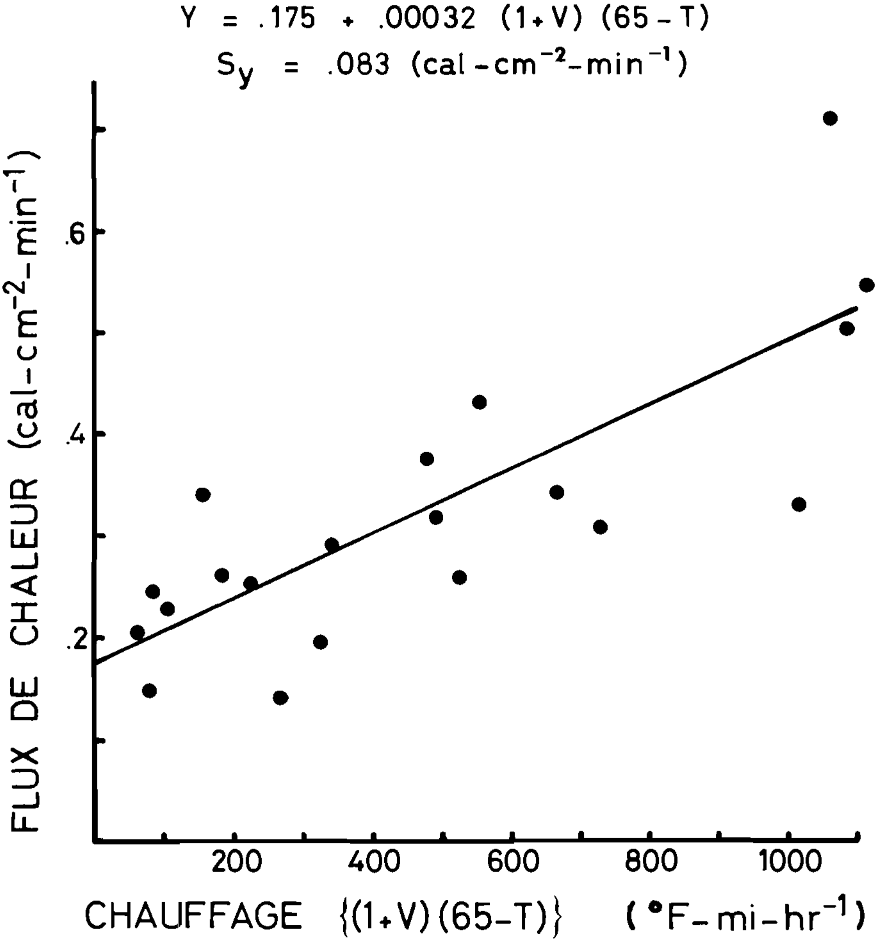


Fig. 7 Flux moyen de chaleur urbaine, Y, en fonction du chauffage, $(1 + V)$ $(65 - T)$, pour les vents transversaux à l'axe principal de l'île. S_y, écart type des points de part et d'autre de la droite de régression.

base selon laquelle la chaleur urbaine est une fonction unique du chauffage, alors qu'elle peut dépendre aussi du rayonnement solaire.

On peut, à l'aide de l'équation de la figure 7, calculer la chaleur urbaine totale générée dans une année et comparer cette valeur à la chaleur artificielle générée par les combustibles consommés dans la même période dans la région montréalaise.

8 Calcul de la chaleur urbaine

Powe (1969) nous a fourni la moyenne mensuelle du vent à Dorval et des degrés-jours (inférieurs à 65°F) à la station McGill dans le centre-ville. En incorporant ces données dans l'équation de la figure 7 et en utilisant la surface du territoire sur lequel la chaleur urbaine fut mesurée, on obtient une production annuelle de 26.8 $\times 10^{16}$ calories pour les sources constantes et 13.4 $\times 10^{16}$ calories pour les sources de chauffage, soit un total de 40.2 $\times 10^{16}$ calories.

9 Calcul de la chaleur artificielle

On peut obtenir un estimé de la chaleur artificielle générée par les combustions de toutes sortes en suivant la méthode utilisée par Summers (1965) et en utilisant les chiffres du Bureau des Statistiques (1968) sur la consommation des pétroles. Les hypothèses sont les suivantes :

1 – 57% des pétroles livrés dans le Québec sont consommés dans Montréal (statistiques de 1961);

2 – la production calorifique est de 11 kilocalories par gramme de pétrole;

3 – 82% de la population (recensement de 1961) se chauffe à l'huile : pour le reste de la population, on a supposé une production de chaleur équivalente à celle produite par le chauffage à l'huile;

4 – l'apport calorifique des sources indépendantes du chauffage est estimé à partir des livraisons faites aux industries.

