DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
MINISTÈRE DU NORD CANADIEN ET DES RESSOURCES NATIONALES

FILE NO. DOSSIER Nº 1009-3-13 (D) CLOSED

VOL. NO. VOL. Nº 1

FROM – DE: 1965

TO – À 21/12 (D)

SUBJECT – SUJET: MACKENZIE DELTA RESEARCH PROJECT (A,C,N.D.) CLOSED

RELATED FILES are listed inside file cover – DOSSIERS CONNEXES énumérés à l'intérieur

For Instructions Re Use of File Cover See Back Cover
Voir au verso comment utiliser la chemise

* 10/76

B. F. ON FOR DISPOSAL OF THIS VOLUME

Reference – Renvoi: Referred To – Destinataire	Purpose – Objet	Date	Initiale – Initiales	Action Taken – Mesures prises: P.A. Date or T. – Date de rangement ou de transmission	B.F. Date – Date de rappel	Initiale – Initiales	Registry Inspection – Examen du service des Archives
W/	6-7 # 218 BF	14-9-65	JHP.	21/9		DW	SEP 23 1965
DO	29-7 # 7789 BF	14-9-	JHP.				SEP 23 1965
DO	9-8 # 142 BF	14-9-65	JHP				SEP 23 1965
DO.	28-6 # 700 BF	14-9-	JHP.	21/9		DW	SEP 23 1965
DO (CMB)	23-6 # 551 BF	24-9-65	JHP				SEP 23 1965
DO	2-9 # 7614	14-9-65	JHP				SEP 23 1965
DO	7-9 # 7683	14-9	JHP				SEP 23 1965
Do (CMB)	21/9/65 - 102 BF	21/9/65	JC.		8-10	C.M.B.	SEP 30 1965
Do	Request	4/10/65	JC	11-10		RD	OCT 15 1965
DO (CMB)	21-9 100 BF	12/10	JC	11-10		RD	
DO	Request	15-2	GD	17-2-66		MB	
DO	22-2-66 2523	23-2	aB	24-2-66		MB	
DO	6-9 # 5263	7-4-66	JHP	13-4		RD	
DO	13-4 261 BF	20-4	JC	2-5		RD	MAY 2 1966
DO	13-4 104 ABF	20-4	JC	2-5		RD	MAY 2 1966
DO	13-4 104 BF	20-4	JC	2-5		RD	MAY 2 1966
DO-3	Req	3-5	aB	4-5 66		MB	MAY 5 1966
K5 (CMH)	9/5/66	634	26/5/66	AG	30-5-66	AL	MAY 30 1966
Dir	10-11	874	19-11	JP	T	RD	NOV 21 1966
A-1	"	"	"	RD	T	WSE	NOV 21 1966
A.3	"	"	16-11	WSE	1	Jacl	NOV 21 1966
Do	Oh Yukon Req	17/11	Jacl	17-11		RD	NOV 21 1966
A1		18-11	JC	21/11		JHP	NOV 21 1966
B1	a B	21-11	JC	21/11		RD	NOV 21 1966

OF 134

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From - 1965

CLOSED

To - May 1966

MANUFAC

Dominion Loose Lea

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Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

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Return to - Retourner à	File no. - N° du dossier	Volume no. - N° du volume
	1009-3-76	1, 2

Do listed files contain personal information
Est-ce-que le(s) dossier(s) mentionné(s) ci-dessus contient(nent) des renseignements personnels ▶ ☐ Yes Oui ☒ No Non

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10-604 (3-95) 7530-21-036-8760

PA/30-5-66
PH

100 9-3-16

A.J. KERR,
NORTHERN CO-ORDINATION & RESEARCH CENTRE

Ottawa 4, May 27, 1966.

Gas Turbine Powered Generators

I refer to your memorandum of May 9, 1966 regarding gas turbine powered generators.

The following list of turbines was taken from the January, February, 1965 issue of the Gas Turbine Magazine. We only list those of low horsepower rating. We do not have the address of any known users of these turbines.

Manufacturer	City	Country of Origin	HP	Weight
BMW - Triebwerkbau BmbH	Munchen-Allach	Germany	25	100 lbs.
David Budworth Ltd.	Harwich	England	60	100 lbs.
Energy Transformation Corp.	Boyertown, Pa.	U.S.A.	15KW 20KW 65	70 80 110
Rover Gas Turbines Ltd.	Solihull War.	England	60	140
Simmering-Graz-Pauker	Vienna	Austria	20	100
Solar, Div. Int. Harvester Co.	San Diego, California	U.S.A.	65	60
Williams Research Corp.	Walled Lake, Mich.	U.S.A.	26.4	

I hope that this is the information you require.

ORIGINAL SIGNED BY
L. G. MacQUARRIE

(L.G. MacQuarrie)
for Chief, Engineering Division

L.Hunt/ac/h

CIRCULATION SLIP

ENGINEERING DIVISION

Chief	☐	A/Chief	☐
Planning	☐	Operations	☑
Administration	☐	Cost Analyst	☐

ACTION:

Could you answer this Mackenzie Delta Res. Project.

1004-3-16

1-4-3-33

CANADA

Department of Northern Affairs and National Resources Deputy Minister

Ministère du Nord canadien et des Ressources nationales Sous-ministre

Reply 27/5/66 L.M.H.

Ottawa 4, May 9, 1966.

MR. C. M. BOLGER

our file / notre dossier

your file / votre dossier

M.D.R.P. - Preliminary Phase Reports

Thank you for relaying the comments of the Divisions on the four preliminary phase reports.

(1) The comments on the Cooper report from the Engineering Division were useful and raise several points to which we shall direct the attention of the author. It would be helpful if some information connected with the comment in the fourth paragraph mentioning the use of small turbine generators in Newfoundland could be supplied:

- the name and address of the manufacturer, and of any known users of the machine.

The comments of the Chief of the Welfare Division on the Mailhot report were also very helpful and provided valuable guidance for the preparation of the final draft. Concerning the need for our attention to be directed toward the "transient" community, I entirely agree with the point of view expressed. We are hoping to send a researcher to Inuvik toward the end of the summer to undertake a study of the transient community along the lines Mr. Neville suggests.

The comments from the Industrial Division indicate misunderstanding of scientific research methods (as opposed to "surveys", "feasibility studies", or "getting the facts") and of the objectives of the Mackenzie Delta Research Project. As listed, our sins appear to be mainly sins of omission rather than sins of comission except in the instance of the comment that the trapping maps in the Wolforth report are inaccurate. I have requested that Mr. Wolforth have these checked by the Game Management Officer in Aklavik. Although the data was originally obtained from his office, some inaccuracy may have crept in.

A. J. Kerr,
Northern Co-ordination
and Research Centre.

10-5

1-5-66

PA

ADMINISTRATOR OF THE MACKENZIE

Ottawa 4, May 4, 1966.

1009-3-16

Mackenzie Delta Research Project -
Field Research Personnel

Attached hereto are two copies of a self-explanatory memorandum just received from the Northern Co-ordination and Research Centre.

Would you kindly transmit a copy to the Regional Administrator, Inuvik, for his information.

André Nault,
Secretariat,
for Director

A. Nault/cl/H

cc: Chief, Engineering Div.
A.J. Kerr, N.C.R.C.

NORTHERN ADMINISTRATION BRANCH

To: Mr. Manuel

Please:

- ☐ APPROVE
- ☐ SIGN
- ☐ NOTE AND FILE
- ☐ NOTE AND RETURN
- ☐ NOTE AND FORWARD TO: _____
- ☐ COMMENT
- ☐ SEE ME
- ☐ PHONE ME
- ☐ REPLY DIRECT
- ☐ REPLY DIRECT, COPY TO ME

Please Prepare:

- ☐ FINAL REPLY
- ☐ DRAFT REPLY
- ☐ MEMO
- ☐ FOR SIG. OF _____
- ☐ DUE BY _____
- ☐ CONSULT WITH _____

REMARKS:

Will you pls send a copy to the Chief Engineer, Dir. of Two copies to ADM AC with the request that he send one to the Regional Administrator

FROM [signature]

DATE 2-

CANADA

Department of Northern Affairs and National Resources Deputy Minister

Ministère du Nord canadien et des Ressources nationales Sous-ministre

Ottawa 4, May 2, 1966.

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MR. C. M. BOLGER

Mackenzie Delta Research Project - Field Research Personnel

To avoid delay in notifying you of the assignment to field research of the persons noted below, I will list information under the headings noted in the provisional form which was sent to you on April 25. This is not to imply that this format will not be changed if you think it advisable.

(1) Names

Clarence Aasen and Walter Wright.

(2) University Affiliation

Department of Design,
Faculty of Engineering,
University of Waterloo.

(3) Professional Field

Graduate Architects (University of Manitoba) doing post-graduate studies in Regional Planning leading to a PhD degree.

(4) Employment Status

Seasonal positions

(5) Research Project

To isolate and evaluate the social and physical components significant for planning in the Delta.

(6) Location of Field Research

The Mackenzie Delta, with headquarters in Inuvik.

(7) Time of Field Study

May 1 to August 31, 1966.

(8) Liaison with Northern Admin. Branch Field Personnel

Mr. R. M. Hill, (Manager of the Inuvik Research Laboratory) has been asked to introduce researchers to the appropriate local officials.

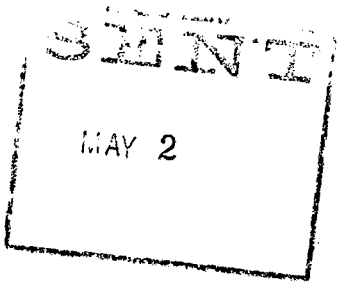
(9) Assistance Needed

Probably access to some statistical information, and time for interviews, at the convenience of branch personnel.

I would be pleased if you could forward this information to the appropriate people in the Northern Administration Branch.

A. J. Kerr,
Northern Co-ordination and
Research Centre

PA-91
3-3
(R.D.)



CHIEF, NORTHERN CO-ORDINATION
AND RESEARCH CENTRE

Ottawa 4, May 2, 1966.

1009-3-16

M.D.R.P. - Preliminary Phase Reports

Your memorandum of April 6th asked for our comments on the four preliminary reports prepared as a result of studies undertaken last summer, with particular reference to (a) validity of data (b) areas where expansion could be useful and (c) misleading or unfair personal references.

I asked Industrial Division to comment on the following three reports:

(1) The Mackenzie Delta - Its Economic Base and Development
(2) Domestic Economy of the Native People - Mackenzie Delta
(3) Technology of the Mackenzie Delta

I asked Engineering Division to comment on "Technology of the Mackenzie Delta" and Welfare Division to comment on "Community Structure - Inuvik - Summer 1965".

The comments received from the Divisions are contained in the following memoranda, copies attached:

(1) From the Chief, Engineering Division, April 20th
(2) From the Chief, Industrial Division, April 21st
(3) From the Chief, Welfare Division, April 29th

I hope these comments and observations will be useful to you. Some, I think, are quite relevant to the points you mentioned. Others are irrelevant, however, in criticizing the reports for leaving out information which I doubt they were intended to include in the first place. Rather than take time to edit these, I am passing along all these comments so that you can make whatever use you can of them immediately. Please let us know if we can offer any other advice or assistance.

~~APPROVED~~

Director

C.M. Bolger/rd

file # 1009-3-16

30-4 X

DRAFT

Technology and the Mackenzie River Delta

Paul Fenimore Cooper, Jr.

This is a draft copy of this report. It is incomplete and all conclusions are to be regarded as only tentative. It is not to be quoted or referred to in this form without the author's express approval.

Contents

The Mackenzie Delta is set apart from the rest of northern Canada in many ways. To the casual visitor, the most obvious is the variety of scenery he finds in a comparatively small area: the typical low delta country of channels, islands, and lakes is bordered on the one side by a line of hills, on the other by the Richardson Mountains - Mackenzie's "snowy mountains" (1) - which afford the traveller a landmark for many miles. The forests at the head of the delta give way, in the north, to gently rolling tundra. Thus, within an area of perhaps fifty by one hundred and fifty miles one can find - in addition to the ever changing river channels - spots strongly reminiscent of the forests of the Canadian shield or of the barren mountains and stretches of arctic coast which are typical of many parts of the Canadian north.

Again in comparison with other parts of the Canadian arctic, this area is one of the richest in renewable resources. The delta proper is an excellent habitat for muskrat and, to a lesser extent, beaver; the tundra to the east has supported herds of reindeer for over thirty years. There are fish and small, though useful, stands of timber. Although these seem too scanty for the needs of the local population, they make the area a good first site to test possibilities of northern development. Here one can find almost all the problems which occur in living in the arctic and sub-arctic parts of Canada while the relative abundance of resources may make it easier to create an environment at least comparable to southern regions in its amenities here than in the more desolate regions farther to the east.

The basic problem of life in northern Canada can be summarized in the words "low standard of living". The resources of the country favour a nomadic life of hunting, fishing, and trapping, which was led by the native population for many years. This way of life has proved virtually irreconcilable with aspirations to enjoy the labour-saving features that characterize present-day life in the south. An impasse has been reached

which seems most difficult to resolve.

In such a situation, a man with scientific training naturally hopes that the various scientific and technical disciplines can offer some help. The "easier life" of the south is dependent, in almost every action, on the advances science and technology have made in the last century. Experience has also shown - as with the DEW line and the Joint Arctic Weather Stations - that it is possible to transfer many of the advantages of life in the south into an arctic environment. As yet, however, this has been successfully done only in circumstances where money can be liberally spent, both in the original development of the site and in its maintenance. Such conditions may arise in military work or in the exploitation of a particularly valuable mineral deposit, but without some such strong reason, there can be no justification for the continuing expenditure of large sums of money to maintain a semblance of southern amenities.

In the writer's view, this is the problem posed by a region like the Mackenzie Delta: with present knowledge, with present resources, one can only hope to maintain a standard of living comparable with the south through a continuous underwriting of many facilities. There are two ways in which science can help solve this problem. First, there must be the continuing search for ways of providing, both cheaply and in small amounts, the facilities which we in the south take almost for granted. This, of course, runs counter to much of southern development; to take a single example, much of the economy of electric power arises from the fact that the demand for it is so huge that it is feasible to build large generating stations. Second, it is necessary to exert constant efforts to develop all possible renewable resources, unpromising as they may seem. We believe that continuing, hard, imaginative work in both these directions forms the only way in which any isolated region like the Mackenzie delta can attain a higher standard of living and take its place as a self-sufficient part of the country.

In this paper we shall consider the present state of the Mackenzie

delta from this point of view. In brief, we shall first survey the natural and social features of the area, for these determine the course of any technological development. As will be seen, although native life has centred more and more on the settlements, there is still a considerable amount of time spent in isolated camps; in subsequent sections we shall consider these different ways of life and try to determine directions of study and research which might result in making them more comfortable and more economic. Finally, we shall return to the question of renewable resources to see if there are any obvious means by which technology might aid in their utilization.

Due to the breadth of the subject, it is impossible for any one person to give more than a superficial summary in dealing with most of the problems that arise; due to the basic nature of most of the inhabitants' needs, it is difficult to produce any particularly original suggestions. The author hopes, nonetheless, that it is useful at least to bring together into one place many of the problems that arise in trying to provide, in this part of the north, the amenities that technology can offer and that his work may be useful as an introduction to more comprehensive and more immediately useful studies.

II

The delta of the Mackenzie River is the seventh or eighth largest in the world (2); it extends about 150 miles from its head, at Point Separation, to the coast of the Arctic Ocean; at its widest, it is some 100 miles wide. There are three settlements on the delta itself: Inuvik, the present administrative centre; Aklavik, the former administrative centre and, originally, a trading post; and Reindeer Station, the headquarters for the reindeer herding project.

In the present study we shall call a somewhat larger area "the Delta" and include three more settlements which do not lie on the true delta. Two of these are to the south: Fort McPherson and Arctic Red River, lying on the Peel and Mackenzie Rivers, respectively, above Point Separation. The third, Tuktoyaktuk, is to the north, and is on the coast some twenty miles to the east of the mouth of the East Channel. In doing this, admittedly, we violate both geographical unity (though McKay (3) holds that Richards Island and the Tuktoyaktuk Peninsula are remnants of older, preglacial deltas) and any anthropological unity*. Nonetheless, by arctic

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* We of course have both Indians and Eskimos present already in Inuvik, but in a more mixed milieu than the Indian settlements of Ft. McPherson and Arctic Red River or the Eskimo one of Tuktoyaktuk. In particular, Smith (4) emphasizes the anthropological difference between the Eskimos of Inuvik and Aklavik and those of Tuktoyaktuk.

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standards the six settlements are quite close together. For many purposes they already are treated as a unit, as with air transportation, in which the main air service from the south goes to Inuvik alone, with the other settlements being fed from there by a local service. We shall come across others; as we shall see, this closeness may also help the overall development of the area in the future.

Returning for the moment to the geographical delta, we can see on a map that although it has some of the familiar triangular shape of a delta,

there is not the typical extension of sedimentary deposits into the ocean, such as is found, for example, in the Lena or Mississippi Deltas. This seems due to a rather low rate of deposition of sediment, which Camsell (5) attributed, at least in part, to the large lakes in the Mackenzie River drainage system acting as settling basins.

On closer examination, however, we find that the true modern delta is not triangular in shape either. Its southern end is not pointed, but quite broad, for it is formed by the junction of the Peel and Mackenzie valleys, and, in fact, the sediments carried by the Peel River have contributed substantially to the formation of this part of the delta (6). The southern half of the delta is confined between the mountains on the west and hills and rolling uplands on the east, and is of almost constant width. North of the Caribou Hills, and separated from them only by a small channel, is Richards Island; the eastern part of this consists of older sedimentary formations with a more rolling topography than the modern delta and again limits it on the east. Thus we find that in fact true "delta country" is confined to an almost rectangular strip, some thirty to forty miles wide, which gradually curves westward as one goes downstream and to a small subsidiary delta between Richards Island and Kittigazuit at the mouth of the East Channel.

The natural conditions of this area that affect engineering techniques and, more broadly, technological development, fall into two broad classifications: the soils and the weather. The nature of the land is important, obviously, in any considerations of road-building or general construction; as is well-known, the Mackenzie Delta offers a variety of problems in this connection.

In the first place, the low lands of the modern delta are, as one would expect, almost entirely silt. The whole region, moreover, is singularly lacking in suitable materials for construction. There are a very few few small riverine deposits of gravel in the delta, of which that at Point Separation is the main example (7). The paleozoic outcroppings at

Inuvik are overlain, farther south, by fine-grained glacial deposits; the same situation occurs in the Caribou Hills. The older pleistocene deposits of Richards Island and around Tuktoyaktuk are again fine sand or boulder clay (8). The gravel beds at Inuvik are the most extensive known in the area; even these do not extend the eight miles from the settlement to the airport(9).

Lack of materials is not the end of the problems any construction must face in this region; in common with most of the rest of northern Canada, the whole delta region is underlain by permafrost. The depth to which the ground is frozen is large - a measurement of about 500 feet has been obtained on Richards Island (10) - and the depth of the "active layer", or of summer thawing, is small, being, in typical undisturbed areas, about one to two feet (11).

Under certain conditions - in particular, when the bearing strength of the soil is the same whether it is frozen or thawed - the presence of permafrost can be neglected. This, unfortunately, does not happen in the Mackenzie Delta. At all the settlements the amount of water in the soil is large; frequently it appears as "ice lenses", or large buried masses of practically pure ice. In such cases, thawing can lead not only to a loss of bearing strength, with consequent settling of any structure, but also to a more drastic slumping of the soil. Heat to do this can be transmitted into the ground in various ways; the two most obvious are constructing a heat source, such as a building, in contact with the ground or disturbing the natural cover of vegetation. Removal of this last disturbs the thermal balance at the surface and leads to a considerable increase in the thickness of the active layer; at Inuvik this increase is to about --" (12). One of the basic problems of construction in a region like the Mackenzie Delta is the prevention of any such transfer of heat.