L'application de ces règles aux chiffres fournis pour 1967 donne une production calorifique annuelle de 4.75 $\times 10^{16}$ calories pour le chauffage et de 3.65 $\times 10^{16}$ calories pour les industries, soit un grand total de 8.40 $\times 10^{16}$ calories. En comparant cette valeur de la chaleur artificielle générée dans une année à la chaleur urbaine totale mesurée directement dans l'atmosphère, soit 40.2 $\times 10^{16}$ calories, on voit qu'elle ne représente que 21 pourcent de la chaleur urbaine mesurée.

Dans le calcul de la chaleur artificielle, on doit en fait, inclure la chaleur dégagée par la consommation électrique. En 1968, cette consommation était de 10.79 $\times 10^{9}$ kilowatt-heures; si on assume que toute cette énergie est transformée en chaleur, ceci représente 0.93 $\times 10^{16}$ cal. En ajoutant ceci à la chaleur artificielle déjà calculée (8.40 $\times 10^{16}$ cal.), on obtient un total de 9.33 $\times 10^{16}$ cal., ce qui ne représente encore que 24 pourcent de la chaleur urbaine mesurée.

10 Conclusions

D'après les mesures de température enregistrées en hélicoptère pour 37 journées à 12 points de sondage, la chaleur générée par la ville dépasse de beaucoup la chaleur artificielle mesurée à partir des combustibles utilisés dans la région montréalaise. Il semble donc que la contribution du rayonnement solaire ne soit pas à négliger dans l'explication de la chaleur urbaine. Seul, un modèle mathématique assez complexe impliquant des mesures de la radiation solaire et terrestre à divers niveaux en plus d'une distribution plus réelle des sources de chaleur pourra établir dans quelles proportions respectives le rayonnement solaire et la chaleur de combustion contribuent à la chaleur urbaine.

Remerciements

Cette étude a été réalisée grâce à une subvention de recherche sur la Santé Publique (projet 604-7-593) du Programme de Subventions de la Santé Nationale.

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BOOK REVIEWS

BIBLIOGRAPHY OF CLIMATOLOGY OF THE PRAIRIE PROVINCES 1957–1969. *The University of Alberta Studies in Geography, Bibliography I*. By Richmond W. Longley and John M. Powell (editors). The University of Alberta Press, Edmonton, Canada, 1971, 64 pp., $5.00.

This collection of references to the climate of the three Prairie Provinces was initiated by the Alberta Climatological Committee of the Research Council of Alberta and has been designed to bring up to date the Prairies' portion of an earlier bibliography of Canadian climates published by the Meteorological Branch of the Department of Transport.

The Prairie Provinces' bibliography consists of references to articles, papers, reports and books published, in general, over the period from 1957 to 1969. Some 665 items have been included and the coverage is unusually complete. The book consists of 64 pages of which 6 are given over to a good subject index, a very necessary part of any bibliography. Since the items in the main body of the bibliography are arranged alphabetically by author, a two-page second author index allows the user to quickly locate a reference even when he does not know the name of the prime author. This book is a welcome edition to our rapidly growing literature on the climatology of Canada.

M.K. Thomas
Atmospheric Environment Service
Toronto

BIOMETEOROLOGICAL METHODS. By R. E. Munn. Academic Press, New York and London, 1970, 336 pp., $6.95.

This is an unusual and arresting book, unique in its field. Having reviewed it I have not put it back on the shelf, but shall keep it on my desk with the *Smithsonian Tables* and Bartlett's *Familiar Quotations*. As the author puts it, "the book seeks to place in perspective the various experimental, empirical, analytical and physical methods that are being used or could be used in biometeorology." He also hopes that it will be found "controversial in a positive sense." An accurate compendium of useful research methods can be controversial only in choice of subject, or in the author's judgement of those methods. No two workers would be likely to pick the same set, and I would not have chosen the set picked by Dr. Munn. But that is precisely why I value the book.

After a brief review of the scope of biometeorology the book covers sampling and experimental design problems, followed by a review of statistics. The reader does not get far into the text before he begins to question Dr. Munn's assumption that "a layman's familiarity with meteorology and a knowledge of elementary statistics are the only prerequisites for most chapters." Differential equations appear as early as page 20, and a wide familiarity with classical physics is clearly assumed. The ideal reader of this section will be the graduate student reading a course in the subject, not a layman.

The text then goes on to physical methods, which include as subheadings: deductive and inductive reasoning, dimensional analysis, modeling, water budget, metabolism, energy balance, energy chains, diffusion and ventilation. These are illustrated by examples chosen from physiological climatology and ecosystem competition. Here as elsewhere the well-informed reader will sit scratching his head wondering just how Dr. Munn chose these fields, and put them in the order used. It did me good to wonder, and although I did not always agree, I must say that the text taught me some relationships and cross-references that I had never suspected.

Dr. Munn then takes the reader through synoptic applications, seasonal relationships, palaeoclimatology and climatic classification (I was surprised to see that venerable fossil, Köppen's scheme, still on display), and finally treats engineering and economic applications. The 481-item bibliography (to which this reviewer contributed only one article) is an impressive tribute to the author's erudition. More than 300 of them were unfamiliar to me.

As Dr. Munn himself realises, biometeorology is a cross-disciplinary study in which each of the specialisms straddled has a huge research literature of its own, and a deep-seated conservatism and sense of self-sufficiency. He is to be congratulated, not least by others who might have set about it otherwise, on transcending the limitation of his own field so outstandingly.

F. Kenneth Hare
University of Toronto

CORRESPONDENCE

To the Editor:

Dr. Munn's review (*Atmosphere* **9**, p. 59) of *This Good, Good Earth: Our Fight For Survival* by Brinkhurst and Chant suggests once again that the "sick science" diagnosis one hears so much about these days must be correct. The sickness in question has to do with communication, or rather the lack of it.

The simple fact that Dr. Munn, a reputable scientist and recognized authority in his special field, is prepared to equate to science fiction a serious book by two other scientists, equally reputable and equally recognized as authorities in their special fields, detracts from the credibility of his assertion that there exists a consensus of present scientific opinion on the future of the natural environment. The opposite seems more likely to be true and, furthermore, past performance on projects that disturb the environment suggests that even when there is a degree of scientific consensus, it tends to have little or no effect on government policy.

This is the consequence of the failure of science to develop the means whereby it might be able to provide our political institutions with an understanding of the whole environmental system. Environmental Science, which is by definition inter-disciplinary and directed towards a goal of harmony with nature and reduction of the frequency and magnitude of ecological catastrophes, has not been adequately recognized. Science is still being carried on in what is essentially the traditional fragmented way, even though the tools now available could be applied to help overcome specialization and enable man to assume the comprehensivist role.

It is probable, distasteful as the prospect may be to Dr. Munn, that the specific means to more effective Science will come about only through the kinds of conflict suggested by Brinkhurst and Chant. The value of conflict in bringing about acceptance of ideas which run counter to those of the prevailing establishment has been documented over and over again in history.

My own view of the book is that while it has certain defects, it is an excellent contribution to the task of bringing about environmental sanity, and of notifying the public that there are serious questions about the capabilities of Science, as now organized, to give guidance in matters ecological.

H. B. Kruger
Atmospheric Environment Service
Toronto

NOTES FROM COUNCIL

The following were accepted as members by Council:

October 25, 1971

Member	Dave Devall John Dublin*	Edgar Wendell Hewson Edward Victor Stashko*
Student Member	Richard Curtis Bennett Richard Leonard Berry Kenneth A. Devine*	Jack Edward Donegani* David Ray Smith

December 9, 1971

Member	H. T. (Bob) Beal* Peter Enns	David Douglas Kemp*
Student Member	Randolph Perry Angle* Richard Louis Drouillard* James Richard Gillespie* Claude Rene Girard*	Paul Francis Haley Donald C. McKay* Roy Ambury Stuart

*1972 Membership

Appointment of Committees
Council appointed committees for 1971–72 at the October 25, 1971 meeting as given below. The President is an *ex officio* member of all committees.

Nominating Committee
S. V. A. Gordon, Chairman
E. H. V. Dexter
H. M. Fraser
D. M. Robertson

Awards Committee
K. L. S. Gunn, Chairman
R. H. Douglas
M. Kwizak
I. D. Rutherford
E. J. Truhlar

Centres and Chapters Committee
G. A. McKay, Chairman
J. D. McTaggart-Cowan

Membership Committee
H. L. Ferguson, Chairman
G. A. McPherson (ex officio)
Chairman or appointee from each Centre

Editorial Committee
E. J. Truhlar, Chairman
H. B. Kruger
J. A. W. McCulloch
R. E. Munn

The Canadian Meteorological Society and Public Information

At the 1970 CMS Annual Congress, members voted to accept the "standing committee" recommendation of the CMS Development Committee. Among the first to be set up as a result of this was the Standing Committee on Public Information under the Chairmanship of C. M. Penner. This Committee had some success, notably the publication of a letter to the Editor in *Science Forum* (Aug. 1971) and the pick-up by at least one newspaper (*Edmonton Journal*) of a news release issued in June, both commenting on the newly formed Deparment of the Environment. The Committee also responded to the Executive's request for advice and suggestions on the Society's participation in AES Centennial celebrations, and on a proposal for a survey of Canadian meteorology.