In Fig. 1 we show the variation of ground temperature with depth at a site in Inuvik where the ground cover has not been disturbed (13). One particular feature should be noted here: the fact that the mean ground

temperature, even just below the surface, is noticeably higher than the mean annual air temperature (about 15° F). This difference also occurs in other parts of the world; it arises primarily from the enhanced ability of the soil cover to absorb and transmit heat in summer, when it is wet, and followed by its increased insulating ability in winter, when it is not only dry but also covered by snow. As we shall see, this temperature difference can be troublesome in making use of the ground as a natural refrigerator; it could, in theory, be put to practical use as a source of heat in the winter, but it is hard to see how this could be done economically.

The direct origin of the permafrost layer is open to debate, but it clearly can be traced back eventually to the cold climate. Not only is the cold and length of the northern winter an influence on almost every side of everyday life, but we must consider other climatic factors - for example the light rainfall of the region. For completeness, we shall briefly run through the most familiar and important features.

The basic factors determining the climate of the Mackenzie Delta are its high latitude and the fact that, although it lies on the ocean, this is a cold, rather than a warm ocean, such as is found in northern Scandinavia. The high latitude means that the sun never attains a great elevation; furthermore, since the Mackenzie Delta lies entirely within the Arctic Circle, there is a period in winter during which the sun does not rise. This region is still far enough south, of course, that there is considerable twilight during this period; even in mid-December there is enough light for several hours of outdoor work. Fig. 2 (14) shows the times of sunrise and sunset and also of the beginning and ending of twilight (as defined in two different ways*) for Inuvik at different times of the year.

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* Civil twilight is the period during which the sun's centre is not more than 6° below the horizon; nautical twilight begins and ends when the centre of the sun is 12° below the horizon. "The degree of illumination at the beginning of morning and end of evening civil twilight is such t

the brightest stars are just visible, and terrestrial objects can be easily distinguished;... at the ~~end~~ beginning and end of nautical twilight (it) is such that general outlines of ground objects are visible, although the horizon is probably indistinct, all detailed operations have become impossible and all the navigational stars can be seen."(15)

The short days and low altitude of the sun mean that the winters are long; in the summer, although the sun is still comparatively low, the days are long and, as a result, warm. The transitions between these two seasons are abrupt. This is put in quantitative form by the average temperatures given in Fig. 3 (16). As a minor point of interest, we can also see in these the small tempering effect of the sea on the climate as we go down the delta from Ft. McPherson through Inuvik to Tuktoyaktuk.

For many purposes, the coldness of the climate can be gauged by the number of degree days*; in particular, these units have proved to bear

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* There are as many degree days in a single calendar day as the number of degrees by which that day's mean temperature falls below 65° F.

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a direct relationship to the amount of heat needed to keep a building warm and are widely used in estimating the amount of fuel needed for heating purposes. Average numbers of degree days per month for Inuvik are given in Fig. 4 (17); Table I gives yearly totals of degree days for Inuvik and, for comparison, more southerly places.

The length and coldness of the winter mean that the river channels and the ocean are covered with ice for most of the year. This is of particular importance in the Mackenzie Delta, where there is no extended road network and where, consequently, life must depend to a great extent on the suitability of the river channels for travel, either by boat or on the ice. Table II (18) gives average dates for break-up and freeze-up; in brief, we can say that there are three and a half to four months, from June to September, during which boat travel is possible. The ice on the river

channels and lakes is generally thick enough for travel in late October or early November and remains so until May.

Other climatic factors which may influence the utility of some technological design are rain, snow, and the incidence of cloudy weather and fog. Fig. 5 (19) gives the average precipitation per month (measured as rain) for Inuvik and Tuktoyaktuk; the Mackenzie Delta shares the dryness of the rest of arctic Canada. Fig 6 (20) gives the average snow thickness on the ground for the same two places. Here we may note two features: there are only four months in which we do not expect a snow cover on the ground, and the average depth of snow diminishes as we go northward from the head of the delta to the coast (21). Due to winds and the dryness of the snow, of course, deep drifts can be formed, and thus these "average" depths do not convey a true picture of what the country looks like in winter.

In Fig. 7 (22) we have the percentage of available sunlight that actually occurs at Inuvik; the summer months are, in general, quite fine weather, especially in comparison with the more overcast nature of the fall months. This condition is typical of the inland portions of the delta (23); along the coast, as we should expect, there is a higher chance of overcast skies and fog. Table III (24) gives some data on the relative incidence of fog at Inuvik and Tuktoyaktuk.

This brief summary touches on the more important features of the landscape and climate of the Mackenzie Delta from our present point of view. Since our purpose in this report is to discuss the applications of technology to the life of the inhabitants of the region, we must go further than a mere physical description of the place, and we shall now try to give a parallel description of the present-day inhabitants of the area.

In the area we cover in this report there is a total population of some five thousand; approximate figures for the various settlements are given in ~~Fig~~ Table IV (25). The first thing to note about the native

element of the population is what we have already noted: the Delta is a meeting place for peoples in the same way that it is the boundary between the arctic and the sub-arctic. The settlements at the head of the Delta - Fort McPherson and Arctic Red River - are typically Indian; Tuktoyaktuk is a coastal Eskimo settlement; both races are present in Inuvik and Aklavik.

The modern history of this region is the story of the shift of the native peoples' habits to those of the southern civilization. This first appeared in the introduction of manufactured goods and a semblance of a cash economy, then more recently in a decided shift from a nomadic life into concentration in the various settlements. Although it is beyond the scope of this paper to go into these matters in any detail, we can in particular see that the settlements have grown up recently enough that, in every case, they still show the purpose which called them into being. A summary of the history is therefore useful in understanding the peculiarities of the various settlements.

In general terms, we can trace the changes in the natives' way of life back to three sources. The first, and to date the most lasting, of these was the introduction of fur-trading. Although Mackenzie travelled through the delta in 1789 (26) and various explorers, including Sir John Franklin, visited it in the course of the next fifty years (27), commercial fur-trading was not established in the region until 1840. In this year Fort McPherson was founded; it was originally some four miles up the Peel River from its present site, which is located on a knoll rising above the surrounding swamps; it was moved here in 1852 (28). In the early years of its existence, Ft. McPherson was frequented both by Indians and Eskimos; toward the end of the last century the latter moved northward, perhaps as a result of the depopulation caused by the whalers' coming. This resulted in the foundation of a second trading centre in 1912, which became the present town of Aklavik.

In one sense, the introduction of fur-trading did not interfere too

violently with life in the Mackenzie Delta, for it did not change the fundamental nomadic life of the people and it did not create the severe economic problems associated with living in the present-day settlements. On the other hand, it did make the local inhabitants dependent on goods imported from the south and it brought the use of money into this part of the arctic long before this happened elsewhere (29).

Fur-trading ~~also~~ thus caused the foundation of two of the present-day communities; the next wave of change had much more violent effects on the people but resulted in no new settlements in our region. This was the advent of the whalers to the Beaufort Sea in 1890. The usual wintering grounds were to the west of the Mackenzie Delta, and thus the only permanent Canadian settlement that resulted from whaling in this part of the world was also to the west, at Herschel Island. The whalers fished the seas of this district out quite quickly; by 1906, at the time of Stefansson's stay in the Delta, there were only a couple of whaling boats left (30). Nonetheless they introduced diseases that led to a virtual depopulation of the Mackenzie Delta eskimos and thus, indirectly, led to a wave of immigration from Alaska, they introduced the wide-spread use of fire-arms, and they left as a legacy many people of mixed blood (31).

Third and most recent is the change from a nomadic hunting and trading economy to a life of which the greater part is spent in a settlement. The beginning of this may perhaps be dated to the foundation of Tuktoyaktuk in 1934 as a trans-shipment centre between river boats and the ocean-going vessels which supply the coastal settlements to the east. The harbour at Tuktoyaktuk has been a favoured place for many years; Stefansson stayed there in 1906-07 (32), and in 1924 Rasmussen counted six houses with a total of thirty-five inhabitants there (33). After it became a transport centre, however, a gradual centralization of facilities along the coast into Tuktoyaktuk occurred: the trading post at Herschel Island was closed in 1938, that at Stanton in 1954 (34). The movement of the Eskimos toward Tuktoyaktuk became intensified in 1954 with the building of the DEW lir

site there, and this last date can be considered a clear dividing line in the coastal Eskimos' change from a nomadic type of existence to a more settled one.

Chronologically, the small settlement of Reindeer Station was the next to be started. This settlement lies somewhat outside the main course of life in the Mackenzie Delta for several reasons. It was founded in 1935 as the headquarters for the reindeer herding project which was then being started (35). As such, it represents an endeavour to exploit an agricultural resource of the region. This it still remains; with the exception of the schoolteacher, the Hudson's Bay Company store manager, and their families, the population consists solely of men who work for the reindeer project and their dependents. As a "company town", albeit on a very small scale, it has a rather anomalous position in the Delta and is somewhat beyond the purview of the present paper. We shall seldom have occasion to refer to it in discussing possible development of facilities in the other towns of the Delta, though, as we shall see, it may play considerable part in exploiting the local renewable resources.

The most recent of the settlements is Inuvik. This town again reflects, primarily, one side of life in the Mackenzie Delta, this time that of government administration. In the early 1950's it was decided that Aklavik - at that time a settlement of about 1500 people - was not suitable as a long-term governmental centre. Aklavik's site is low and subject to occasional floods at break-up; the ground is silty and poor for construction; and there is no site for an airstrip suitable for heavy aircraft (thus, in one respect, Inuvik represents the air-age counterpart to the shipping facilities at Tuktoyaktuk).

At first, it was hoped that it would be possible to create a new town which would replace Aklavik entirely. When it was found that there were no suitable sites for an airstrip on the west side of the delta, however, a location for the new town had to be found on the east side. The hunting and trapping are pooer there; in the end, people with permanent or semi-

permanent wage employment have moved to Inuvik, while Aklavik has gone back to being a centre for people living more off the land.

From the point of view of technology, Inuvik is the most important settlement of the Delta. It was consciously designed to demonstrate the possibility of building a northern town with as many of the features of our urban civilization as possible; this design was realized in a generous manner. Thus, the town stands as a demonstration, a thing which is in itself not unimportant; furthermore, the vast body of experience gained there is of immeasurable use in trying to solve the problem of raising the standard of living in communities where money is not as freely available as it was in the building of Inuvik.

There is another word of caution that must be remembered in using elsewhere the design principles that have been used in Inuvik. This is that Inuvik was conceived, as we have said, as a government centre; its primary purpose was to be to provide schools, a hospital, federal buildings, and the various ancillary functions - housing, a laundry - that these entail. One approach in solving this problem economically is to treat the town as a large industrial plant. This has been done, unquestionably with a large degree of success, but it has resulted in a centralization of facilities that may not be practicable elsewhere and also in a certain lack of flexibility in expansion. One must always remember this, both before hastening to criticize the town and before making a carbon copy of its facilities for use elsewhere.

In more general terms, we note that Inuvik has created employment, both during its construction and later; thus it has contributed, in the same way as the building of the DEW line stations, to teaching the natives of the delta to live in towns. The economic basis of the life of the native inhabitants is treated elsewhere (36); nonetheless, the present tendency towards living as much as possible in the settlements is obvious and is one that has great bearing on the technological provision of facilities. It is true, of course, that steady employment is available

primarily in Inuvik alone. There are very few jobs elsewhere, and as a result the majority of the people in these other settlements have to live, in part at least off the land*. This situation will, in the writer's opinion, last for many years; we shall therefore consider in some detail possibilities of making such a life easier. On the whole, though, the trend towards living in settlements seems irreversible; it is a process that has only been quickened, by such projects as the construction of Inuvik and the DEW line station at Tuktoyaktuk; that it will probably continue must be borne in mind in any thinking about the future of the delta. The greater part of the following chapters will be spent in considering features of this type of life.

* As an example, it has been estimated (37) that approximately 60% of the population of Aklavik goes trapping for an average of five weeks in the spring of each year; about 40% may go fishing during the period mid-August to freeze-up.

Before proceeding to the discussion of various utilities, it may not be amiss to pause and summarize the general appearance of the delta. This can, perhaps, be done through describing an airplane flight the author took across the delta, from Aklavik to Inuvik, late one winter afternoon. As he left Aklavik, the mountains of the Richardson range were hidden in the clouds behind him. Below him lay the delta with its dark spruce trees contrasting to the white of the ice-covered channels and lakes. Across the delta could be seen the row of hills which line its eastern side; below these sparkled the lights of Inuvik. Far to the north the lights at Reindeer Station were just visible. Beyond the horizon, a hundred miles to the south, were other spots of light - ~~the oases of~~ Ft. McPherson and Arctic Red River; to the north, Tuktoyaktuk lay on the shore of the frozen sea.

In many ways, these towns are isolated and primitive; in some, remarkably advanced. These are the details we must now turn to.

III

In broad terms, the principal ways in which technology has made our every-day life easier are obvious. Probably the most fundamental is the cheaper provision of heat and light. Electric power has become a vital extension of these, and, particularly in cities and towns, we rely on convenient water supply and sewage disposal. The development of cheap and easy methods of insulating buildings is important in any cold climate. Other general advantages have come from economic, quick transport, and, more generally, from the possibility of rapid communication between places at some distance from each other. Beyond this we get into peripheral, though still important, matters - technological aids in the provision of better medical service is an example - and then to the many ways, of which movies and television are the most obvious, in which technology has contributed to the spending of leisure time.

This last is beyond the scope of the present paper; even so, a coherent description of the present development of the other facilities is difficult. There are two main sources of confusion. First is the striking division in the extent of available amenities between the administrative and technical people who are in the district for a relatively short term and the native population. In every settlement government workers enjoy a way of life that is, in reality, quite comparable to that in the south; the native population, in the main, does not. The width of this division is clear to the tourist, no matter how short a time he spends in the district; the sociological results are equally obvious, and are treated in some detail in accompanying papers (38). We shall see that, at present, it would be difficult to extend the availability of these utilities to most - not all - of the population without continuing wholesale subsidization, of which the present proposed subsidization of electricity is but a single example. The writer feels that the only suitable long-term solution for a region like the Mackenzie Delta is for it to be substantially self-sufficient; this, of course, is the general problem of

which the engineering problem of discovering cheaper ways to make such facilities available is but one side.

Further confusion arises from the fact that it is not practicable to separate facilities into water-tight compartments to make their description easy. Even in the south, of course, this cannot be done completely; as an example, the problem of heating buildings is obviously intimately bound up with that of insulating them. In the north, this overlap extends further. Let us take another example, the laying of water and sewer pipes. In the south one digs below the frost line and lays the pipes in whatever way is most convenient. In the arctic it is impracticable to dig below the permafrost; pipes would quickly freeze if laid in permafrost without precaution. One solution is to enclose the water supply pipes and sewers in a single, insulated box, which has some provision for being heated. This is called a "utilidor"; such systems are in use in the two towns of the Mackenzie Delta that have year around water systems. In Inuvik the heating system is included in the same unit; in Russia the same general approach is used, but with the addition of the electric supply cables.

Nonetheless, it is still possible to make a fairly straight-forward description of the extent of the development of these various "basic" settlements of
utilities in the/Mackenzie Delta; in the remaining sections of this chapter we shall do so and, at the same time, to point out places where future study might best be concentrated.

1. Heat.

It is obvious that it is harder to heat buildings in the north than in a more temperate region. As we have already mentioned, we can put this observation on a more quantitative basis with the use of degree days; as Table I shows, it would require - other things being equal - nearly three times as much fuel to heat the same house in Inuvik as in Montreal.

The basic contribution of technology to the problem of heating has been to make fuels - coal, oil, natural gas - readily available and easily

usable. Oil is produced at Norman Wells, 385 miles up the Mackenzie River from Inuvik; together with wood, it forms the basic fuel for the Delta. Beyond this point, however, heat is produced in various ways. The most complex system is that at Inuvik: superheated water is produced in the central plant and distributed to the buildings forming the core of the town: the school, hostels, government housing, the hotel, stores, and administrative buildings. As we have said, this heating system is also used to heat the utilidors, as can be seen from the cross-section of one given in Fig. 8. Heat exchangers in the separate buildings furnish individual sources of heat.

Elsewhere in the region - and also in that part of Inuvik which is not reached by the utilidor - heat is principally furnished by oil burners of various types. Forced air systems and such conventional equipment are found in government buildings throughout the area; heating systems range from these through oil ranges and space heaters to the home-made stoves used in some of the native housing. Wood is also used to a limited extent, even at Tuktoyaktuk, where there is a fairly plentiful supply of driftwood along the coast. Recent information (39), however, indicates that this last source of fuel is being used up faster than it is being replenished.

The basic drawback with oil heat in the Mackenzie Delta is the high cost of the oil. Although the region is fortunate in being situated less than four hundred miles from a refinery, and so there are not the high transport costs that occur in other parts of the Arctic, oil is not cheap by southern standards. For example, the retail price of fuel oil at Inuvik is $0.35 per gallon (of which transportation accounts for about seven cents); at Tuktoyaktuk it is $0.45 a gallon. Thus, in cost the difference between heating a house in Montral and a similar one in Inuvik is not the factor of two and a half or three that would appear from the difference in the number of degree days, but more nearly a factor of seven to nine. Even a small house, accordingly, is expensive to heat. As an example, a small (16 ft by 28 ft) well-built log house at Tuktoyaktuk is

estimated (40) to need about 1350 gallons of fuel oil for one year's heating, at a cost of over $620.00.

The problem of lessening the expense of heating is probably the single most important of those faced by technology in the Mackenzie Delta; it is also the most difficult to solve. There are, of course, various ways of reducing the price of fuel oil, in particular by reducing the cost of transport. In a similar vein, one can reduce the amount of building insulation, within the limits imposed by the added costs of construction. Both of these we shall return to later; the figures given above, however, are sufficient to show that it would be difficult, by such means, to reduce heating costs to a point where they became competitive with those in the south.

A different approach is that used in Inuvik. Here, by combining the heat loads of many buildings into a central power plant, it has proved feasible to use a lower grade of oil. This residual oil is available, wholesale, at $0.17/gallon rather than the $0.276/gallon that fuel oil costs there (40). This is a substantial saving; as a further advantage, bringing all the heating units together into one place substantially reduces the risk of fire.

The arguments against the value of such heating plants as a standard method of heating settlements are obvious. In the first place, as we have pointed out already, such a plant is comparatively inflexible in design; as experience in Inuvik has shown, it is not easy to make the continual extensions to, and changes in, service that a town would require. Furthermore, the costs of the heat distribution system are high; at Inuvik, it represents over 30% of the costs of the utilidors (41). There is a substantial heat loss in the Inuvik utilidors; though much of it might be eliminated by more careful - and possibly more expensive - design, a certain amount of loss is inevitable. All these factors act to reduce the advantages of a cheaper fuel.

The only way out of this situation may well be to find an alternat-

source of heat energy. One such avenue of escape might be the discovery of extensive oil fields in the Delta, though the evidence from Norman Wells would not cause one to be too sanguine about this affording a substantial reduction in price. Another possibility is that of using hydro-electric power for heating. We shall have occasion to mention this again below; here we can observe that one gallon of diesel oil contains about 46.5 kwh of heat energy, so that even under the most favourable circumstances - at Tuktoyaktuk - electricity would have to cost about one cent per kwh to compete with fuel oil for heating. The capital investment in a hydroelectric plant is so large, the settlements so scattered, and foreseeable electric demand so small that such a rate seems unlikely. Finally, one might think that the peat found in the region might be of value as a fuel, but the climate is too cold to produce useful peat for such purposes (42). All things considered, the writer feels that this problem is very difficult of solution on an economic basis.

There is, however, one side of the heating picture which seems more amenable to further study. This is the utilization of the waste heat arising in the generation of electricity. At present almost all the electric power used in the Mackenzie Delta is provided by diesel generators; these are only between 30% and 35% efficient in converting the heat content of the fuel into electricity. The remainder is dissipated, with about half the heat going into the exhaust gases and the other half into the coolant. Unfortunately this heat is not in a particularly accessible form; the exhaust gases in particular are not at a sufficiently high temperature to be of much use in producing steam. It is quite conceivable, though, that usable heat for certain buildings or for some agricultural scheme might be obtained from the exhaust or by a heat exchanger through which the cooling water passed.