The members of the Standing Committee on Public Information for 1971–72, appointed by the new Executive in September of 1971 are: H. B. Kruger – Chairman; L. B. MacHattie; D. K. Smith; and Dr. T. A. Black. Their main accomplishment to date has been discussion leading to a preliminary activity plan based on the Committee's terms of reference:

> "To advise the Executive Committee of the Canadian Meteorological Society on matters, within the concern of the Society, requiring the provision of information to the public in general, or to specific groups. Such studies and reviews may be made on the request of the Executive Committee or on the initiative of the Standing Committee."

The consensus is that a significant amount of publicity should result from CMS initiatives on controversial issues which from time to time appear in the press, especially if almost immediate reaction can be arranged. The Committee intends to work towards the goal of "immediate response" by developing a file of statements solicited from knowledgeable members on a range of likely subjects, and then adapting these statements into CMS press releases as appropriate.

Among the subjects that have a high probability of coming up in the news at one time or another are:

- Pollutant Concentration Factors
- Atmospheric Quality and Health
- Transports of Pesticides and Other Air-borne Substances
- Radioactive Fall-out
- The Costs of Air Pollution
- Pollution Control
- The Private Automobile: Ultimate Absurdity?
- Thermal Pollution
- Noise Pollution
- SST's and Weather
- The Importance of Ozone
- Solar Radiation Changes
- Environmental Ethics, Aesthetics, and Education
- The Role of Citizen Action Groups
- Ecological "Prophets of Doomsday"
- The James Bay Hydro-electric Project and Climatic Change
- The Stability of Climate
- Environmental Monitoring
- Environmental Management
- The Role of the Atmosphere in Ecosystems
- Land Use Planning
- The Arctic
- Meteorological Applications
- Weather Forecasting
- Failures in Predicting Severe Weather
- Hail Suppression
- Weather Modification
- Environmental Rights Bill
- Government Science Policy
- Federal-Provincial Cooperation in Environmental Matters
- Tourism and Recreation
- Implications of Computers
- National Communications Spine
- Satellites
- Simulation Models
- Etc...

Input from members, either in the form of draft statements or names of people who might be able to help, would be most welcome. In addition, members are encouraged to write letters to Editors, signed as member of the CMS, and clear them with the Executive before mailing. Of course, every member is free to write to any publication as a private person.

Local Centres are urged to give wider publicity to their meetings, particularly when a presentation is expected to be of interest to the layman. Press summaries directed towards likely publications should be considered. Centres might also consider establishing an inventory of members who are willing to make themselves available for addressing schools, citizen's groups, etc., and then ensure utilization of the inventory by notifying all groups likely to be interested.

The Annual CMS Congress, which in 1972 will be held in Edmonton, probably represents the best opportunity for getting information to the public and to specific groups. The Congress Program Committee, which among other things is responsible for publicity arrangements, should seriously consider preparing media summaries of papers that are newsworthy or of general interest. The Standing Committee could assist in Congress publicity at the national level by preparing a news item for release to the media shortly before the opening date.

One of the functions of the Standing Committee should probably be to provide guidance, in as much detail as possible, to the Annual Congress Program Committee on how to approach this question of publicity. Unfortunately, this is a very difficult thing to do at this point in time because there is no record of the experiences of past Program Committees. Congress publicity in past years has ranged all the way from mediocre to an outstanding success – so that most, if not all, of the do's and don'ts probably reside among us somewhere. If you have had a role in Congress publicity activities in the past, please consider putting your experiences down on paper to help the Standing Committee start a permanent file which can serve as future guidance. About the best advice that can be given without such guidance is that any activity which is brought to the attention of the media should meet the criterion of newsworthiness.

Because members of the Standing Committee on Public Information are scattered around the country, it is usually not possible to arrange full Committee meetings. This year was an outstanding exception because the AES Centennial Symposium, *A History of Meteorological Challenges*, provided the opportunity for all but one of the Committee members to discuss issues and problems face-to-face.

In an activity such as this, participation and communication by members-at-large is all important. If one of the Standing Committee members belongs to your Centre, he will gladly undertake to act as your point of communication with the Committee; alternatively, you may contact the Committee through the CMS Corresponding Secretary. Please let us hear from you.