2. Light and electric power.

In temperate regions electricity has come to be one of the most indispensible features of everyday life. For lighting purposes alone, it

is even more desirable in a land with month after month of short winter days, though one cannot underestimate the value the native peoples of the Delta set by electric appliances*. Here again economic factors work

*An indication of this can be seen in the requests for electric power made at Tuktoyaktuk in the spring of 1965 (42). In these applications, people listed the various appliances they would like to be able to use; in thirty-four applications, the following main items appear (not including, of course, the universal desire for electric light): washing machine and electric iron (21 times each); radio (18 times); hot plate (14); phonograph (13); other items which were listed several times included electric coffee pots and electric fry pans.

to make electricity a high-priced item and to deepen the division between the government workers, who have an adequate supply, and the natives who have little or none.

Every community has electric generating equipment. With the exception of Inuvik, diesel power is universally used; Inuvik has both diesel equipment and a steam turbine. The size of the various power plants is given in Table V, which also gives the rates for the purchase of electricity for domestic use. These are high by city standards; 60 kwh of electricity a month (using a low figure to cover lighting and small appliances alone) cost $5.10 at Inuvik and $7.20 at Tuktoyaktuk, compared with $1.59 at Montreal, $1.67 at Ottawa, $1.64 at Winnipeg, and $2.21 at Vancouver (43; these are 1962 prices for the southern cities). Such a comparison is not fair, of course, because of the vastly larger and more economical systems possible in a densely populated, highly industrialized area; these large systems have made the extension of cheap power into the rural districts of the south possible. A more valid comparison is with similarly isolated settlements. An interesting example is the Nantucket Gas and Electric Co., on Nantucket Island, Massachusetts, U.S.A. Here, for the same 60 kwh per month, the cost would be $6.40 during the winter months (Oct. 1 to May 31

and $11.93 in the summer (44). The situation in northern Alberta is similar. The generating station at Fairview, Alta., has a capacity of 10,200 kilowatts; for residential purposes, 60 kwh per month costs $4.30. The plant at Jasper has a total capacity of 4080 kilowatts, and 60 kwh per month would cost $4.70 (45). These figures allow us to see the Mackenzie Delta prices in better perspective: they are not out of line for the size of community they pertain to.

Another basis of comparison is with the alternate way of obtaining light: gasoline lamps. Even if electric power costs $0.12 per kwh these are an uneconomic form of illumination - at Tuktoyaktuk a gallon of white gas costs $0.85; this will run a single burner Coleman lantern (Model 200A, approximately equivalent to a hundred watt incandescent light) for 56 hours, or a double-burner one (Model 220F, equivalent to between 100 and 200 watts in an incandescent bulb) for 43 hours (46). It costs $0.67 to run the one hundred watt incandescent light for 56 hours at $0.12 per kwh.

We must not, of course, be misled by these figures into thinking that electricity is not a luxury in the Mackenzie Delta. For the native population, the price is high. Partly as a result of this, and partly due to the fact that it is not feasible at present to supply electricity to everyone who wants it*, the use of electric power is, by and large, limited

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*This is particularly true at Tuktoyaktuk; the distribution system there is inadequate to supply anyone beyond a small distance from the generating plant.

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to the white population. Inuvik is an exception; there almost every house in the settlement has electric service. In Aklavik, on the other hand, there are a total of between thirty-five and forty private customers, not including the two missions nor the Hudson's Bay Company store; of these only nine can be described as "non-government non-white" families (47). At Tuktoyaktuk the only non-government users of electricity are the Hudson's Bay Company and the Anglican and Roman Catholic missions.

This problem is only less serious than that of the cost of fuel for heating in the respect that heat is a necessity of life in the arctic, while electricity is but a luxury - although one by which people set great value. In the short term future, as we should expect from the above comparison with isolated places in the south, there seems only slight hope for radically cheapening the cost of power.

For the sake of completeness, we can briefly consider the other means currently available for generating power. The nearest direct competitor to a diesel generator is a gas turbine generator. It is not economic to build turbine generators as small as diesels - the lower end of the practical range for a turbine generator is about three to four thousand kilowatts - so they would not be suitable for the current demands of any settlement in the Delta other than Inuvik. Gas turbine units have two main advantages: they can have a relatively low capital cost per kilowatt of installed capacity (46), and they require comparatively little maintenance. Set against these are two disadvantages. First, they have a lower overall efficiency than a diesel generator. At peak load, a 3500 kw gas turbine generator has an efficiency of about 20%, compared to the 30% to 35% of a diesel unit; in this connection, we must remember that the efficiency of a diesel generator is about the same as that of a large steam-powered generating station. This loss in efficiency is counterbalanced to a large extent by the fact that the exhaust gases are at a much higher temperature (about 900° F at full load) so that they can be used in a waste heat boiler. Again considering Inuvik, we might be able to substitute a gas turbine generating system for the diesel generating system and part of the steam generating equipment at approximately the same efficiency.

At this point, we run into the second disadvantage: the steam boilers at Inuvik, as we have said, run on a residual oil, while gas turbines, although they can run on diesel oils or similar distillates, cannot at

present use the heavier residual oil with its corrosive elements. As has been mentioned above, there is a considerable saving in expense in the use of this residual oil, and, accordingly, it is difficult to see how gas turbine generators could prove very useful in the Mackenzie Delta under present conditions.

Atomic power is another means of generating electricity, and one which seems to sum up in its name much of the wonder of modern technology. Unfortunately it can be immediately ruled out in the present application on the basis of size. In the south, atomic power plants become competitive with other types of thermal generation only when the amount of electricity produced is in the range of hundreds of thousands of kilowatts. The foreseeable market for electric power in the entire Mackenzie Delta is, of course, nowhere near this level. The lack of economy of small atomic power plants can be seen in the results of a study prepared with specific reference to Frobisher Bay (47; although this study was done in 1960, technological advances made since then seem only to help in the design of much larger reactors). Among the conclusions of this study is the opinion that, under the most favourable circumstances, a five thousand kilowatt atomic plant might compare with a diesel plant if oil cost $0.28 per gallon or more; a twenty-five hundred kilowatt atomic plant might be competitive if oil cost $0.48 per gallon.

A third alternate way of generating electricity is through the direct conversion of heat to electric power. This has, as yet, been done on only a small scale, and does not seem to hold much promise for supplying the needs of even a small settlement. It might have application in a single camp; we shall ~~therefore~~ discuss ~~it~~ This in the next chapter.

Although alternative means of generating power thermally do not seem to lead to cheaper electricity, there are some means by which it might be possible to reduce its cost. It is obvious that substantial reductions in the cost of power are possible at present only if some degree of centralization can be produced. ~~Both~~ Neither the overhead in operating a power

plant nor the number of men required to operate it increases in direct proportion to the number of kilowatts generated. The extent of this is shown in estimates (48) on the size of operating crew needed for plants of different sizes: for a plant smaller than 250 to 300 kilowatts, three or four men are adequate; above this size, one should have five or six, and more men are needed only when the plant gets above 1000 kilowatts capacity. In other words, small diesel plants may spend considerably more on salaries and wages than on fuel; this is indeed the case in many of the settlements of the Northwest Territories*.

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* The followings are figures for the fiscal year 1963-64: The diesel plant at Ft. Smith (2250 kw capacity) spent $74,813 on salaries and wages against $85,419 on fuel; that at Ft. Simpson (1075 kw) $49,536 on salaries and wages and $25,487 on fuel; and that at Ft. Resolution (325 kw) $22,544 on salaries and wages and $8,519 on fuel (49).

The obvious way in which centralization could be effected is by constructing transmission lines between the various settlements. Admittedly, this would be an expensive undertaking; still, crude calculations - the only type possible because of the uncertainties involved - indicate that, with present usage, it might be competitive with present rates to furnish power to Aklavik over a transmission line from Inuvik, and that, if the Aklavik usage were doubled, it should probably be so. The situation is much less favourable with the other settlements, due to the greater distances and, at Ft. McPherson, the continuing need for some sort of local plant to heat the hostel. Nonetheless, the possibility is intriguing and deserves further investigation.

A more radical centralization scheme would include building a hydroelectric plant. Sources of hydroelectric power exist in the region (50); in addition to the savings in having a single plant, this would, of course, mean that the expense of the diesel fuel would be cut out. At present this is a comparatively small fraction of the total cost of elect-i-

power (it contributes about $0.02/kwh at Inuvik and perhaps $0.03/kwh at Tuktoyaktuk), but with any reduction in overall price it would become more important, since it is a base price which can never be reduced with the current system.

Although hydroelectric power may be a long-term solution to the problem of expensive electricity in the region, the construction of the requisite dam alone would obviously be a great expense. It would probably be as much of a subsidization, although occurring all at one time, as the present scheme for direct payments to reduce the cost of power. Here again, however, it would still seem valuable to study the matter further so that a usable comparison between the two systems could be produced.

3. Water supply and sewage disposal.

In most temperate regions, small communities do not need a system of water supply and sewage disposal; individual wells and means of waste disposal such as septic tanks are adequate. In northern regions like the Mackenzie Delta the problem is vastly more complicated. One cannot, in practice, drill wells for water*, and so even the smallest settlement must

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* In principle, of course, one can drill through the permafrost layer; the Russians have done this on occasion (51) and have found the water so obtained to be heavily mineralized - for example, a sample from Noril'sk had 2700 ppm of dissolved minerals.

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depend on surface water, with its concomitant problems of contamination and transport. Septic tanks with leaching systems are not practicable due to the permafrost. Waste water accumulates during the winter months in grey glacier-like formations. Finally, one can not use conventional piped water supply and sewerage systems, for unheated, uninsulated buried pipes would quickly freeze.

In this field, then, the basic problem is that the community, no matter how small (and consequently, no matter how little money is available for

such purposes) is faced with providing water supply and sewage disposal services by means which are almost always unconventional and frequently may be very costly. This problem has three parts: obtaining water in sufficient quantity for the needs of the community, the ultimate sanitary disposal of wastes, and the provision of an economical system to make these facilities available to the inhabitants. For the sake of clarity, we shall discuss each of these in turn.

a. Water supplies. Fortunately, the Mackenzie River is sufficiently large and the population along it sufficiently small that it furnishes a handy and unpolluted source of water for the communities of the Delta; it would be strange if most of them did not use it in one way or another.

Inuvik and Ft. McPherson use lakes as reservoirs, but at Inuvik the lake is kept full by pumping water up from the river. Both these settlements have water treatment plants. Aklavik also uses a lake as a reservoir, but only in the summer. Here, the lake is flooded every spring by the river; again, there is provision for filtration and chlorinization, though its use seems rather intermittent (52). In the winter, ice blocks are cut from the river and used as a supply of water; this ice is also stored in ice-houses and used as a summer supply of drinking water for the government employees.

Arctic Red River and Reindeer Station use river water directly, though some thought has been given at the latter place to using a lake on the hill behind the settlement as a source of water for a pressure system. Finally, the situation at Tuktoyaktuk is quite similar to that at Aklavik. In summer, water is taken from a lake and chlorinated before distribution. In the winter, water for the government employees is taken from the harbour (although Tuktoyaktuk is on the ocean, it is sufficiently near the mouth of the Mackenzie that the harbour water gradually becomes fresh in the winter, when mixing of the water by the wind is prevented by the ice); the natives again cut ice.

In brief, availability of water is no problem at any of the settle-

ments, nor, in general, is treatment to ensure that it is safe for drinking purposes.

b. Waste disposal. The most sophisticated form of ultimate disposal of sewage used in the region is the sewage lagoon; even these are rather rudimentary in comparison with those used in southern Canada (53). Such lagoons are used at Inuvik and Tuktoyaktuk; essentially they are used as storage ponds, with periodic cleaning out under conditions that would not influence the settlement's water supply - at Inuvik during the spring floods, at Tuktoyaktuk by heavy storms.

At Ft. McPherson a lake is used for disposal purposes, with reliance put on dilution; Aklavik has a rudimentary form of lagoon, which again is flooded in the spring. In the winter sewage is disposed of at Aklavik by being put on the river ice and left until spring (54). The smaller settlements have no organized facilities.

Waste water disposal is a serious problem outside the central serviced areas of Inuvik and Ft. McPherson. Aklavik has a system of open drains, which furnish moderately satisfaction in the summer. In general, however, waste water is dumped on the ground. In the winter, as mentioned above, it freezes and accumulates, leading to the spring-time production of unsightly puddles which are gradually dispersed by rain.

This problem of waste water is obviously directly dependent on the problem of sewage collection; apart from it, we see that - again due to the isolated nature of the settlements - it is possible to dispose of sewage in a reasonably satisfactory manner. As Yates and Stanley point out (55) further study on the problems of sewage lagoons in the north would be useful for more rational engineering design, but under the circumstances present in the Mackenzie Delta this does not seem particularly pressing.

c. Water distribution and sewage collection. We are left with the problem of making the water conveniently available to the inhabitants and of providing for the easy removal of sewage and wastes. This is the most

difficult side of the whole question, and one which has, so far, resisted solution in a sufficiently cheap form to be of wide application. In northern Canada, there have been two general approaches to this problem: supplying water and removing sewage by truck or constructing an insulated system to which heat is supplied in some form and which contains both the water supply and sewerage systems. Both of these general approaches are in use in the Mackenzie Delta.

The more satisfactory of them is, obviously, the use of piping systems. For economic reasons, however, this is generally much harder to justify; as a result, the two systems of this type - the so-called "utilidors" at Inuvik and at Ft. McPherson - are limited in their extent and serve only the part of the towns used for governmental purposes. Since both these systems are above ground level, they form a highly visible sign of class distinction. The following description may show why they are so expensive and also some of the difficulties that arise in their use.

The Inuvik system is both the more extensive and the more complicated. As we have already observed, in it heat is supplied to the water and sewer pipes by enclosing them in an insulated box with the pipes containing the building heating water (Fig. 8). Although this system is expensive - the utilidor proper costs about $224 per foot (56) - it has worked quite well. Various technical problems, to be sure, have arisen. In particular, it was necessary to build the utilidor with the heating pipes above the water supply pipes in order to keep the drainage points on the buildings - and, consequently, the height of the piles on which they rest - as low as possible. In the winter, pronounced stratification of the air mass inside the utilidor takes place, with the colder air settling to the bottom. Furthermore, strong convection currents are set up in sloping sections, which frequent baffles cannot entirely stop. The immediate result of these was that the water supply and sewage pipes did not receive as much heat as expected, and it was necessary to remove insulation from the heating

pipes in places to keep the water pipes from freezing. A further consequence has been large losses of heat; under certain circumstances, it is estimated that 20% of the heat produced in the central plant is used in heating the utilidor (57).

A minor inconvenience of the Inuvik utilidor is that it is impossible to supply cold drinking water, particularly in the summer. This shortcoming is the subject of many complaints.

On the whole, though, this system works quite satisfactorily, particularly in the short sections ("utilidettes") which join the main structure to the individual buildings. These have their own source of heat and are not liable to freezing. This last is a particular drawback of the other utilidor system in the Delta, that at Ft. McPherson. Here we have a considerably less ambitious and cheaper venture. The utilidor (a typical cross-section is shown in Fig. 9) contains only pipes to supply water and remove sewage. The water supply line runs in a loop, through which water circulates continuously; in this way heat is supplied to keep the water and sewerage systems from freezing. The connecting lines to the houses, however, do not have an independent heat source, so it is possible that they will freeze if water is not used in a building and, consequently, there is no flow through them.

The alternate method of supplying water and removing sewage, trucking, is most developed at Tuktoyaktuk. There the government housing has individual pressure systems: each house has a 180 gallon water storage tank, which is filled twice a week and provides water at 20 to 40 psi pressure. There is also a 500 gallon waste tank in each system. Even this system, however, does not extend to the native population, but there are three 700 gallon water tanks in the settlement which, during the summer months, the Department of Northern Affairs keeps filled as public sources of water.

A more or less similar system is planned for Aklavik. At present there is only a summer water supply system: a run of 3" pipe, laid on

the surface, with taps at frequent intervals. This is fed, through a pressure tank, from the lake described above. In the winter the system is shut down; even so, considerable trouble has been had with crackage in the pipes (58). This is being refurbished, and it is currently planned to install water tanks in heated quarters at three points in the settlement to furnish a source of water during the winter.

In general, trucking water for the native population seems not to have been too successful, for they would rather get it themselves than pay for a truck to bring it. It is still used quite widely in the unserviced area of Inuvik, however; there there is also a provision of central pick-up points for the disposal of waste from chemical toilets. In Ft. McPherson, on the other hand, the only public supply of water is a tap at the central power house.

Apart from what has been described, sewage disposal is at a rudimentary level. The practice at Aklavik is perhaps typical: there it consists of lining bucket-type toilets with plastic garbage bags, and eventually tying these up and putting them with the other sewage. The use of these bags certainly cannot be criticized in that they make an unattractive job somewhat less so, but, as we shall remark later, their ultimate sanitary suitability is open to some question.

This description is sufficient to show the complexity of the whole question of water supply and sewage disposal. In the writer's opinion, it seems clear that the only long-term solution which will compare with southern facilities is the development of the cheapest possible piped systems. Trucking water has advantages, especially in the smaller settlements; but experience seems to be showing that the extra convenience this may bring to the native population is not considered by them to be worth any expense. There is some hope that year around running water and waste removal would not produce the same reaction.

There are several problems connected with the design of such piped systems, or utilidors. A large part of the design, of course, is dictat...

by local conditions, such as the terrain on which the townsite lies (if one intends to use gravity flow sewers) or available sources of heating, so it is impractical to generalize too much. On the other hand, it is interesting to contrast the various types that have been tried and to see what might be of future use in the Mackenzie Delta.

By and large, practice in climates comparable with that of the Mackenzie Delta has been to put water supply and sewerage systems in the same container, usually insulated, and to supply heat, either to both lines, or to the water line alone; in this last case, enough heat must be transferred from one pipe to the other to keep it from freezing. Various sources of external heat have been used: at Inuvik, as we have seen, it is provided by the pipes which carry the building heating water; at Norman Wells (59) heat is similarly provided by a steam line. Elsewhere the pipes have been heated electrically (60).

A second approach is to heat the water at the input of the system; at Vorkuta and Noril'sk in the U.S.S.R. this is accomplished by using the cooling water from the power plants for the city water supply (61). Again, there are different means for ensuring continuous flow to keep the whole system above freezing. One is to bleed the system, as is done at Dawson (62), and, in the U.S.S.R., at Tiksi (63). Such a practice is inevitably more or less wasteful of water; at Tiksi 50% of the settlement's water supply is wasted through the drains.

A more economic system is to have a recirculating water line and to add heat in the supply plant as required. This is what has been done at Ft. McPherson. An interesting extension of this scheme is to have a recirculating system both in the water supply and sewerage systems, as is planned for installation at Frobisher Bay (64). There, it is planned to have septic tanks (which will have to be cleaned periodically) in each of the houses served, and to pump the effluent from them into the sewage line. The advantages of such a system are considerable: there will be no need to worry about adequate heat transfer to the sewer line; of more importance

for many applications, the need to design the sewerage system to allow gravity flow will be removed. The detailed behaviour of this system will inevitably have great influence on the design of future water and sewerage systems in the Canadian north.

Apart from this, though, there are various questions of immediate consequence for the Mackenzie Delta. One is the problem of ensuring sufficient heat gets to the sewer in a system where it does not contain its own heat. One solution to this might involve the use of thermal connections, such as metal straps, between pipes, though these would have to be used with metal pipes (or plastic-clad aluminum pipes); such a scheme would be useless with the transite pipes used at Inuvik. Another is the finding of means to reduce the stratification of the air in the utilidor at Inuvik - one answer to this, of course, is to fill sections of the utilidor entirely with insulation, as was planned for the utilidor extension at Norman Wells, though the thermal results of such an expedient are not clear. All these are aspects of the larger question of providing adequate heat transfer between the pipes of the utilidor with minimum losses to the exterior. Another side of this question is the search for cheaper insulating materials; insulating with moss has been suggested and is used in more southerly environments (65), and has been suggested, in combination with electric heating of the sewer, for Tuktoyaktuk (66), but the possible value of either of these in the Delta does not seem to have been critically investigated.

A second important question is the practicability of burying utilidors in soil conditions such as those of the Mackenzie Delta. There are considerable advantages in having the utilidor on or above the surface. In the first place, as we have seen, the ground in the region loses its bearing strength if thawed. It is, of course, possible to design a buried system in which the heat loss to the ground is so small that it would not disturb the permafrost conditions, but it seems never to have been tried; little, in fact, seems known about the rate at which pipes would lose hea

under these conditions. A second cause of trouble with a buried system would be the insulation. This would be necessary, and there is the matter of preventing it from becoming water-logged. Expanded ~~polyethylene~~ polystyrene might be an aswer to this, but, again, its performance in actual practice is unknown. These are serious points of uncertainty; combine them with the ease of getting at a system like the present ones for extension or repair and we have ample justification for the current above-ground systems, which, it seems are also used by the Russians under similar conditions (67).

On the other hand, an underground system has aesthetic advantages and is more convenient in such matters as the extension of roads. It also would profit to a great degree from the insulating qualities of the ground. These advantages would seem large enough to make it worth while to re-examine the questions raised in the last paragraph ~~and~~ to see if, with present-day knowledge, it might not be possible to produce a usable underground system, and to compare such a system with above ground ones for cost.

Before we leave this part of our subject, we should return briefly to the use of plastic garbage bags in bucket-type toilets. The disadvantage of these lies purely in the fact that the plastic not only provides an impermeable container but also one which seems very long lived. Their use might therefore be a potential source of disease. For this or similar reasons, some trouble has been had with them at Rae (68). Their use has such obvious advantages, however, that it seems a search for some material which would serve as a toilet liner and yet not have the potential disease carrying ability would be extremely useful.

4. Housing.

Technological research has made great contributions to the problems of housing in the Mackenzie Delta, particularly in showing methods of construction on permafrost. There are other fields in which it still can be of great utility, though, as we shall see, the direct relation of these to present conditions may be somewhat uncertain.

Speaking in broad terms, the technical problems of building construction in a region where permafrost is present are known and can be dealt with. As we have mentioned above, as long as the frozen soil remains frozen, we have no problem with bearing strength; it is only when it thaws that one runs into trouble. The solution to this is thus simply stated, regardless of the difficulties that may arise in its application: one maintains the ground as nearly as possible in its original state; in other words, do not damage the natural surface layer, if this can be done, and avoid having extraneous heat, as from a warm building, entering the ground.

Two ways have been used to accomplish these ends, both in the Mackenzie Delta and elsewhere. The more elegant is to support the building on piles. If these are set into the ground and allowed to "freeze in", ample bearing strength can be obtained. By leaving a free airspace between the bottom of the building and the ground the heat transferred between the two is diminished greatly. This method has been widely used in construction at Inuvik, apparently with virtually complete success. There has been a minimal amount of difficulty with the piles used in the construction* and none with building settling.

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* The few piles that have shifted seem either to have been in places where water could accumulate or in positions where they bore abnormally light loads, as in the utilidor system (69).

Setting piles is, however, an expensive procedure. An alternate and cheaper solution is to put a layer of some insulating material - typically a gravel pad - on top of the natural soil cover and use this as the foundation for the house. This method, of course, does not produce as great bearing strengths as piles do, but it is entirely adequate for small buildings, in particular low cost housing. For our present purposes, accordingly, we can consider the provision of suitable building foundations a minor matter. The design of large buildings is something else again, and the detailed nature of the ground at the site must be considered -

but then the design of large structures is a problem in any part of the world.

Another broad technological problem in northern housing construction is that of avoiding the loss of heat wherever possible. The most straightforward approach to this is to avoid building individual houses and to combine dwellings as far as possible into apartment houses. By so doing the proportion of each unit which consists of outside wall is reduced, and, consequently, so is the amount of heat lost to the environment. It also becomes possible, in general, to use a more efficient heating plant.

Such an approach is, of course, used by the Russians in their northern cities; it is also common practice in military-type installations. It is doubtful how well it would work in any part of Canada; certainly at Inuvik, where there are apartments of varying sizes in the government housing, the single houses have a higher prestige value. The ghost of regimentation hangs over the draconic suggestion of combining the houses of each settlement into a few apartment buildings; it seems of little practical value. Some slight, but probably more acceptable, progress towards the same end can be made by making detailed arrangements of buildings in compact groups to take best advantage of winter sunlight and to afford the most protection in storms; again, a great deal of work on these lines has been done in the U.S.S.R. (see, for example (70)). This, however, belongs more to the field of town planning and is beyond the scope of the present paper.

The remaining way of reducing heat loss from buildings lies in their detailed design. In the building industry, the end result of such technological study has been, in the field of low-cost houses, to produce prefabricated buildings. In these attention has been paid to providing as good insulation in the walls and as tight windows as possible; in addition, the benefits of mass production can be turned to the production of a good quality product at the lowest possible cost. Such housing is extremely useful in most of the Canadian arctic, where building materials

are at a premium. Prefabricated houses can easily be imported by boat, or, if necessary, by air, and assembled and put into use with a minimum of labour. In the eastern and central arctic this seems the only way to provide low cost houses of good quality.

In the Mackenzie Delta, the situation is different; in particular, there is a fair supply of local timber ~~with~~ of suitable quality for such housing (71). Nonetheless, prefabricated houses seem generally preferred, particularly at Inuvik, and are again imported from the south. Presumably the reason for this is that in this way the owner gets a building which is better made and "tighter" with a minimum of effort; in other words, he is depending on the technical knowledge and experience available in the southern construction companies. Unfortunately this type of technology does not seem aimed at contributing in a broad way to the economy of the native inhabitants of the Mackenzie Delta.

The basic problem here seems the continuing encouragement of local construction of good quality; this lies much more in the fields of administrative direction and education than in that of technology; we shall accordingly limit ourselves to a few comments. One is to mention the building of log houses. This has already been tried in various settlements in the Delta but seems capable of wider use. Of course, insofar as it relates to technology at all, building log houses does so at a much more primitive level than the other subjects we have been discussing in this paper. About the only engineering statement it seems worth making about such buildings is that wood is a fairly good insulating material - it transmits heat only about two and a half to three times better than standard commercial products like rock wool. Thus logs, if thick enough, can furnish entirely satisfactory insulation. Log houses may be somewhat primitive in appearance, but if well built they are quite satisfactory for housing at about the lowest overall cost possible in the region; it seems unfortunate that more of an effort is not made to promote them.

Of course, local wood and a saw-mill are both available in the Delta,

and so frame houses can also be built locally. Here again the principles of construction are so well-established that they require no comment. In these regions, however, insulation is a virtual necessity in a frame building; again, this is quite standard, but represents an item which would have to be procured from the south. From time to time the question is brought up of using low density plastic polymers, such as foamed polystyrene or polyurethane, for insulation (72). Inch for inch, however, these do not give significantly better insulation than more standard materials, and so their only advantage would be a reduction in the weight that had to be shipped; it is doubtful if this could counterbalance the increased base cost. Thought also might be given to the possibility of transporting the insulation into the region in unpolymerized form and "foaming" it locally as needed.

The heat losses through windows and around doors can be large unless care is taken; again, suitable parts would have to be brought into the region or considerable attention paid in local construction if a usable building is to be obtained.

In general, nonetheless, the technological problems of low-cost housing in the Mackenzie Delta seem few and fairly easily disposed of; what is needed here is not further study so much as continuing encouragement, the provision of local means of learning the trades involved as much as possible, and supervision to provide the best quality possible with the means at hand.

5. Transport.

We have already seen some of the effects of the Mackenzie Delta's isolation and location in the arctic, in the way they make both heating and the provision of electricity serious problems. The short summers and long winters and the great distance to centres of production combine again to make transportation another very difficult problem.

Transport is also a difficult matter to discuss in that it covers such a wide range. For clarity, we shall divide it into three parts

according to the distances involved: transport within a single settlement; transport within the Delta as a whole; and transport to and from the more heavily populated regions of Canada.

a. Transport within a settlement. The ability to bring heavy materials and equipment to every house in a town is such a fundamental requirement that we almost always take it for granted. Without it, we could preserve few of the benefits of communal living. If examples are necessary, we have the need of quickly getting fire equipment to a fire and the need of easy access to buildings to maintain their services (or, in the case of settlements in which trucks are used to haul water, to deliver water). The standard way of ensuring this ability is to build roads. Each of the communities in the Delta has some sort of road system (excepting Reindeer Station, which is little more than a row of houses along the river), but these systems are of widely varying usefulness.

Inuvik and, to a lesser extent, Ft. McPherson, are the only settlements with what could be called satisfactory road systems. In Inuvik this has taken place due to its position as governmental centre; the roads are gravel and kept in good repair. At Ft. McPherson a town plan was laid out in 1948 (73) and roads have been built according to it. As we have seen above, the nearest gravel to Ft. McPherson is the bed at Pt. Separation; this is too expensive for practical use in road building, and the roads at Ft. McPherson are surfaced with soft shale dug from a pit at the town. As Henoch says (74) "fortunately there are only a few vehicles in Fort McPherson".

Aklavik's roads are notorious. Again, there is a fairly satisfactory street plan. The roads, however, are only tracks in the silt; they are all right when the ground is frozen in winter or during dry periods in the summer. During the spring, and after any rain at all in the summer, they become extremely muddy and virtually useless. They also require a disproportionate amount of work. They only respect in which they merit any praise is the fact that they do reach almost all the buildings of

the settlement.

The situation at Tuktoyaktuk is almost the reverse. There is a certain amount of sand and gravel available there for building roads, although the present extent of the deposits is not presently known. Roads, however, have not been built. There is a road connecting the settlement with the airstrip and the DEW line station; this, fortuitously, runs past - or near - about half the houses of the settlement. Beyond this, construction has been haphazard. Again, a plan exists, with road allotments marked out; but, without the roads being physically there, no attention has been paid to the plan in building new houses. In addition, many of the houses are strung out along the bay at considerable distances from the existing road. The only sensible way of reaching these at present is by crossing the bay, by boat in the summer and on the ice in winter.

Thus we see that the settlements of the Delta are far from providing suitable, all-weather road networks. Considering their limited extent, it would not seem uneconomic to build such systems. Where sand are gravel are available, the technical problems can be quite easily solved; apart from the experience gained at Inuvik, the techniques of building roads on muskeg and permafrost have been extensively studied in connection with construction projects farther south (75). The situation at Aklavik, to be sure, presents serious problems. In this connection, the possible use of bonding agents (for example, soil cement (76)) to make a subgrade directly on the permafrost does not seem to have been studied. At first sight, this would seem a fruitful line for investigation. In general, a study of the relative costs of building different types of road for the settlements of the Delta should be both interesting and useful.

b. <u>Transportation within the Delta</u>. Beyond the limits of the individual towns conditions become quite different. The only roads of any extent are the one between the settlement of Tuktoyaktuk and the DEW line site, which we have already mentioned, and roads connecting Inuvik with its airport and with the naval station - perhaps fifteen miles in all. Th...

are no all weather roads between the settlements; the only "winter roads" or trails are the one between Ft. McPherson and Arctic Red River and one from Tuktoyaktuk to a fishing site at the Eskimo Lakes*. This lack, of

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* There are also the winter roads built by the oil companies; one of these connects the present oil drilling rig on Richards Island with an airstrip; another runs 30 miles from Ft. McPherson to a site in the Richardson Mountains. Both of these are probably fairly short-term undertakings, but they are useful in showing the difficulty of building and maintaining such roads in this region.

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course, is counteracted to a large extent by the river channels. These can be used by boats in the summer and as open trails in the winter; their disadvantage is that during freeze-up the ice is not sufficiently thick, and during break-up too soft, to allow surface travel with present-day vehicles. These two periods, taken together, total two months.

Light aircraft have greatly reduced the isolation of the settlements, particularly during break-up and freeze-up. Inuvik and Tuktoyaktuk have year-around airstrips, so it is always possible to get from one to the other, as long as the weather is good enough; given the choice between aircraft on floats, wheels, or skis, one can reach Aklavik and Ft. McPherson with only brief interruptions in the fall and spring; only Arctic Red River retains a certain degree of isolation during these periods.

Travel within the Delta falls into two main classes. One is that going strictly from one settlement to another; people do this to a considerable extent and there is also some haulage of freight. The second is the travelling the natives do in connection with hunting, fishing, and trapping.

Travel from settlement to settlement is mostly done by air, and follows a network radiating from Inuvik. This is supplemented by a small amount of surface travel between Inuvik and Aklavik, especially in the summer. A considerable amount of freight is also carried by air from Inuvik to the smaller settlements. Surface freighting within the Delta

is quite limited. There is at present a certain amount of lumber carried around the Delta by barge in the summer, and a very small amount of hauling done by Bombardier Sno-mobile in the winter. The main pattern of surface freight transport, however, is that connecting the Delta settlements more or less individually with the south by the river. This is due to the expenses of trans-shipment; rather than unloading goods in, say, Inuvik and then distributing them around the Delta, it is cheaper for barges to go to the different settlements individually.

Apart from these barges, surface travel within the Delta falls principally into our second class. There is a considerable amount of travel by the native inhabitants - people going to camps to fish or to hunt muskrat, going on a whale hunt, and so on. The traditionaly means of doing these was by canoe in the summer and dog team in the winter. Technology has influenced both of these forms of transport.

The older of these is the adoption of mechanical propulsion for boats. For the canoes and small boats that are common in the Delta, outboard motors are standard. Larger boats with inboard motors are also seen, primarily at Tuktoyaktuk; these are used for whaling.

More recently, mechanical competition has arisen for the dog team; the most widely used forms are the "Ski-doo" (a mechanized toboggan) and the larger "Sno-mobile", which is invariably called a "Bombardier" after the name of the firm that builds it. The "Ski-doo" is quite closely equivalent to a dog team; it can carry one, or possibly two, passengers, and can tow loads of up to 500 pounds on a well-packed trail (76). It has a one cylinder motor which drives an endless belt to furnish propulsion. These vehicles are quite popular at Tuktoyaktuk, which, as an estimate, there are about the same number of "Ski-doos" as dog teams (77; roughly speaking, two dozen of each). Inland, they are less popular - at present, there are only two or three at Aklavik, compared with -- dog teams. The reason for this lack of popularity is not immediately clear; one possibility is that the afforested parts of the Delta have, on the average, softer snow

and may therefore be less suitable for the vehicle.

The "Bombardier" is a larger, fully enclosed vehicle; it can carry approximately 2000 lbs. of cargo. Due to its size and high cost (about $5000 new), its use is not very widespread among the native population. Most of the vehicles of this type used in the Delta belong to the government, to the missions, or to organizations such as the Reindeer Project. There are only two privately owned ones at Aklavik and three at Tuktoyaktuk.

It would seem that both these vehicles are used mainly because of a lack of anything better. Both types are apt to have frequent mechanical trouble; in addition the "Bombardier" is expensive to run, since, under average operating conditions, it only goes 4 to 5 miles on a gallon of gas (78).

The problems presently faced in the Mackenzie Delta in the field of transportation are clear. First, surface transport in any form is not available during break-up and freeze-up; i.e., for about two months of the year. This is a serious matter, since, as we have seen, much of the native population is at present in camps on the Delta during these periods. Even with the decline in trapping, it seems that this situation will continue for many years, and, consequently, the writer feels that it is justified putting considerable effort in the search for some means of transport which can reduce the physical isolation of the camps during these times.

Second, with the possible exception of the dog team, the available forms of winter transportation are unreliable and uneconomic; dogs require a large expenditure of time in the summer in catching fish. This difficulty is reflected not only in the question of private transport during the winter; it also means that surface freighting is limited, economically, to the summer months alone.

During the past several years considerable hope has arisen that air-cushion vehicles would at least answer the problem of year around usability and might also prove more economic than light aircraft as a freight carrier. This matter has been discussed in detail elsewhere with emphasis

on basic points of feasibility (79). As presently built, however, air-cushion vehicles would suffer from a variety of technical problems in cold weather operation. Furthermore, it seems that such vehicles may be commercially feasible only in relatively large sizes; even with these operating and maintenance costs would be high with the craft in its present form. It is clear that further developmental work is necessary before such vehicles could see general use in the Mackenzie Delta.

Air-cushion vehicles remain, nonetheless, the most promising means of providing year around service in the region. As an academic matter, we may note that, if we do not insist on having transport during freeze-up and break-up, the question of carrying freight during the winter months is quite capable of solution. Winter roads, whether used by tractor trains or trucks, are quite a conventional form of transport both in northern Canada and in northern Russia (80). They have been successfully used in the part of the arctic we are concerned with (81). A scheme of winter roads linking the various settlements of the Delta has been proposed (82). Here is a situation in which the technical problems are, by and large, known. The difficulty is purely economic. Winter roads, in general, lead to expensive freighting; figures of $0.10 to $0.60 per ton-mile are common estimates for hauling over them by truck. The lower rates can be attained only if considerable effort is made in laying them out and in maintaining them so that trucks may travel at speeds of 30 to 40 mph. As we have seen, with present transportation problems there is little freight carried between the towns of the Delta - quite possibly not even enough to justify the maintenance, let alone the construction, of winter roads. In the future, of course, the pattern of supplying freight to the Delta may radically change, as would probably happen if a road were built to Ft. McPherson from the south. In this case the whole transport pattern within the Delta would also change, and a network of winter roads might find stronger economic justification.

The problem of cheap individual transport in the winter months is

more difficult. Over-snow vehicles have been extensively studied, particularly from the point of view of military applications (83); the basic principles for design are well known. There are a great number of military over-snow vehicles, but the majority are not available commercially; when they are, they are so high priced that few people could afford to own one. We are up against the economic law of supply and demand; the "Bombardier" remains in use not because it is particularly good, but because there is little competition in the civilian market. More hope might be had for the present popularity of vehicles like the "Ski-doo" leading to increased reliability and, overall, a more useful product for northern use. The fact that these are bought generally for short-term sporting use does not seem to encourage such a hope.

In general, the conclusions of this discussion on the problems of transport within the Delta can only be described as cheerless. The only prospective candidate for year-around surface transport in the region, the air-cushion vehicle, seems to require a great deal of improvement before it can be considered a useful vehicle; even then it promises to be expensive to operate. On the other hand, the availability of better individual transport for the winter months and of better surface freighting facilities is limited not so much by the need for further technological research as it is by the inevitable small demand produced by the natural conditions of the region.

c. Transport linking the Mackenzie Delta with the South. Here, of course, we have a comparatively economic means of moving freight in bulk: the Mackenzie River. Since the shipping season is short (late June to mid-September), freight rates are not as low as one commonly finds with water carriage. They range about $0.03 per ton-mile; products requiring special handling are, of course, more expensive; for example it costs $0.75 per hundredweight to ship oil from Norman Wells to Inuvik, or nearly $0.04 per ton mile. Such expense, of course, is hard to overcome in a situation where the barges and other equipment must lie idle for the greater part

of the year.

Air freight forms a way of supplementing service by barge, particularly in bringing perishable goods and things needed in a hurry into the region. There are three commercial flights a week between Edmonton and Inuvik, and occasional service to the Yukon. Wolferth (84) discusses the amounts of freight carried by barge and by air and the relations between them in some detail.

The disadvantages of having to bring as much as possible of the year's supplies into the settlements during the summer months are obvious. Large inventories must be kept on hand; this is an inflexible and costly procedure. Food is a particular problem. Fresh food must be brought in by air nine months of the year, and tends to be carried in that manner all year, due to the distance and/time required for barge shipping. Almost any unexpected failure of a piece of equipment requires air transport and, consequently, can be extremely costly and time consuming.