H. B. Kruger, Chairman
CMS *Standing Committee on Public Information*

REPORTS

Second Canadian Conference on Micrometeorology
With the growing emphasis on and necessity for interdisciplinary research to solve environmental problems, there is an ever-increasing need to arrange major conferences where scientists can attempt a meaningful dialogue with one another. Such occasions have been rare in Canada. However, 1971 provided an excellent opportunity which not only reinforced this need but helped to satisfy it. The Second Canadian Conference on Micrometeorology was co-sponsored by the Canadian Meteorological Society and the National Research

Council through its Associate Committee on Geodesy and Geophysics, Subcommittee on Meteorology and Atmospheric Sciences. Sessions were held at Macdonald College, P.Q., May 10–12, with the Montreal Centre of the CMS as host.

A few highlights of the first two days are reported here, since the joint sessions held with the CMS on May 12 and devoted to the topic "Meteorology and the City" have been published in detail elsewhere (*Atmosphere*, **9**, 80–83).

Instrument development, design and improvement are of vital concern to the progress of micrometeorological measurements and this was the subject of almost a full day of presentations. However, design problems and their solutions were also critical in the discussions given in the other sessions. The range of instruments was very wide from a huge new 20-ft diameter mechanical weighing lysimeter built according to the design of E. I. Mukammal, G. H. McKay and V. R. Turner (Atmospheric Environment Service – AES – Toronto) yet capable of detecting a layer of dew 0.015 mm thick; to a mini-sonde developed by J. Markes, Dr. H. E. Turner and M. S. Hirt (AES, Toronto) to explore the boundary-layer temperatures and winds up to a height of 2000 m.

One novel device to make flux measurements was described by Dr. R. Desjardins (CDA, Ottawa) who worked with Dr. M. Johnson (Cornell University): gas was collected in two separate bags (for up and down fluxes) at a rate proportional to the vertical velocity as measured by a propellor anemometer. Simpler and more accurate flux differences could be evaluated in this way and the device shows promise for possible application in air sampling networks.

The veteran instrument designer could learn from the novice. D. Champ (AES, Toronto) related how he had improved on G. Gill's 20-year experience with wind-measuring devices by using flat-bladed metal propellors, since Gill's own helical variety was too difficult to fashion from metal. Later Prof. Gill (Univ. of Michigan) offered several suggestions for further improvement.

Logical and systematic improvements to existing instruments using recently available components were also reported by other speakers and these included a hydraulic wave follower, sunshine recorder, wind direction digitizer, standard precipitation gauges and an evapotranspiration device.

Two elegant examples of basic research in heat transfer from plants had been presented at the opening of the Conference by staff members of Macdonald College: Dr. P. Schuepp, who used Ni-plated leaves in an electrochemical solution; A. Kumar and Prof. N. Barthakur, who studied live plants in a wind tunnel. Both of these papers emphasized the importance of intelligent instrument design to obtain accurate data for verification and/or extension of theory.

The dividing lines between sessions were hard to define. Papers dealing with the dispersion and diffusion of particulates under "Air Pollution" could easily have been assigned to the sessions on "The Ekman Layer" or "Turbulence and Fluxes." However, all papers showed that more accurate data are being accumulated across a wide front, with better measurements under more varied atmospheric conditions in the boundary layer. For example, AES studies by O. Johnson, K. Kembry and J. A. McCallum at Suffield showed that longitudinal eddies had less than half the slope of lateral eddies; Dr. H. Martin (AES, Toronto) presented interesting results from his study of dry cold fronts with 10-cm radar. Fine details of horizontal wind speed and temperature could be measured relatively easily. A number of other papers dealt with the determination of drag coefficients under different meteorological conditions.

An important paper by J. McDonald and Prof. M. Miyake (UBC, Vancouver) stressed the necessity of intercomparing instruments on the international plane in order to help with the design and correction of instruments to measure winds, temperature and humidity. They discussed the tests carried out by Australian, Canadian, American and Russian scientists in the USSR.

Almost an entire session was given to the heat and water budgets of Perch Lake near Chalk River where studies had been carried out to estimate the evaporation. The water vapour concentration over the lake was calculated by means of a mass transfer equation modified by Dr. W. Selander (AECL, Chalk River); his results were compared with those values determined from measurements of the evaporated tritiated lake water.

Two invited speakers contributed to the success of the Conference, Dr. H. H. Lettau (Univ. of Wisconsin) spoke about Climatonomy which has a wide and general application to the calculation of the spatial-temporal variations of climatic elements by means of a "systems engineering" approach.

Dr. R. W. Stewart (UBC, Vancouver) discussed the relationship between GARP and small-scale meteorology. The first tropical GARP experiment will take place in 1974 in the Atlantic to assist in determining the mesometeorology of the tropical atmosphere. This will support the aims of GARP: to improve weather forecasting for the 1–12 day period and to improve the physical explanation of climate to account for any changes that may occur. Small-scale effects will be parameterized for input into large scale models of atmospheric motion, e.g., stress u_*^2 at 8 m can be related to U^2 at the same level; water vapour flux ku_*q_* with $U\Delta q$. This is necessary since sensible heat and heat from evapotranspiration depend on the boundary conditions.

Although a few of the papers will be published in *Atmosphere, Boundary-Layer Meteorology* or other journals, it was unfortunate that resources (staff and money) could not be obtained to publish the entire proceedings.

Most scientists attending the Conference were grateful for the opportunity to meet their colleagues and to freely exchange ideas with them. The First Conference held in Toronto during 1965 was also successful. It is to be hoped that less than six years will elapse before the next one will be convened.

SOMAS Meeting 25 October 1971

The Sub-Committee on Meteorology and Atmospheric Sciences held its 23rd meeting in Toronto on October 25, 1971 in conjunction with the official opening of the new Atmospheric Environment Service headquarters building.

The committee was informed that, through the efforts of Mr. Arnold Peters (M.P. from Timiskaming), the weather modification bill was amended to provide for unrestricted public access to the information collected under the provisions of the bill, as was recommended by SOMAS.

The committee considered a proposal put forward to form a structure akin to the American Geophysical Union to replace the present NRC related committee. While the committee had no fundamental objections to the proposal, it held the following two aspects to be essential:

1) that any new structure would maintain a connection with the International Association of Meteorology and Atmospheric Physics;

2) that any new structure would serve to strengthen the Canadian Meteorological Society.

Alberta Centre

The first meeting of the winter session was held on Wednesday, November 10, 1971, at the University of Alberta. Mr. D.H. Smith, Regional Director, Atmospheric Environment Service announced the recipients of ten Centennial Plaques awarded by the Western Region. Those receiving plaques were:

Professor Richmond W. Longley—University of Alberta
Canada Agriculture Research Station, Lacombe
Canada Agriculture Research Station, Lethbridge
Olds Agricultural College, Alberta Department of Agriculture
T.D. Waite—climatological observer, Ranfurly, Alta.
J.J. Price—weather observer, Watino-Hemaruka, Alta.
W. Wallace—weather observer, Campsie, Alta.
Fort Good Hope R.C. Mission—climatological station
Mrs. V. Butler—officer-in-charge, meteorological station, Jasper, Alta.
Yukon Dept. of Highways and Public Works—maintenance camps supplied daily meteorological and climatological data via radio.

On hand to receive their plaques were Professor R.W. Longley, Mr. J.R. Gillespie for the Lacombe Research Station, and Mr. B.J. Godwin for Olds Agricultural College.

Following the presentation of the Centennial Plaques, Mr. Don Storr, hydrometeorologist connected with the Alberta Watershed Research Program, spoke to the over forty persons present on the subject *Meteorological Problems and Progress in Watershed Research in Southern Alberta.* They were soon made aware of some of his problems as he talked and showed slides of the terrain of Marmot Creek Basin, which varies in elevation from 5,000 to 9,200 feet with an average slope of 39 per cent, and is currently the main area of his study. Photographs of instrument shelters partly buried in snow, or eaten by porcupines, and tales of radiation sensors and recorders found yards down slope from the instrumented site, probably the work of interested bears! His main problems in this mountainous basin which he termed a "water factory" were the measurement of precipitation, calculation of evaporation and evapotranspiration, and the determination of snowmelt. He ably showed that progress is being made in obtaining an inventory of the various climatic parameters for this basin where mean annual precipitation varies by twenty inches over two miles and two thousand feet elevation. He ended his talk by developing an annual energy balance for the basin which included values for ground and forest radiation, snowmelt and photosynthesis as well as for latent and sensible heat. By this budget method he was able to accurately predict the annual surface runoff for the 1969/70 season to the pleasant surprise of the hydrologists whose stream gauges were actually measuring the runoff. Work remains to be done to further substantiate some of his estimated budget values, while there is an urgent need to develop energy balances for each of the sub-basins before manipulation, through removal of the spruce/fir forest, is commenced in 1973.

J.M.P.