Current technological developments might reduce the cost of transporting particular items. One important example is oil; there is a device, the Dracone, which has been specifically developed for transporting liquids that float on water. It consists of a large sausage-like container of nylon, which can be filled with oil and towed behind a tug. When empty, it can be folded into a small volume and returned as deck cargo; this might be a considerable advantage in the present instance with the low loads carried on the barges going upstream from Inuvik. To form some idea of the sizes involved, a small Dracone carries 11,300 gallons. It is 5' in diameter and 101' 9" long, with an empty weight of 2,240 pounds (85). Obvious problems that might arise with one are the practicability of emptying it completely and that of towing one through any loose ice that might be encountered on the ocean.

In general, though, we are again faced with the problem of providing cheap, year around transport. One means of doing this that is suggested from time to time is the airship; there currently seems to be a revival

of interest in them in Russia (86). They are suggested as having particular promise for carrying building materials to isolated places and in various applications in forestry. Operating costs are estimated as roughly one third that of aircraft and three times that of road transport; this, of course, does not take the cost of building and maintaining the road into account.

Airships have, of course, been used several times in the arctic, most recently in a trip to Resolute Bay and Ice Island T3 in 1958 (87). Although their use is certainly possible in carrying freight to the Mackenzie Delta, they have several features which cause doubt about its economic practicibility. One is the need to fly at low altitude on long range flights, with attendent problems of icing in cold weather and - under overland conditions such as would prevail in any route to the Mackenzie Delta - of increased air temperatures in warm weather. Second, due to their lower speed (the airship used in 1958 cruised at 40 to 43 kts), airships are more adversely affected by winds than are aircraft. Third, a fair degree of care is needed in preparing a landing strip and a mooring pole, and large ground handling crews are necessary; in 1958 crews of 37 were needed both at Churchill and at Resolute Bay. All things considered, the advantages to be gained by the use of airships seem very small.

Again, surface transport seems the chief competitor to aeroplanes for any year around purposes, and again trucks seem the logical answer. As we have noted, trucking costs are higher than shipment by barge, but the convenience gained goes far to make up the difference, as experience at Yellowknife has shown (88). Certainly the potentialities of a winter road joining the Delta with the south should be fully investigated. As a long term project, a road seems the most practical solution to many transport problems; winter roads could form a highly satisfactory supplement to the present summer-only service. As we have said above, however, these are economic problems rather than ones requiring technological development, and so fall outside the province of the present study.

The main points emerging from this discussion can be briefly stated. On all levels, there is a need to study the economics of roads: within the settlements, the costs of providing satisfactory all weather roads deserve careful consideration; winter roads seem, for the present, the most logical answer for supplementing barge and aircraft service within the Delta and linking the Delta with the south. Any technical problems arising in building winter roads of good quality in the particular conditions of the Mackenzie Delta should, of course, be studied. On the whole, though, these problems seem quite well known; further technological research would, however, seem needed on the question of providing suitable streets for a settlement built, like Aklavik, on silt and fine sand, and without a local supply of sand and gravel.

Within the Delta there is a need for a vehicle that could provide reliable, year around transport between any two points. Though the air-cushion vehicle holds promise in doing this, as it is presently built it seems far away from being more than an experimental machine in these regions. It is also not obvious that the air-cushion principle furnishes the best answer to the combinations of ice and water found in the Delta. In addition, there is a need for a commercially built, reliable, cheap form of oversnow transport for individual use in the winter months.

6. Communications.

The entire field of communications has received intensive study during the present century. Isolated regions, in particular, have benefited, and the Mackenzie Delta is no exception. In general, the region has - or shortly will have - facilities quite comparable with those in the south.

One example of this is the telephone service linking the various settlements. At present, each settlement (except Arctic Red River, which is tied into Ft. McPherson) has its own automatic dial telephone system; there is an automatically controlled radio system connecting Inuvik, Aklavik, and Ft. McPherson, which will include Tuktoyaktuk in the summe

of 1966. With the exception of minor interruptions, this system provides completely satisfactory service.

In 1966 Inuvik - and the other settlements of the Delta - will be linked to southern Canada by a telephone line. The capacity of this line - one pair of single conductor wires - is a good example of what modern communications technology can provide. The entire system can carry up to sixteen channels; from Inuvik there will be three toll circuits to Yellowknife and southern points in general, two to Norman Wells and one to Fort Good Hope; there will also be two program circuits to carry CBC radio programs, one circuit for air traffic control, and a voice frequency carrier telegraph circuit, which, in itself, can carry fifteen teletype circuits. This should remove a considerable part of the isolation of a region in which the only rapid means of communication with the south is, at present, radio-telegraphy*.

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* In any discussion of this land line someone, it seems, raises the question of why wires were used rather than a series of microwave repeaters, which could then carry television. It may not be amiss to observe that microwave systems are designed for bulk transmission; a single system can carry six channels, each with a capacity of six hundred voice channels - or over two hundred times the capacity of the system presently being built, which seems quite generous for the foreseeable needs of the region. A small microwave system - say one with sixty channels - which was designed for the needs of the area would not be large enough to carry television, which needs some six hundred channels. Apart from questions of over-design, there is also the element of cost: a microwave system would cost at least ten to twenty times what a land line does.

Another familiar facility in everyday life is the radio. The Mackenzie Delta has its own radio station, CHAK, at Inuvik, and almost every family has a radio. CHAK, in addition to more familiar types of programs, broadcasts messages to people in the outlying settlements and

on the delta three times a day; this makes up, to a certain extent, for the lack of a more widespread telephone service.

Apart from these, there is, among the governmental part of the population, a considerable reliance on two-way radio-telephone - for example, between the RCMP detchments, between the Inuvik hospital and the nursing stations throughout the Delta, and so forth. As is well known (89), radio telephony in the arctic is particularly subject to blackouts and fading; the services in the Mackenzie Delta are generally in the medium frequency range and are no exception. On the whole, though, they are adequate for the required reliability in communication.

The most desirable way in which communications techniques could improve life among the native population would seem to be the provision of emergency means of communication with isolated cabins, to which we shall return in the next chapter. By and large, problems associated with the settlements have been recognized and solved.

7. Food.

One of the most obvious ways in which life in the Mackenzie Delta does not compare with that in the south is in the matter of food. Even in summer, the variety of fresh vegetables in the stores is meagre; what is available is expensive and of poor quality. In winter the situation is worse. Meat is also expensive, especially outside of Inuvik; an exception to this is reindeer meat, which can be bought cheaply in the fall. All food prices are high.

Basically, of course, this situation arises from the fact that the Mackenzie Delta is too far north for dependable farming; vegetables have been grown, on a small scale, at Aklavik, Ft. McPherson, and Arctic Red River, and dairy cattle were kept at Aklavik during the war (90). Poor soils and short growing seasons tend to rule out any form of truck farming, though, and the labour involved and the availability of cheap forms of condensed and dried milk make dairy farming an uneconomical venture.

Nevertheless, it is interesting to note that there has been a

general decline in agriculture, not only in the Mackenzie Delta, but also in the whole Mackenzie River valley, during the last half century. In 1944, from Ft. Providence north, there were a total of between 50 and 60 acres of gardens and over 100 acres of farms (91); today it is difficult to find land actively under cultivation apart from a few acres at Ft. Simpson. In 1910 there is supposed to have been even more land cultivated than in 1944.

One reason for this decline may lie in what can presently be seen at Inuvik. Most civil service employees there either take the bulk of their food in standard government rations or buy it wholesale from Edmonton and have it shipped in by barge in the summer. In addition, the Inuvik Naval Base has fresh food flown in twice a month for its personnel and their dependents. The great majority of the white population, therefore, is not dependent on local markets for the greater part of their food. With the present low economic level of most of the native population, they buy only the bare minimum of food in the markets; thus the amount shipped in for the white population, which does not pass through the local shops, represents a sizeable fraction of all the imported food consumed in the region. Not only are food prices higher because of this lessened demand, but there is also hardly any incentive to experiment with agriculture.

Nonetheless, it is interesting to explore the various methods in which technology could help to reduce the cost of food. At the outset we note that these apply principally to meats and vegetables; bulk foods - flour, sugar, tea - which form a large part of the native population's purchases from the shops do not at present seem amenable to lowering of prices, except by a reduction in the costs of transport.

The first line of attack is the brute force method. This may most easily be summed up in the question: is it really impossible to grow sufficient foods of various types in the Delta to meet local needs? The answer to this is no; a gteat variety of vegetables have been grown there already. In northern Russia, great emphasis is put on self-sufficiency

in this respect, with a claimed large amount of success. The Russian experiments do not appear to be economical undertakings, though: they use greenhouses, and often a great deal of artificial light to lengthen the growing season. As an example, at Noril'sk 300 kwh per sq. metre of electric power (in addition to heating) were used to grow 23 kilograms of tomatoes per sq. metre - or about 6 kwh per pound of fruit (92). In a region of high electric rates this would obviously be impractical on a profit making basis. A more promising approach is the use of low grade heat from diesel generators to warm the ground in which vegetables are planted. Warming the soil has also been tried at Noril'sk (93) with a claimed tripling or quadrupling of the crop, reduction of the production cost by a factor of three to four, and the recovery of the capital expenditures in two to three years. The cost and feasibility of such a scheme might be worth investigating for the Mackenzie Delta, but, at first glance, it does not seem too promising; one complication would be, as the author of the Russian paper remarks, that "geocryological factors must also be considered in the design of soil-heating systems in open fields".

Second, we can attempt to cheapen the cost of bringing food into the Delta. One thing here is to reduce the costs of transport in general; this has been discussed in the preceding section. A second is to find the nearest place where vegetables can be imported on a profitable basis and import them from there. This would seem to be Ft. Simpson, some 600 miles up the river, where there was an Experimental Station of the Department of Agriculture for many years and where truck gardening on a moderate scale has recently been undertaken (94). Here, as to other places on the Mackenzie, it is presumably necessary to import fertilizer; still, one should expect the overall cost of the food from there, which need be brought only 600 miles to Inuvik, to be cheaper than that from Edmonton, which must be brought 1700 miles.

Importing food from Ft. Simpson, however, runs into a curious difficulty. The vegetables there normally ripen in late August or early

September. There is still ample time to transport them by barge to, say, Inuvik before freeze-up there - which, as we have seen, comes in late September or early October. The barges, however, come from Hay River, which is still 400 miles farther upstream than Ft. Simpson; the last barge trips to points north of Norman Wells leave Hay River in mid-August, and so are past Ft. Simpson before most of the vegetables are ripe. This type of problem can be solved; it is a question of economics and of investigating and developing markets.

A third way of reducing the cost of bringing food to the Delta is to lighten the load that is transported. One first thinks of dehydration to reduce the cost of food; this has long been used with such items as milk, orange juice, potatoes, and onions. A great deal else is also available in dehydrated form, but, in general, the market for foods of this type is so low that they cannot compete with other kinds; the added cost of production is more than the saving in freightage would be.

Another familiar way of lightening preserved foods is to freeze rather than can them, and so saving the weight of the container. The first question here is that of preserving the frozen foods after they arrive in the Delta; this we shall come to shortly. Second, we find that bringing frozen food to the Delta is an expensive process; it has to be carried by refrigerated truck to Hay River and then shipped on a refrigerated barge. As a result, it costs -- to bring 100 lbs. of frozen food to Inuvik. When we recollect that frozen foods are, even in the south, considerably more expensive than the same foods in cans, we see that the small saving in weight is not enough to give us a cheaper product in the Delta*.

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* In this context we must mention the possibility of preserving food by treatment with gamma radiation. This method has appeared promising for several years now; there is at present concern about long-term effects of such radiation in converting sugars into poisonous or carcinogenic substances. It is, of course, most useful for such products as meat and

butter; as such, it is not clear that it would have any effect on the economics of life in the Mackenzie Delta, particularly if large scale frozen food storage facilities became available.

The most satisfactory way of reducing the cost of food seems to be growing it as near as possible to the Delta. There is then the question of preserving it. The cheapest and on the whole most satisfactory method of doing this is freezing. At present there are, however, no generally available ways of keeping frozen foods. It is true that ice-caves, or holes dug into the permafrost, have been used, mainly for keeping fish, both in northern Canada and in northern Russia (95) for many years; more widespread use is advocated from time to time (96). Ice-caves have two drawbacks: they cannot absorb a large quantity of heat quickly and maintain a below-freezing temperature - in other words it is difficult to freeze a large quantity of food in them - and their lowest temperature can be no less than that of the ground where they are dug. As we have seen, at Inuvik the temperature several feet below the surface is of the order of 20° F; this is much too high for the long term storage of frozen foods, for which a temperature not above 0° F is recommended.

It would seem possible to solve this problem with a comparatively small amount of study and experimentation. One possibility could by the use of a completely passive system (97). This would take advantage of the fact that there are, in the Mackenzie Delta, sufficient days of below-zero weather to freeze some liquid, say a brine, whose freezing point was near that temperature. This could then be used as a heat sink for an insulated building for the warmer months of the year.

Another method worth consideration would be to use the ground as a heat sink to reduce the temperature of a storage plant to 20° F whenever necessary and then have a mechanical unit to chill it from there to 0° F.

The conclusions drawn from this discussion, then, are that it might well be possible to reduce the costs of vegetables and such items in the

Mackenzie Delta by combining its importation from some place, like Ft. Simpson, which is comparatively near the Delta and yet has a sufficiently warm climate to make fairly risk-free farming possible, with the development of local means of preservation, say by freezing. This deserves further study; furthermore, as we have said, the possibilities of artificially lengthening the growing season at places like Inuvik should be systematically investigated. Although large-scale farming there seems an unprofitable venture, this does not mean that the possibilities of growing food locally should be abandoned out of hand. They should, rather, be studied and encouraged to the fullest extent possible.

8. Medical services.

Considering the isolation of the Mackenzie Delta, the medical services available there seem, to a layman, to be of high quality. This isolation does, nonetheless, limit medical care in several ways. It is interesting to explore the usefulness of modern technology in counteracting this.

Medical care in the region is organized around a central hospital at Inuvik with satellite station - "nursing stations" - in the smaller settlements. The Inuvik hospital is, by southern standards, quite large for the region it serves - it has 100 beds for the approximately 7000 inhabitants of the Inuvik Zone*. It is modern and well-equipped: large rooms, good

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* The zone extends east to Paulatuk on the mainland and to Sachs Harbour on Banks Island, west to Herschel Island and Old Crow, and south to Ft. Norman and Ft. Franklin. It therefore comprises a much larger area than the Mackenzie Delta.

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laundry service, full x-ray facilities and a chemistry laboratory. One technical problem is southern hospitals, an adequate record facility, is somewhat less troublesome here, since the area served is so large that the native population generally remains inside it.

The nursing stations - within the area covered by this report there are three: Aklavik, Ft. McPherson, and Tuktoyaktuk - are each staffed by

one or two nurses, and also have comparatively full equipment, including x-ray apparatus. Due to the limited distances between the settlements of the Delta, it is possible to get seriously ill people to the hospital by aircraft on very short notice.

Broadly speaking, the advantages that technology can offer in such a situation are comprised in bringing this region into closer touch with the rest of the world. This, of course, is already done to a large extent: more seriously ill patients and some cases where diagnosis is difficult (a total of 43 for both categories in 1964 (98)) are taken by aircraft to the hospital at Edmonton. Technology can help, however, in making technical advice more quickly available. This might be done in several ways in a place like Inuvik. Due to the small size of the population, it is not feasible to have specialists of many types in residence; thus, there is no cardiologist, pathologist, nor radiologist in the region. When expert advice is needed in one of these fields - the interpretation of an obscure x-ray, for example, the photograph has to be sent to Edmonton by mail. This may mean up to a week's delay. Similar problems can arise in the interpretation of electrocardiograms and with biopsies.

The completion of the land line will offer possible help with many such problems. Specifically, electrocardiograms are now sent over telephone lines as a routine matter (99). The problem of transmitting x-rays is under study at the Walter Reed Army Medical Center in Washington, U.S.A. There they currently transmit x-rays over a closed-circuit television system linking various parts of the Medical Centre and some other hospitals in the area. No difficulties have yet been found either in resolution or in contrast. In principle, it is possible to transmit x-rays by a facsimile process; the advantage gained by television with its higher frequencies and broader bandwidth can be considered, in this instance, as the ability to transmit many pictures rapidly, which is not necessary in dealing with x-rays. There may be difficulties in using commercial equipment in this

application; it is this question that is currently under study (100).

In the future, it may be possible to use similar means to transmit images of slides in colour for pathology studies. Here the principal difficulty at present lies in keeping fidelity of colour and in being sure that the transmitted image is a true reproduction of the original. In time, this can be overcome; meanwhile, the ability to transmit x-rays would be a considerable advantage.

Another way of using technology to lessen isolation is already in use in the Mackenzie Delta: the nursing stations are in a radio net which links them with the Inuvik hospital. This, of course, could be extended, and radio contact could be set up between the hospital at Inuvik and one in Edmonton or elsewhere. On a smaller scale, this has been done in the rural district around Albany, New York, and in other places (101). This has proved a useful tool for post-graduate training, which, of course, is an important matter in medicine. The benefits of the interchange of information and experience possible with two-way radio communication have proved so great that, in one instance at least, television has been used (102), with a resulting increase in the amount of data that can be considered and discussed.

It would be interesting to investigate the value of such programs further. The end result of exploiting these and similar possibilities would be to provide improved medical service in the remote region of the Mackenzie Delta and, probably, to do this with reduced running expenses; both these are extremely desirable goals.

9. Conclusion.

The various suggestions for further study that have arisen in the course of this chapter will be summarized in the concluding chapter of this report. Here we may look at them from a general point of view. If we do so, a general pattern appears. Time and time again we have run into the point that life in the region is expensive, in one way or another, because of the small number of people there. This agrees with the

observation made earlier that the amenities of life we enjoy in more densely populated regions are cheap - or even available at all - because they can be produced, and used, in large quantities. Insofar as this problem can be solved in the Mackenzie Delta, the solution is clear: one must try to pull the settlements of the region together in as many ways as possible; one must also try to render the distribution of facilities within the area as cheap and as simple as possible.

There are, of course, various areas where specialized research is needed; determining the possibilities of extending the growing season or studying the difficulties to be encountered in an underground sewerage system are but two examples. The broad problem, though, is to accept the fact that the impetus of modern technology lies in taking advantage of the economies of large-scale production wherever possible. The Mackenzie Delta is a region where natural conditions force the dispersal of the population; to ensure its economic development from a technological point of view one must accept this dispersal and find ways of linking the settlements together so that the advantages of centralization can still be gained.

IV

So far we have discussed technology as it applies to living in the settlements of the Mackenzie Delta. This is not the whole story; as we have remarked earlier, a large part of the native population may spend months at a time living in camps away from these settlements. Although there is a decided trend toward living in the communities, any exploitation of the available renewable resources will continue to require, in the foreseeable future, some living in these isolated camps. In this chapter we shall very briefly discuss some possible ways in which technology might make such a life less laborious and less isolated.

The type of life - fishing and trapping - led at these camps relies on surface transportation. The problems involved here have already been discussed extensively. All we need do/is now remind the reader of the need, both of some sort of year around transport to relieve the isolation of these camps during freeze-up and break-up, and of a cheap, reliable form of mechanized winter transport.

Housing and heating are two other subjects we have already considered which can be applied equally well to individual living. Here we might only add that the physical structure of the Delta is such that one can get to almost every camp with a quite sizable boat if there were any desire to bring materials for building purposes.

Another subject of some interest is the provision of better water and sewage facilities at these camps. Water, as we have seen, is generally available throughout the region. Sewage and waste disposal at an isolated place are, naturally, far from the serious problem they are in the settlements of the Delta. Nonetheless, we might note that there are many schemes for individual sewage disposal systems which have been specifically designed for a northern environment (103). Some of these might be of use in making life at a camp more strictly comparable with that in a town.