British Columbia Centre

The first meeting of the 1971–72 season was held October 15th at U.B.C. The speaker was Dr. I.K. Fox, Director of Water Resources Research Centre, U.B.C. whose talk was entitled *Prospective Program of the New Water Resources Research Centre.*

Prior to Dr. Fox's talk the executive for the 1971–72 season was elected. Elected were Chairman–Don Faulkner; Vice-Chairman–Dr. M. Miyake; Secretary-Treasurer–Bill Thompson; Program-Chairman–Dr. T. Oke; and Member-at-Large–Dr. R.B. Sagar.

The new executive met on October 20th to formulate a policy for the forthcoming season. After some discussion it was agreed to attempt to foster interest in meteorology at a less theoretical level than has been done in the past to promote greater public appeal. With this as an objective, the feasibility of giving a series of seminars directed at atmospheric environmental problems during early 1972 is being investigated.

W.C.T.

Toronto Centre

The Toronto Centre of the CMS held its first meeting of the 1971–72 season on Wednesday, September 22, in the main auditorium of the new Atmospheric Environment Service building. The guest speaker for the evening, Mr. Colin J. Macfarlane, Assistant Director of the Ontario Air Management Branch, presented a particularly entertaining and informative talk entitled *Pollution, Prediction, Planning.*

Mr. Macfarlane illustrated the wide variety of pollution problems an environmentalist must be prepared to cope with – ranging from the complaint of a rural hog farmer about his upwind neighbour who also keeps hogs, to the complaint of a city apartment dweller about his neighbour, a large incinerator.

Special emphasis was placed on the necessity of a multidisciplinary approach to air pollution. It is no longer sufficient to deal only with the engineering problems of gas scrubbing and particle filtering at the source, or meteorological problems of transport and diffusion; one must consider the planning of land use carefully so that previous pollution abatement measures will not be compromised. Thought must be given to the cost of control measures to the consumer. As an example of this latter consideration, Mr. Macfarlane pointed out that the application of effective odour control measures to chicken farms in Ontario would be so expensive at the present, that all but a few farmers would be unable to continue operating, with the result that the cost of poultry and eggs would increase radically. This, the consumer would find unacceptable.

The speaker succeeded in making the audience more aware of the scope of air pollution problems and also in encouraging them, to consider, both as people concerned with the environment and as consumers, what acceptable solutions to these pollution problems really do consist of.

The enthusiastic discussion which followed the presentation continued later around the coffee table, indicating that the first meeting of the Toronto Centre was indeed a successful one.

D.W.

A joint meeting of the Toronto Centre with the University of Toronto Department of Physics on October 20, 1971, had the pleasure of hearing Mr. J.S. Sawyer of the U.K. Meteorological Office. He spoke on *Possible Effects of Human Activity on World Climate* and discussed the climatic effects caused by carbon dioxide increases, water vapour and other chemicals from aircraft and rockets, agricultural practices, direct thermal input from industrial sources as well as man's and naturally occurring particulate pollution. Since the amounts of energy involved in large-scale meteorological phenomena are generally much greater than man's sources of energy, Mr. Sawyer concluded that any influence on climate would most likely result from interference with the solar energy input. He also pointed out that the general circulation of the atmosphere appears to be less sensitive to such interferences than some suggest.

The discussion that followed the presentation focussed on the problem of whether large variations from the mean trends, either regular or single ocurrences, which had been discussed by Mr. Sawyer, might trigger larger changes in the general circulation. The general feeling was that a better quantitative understanding of atmospheric processes was required to be able to assess the potential of these disturbances to climate. Over eighty persons, including many members of the GARP Joint Organizing Committee, attended this very interesting meeting at the University of Toronto.

G.B.

The Toronto CMS meeting held on Wednesday, November 17, 1971, took the form of a tour of the Robert D. Defries Building of the Connaught Medical Research Laboratories of the University of Toronto. This building provides accommodation and equipment for the preparation of insulin for the medical treatment of diabetes.

Prior to touring the building, Dr. Ferguson, Director of the Connaught Laboratories, gave an introductory talk on the operation and organization of their facilities. Afterwards members in groups of half a dozen each were guided by laboratory section heads to view the operations and procedures carried out to extract insulin from the pancreas glands of animals. These glands are shipped to the laboratories from all major packing houses in Canada and are the basic ingredients for insulin preparation. The pancreas glands are stored at temperatures of $-50\,^{\circ}C$ before being used. The ground-up glands are mixed with large quantities of alcohol in a very commercial-like operation, carried out in explosion-proof and most sanitary surroundings. The insulin is then recovered in crystalline form, after removal of the tissue animal fats.