Of more importance is the provision of electricity to one of these isolated spots. Diesel or gasoline generators are, of course, availat

in small sizes, but they are comparatively expensive to run. Apart from this there is, as we have mentioned, the intriguing possibility of using direct conversion of heat to electricity. By nature this is an inefficient process. The simplest devices - those operating on the thermo-electric principle - typically achieve efficiencies of one to two per cent; more sophisticated solid state devices (which produce power at a low voltage and require considerable ancillary apparatus to be useful) may reach, at present, 5% to 10%. The theoretical maximum efficiency obtainable is in the vicinity of 30% (104), which is no better than the diesel generators in the Delta communities, so this method is of little use there. But an individual cabin is another matter. It must be heated; a device which converts a small part of that heat to electricity would be a great boon. Simple calculations show that, on the basis of a 5% efficient system, a stove burning 2½ gallons of oil a day could produce 200 watts of electric power. This would not run mechanical equipment, but it would power an electric light and a radio or short-range transmitter. These alone would ease the isolation and laboriousness of the life, and a more detailed investigation of the practicability of such a system would be interesting.

The availability of such an independent supply of electricity would be useful in developing another means of reducing the isolation of these camps. This is the provision of some form of emergency communication. At present, if an emergency arises at a camp, it may well be virtually impossible to send out a message for help; it has been suggested (105) that as people tend to live more in settlements they grow less familiar with this side of living in isolation, and that this may be a contributing factor to the decline of trapping and the resultant decline in the cash economy of the Delta. Serious thought has been given to the problem of providing emergency radio communication elsewhere (106) but without conspicuous success.

A major problem is finding means of powering such emergency transmitters. Conventionally, this is done with batteries. The major fault

with batteries, of course, is that they cannot deliver much energy when they are cold; the shelf life is also diminished in cold weather. In other words, they are not suitable for providing emergency power in places that are unheated for long periods of time. Here a means for the direct conversion of heat to electricity would seem of great utility, for it would furnish a means of power that would only depend on getting the stove going, and would not deteriorate in cold weather.

A second problem that arises in such an emergency service is the choice of frequency to use. Almost every frequency is subject, in the arctic, to signal fading and periods of complete blackout (107). Here the Mackenzie Delta would seem to have a considerable geographical advantage. With the mountains and hills around the delta, it should be feasible to select a few sites which would allow line-of-sight communication with the whole area and use frequencies in the VHF range. This should provide minimal trouble with auroral disturbances.

In short, the most immediate ways in which technology could help life in camps in this region - apart from transport - seem to be the development of a cheap form of providing at least a small amount of electricity and, working with this, of providing some form of emergency communications. The above suggestions are obviously but one way of meeting these ends; the basic problem remains an interesting requirement for development.

V

In the last two chapters we have been concerned with the role of technology as an aid in providing the amenities of life. It can make at least an equal contribution in the exploitation of renewable resources; in a long-term view this is probably of greater importance. As we shall see, the situation in the Mackenzie Delta is such that one can give only an outline of these possible technological contributions. This is still worth doing briefly and forms the subject of the present chapter.

There are three basic renewable natural resources in the region: forests, wildlife, and fish. They are discussed in detail elsewhere (108); here we need only observe that, though the region has been known for its furs for many years, the fishing and especially the forests are of a fairly low grade in comparison with what is available in the south. Nonetheless, from the point of view of the economy of the region, one cannot afford to disregard any resource when there are so few, and it is necessary to study how each can be developed to the greatest extent possible.

The forests of the Mackenzie Delta are unpromising at first glance: the trees are small, grow fairly slowly, and due to the large number of branches near the ground, have many knots. They contain, however, the only substantial stands of timber north of the Liard River; as such, they are the nearest source of lumber not only for the Mackenzie Delta but also for much of the western arctic. Professional opinion (109) is that many of these trees, particularly around Ft. McPherson, are of commercial value, particularly, as we have mentioned before, for building low-cost housing.

The forestry problems of the area have not been studied at more than the most superficial level. It is commonly said that trees grow so slowly in this region that they cannot be considered a renewable resource, but this does not seem true*. At an optimistic current usage rate, it seems

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*Thus, the approximate times needed for a spruce to grow to " DBH

(diameter at breast height) are: around Ottawa, 80 years; at the mouth of the Peace River, 110 years; and at Ft. McPherson, 170 years (110).

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that it would be quite easily possible to renew the trees harvested in the region.

The contribution of technology in this instance, as always, is subsidiary to basic research. In this case, very little is known of the factors influencing the growth of trees in the region. It is believed that a mossy cover inhibits the seeding of new trees (111), but the whole question is closely bound up with the highly debatable matter of what factors determine the exact location of the tree line (112). Clearly, studies have to be made first to ascertain the exact influence of the ground cover on the growth of trees; then technology can help in providing the most favourable conditions. With due care, there seems no reason why the forests of the upper Mackenzie Delta should not be used, and used with profit, for years to come.

The traditional means of exploiting the other resources are trapping and fishing. These are, in a sense, complimentary occupations. As is realized in the Soviet Union (113), it is necessary to combine such seasonal occupations to provide suitable year-around employment to compete with other wage-earning occupations. It would seem that the same practice should be encouraged in the Mackenzie Delta.

Trapping, of course, has been a traditional occupation for the last century; the most common fur-bearing animal is muskrat, with mink being of secondary importance (114). Other animals - lynx, beaver, marten - occur, but are rare. In recent years, with increased opportunities for wage employment, trapping has declined; nonetheless, it remains one of the principal means by which money is brought into the Delta.

There are two ways by which technology can help in producing, and maintaining, the maximum possible amount of income from trapping. First, it may be possible, by fairly simple means - building dams and the like

to increase the number of muskrat living in the area. This possibility was suggested several years ago (115) but apparently has not been investigated further; indeed, present indications are that the muskrat population is decreasing even in face of the lessening number of animals trapped (116).

Second, efforts should be made to reduce the amount of labour associated with trapping. One way is by providing better means of transport, as has already been discussed. In the present connection this would allow a man to travel easier and farther in a day, and so to set more traps. Since muskrat caught in traps bring higher prices than those shot after breakup, this would result in an increase in income from trapping.

The present way of preparing pelts is quite primitive; they are often damaged or insuficiently cleaned. It might be possible to devise ways of improving this work. This again would lead to higher quality skins and at the same time lessen the labour spent on trapping.

In this connection one should mention the tannery which is to be built at Aklavik. This will primarily provide furs for local use, in handicraft work. It will have clear value in improving the cash basis of the local economy.

Finally, there are the fish. The fish of the rivers and lakes have been suggested as a source of income for years; experiments - not very successful - have been made in catching and processing whitefish for export (117).

Even more than with forests, the state of fish as a continuing resource is poorly known. Little, if any, work has been done on the vital question of how large a catch can be taken from either the fresh water or from the ocean.

The situation in the Mackenzie Delta seems similar to that with the great Russian rivers; there the importance of fisheries at the river deltas is stressed, although it is realized that they cannot compete in volume

with southern regions (118). One way in which technology can help is in modernizing methods of fishing; in the Mackenzie, as in Russia, these are still primitive. Another is in aiding to learn more of the detailed habits of the fish and so improving catching efficiency. Sonar is widely used in commercial fishing to locate schools of fish; another possibility is the use of divers or manned submersible vessels to help in this study.

It seems that within a very few years it should be possible to harvest fish scientifically as a continuing crop. First, of course, the amount that can be harvested without depletion of the stocks must be known, as also must be the most efficient way of maintaining this stock. Then technological aids may be developed to catch the desired number with a minimum of effort. The general approach may be seen in the case of tuna. Here it has been found that this species of fish tend to congregate over underwater hills where there is a natural flow of nutrient. As the tuna grow, they tend to move to a hill whose top is farther below the surface. They can be kept in the vicinity by improving the flow of nutrient; there are also grounds for expecting that within ten to twenty years it will be possible to keep them in electronic pens. If this can be done, and means can be devised for moving them from one pen to another, then we can hope to have commercial fishing in much the same way as, on a far smaller scale, trout are now raised in fish hatcheries.

It is, of course, open to question whether the Mackenzie Delta could support fisheries on the scale that such, presumably costly, equipment would require to be commercially feasible. Nonetheless the point remains clear: with detailed knowledge of the habits of the local fish, and by making use of techniques and approaches developed elsewhere, it may be possible, in the future, substantially to increase the income from fishing. This may well be the furthest off in time of any of the methods of exploiting resources we have mentioned, but it also may prove the most profitable.

VI

Throughout this report we have noted subjects that might provide interesting opportunities for further study. As a conclusion, we shall list these in one place. Most of them can be grouped under three general headings: studies where some technological research or development seems to be required; studies of matters where the technological problems seem fairly well understood but where the economic feasibility is of interest (these, of course, may require a minor amount of engineering experimentation to provide a sound groundwork for estimates); and subjects where basic scientific research seems needed.

In the first category, a few points have come up where existing technological research and development seem inadequate:

1) Certain points about insulation materials are not clear. It would be useful to know the long term properties of local mosses as insulators. Similarly, knowledge of the long term resistance of such materials as expanded polymerized plastics to moisture would be of value in the possible design of underground utilidors.

2) Experience seems to be lacking on ways of constructing paved roads on silt and permafrost, as occurs at Aklavik, with the use of a minimum of imported materials.

3) Development of a compact, reasonably efficient device to convert heat to electricity with a useful amount of power generated would be valuable.

4) Technological aids to the exploitation of the renewable resources are needed. This would include possible ways of increasing the muskrat population, ways of encouraging the growth and seeding of trees, and ways of increasing the efficiency of catching fish.

5) The extent of the problems facing the use of waste heat to warm the ground for agricultural purposes would be fully investigated.

6) Oversnow and year-around vehicles form a continuing and difficult

subject for technological research.

Second, we have subjects where the emphasis is primarily on the economics of the situation:

7) The practicability and usefulness of freezing plants, either passive or using the ground as a heat sink, should be studied.

8) The benefits and disadvantages of the use of electric transmission lines between some or all of the settlements should be investigated more fully.

9) The long term potentialities of a hydro-electric installation should be studied.

10) The costs and probable effects of a network of roads or winter roads within the region, as well as those of a road or winter road giving access to the region from the south, should be considered in some detail.

Third, we have come across two main fields where basic research is needed:

11) Forestry. The mechanisms influencing the seeding of trees are not fully understood. This, as we have seen, seems closely bound up with the question of the detailed action of a moss cover on a forest.

12) Fish. Detailed knowledge of the extent of the stocks of fish, their rate of reproduction, and their habits are essential to any sensible attempt to exploit them.

Finally, there are, as always, a few subjects which do not fit into the above scheme, but still deserve further consideration:

13) It would be interesting to investigate the possibilities of the improved communications facilities that will soon become available to improve medical services.

14) Ways should be found to encourage the local market for fresh food; and

15) Means should be sought to encourage local housing construction.

VI

Such a list is, of course, not complete, and the subjects mentioned are of vastly differing importance. It serves, however, to indicate the variety of problems and the degree of imagination required in the man who has the spirit to help develop a region as fascinating and as forbidding as the Canadian Arctic.

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CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

DIRECTOR

Ottawa 4, April 29, 1966.

our file / notre dossier

your file / votre dossier 1009-3-16

N.D.R.C. Preliminary Phase Report

In your memorandum of April 3 you asked me to comment on Mailhot's report to the N.C.R.C. entitled "Community Structure" - Inuvik - Summer 1965". A report of this kind needs to be studied at length to fully appreciate its comments. Much of the information in it is germane to virtually all disciplines offering services of one kind or another in the "Inuvik communities". I have not been able to give it the time it deserves. My comments, therefore, will have to be favoured accordingly. I hope I will have the opportunity to study it at greater length later.

By way of general comment, I think the report is a good one. Considering the short time allowed to do the study, the breadth of the subject and the limited number of staff involved, it is a wonder that the researcher was able to accomplish so much. I have only a few criticisms to make and again these are based upon a rather superficial first reading.

The first part of the report may pose some problems in terms of confidentiality, depending upon the Centre's plans for its use and distribution. A very thin veneer of animosity protects the identity of several leading figures at Inuvik, particularly among the religious communities. This veneer could easily be chipped off, depending upon who sees the report. Virtually anyone at Inuvik could identify the characters concerned. This is not a problem, if N.C.R.C. plans to restrict circulation. However, if the Centre intends to distribute the report widely, then I believe there is an ethical problem at stake for the researcher and for the Centre. Apart from the matter of ethics, however, this part of the report could create misunderstandings or possibly animosity if by chance or by design it were to fall into the hands of those who figure prominently in it.

The only other comment I have to make at the moment has to do with the recommendations which follow upon the basic conclusion that Inuvik is in fact two communities. I got the impression from reading the report only once that the dicotomy which exists is for all intents and purposes irreperable. The recommendations for a future course of action appear to be directed exclusively to the "northern oriented" community. The "non-permanent white" community seems to be written off all together. If this first impression is correct, then I can

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only say that I do not agree with it. It would seem to me that an effort should also be made to bring about changes in the attitudes of this group. Perhaps, one way of doing this would be through an adult education program at the local level to complement the program to be designed for the "northern" groups as well as through discussions at a higher level in Ottawa among the federal departments concerned.

F.J. Neville,
Chief,
Welfare Division

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

DIRECTOR

Ottawa 4, April 21, 1966.

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your file / votre dossier

M.D.R.P. - Preliminary Phase Reports

In accordance with your request of April 13, I attach comments on the three Northern Co-Ordination and Research Centre reports on the Mackenzie Delta.

For J.W. Evans
Chief,
Industrial Division

Mackenzie Delta Research Program Reports - 1965

General Comments:

The reports make good general reading. However, too much time is spent in dealing in generalities. The need for comprehensive background research is apparent in all of the reports.

There is too much repetitiveness. The fault appears to be an organizational one. One feels the researchers were capable of more organized research. There appears to have been a need of co-ordination in the program and between authors.

The geographical limitations of the reports appear to be too narrow. Accurate descriptions of the inter-relationships between man and his environment fail through limiting the studies to the delta proper.

The reports can scarcely be termed action reports; however, this does not appear to be one of the goals of the program.

Hild

The Mackenzie Delta - Its Economic Base and Development

Comments:

1. Insufficient detail.

2. Boundaries of the study were too limited. There is insufficient concern with inter-relationships of man and his environment existent in the lower Mackenzie region.

3. The settlement base is insufficiently dealt with, particularly in connection with economic activities.

4. Forestry - No use appears to have been made of the Forrestal report.
   - No maps were used to show logging sites, etc.
   - Statistical information is insufficient to accurately gauge the costs of production.

5. Trapping - Maps are inaccurate.
   - Not enough detail given regarding the costs of trapping.
   - No figures shown for average income from trapping
   - No information given on techniques of trapping

6. Fishing - No indication as to what species are available - when they are available and what markets exist either locally or elsewhere.
   - Insufficient data given on costs of harvesting.
   - Insufficient attention paid to problems of local needs versus commercial fishing.

7. Employment - No attention paid to means of expanding employment, nor concerning employment in terms of the social milieu.
   - No attention paid to factors affecting employment such as welfare, education, social background, etc.

8. Population - Present economic status of the population not shown.
   - No indication of the potential of the region to meet expanding needs of the population, nor of the potential of the population to adapt to social and technological change.

Domestic Economy of Native People - Mackenzie Delta

1. Lack of detail - too generalized

2. Failure to comment adequately on the social milieu.

3. Description of the modified subsistence economy is inadequate.

4. No attention paid to the place of settlements in the domestic economy.

5. As a general commentary, the report raises a number of questions which could have been answered in the report. There are in existence a number of reports dealing with the native people of the Mackenzie Delta. The findings of these reports have not been incorporated in the report and have received very little attention on the part of the author.

Technology of the Mackenzie Delta

1. The report is interestingly written but it is more of a resumé of the current use of mechanical equipment in the Delta. Too much space has been given to general items.

2. There is a lack of background material. There are a number of reports of extremely high calibre in existence in respect to technology.

3. Although the report is titled "Technology of the Mackenzie River Delta", the author has not really come to grips with the subject of applying technological solutions to the problems of the Delta.

4. The recommendations are inconclusively developed.

DIRECTOR

Ottawa 4, April 21, 1966.

1009-3-16

M.D.R.P. - Preliminary Phase Reports

In accordance with your request of April 13, I attach comments on the three Northern Co-Ordination and Research Centre reports on the Mackenzie Delta.

Original signed by
A. M. MILLICAN

J.W. Evans
Chief,
Industrial Division

A.F. Flucke/jp/h

Mackenzie Delta Research Program Reports - 1965

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CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

J.L. 9/4

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CHIEF, INDUSTRIAL DIVISION

Ottawa 4, April 13, 1966.

Please suggest distribution.

15.4.66

our file / notre dossier 1009-3-16

your file / votre dossier

M.D.R.P. - Preliminary Phase Reports

You will see from the attached copy of a memorandum dated April 6th from Mr. Kerr of the Northern Co-Ordination and Research Centre that he would like to have our comments on the draft reports of the four studies undertaken last summer in connection with the preliminary phase of the Mackenzie Delta Research Project. We should have your comments on two of these reports and your comments as well as those of the Chief Engineer on a third report. All three reports are attached as follows:

1. Domestic Economy of the Native Peoples, Mackenzie River Delta, N.W.T. by Derek G. Smith

2. The Mackenzie Delta - Its Economic Base and Development by John Wolforth

3. Technology and the Mackenzie River Delta by Paul Fenimore Cooper, Jr.

Would you please arrange to have these reports read carefully in your Division with Mr. Kerr's questions in mind and let me have your comments if at all possible by April 21st. I would ask that you give priority to the third paper entitled "Technology and the Mackenzie River Delta" so that you could pass it to Mr. Yates for comments by the Engineering Division which I would like to have by April 21st. I am sending a copy of this memorandum to Mr. Yates so that he will be expecting to receive the paper from you. (not required.)

- Director

Mr Fluck — to prepare comments. I want to be able to read before I leave for POU. I would like to go over them on my return.

reply with Comments by Bissett 24/4/66

15/4/66

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CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

Ottawa 4, April 6, 1966.

our file / notre dossier

your file / votre dossier

C. M. BOLGER,
NORTHERN ADMINISTRATION BRANCH

N.D.R.P. - Preliminary Phase Reports

Previous to the Research Planning Conference of February 28 and March 1, preliminary draft copies of reports for the four studies undertaken last summer were sent to you. Before final editing and publication of these reports, it would be very helpful to us if we could receive from the Branch any comments about them you wish to make regarding particularly:

(a) The validity of quantitative or qualitative data presented.

(b) Areas of the reports needing explanatory expansion (within the limits of the data available).

(c) Any references to family or personal matters which you feel might be unfair or misleading.

I shall be getting in touch with you shortly to arrange to discuss further the ways in which our research can better assist northern administration.

A. J. Kerr
for Chief,
Northern Co-ordination and
Research Centre.

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

DIRECTOR

OTTAWA 4, April 20, 1966.

our file / notre dossier 1009-3-16

your file / votre dossier

M.D.R.P. - Preliminary Phase Reports

In your memorandum of April 13th to the Chief of the Industrial Division, with a copy to me, you asked for my comments on the draft report entitled "Technology and the Mackenzie River Delta" by Paul Fenimore Cooper, Jr.

In general, I find this report to be quite useful in that it sets out those areas where further investigation might be done. The points I list below may be of some value to indicate areas of the report that could be expanded or perhaps to present some other ideas that the author might like to investigate and comment on in the report.

The author comments on the amount of heat that is wasted by the diesel generating units. I certainly agree that this wastage exists and while we have experimented with various ideas to make use of it, we have often found it to be quite a complex and costly operation. There seems reason to believe, however, that the difficulties now encountered in using the waste heat to heat buildings might not be encountered were this heat to be used in conjunction with utilities. It also seems possible that a more efficient heat exchange process could be obtained from a gas turbine generator as opposed to a diesel generator. What I am thinking of here is that the heat needed for water pipelines could be obtained from this source.

The author states that only gas turbines in a large (3,000 kilowatt) size are now available. This is not the case. Thirty horsepower turbine generators are readily available and have, I believe, had a great deal of success on the Newfoundland coast.

On page 24 of the report, the statement is made that three or four men are required to operate a diesel generating plant under 250 or 300 kilowatts. I do not think this is correct and I think that such a plant can be operated semi-automatically with one man only. The author has, of course, extracted his information from the operations of N.C.P.C. If he were to examine, however, some of the D.O.T. and even some of our own operations, he would find that it is possible to operate with a smaller staff, provided certain risks are taken.

The author concludes that underground piped sewer and water systems in permafrost are not practical. We feel that they are indeed practical and are proposing to experiment with them. The disadvantages of an above-ground utilidor are severe and I think we should do everything possible to get underground. The U.S.S.R. has installed utilidor systems underground in permafrost areas.

Mention is made of the potential health hazard of the plastic bag. A useful area of research might be to develop a plastic bag which would disintegrate under bacteriological action.

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In connection with the provision of food, the author does not mention the freeze-dry process, which might perhaps be referred to. In this connection also he refers to the use of a heat sink. Such a heat sink as referred to on page 55 was constructed at Tuktoyaktuk. The author might like to find out how it performed.

As I said above, I find the report generally to be quite a good one, covering most of those subject on which research would be desirable. I do have opinions, however, on which of the projects would be of the greatest value, but I am not expressing these at this time until the final report is available for comment.

A.B. Yates,
Chief,
Engineering Division.

PAPER
21-4-66
MB

DIRECTOR

OTTAWA 4, April 20, 1966.

1009-3-16

M.D.R.P. - Preliminary Phase Reports

In your memorandum of April 13th to the Chief of the Industrial Division, with a copy to me, you asked for my comments on the draft report entitled "Technology and the Mackenzie River Delta" by Paul Fenimore Cooper, Jr.

In general, I find this report to be quite useful in that it sets out those areas where further investigation might be done. The points I list below may be of some value to indicate areas of the report that could be expanded or perhaps to present some other ideas that the author might like to investigate and comment on in the report.

The author comments on the amount of heat that is wasted by the diesel generating units. I certainly agree that this wastage exists and while we have experimented with various ideas to make use of it, we have often found it to be quite a complex and costly operation. There seems reason to believe, however, that the difficulties now encountered in using the waste heat to heat buildings might not be encountered were this heat to be used in conjunction with utilities. It also seems possible that a more efficient heat exchange process could be obtained from a gas turbine generator as opposed to a diesel generator. What I am thinking of here is that the heat needed for water pipelines could be obtained from this source.

The author states that only gas turbines in a large (3,000 kilowatt) size are now available. This is not the case. Thirty horsepower turbine generators are readily available and have, I believe, had a great deal of success on the Newfoundland coast.

On page 24 of the report, the statement is made that three or four men are required to operate a diesel generating plant under 250 or 300 kilowatts. I do not think this is correct and I think that such a plant can be operated semi-automatically with one man only. The author has, of course, extracted his information from the operations of N.C.P.C. If he were to examine, however, some of the D.O.T. and even some of our own operations, he would find that it is possible to operate with a smaller staff, provided certain risks are taken.

A.B. Yates:mab

The author concludes that underground piped sewer and water systems in permafrost are not practical. We feel that they are indeed practical and are proposing to experiment with them. The disadvantages of an above-ground utilidor are severe and I think we should do everything possible to get underground. The U.S.S.R. has installed utilidor systems underground in permafrost areas.

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A. B. Yates

A.B. Yates,
Chief,
Engineering Division.

c.c. Chief, Engineering Division

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

CHIEF, INDUSTRIAL DIVISION

Ottawa 4, April 13, 1966.

our file / notre dossier 1009-3-16
your file / votre dossier

M.D.R.P. - Preliminary Phase Reports

You will see from the attached copy of a memorandum dated April 6th from Mr. Kerr of the Northern Co-Ordination and Research Centre that he would like to have our comments on the draft reports of the four studies undertaken last summer in connection with the preliminary phase of the Mackenzie Delta Research Project. We should have your comments on two of these reports and your comments as well as those of the Chief Engineer on a third report. All three reports are attached as follows:

1. Domestic Economy of the Native Peoples,
   Mackenzie River Delta, N.W.T.
   by Derek G. Smith

2. The Mackenzie Delta -
   Its Economic Base and Development
   by John Wolforth

3. Technology and the Mackenzie River Delta
   by Paul Fenimore Cooper, Jr.

Would you please arrange to have these reports read carefully in your Division with Mr. Kerr's questions in mind and let me have your comments if at all possible by April 21st. I would ask that you give priority to the third paper entitled "Technology and the Mackenzie River Delta" so that you could pass it to Mr. Yates for comments by the Engineering Division which I would like to have by April 21st. I am sending a copy of this memorandum to Mr. Yates so that he will be expecting to receive the paper from you.

Director

CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

Ottawa 4, April 6, 1966.

our file / notre dossier

your file / votre dossier

C. M. BOLGER,
NORTHERN ADMINISTRATION BRANCH

M.D.R.P. - Preliminary Phase Reports

Previous to the Research Planning Conference of February 28 and March 1, preliminary draft copies of reports for the four studies undertaken last summer were sent to you. Before final editing and publication of these reports, it would be very helpful to us if we could receive from the Branch any comments about them you wish to make regarding particularly:

(a) The validity of quantitative or qualitative data presented.

(b) Areas of the reports needing explanatory expansion (within the limits of the data available).

(c) Any references to family or personal matters which you feel might be unfair or misleading.

I shall be getting in touch with you shortly to arrange to discuss further the ways in which our research can better assist northern administration.

A. J. Kerr
for Chief,
Northern Co-ordination and
Research Centre.

Deputy Minister of
Northern Affairs and
National Resources

Sous-ministre du
Nord canadien et des
Ressources nationales

TO:
A: MR. C. M. BOLGER

Date April 14, 1966.

- ☐ Approval / Approbation
- ☐ Signature
- ☐ Comment / Commentaire
- ☐ Action / Donner suite
- ☐ Direct Reply / Répondre directement
- ☐ Copy for this office / Copie pour ce bureau
- ☐ Preparation of reply by / Réponse d'ici le .....

- ☐ May we discuss / Discussion avec nous
- ☒ As requested / Selon indications
- ☐ Note / Noter
- ☐ Note and return / Noter et retourner
- ☐ Note and forward to— / Noter et faire suivre à .....
- ☐ Information
- ☐ .....

"As per your request"

for A. J. KERR.

000112

1009-3-16

DRAFT

Technology and the Mackenzie River Delta

Paul Fenimore Cooper, Jr.

This is a draft copy of this report. It is incomplete and all conclusions are to be regarded as only tentative. It is not to be quoted or referred to in this form without the author's express approval.

Contents

The Mackenzie Delta is set apart from the rest of northern Canada in many ways. To the casual visitor, the most obvious is the variety of scenery he finds in a comparatively small area: the typical low delta country of channels, islands, and lakes is bordered on the one side by a line of hills, on the other by the Richardson Mountains - Mackenzie's "snowy mountains" (1) - which afford the traveller a landmark for many miles. The forests at the head of the delta give way, in the north, to gently rolling tundra. Thus, within an area of perhaps fifty by one hundred and fifty miles one can find - in addition to the ever changing river channels - spots strongly reminiscent of the forests of the Canadian shield or of the barren mountains and stretches of arctic coast which are typical of many parts of the Canadian north.

Again in comparison with other parts of the Canadian arctic, this area is one of the richest in renewable resources. The delta proper is an excellent habitat for muskrat and, to a lesser extent, beaver; the tundra to the east has supported herds of reindeer for over thirty years. There are fish and small, though useful, stands of timber. Although these seem too scanty for the needs of the local population, they make the area a good first site to test possibilities of northern development. Here one can find almost all the problems which occur in living in the arctic and sub-arctic parts of Canada while the relative abundance of resources may make it easier to create an environment at least comparable to southern regions in its amenities here than in the more desolate regions farther to the east.

The basic problem of life in northern Canada can be summarized in the words "low standard of living". The resources of the country favour a nomadic life of hunting, fishing, and trapping, which was led by the native population for many years. This way of life has proved virtually irreconcilable with aspirations to enjoy the labour-saving features that characterize present-day life in the south. An impasse has been reached

which seems most difficult to resolve.

In such a situation, a man with scientific training naturally hopes that the various scientific and technical disciplines can offer some help. The "easier life" of the south is dependent, in almost every action, on the advances science and technology have made in the last century. Experience has also shown - as with the DEW line and the Joint Arctic Weather Stations - that it is possible to transfer many of the advantages of life in the south into an arctic environment. As yet, however, this has been successfully done only in circumstances where money can be liberally spent, both in the original development of the site and in its maintenance. Such conditions may arise in military work or in the exploitation of a particularly valuable mineral deposit, but without some such strong reason, there can be no justification for the continuing expenditure of large sums of money to maintain a semblance of southern amenities.

In the writer's view, this is the problem posed by a region like the Mackenzie Delta: with present knowledge, with present resources, one can only hope to maintain a standard of living comparable with the south through a continuous underwriting of many facilities. There are two ways in which science can help solve this problem. First, there must be the continuing search for ways of providing, both cheaply and in small amounts, the facilities which we in the south take almost for granted. This, of course, runs counter to much of southern development; to take a single example, much of the economy of electric power arises from the fact that the demand for it is so huge that it is feasible to build large generating stations. Second, it is necessary to exert constant efforts to develop all possible renewable resources, unpromising as they may seem. We believe that continuing, hard, imaginative work in both these directions forms the only way in which any isolated region like the Mackenzie delta can attain a higher standard of living and take its place as a self-sufficient part of the country.

In this paper we shall consider the present state of the Mackenz...

delta from this point of view. In brief, we shall first survey the natural and social features of the area, for these determine the course of any technological development. As will be seen, although native life has centred more and more on the settlements, there is still a considerable amount of time spent in isolated camps; in subsequent sections we shall consider these different ways of life and try to determine directions of study and research which might result in making them more comfortable and more economic. Finally, we shall return to the question of renewable resources to see if there are any obvious means by which technology might aid in their utilization.

Due to the breadth of the subject, it is impossible for any one person to give more than a superficial summary in dealing with most of the problems that arise; due to the basic nature of most of the inhabitants' needs, it is difficult to produce any particularly original suggestions. The author hopes, nonetheless, that it is useful at least to bring together into one place many of the problems that arise in trying to provide, in this part of the north, the amenities that technology can offer and that his work may be useful as an introduction to more comprehensive and more immediately useful studies.

II

The delta of the Mackenzie River is the seventh or eighth largest in the world (2); it extends about 150 miles from its head, at Point Separation, to the coast of the Arctic Ocean; at its widest, it is some 100 miles wide. There are three settlements on the delta itself: Inuvik, the present administrative centre; Aklavik, the former administrative centre and, originally, a trading post; and Reindeer Station, the headquarters for the reindeer herding project.

In the present study we shall call a somewhat larger area "the Delta" and include three more settlements which do not lie on the true delta. Two of these are to the south: Fort McPherson and Arctic Red River, lying on the Peel and Mackenzie Rivers, respectively, above Point Separation. The third, Tuktoyaktuk, is to the north, and is on the coast some twenty miles to the east of the mouth of the East Channel. In doing this, admittedly, we violate both geographical unity (though McKay (3) holds that Richards Island and the Tuktoyaktuk Peninsula are remnants of older, pre-glacial deltas) and any anthropological unity*. Nonetheless, by arctic

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* We of course have both Indians and Eskimos present already in Inuvik, but in a more mixed <u>milieu</u> than the Indian settlements of Ft. McPherson and Arctic Red River or the Eskimo one of Tuktoyaktuk. In particular, Smith (4) emphasizes the anthropological difference between the Eskimos of Inuvik and Aklavik and those of Tuktoyaktuk.

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standards the six settlements are quite close together. For many purposes they already are treated as a unit, as with air transportation, in which the main air service from the south goes to Inuvik alone, with the other settlements being fed from there by a local service. We shall come across others; as we shall see, this closeness may also help the overall development of the area in the future.

Returning for the moment to the geographical delta, we can see on a map that although it has some of the familiar triangular shape of a del

there is not the typical extension of sedimentary deposits into the ocean, such as is found, for example, in the Lena or Mississippi Deltas. This seems due to a rather low rate of deposition of sediment, which Camsell (5) attributed, at least in part, to the large lakes in the Mackenzie River drainage system acting as settling basins.

On closer examination, however, we find that the true modern delta is not triangular in shape either. Its southern end is not pointed, but quite broad, for it is formed by the junction of the Peel and Mackenzie valleys, and, in fact, the sediments carried by the Peel River have contributed substantially to the formation of this part of the delta (6). The southern half of the delta is confined between the mountains on the west and hills and rolling uplands on the east, and is of almost constant width. North of the Caribou Hills, and separated from them only by a small channel, is Richards Island; the eastern part of this consists of older sedimentary formations with a more rolling topography than the modern delta and again limits it on the east. Thus we find that in fact true "delta country" is confined to an almost rectangular strip, some thirty to forty miles wide, which gradually curves westward as one goes downstream and to a small subsidiary delta between Richards Island and Kittigazuit at the mouth of the East Channel.

The natural conditions of this area that affect engineering techniques and, more broadly, technological development, fall into two broad classifications: the soils and the weather. The nature of the land is important, obviously, in any considerations of road-building or general construction; as is well-known, the Mackenzie Delta offers a variety of problems in this connection.

In the first place, the low lands of the modern delta are, as one would expect, almost entirely silt. The whole region, moreover, is singularly lacking in suitable materials for construction. There are a very few few small riverine deposits of gravel in the delta, of which that at Point Separation is the main example (7). The paleozoic outcroppings at

Inuvik are overlain, farther south, by fine-grained glacial deposits; the same situation occurs in the Caribou Hills. The older pleistocene deposits of Richards Island and around Tuktoyaktuk are again fine sand or boulder clay (8). The gravel beds at Inuvik are the most extensive known in the area; even these do not extend the eight miles from the settlement to the airport(9).

Lack of materials is not the end of the problems any construction must face in this region; in common with most of the rest of northern Canada, the whole delta region is underlain by permafrost. The depth to which the ground is frozen is large - a measurement of about 500 feet has been obtained on Richards Island (10) - and the depth of the "active layer", or of summer thawing, is small, being, in typical undisturbed areas, about one to two feet (11).

Under certain conditions - in particular, when the bearing strength of the soil is the same whether it is frozen or thawed - the presence of permafrost can be neglected. This, unfortunately, does not happen in the Mackenzie Delta. At all the settlements the amount of water in the soil is large; frequently it appears as "ice lenses", or large buried masses of practically pure ice. In such cases, thawing can lead not only to a loss of bearing strength, with consequent settling of any structure, but also to a more drastic slumping of the soil. Heat to do this can be transmitted into the ground in various ways; the two most obvious are constructing a heat source, such as a building, in contact with the ground or disturbing the natural cover of vegetation. Removal of this last disturbs the thermal balance at the surface and leads to a considerable increase in the thickness of the active layer; at Inuvik this increase is to about --" (12). One of the basic problems of construction in a region like the Mackenzie Delta is the prevention of any such transfer of heat.

In Fig. 1 we show the variation of ground temperature with depth at a site in Inuvik where the ground cover has not been disturbed (13). One particular feature should be noted here: the fact that the mean ground

temperature, even just below the surface, is noticeably higher than the mean annual air temperature (about 15° F). This difference also occurs in other parts of the world; it arises primarily from the enhanced ability of the soil cover to obsorb and transmit heat in summer, when it is wet, and followed by its increased insulating ability in winter, when it is not only dry but also covered by snow. As we shall see, this temperature difference can be troublesome in making use of the ground as a natural refrigerator; it could, in theory, be put to practical use as a source of heat in the winter, but it is hard to see how this could be done economically.

The direct origin of the permafrost layer is open to debate, but it clearly can be traced back eventually to the cold climate. Not only is the cold and length of the northern winter an influence on almost every side of everyday life, but we must consider other climatic factors - for example the light rainfall of the region. For completeness, we shall briefly run through the most familiar and important features.

The basic factors determining the climate of the Mackenzie Delta are its high latitude and the fact that, although it lies on the ocean, this is a cold, rather than a warm ocean, such as is found in northern Scandinavia. The high latitude means that the sun never attains a great elevation; furthermore, since the Mackenzie Delta lies entirely within the Arctic Circle, there is a period in winter during which the sun does not rise. This region is still far enough south. of course, that there is considerable twilight during this period; even in mid-December there is enough light for several hours of outdoor work. Fig. 2 (14) shows the times of sunrise and sunset and also of the beginning and ending of twilight (as defined in two different ways*) for Inuvik at different times of the year.

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* Civil twilight is the period during which the sun's centre is not more than 6° below the horizon; nautical twilight begins and ends when the centre of the sun is 12° below the horizon. "The degree of illumination at the beginning of morning and end of evening civil twilight is such

the brightest stars are just visible, and terrestrial objects can be easily distinguished;... at the ~~end~~ beginning and end of nautical twilight (it) is such that general outlines of ground objects are visible, although the horizon is probably indistinct, all detailed operations have become impossible and all the navigational stars can be seen."(15)

The short days and low altitude of the sun mean that the winters are long; in the summer, although the sun is still comparatively low, the days are long and, as a result, warm. The transitions between these two seasons are abrupt. This is put in quantitative form by the average temperatures given in Fig. 3 (16). As a minor point of interest, we can also see in these the small tempering effect of the sea on the climate as we go down the delta from Ft. McPherson through Inuvik to Tuktoyaktuk.

For many purposes, the coldness of the climate can be gauged by the number of degree days*; in particular, these units have proved to bear

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* There are as many degree days in a single calendar day as the number of degrees by which that day's mean temperature falls below 65° F.

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a direct relationship to the amount of heat needed to keep a building warm and are widely used in estimating the amount of fuel needed for heating purposes. Average numbers of degree days per month for Inuvik are given in Fig. 4 (17); Table I gives yearly totals of degree days for Inuvik and, for comparison, more southerly places.

The length and coldness of the winter mean that the river channels and the ocean are covered with ice for most of the year. This is of particular importance in the Mackenzie Delta, where there is no extended road network and where, consequently, life must depend to a great extent on the suitability of the river channels for travel, either by boat or on the ice. Table II (18) gives average dates for break-up and freeze-up; in brief, we can say that there are three and a half to four months, from June to September, during which boat travel is possible. The ice on the river

channels and lakes is generally thick enough for travel in late October or early November and remains so until May.

Other climatic factors which may influence the utility of some technological design are rain, snow, and the incidence of cloudy weather and fog. Fig. 5 (19) gives the average precipitation per month (measured as rain) for Inuvik and Tuktoyaktuk; the Mackenzie Delta shares the dryness of the rest of arctic Canada. Fig 6 (20) gives the average snow thickness on the ground for the same two places. Here we may note two features: there are only four months in which we do not expect a snow cover on the ground, and the average depth of snow diminishes as we go northward from the head of the delta to the coast (21). Due to winds and the dryness of the snow, of course, deep drifts can be formed, and thus these "average" depths do not convey a true picture of what the country looks like in winter.

In Fig. 7 (22) we have the percentage of available sunlight that actually occurs at Inuvik; the summer months are, in general, quite fine weather, especially in comparison with the more overcast nature of the fall months. This condition is typical of the inland portions of the delta (23); along the coast, as we should expect, there is a higher chance of overcast skies and fog. Table III (24) gives some data on the relative incidence of fog at Inuvik and Tuktoyaktuk.

This brief summary touches on the more important features of the landscape and climate of the Mackenzie Delta from our present point of view. Since our purpose in this report is to discuss the applications of technology to the life of the inhabitants of the region, we must go further than a mere physical description of the place, and we shall now try to give a parallel description of the present-day inhabitants of the area.