In the course of the tour some of the history relating to the discovery of insulin by Drs. Banting and Best, were shown in very interesting historical displays. These included the notes kept by Dr. Best during his first treatment of dogs which revealed how successful insulin had been in testing dogs suffering from severe diabetes.

In addition to insulin preparation, this building of the laboratory also carries out the purification and fractionation of stale blood received from Red Cross blood banks. This process recovers human plasma, fibrinogen and other blood enzymes so that these products are available for treatment of various diseases in humans.

The evening concluded with delicious coffee and tasty snacks provided by the host, served in the cafeteria of the library of the Connaught complex. This informative meeting was much appreciated by all who attended.

C.T.

The 1973 International Solar Energy Congress

Plans are developing for the 1973 Solar Energy Congress to be held at Paris, France, from 2 July to 6 July. The program is planned to include three principal themes, under the general title, *The Sun in the Service of Man.* The three themes are:

A The Sun and the Environment

Urban Problems
Architecture
Materials of Construction

B The Sun and Energy

Flat Plate Collectors and Their Applications
Focusing Collectors and Their Applications
Conversion of Solar Energy to Other Energy Forms (solar cells, etc.)

C The Sun and Life

Plant Biology
Animal Biology
Human Biology

This plan for the Congress is intended to bring together three major groups who have common interests in solar radiation, its use, and its control. These are the people whose main interest is in design and development of the man-made environment, those interested in solar energy as an energy resource, and those whose concern is for the interactions of solar radiation and various life forms.

The Congress is to be sponsored by AFEDES, the French solar energy society, with the cooperation and co-sponsorship of ISES and COMPLES. It is expected that there will be, in conjunction with the Congress, meetings of the Board of Directors and the membership of ISES.

Further information can be obtained from:

Secretary Treasurer
Solar Energy Society
P.O. Box 52, Parkville
Victoria, 3052, AUSTRALIA

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Section A: Index of Contributions by Author

Figures in italics refer to 5th Annual Congress issue of *Atmosphere*.

Section B: CMS Subject Index

Section C: General Subject Index

CALL FOR PAPERS – SIXTH ANNUAL CONGRESS

The Sixth Annual Congress and Annual General Meeting of the Canadian Meteorological Society will be held at the University of Alberta, Edmonton, Alberta, May 31 and June 1–2, 1972. The theme of the Congress is *Meteorology of the North* and all sessions on the first day, May 31, will be devoted to invited and contributed papers on this topic. If adequate contributions are received, sessions will be held on Numerical Weather Prediction, Hail Studies, Instrumentation, Marine Meteorology, Applied Meteorology, and Micrometeorology.

Society members and others wishing to present papers at this meeting should send titles and definitive abstracts (preferably less than 300 words) to the Program Chairman, Prof. K. D. Hage, Department of Geography, University of Alberta, Edmonton, Alberta *not later than* February 29, 1972. Shorter contributions of 5 minutes duration on important recent findings, instrument developments, new applications, etc., will be accepted at this meeting provided that a suitable title is submitted not later than May 1, 1972.

One complete written copy of each paper accepted for presentation at the Congress must be submitted upon registration in order that copies can be made available on request to delegates attending the meeting.

Information on registration, accommodation, field trips, etc., will be provided in due course. Mr. A. F. Ingall of the Atmospheric Environment Service, Edmonton is Local Arrangements Chairman for the Congress.

CALL FOR NOMINATIONS – 1971 AWARDS

Nominations are requested from members and Centres for the 1971 Society Awards to be presented at the 1972 Annual Meeting. Four awards are open for competition: 1) the President's Prize for an outstanding contribution in the field of meteorology by a member of the Society; 2) the Prize in Applied Meteorology for an outstanding contribution in the field of applied meteorology by a member; 3) the Graduate Student Prize for a contribution of special merit by a graduate student; and 4) the Dr. Andrew Thomson Undergraduate Student Prize for a contribution of special merit by an undergraduate student. The awards will be made on the basis of contributions during the 1971 calendar year. Nominations should reach the Corresponding Secretary not later than March 1, 1972.

1972 LECTURE TOUR

Professor Maurice Danard of the Faculty of Engineering of the University of Waterloo will carry out the 1972 CMS national lecture tour to speak at Centres of the Society. His topic is *The Role of Meterology in the Environmental Management of a Watershed*. In addition he will meet with AES regional meteorologists, other scientists and CMS members to present a technical session, tentatively entitled *Quantitative Precipitation Forecasting*.

After the western tour has been completed in early February, Centres east of Montreal will be visited during the first week in April.

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