In the area we cover in this report there is a total population of some five thousand; approximate figures for the various settlements are given in Fig~~x~~ Table IV (25). The first thing to note about the native

element of the population is what we have already noted: the Delta is a meeting place for peoples in the same way that it is the boundary between the arctic and the sub-arctic. The settlements at the head of the Delta - Fort McPherson and Arctic Red River - are typically Indian; Tuktoyaktuk is a coastal Eskimo settlement; both races are present in Inuvik and Aklavik.

The modern history of this region is the story of the shift of the native peoples' habits to those of the southern civilization. This first appeared in the introduction of manufactured goods and a semblance of a cash economy, then more recently in a decided shift from a nomadic life into concentration in the various settlements. Although it is beyond the scope of this paper to go into these matters in any detail, we can in particular see that the settlements have grown up recently enough that, in every case, they still show the purpose which called them into being. A summary of the history is therefore useful in understanding the peculiarities of the various settlements.

In general terms, we can trace the changes in the natives' way of life back to three sources. The first, and to date the most lasting, of these was the introduction of fur-trading. Although Mackenzie travelled through the delta in 1789 (26) and various explorers, including Sir John Franklin, visited it in the course of the next fifty years (27), commercial fur-trading was not established in the region until 1840. In this year Fort McPherson was founded; it was originally some four miles up the Peel River from its present site, which is located on a knoll rising above the surrounding swamps; it was moved here in 1852 (28). In the early years of its existence, Ft. McPherson was frequented both by Indians and Eskimos; toward the end of the last century the latter moved northward, perhaps as a result of the depopulation caused by the whalers' coming. This resulted in the foundation of a second trading centre in 1912, which became the present town of Aklavik.

In one sense, the introduction of fur-trading did not interfere too

violently with life in the Mackenzie Delta, for it did not change the fundamental nomadic life of the people and it did not create the severe economic problems associated with living in the present-day settlements. On the other hand, it did make the local inhabitants dependent on goods imported from the south and it brought the use of money into this part of the arctic long before this happened elsewhere (29).

Fur-trading ~~also~~ thus caused the foundation of two of the present-day communities; the next wave of change had much more violent effects on the people but resulted in no new settlements in our region. This was the advent of the whalers to the Beaufort Sea in 1890. The usual wintering grounds were to the west of the Mackenzie Delta, and thus the only permanent Canadian settlement that resulted from whaling in this part of the world was also to the west, at Herschel Island. The whalers fished the seas of this district out quite quickly; by 1906, at the time of Stefansson's stay in the Delta, there were only a couple of whaling boats left (30). Nonetheless they introduced diseases that led to a virtual depopulation of the Mackenzie Delta eskimos and thus, indirectly, led to a wave of immigration from Alaska, they introduced the wide-spread use of fire-arms, and they left as a legacy many people of mixed blood (31).

Third and most recent is the change from a/hunting and trading nomadic economy to a life of which the greater part is spent in a settlement. The beginning of this may perhaps be dated to the foundation of Tuktoyaktuk in 1934 as a trans-shipment centre between river boats and the ocean-going vessels which supply the coastal settlements to the east. The harbour at Tuktoyaktuk has been a favoured place for many years; Stefansson stayed there in 1906-07 (32), and in 1924 Rasmussen counted six houses with a total of thirty-five inhabitants there (33). After it became a transport centre, however, a gradual centralization of facilities along the coast into Tuktoyaktuk occurred: the trading post at Herschel Island was closed in 1938, that at Stanton in 1954 (34). The movement of the Eskimos toward Tuktoyaktuk became intensified in 1954 with the building of the DEW l[illegible]

site there, and this last date can be considered a clear dividing line in the coastal Eskimos' change from a nomadic type of existence to a more settled one.

Chronologically, the small settlement of Reindeer Station was the next to be started. This settlement lies somewhat outside the main course of life in the Mackenzie Delta for several reasons. It was founded in 1935 as the headquarters for the reindeer herding project which was then being started (35). As such, it represents an endeavour to exploit an agricultural resource of the region. This it still remains; with the exception of the schoolteacher, the Hudson's Bay Company store manager, and their families, the population consists solely of men who work for the reindeer project and their dependents. As a "company town", albeit on a very small scale, it has a rather anomalous position in the Delta and is somewhat beyond the purview of the present paper. We shall seldom have occasion to refer to it in discussing possible development of facilities in the other towns of the Delta, though, as we shall see, it may play considerable part in exploiting the local renewable resources.

The most recent of the settlements is Inuvik. This town again reflects, primarily, one side of life in the Mackenzie Delta, this time that of government administration. In the early 1950's it was decided that Aklavik - at that time a settlement of about 1500 people - was not suitable as a long-term governmental centre. Aklavik's site is low and subject to occasional floods at break-up; the ground is silty and poor for construction; and there is no site for an airstrip suitable for heavy aircraft (thus, in one respect, Inuvik represents the air-age counterpart to the shipping facilities at Tuktoyaktuk).

At first, it was hoped that it would be possible to create a new town which would replace Aklavik entirely. When it was found that there were no suitable sites for an airstrip on the west side of the delta, however, a location for the new town had to be found on the east side. The hunting and trapping are pooer there; in the end, people with permanent or semi-

permanent wage employment have moved to Inuvik, while Aklavik has gone back to being a centre for people living more off the land.

From the point of view of technology, Inuvik is the most important settlement of the Delta. It was consciously designed to demonstrate the possibility of building a northern town with as many of the features of our urban civilization as possible; this design was realized in a generous manner. Thus, the town stands as a demonstration, a thing which is in itself not unimportant; furthermore, the vast body of experience gained there is of immeasurable use in trying to solve the problem of raising the standard of living in communities where money is not as freely available as it was in the building of Inuvik.

There is another word of caution that must be remembered in using elsewhere the design principles that have been used in Inuvik. This is that Inuvik was conceived, as we have said, as a government centre; its primary purpose was to be to provide schools, a hospital, federal buildings, and the various ancillary functions - housing, a laundry - that these entail. One approach in solving this problem economically is to treat the town as a large industrial plant. This has been done, unquestionably with a large degree of success, but it has resulted in a centralization of facilities that may not be practicable elsewhere and also in a certain lack of flexibility in expansion. One must always remember this, both before hastening to criticize the town and before making a carbon copy of its facilities for use elsewhere.

In more general terms, we note that Inuvik has created employment, both during its construction and later; thus it has contributed, in the same way as the building of the DEW line stations, to teaching the natives of the delta to live in towns. The economic basis of the life of the native inhabitants is treated elsewhere (36); nonetheless, the present tendency towards living as much as possible in the settlements is obvious and is one that has great bearing on the technological provision of facilities. It is true, of course, that steady employment is available

primarily in Inuvik alone. There are very few jobs elsewhere, and as a result the majority of the people in these other settlements have to live, in part at least off the land*. This situation will, in the writer's

* As an example, it has been estimated (37) that approximately 60% of the population of Aklavik goes trapping for an average of five weeks in the spring of each year; about 40% may go fishing during the period mid-August to freeze-up.

opinion, last for many years; we shall therefore consider in some detail possibilities of making such a life easier. On the whole, though, the trend towards living in settlements seems irreversible; it is a process that has only been quickened, by such projects as the construction of Inuvik and the DEW line station at Tuktoyaktuk; it must be borne in mind that it will probably continue in any thinking about the future of the delta. The greater part of the following chapters will be spent in considering features of this type of life.

Before proceeding to the discussion of various utilities, it may not be amiss to pause and summarize the general appearance of the delta. This can, perhaps, be done through describing an airplane flight the author took across the delta, from Aklavik to Inuvik, late one winter afternoon. As he left Aklavik, the mountains of the Richardson range were hidden in the clouds behind him. Below him lay the delta with its dark spruce trees contrasting to the white of the ice-covered channels and lakes. Across the delta could be seen the row of hills which line its eastern side; below these sparkled the lights of Inuvik. Far to the north the lights at Reindeer Station were just visible. Beyond the horizon, a hundred miles to the south, were other spots of light - ~~the oases of~~ Ft. McPherson and Arctic Red River; to the north, Tuktoyaktuk lay on the shore of the frozen sea.

In many ways, these towns are isolated and primitive; in some, remarkably advanced. These are the details we must now turn to.

III

In broad terms, the principal ways in which technology has made our every-day life easier are obvious. Probably the most fundamental is the cheaper provision of heat and light. Electric power has become a vital extension of these, and, particularly in cities and towns, we rely on convenient water supply and sewage disposal. The development of cheap and easy methods of insulating buildings is important in any cold climate. Other general advantages have come from economic, quick transport, and, more generally, from the possibility of rapid communication between places at some distance from each other. Beyond this we get into peripheral, though still important, matters - technological aids in the provision of better medical service is an example - and then to the many ways, of which movies and television are the most obvious, in which technology has contributed to the spending of leisure time.

This last is beyond the scope of the present paper; even so, a coherent description of the present development of the other facilities is difficult. There are two main sources of confusion. First is the striking division in the extent of available amenities between the administrative and technical people who are in the district for a relatively short term and the native population. In every settlement government workers enjoy a way of life that is, in reality, quite comparable to that in the south; the native population, in the main, does not. The width of this division is clear to the tourist, no matter how short a time he spends in the district; the sociological results are equally obvious, and are treated in some detail in accompanying papers (38). We shall see that, at present, it would be difficult to extend the availability of these utilities to most - not all - of the population without continuing wholesale subsidization, of which the present proposed subsidization of electricity is but a single example. The writer feels that the only suitable long-term solution for a region like the Mackenzie Delta is for it to be substantially self-sufficient; this, of course, is the general problem of

which the engineering problem of discovering cheaper ways to make such facilities available is but one side.

Further confusion arises from the fact that it is not practicable to separate facilities into water-tight compartments to make their description easy. Even in the south, of course, this cannot be done completely; as an example, the problem of heating buildings is obviously intimately bound up with that of insulating them. In the north, this overlap extends further. Let us take another example, the laying of water and sewer pipes. In the south one digs below the frost line and lays the pipes in whatever way is most convenient. In the arctic it is impracticable to dig below the permafrost; pipes would quickly freeze if laid in permafrost without precaution. One solution is to enclose the water supply pipes and sewers in a single, insulated box, which has some provision for being heated. This is called a "utilidor"; such systems are in use in the two towns of the Mackenzie Delta that have year around water systems. In Inuvik the heating system is included in the same unit; in Russia the same general approach is used, but with the addition of the electric supply cables.

Nonetheless, it is still possible to make a fairly straight-forward description of the extent of the development of these various "basic" utilities in the settlements of the Mackenzie Delta; in the remaining sections of this chapter we shall do so and, at the same time, to point out places where future study might best be concentrated.

1. Heat.

It is obvious that it is harder to heat buildings in the north than in a more temperate region. As we have already mentioned, we can put this observation on a more quantitative basis with the use of degree days; as Table I shows, it would require - other things being equal - nearly three times as much fuel to heat the same house in Inuvik as in Montreal.

The basic contribution of technology to the problem of heating has been to make fuels - coal, oil, natural gas - readily available and easily

usable. Oil is produced at Norman Wells, 385 miles up the Mackenzie River from Inuvik; together with wood, it forms the basic fuel for the Delta. Beyond this point, however, heat is produced in various ways. The most complex system is that at Inuvik: superheated water is produced in the central plant and distributed to the buildings forming the core of the town: the school, hostels, government housing, the hotel, stores, and administrative buildings. As we have said, this heating system is also used to heat the utilidors, as can be seen from the cross-section of one given in Fig. 8. Heat exchangers in the separate buildings furnish individual sources of heat.

Elsewhere in the region - and also in that part of Inuvik which is not reached by the utilidor - heat is principally furnished by oil burners of various types. Forced air systems and such conventional equipment are found in government buildings throughout the area; heating systems range from these through oil ranges and space heaters to/home-made stoves used in some of the native housing. Wood is also used to a limited extent, even at Tuktoyaktuk, where there is a fairly plentiful supply of driftwood along the coast. Recent information (39), however, indicates that this last source of fuel is being used up faster than it is being replenished.

The basic drawback with oil heat in the Mackenzie Delta is the high cost of the oil. Although the region is fortunate in being situated less than four hundred miles from a refinery, and so there are not the high transport costs that occur in other parts of the Arctic, oil is not cheap by southern standards. For example, the retail price of fuel oil at Inuvik is $0.35 per gallon (of which transportation accounts for about seven cents); at Tuktoyaktuk it is $0.45 a gallon. Thus, in cost the difference between heating a house in Montral and a similar one in Inuvik is not the factor of two and a half or three that would appear from the difference in the number of degree days, but more nearly a factor of seven to nine. Even a small house, accordingly, is expensive to heat. As an example, a small (16 ft by 28 ft) well-built log house at Tuktoyaktuk is

estimated (40) to need about 1350 gallons of fuel oil for one year's heating, at a cost of over $620.00.

The problem of lessening the expense of heating is probably the single most important of those faced by technology in the Mackenzie Delta; it is also the most difficult to solve. There are, of course, various ways of reducing the price of fuel oil, in particular by reducing the cost of transport. In a similar vein, one can reduce the amount of building insulation, within the limits imposed by the added costs of construction. Both of these we shall return to later; the figures given above, however, are sufficient to show that it would be difficult, by such means, to reduce heating costs to a point where they became competitive with those in the south.

A different approach is that used in Inuvik. Here, by combining the heat loads of many buildings into a central power plant, it has proved feasible to use a lower grade of oil. This residual oil is available, wholesale, at $0.17/gallon rather than the $0.276/gallon that fuel oil costs there (40). This is a substantial saving; as a further advantage, bringing all the heating units together into one place substantially reduces the risk of fire.

The arguments against the value of such heating plants as a standard method of heating settlements are obvious. In the first place, as we have pointed out already, such a plant is comparatively inflexible in design; as experience in Inuvik has shown, it is not easy to make the continual extensions to, and changes in, service that a town would require. Furthermore, the costs of the heat distribution system are high; at Inuvik, it represents over 30% of the costs of the utilidors (41). There is a substantial heat loss in the Inuvik utilidors; though much of it might be eliminated by more careful - and possibly more expensive - design, a certain amount of loss is inevitable. All these factors act to reduce the advantages of a cheaper fuel.

The only way out of this situation may well be to find an alternate

source of heat energy. One such avenue of escape might be the discovery of extensive oil fields in the Delta, though the evidence from Norman Wells would not cause one to be too sanguine about this affording a substantial reduction in price. Another possibility is that of using hydro-electric power for heating. We shall have occasion to mention this again below; here we can observe that one gallon of diesel oil contains about 46.5 kwh of heat energy, so that even under the most favourable circumstances - at Tuktoyaktuk - electricity would have to cost about one cent per kwh to compete with fuel oil for heating. The capital investment in a hydroelectric plant is so large, the settlements so scattered, and foreseeable electric demand so small that such a rate seems unlikely. Finally, one might think that the peat found in the region might be of value as a fuel, but the climate is too cold to produce useful peat for such purposes (42). All things considered, the writer feels that this problem is very difficult of solution on an economic basis.

There is, however, one side of the heating picture which seems more amenable to further study. This is the utilization of the waste heat arising in the generation of electricity. At present almost all the electric power used in the Mackenzie Delta is provided by diesel generators; these are only between 30% and 35% efficient in converting the heat content of the fuel into electricity. The remainder is dissipated, with about half the heat going into the exhaust gases and the other half into the coolant. Unfortunately this heat is not in a particularly accessible form; the exhaust gases in particular are not at a sufficiently high temperature to be of much use in producing steam. It is quite conceivable, though, that usable heat for certain buildings or for some agricultural scheme might be obtained from the exhaust or by a heat exchanger through which the cooling water passed.

2. Light and electric power.

In temperate regions electricity has come to be one of the most indispensible features of everyday life. For lighting purposes alone, it

s even more desirable in a land with month after month of short winter days, though one cannot underestimate the value the native peoples of the Delta set by electric appliances*. Here again economic factors work

*An indication of this can be seen in the requests for electric power made at Tuktoyaktuk in the spring of 1965 (42). In these applications, people listed the various appliances they would like to be able to use; in thirty-four applications, the following main items appear (not including, of course, the universal desire for electric light): washing machine and electric iron (21 times each); radio (18 times); hot plate (14); phonograph (13); other items which were listed several times included electric coffee pots and electric fry pans.

to make electricity a high-priced item and to deepen the division between the government workers, who have an adequate supply, and the natives who have little or none.

Every community has electric generating equipment. With the exception of Inuvik, diesel power is universally used; Inuvik has both diesel equipment and a steam turbine. The size of the various power plants is given in Table V, which also gives the rates for the purchase of electricity for domestic use. These are high by city standards; 60 kwh of electricity a month (using a low figure to cover lighting and small appliances alone) cost $5.10 at Inuvik and $7.20 at Tuktoyaktuk, compared with $1.59 at Montreal, $1.67 at Ottawa, $1.64 at Winnipeg, and $2.21 at Vancouver (43; these are 1962 prices for the southern cities). Such a comparison is not fair, of course, because of the vastly larger and more economical systems possible in a densely populated, highly industrialized area; these large systems have made the extension of cheap power into the rural districts of the south possible. A more valid comparison is with similarly isolated settlements. An interesting example is the Nantucket Gas and Electric Co., on Nantucket Island, Massachusetts, U.S.A. Here, for the same 60 kwh per month, the cost would be $6.40 during the winter months (Oct. 1 to May

and $11.93 in the summer (44). The situation in northern Alberta is similar. The generating station at Fairview, Alta., has a capacity of 10,200 kilowatts; for residential purposes, 60 kwh per month costs $4.30. The plant at Jasper has a total capacity of 4080 kilowatts, and 60 kwh per month would cost $4.70 (45). These figures allow us to see the Mackenzie Delta prices in better perspective: they are not out of line for the size of community they pertain to.

Another basis of comparison is with the alternate way of obtaining light: gasoline lamps. Even if electric power costs $0.12 per kwh these are an uneconomic form of illumination - at Tuktoyaktuk a gallon of white gas costs $0.85; this will run a single burner Coleman lantern (Model 200A, approximately equivalent to a hundred watt incandescent light) for 56 hours, or a double-burner one (Model 220F, equivalent to between 100 and 200 watts in an incandescent bulb) for 43 hours (46). It costs $0.67 to run the one hundred watt incandescent light for 56 hours at $0.12 per kwh.

We must not, of course, be misled by these figures into thinking that electricity is not a luxury in the Mackenzie Delta. For the native population, the price is high. Partly as a result of this, and partly due to the fact that it is not feasible at present to supply electricity to everyone who wants it*, the use of electric power is, by and large, limited

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*This is particularly true at Tuktoyaktuk; the distribution system there is inadequate to supply anyone beyond a small distance from the generating plant.

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to the white population. Inuvik is an exception; there almost every house in the settlement has electric service. In Aklavik, on the other hand, there are a total of between thirty-five and forty private customers, not including the two missions nor the Hudson's Bay Company store; of these only nine can be described as "non-government non-white" families (47). At Tuktoyaktuk the only non-government users of electricity are the Hudson's Bay Company and the Anglican and Roman Catholic missions.

This problem is only less serious than that of the cost of fuel for heating in the respect that heat is a necessity of life in the arctic, while electricity is but a luxury - although one by which people set great value. In the short term future, as we should expect from the above comparison with isolated places in the south, there seems only slight hope for radically cheapening the cost of power.

For the sake of completeness, we can briefly consider the other means currently available for generating power. The nearest direct competitor to a diesel generator is a gas turbine generator. It is not economic to build turbine generators as small as diesels - the lower end of the practical range for a turbine generator is about three to four thousand kilowatts - so they would not be suitable for the current demands of any settlement in the Delta other than Inuvik. Gas turbine units have two main advantages: they can have a relatively low capital cost per kilowatt of installed capacity (46), and they require comparatively little maintenance. Set against these are two disadvantages. First, they have a lower overall efficiency than a diesel generator. At peak load, a 3500 kw gas turbine generator has an efficiency of about 20%, compared to the 30% to 35% of a diesel unit; in this connection, we must remember that the efficiency of a diesel generator is about the same as that of a large steam-powered generating station. This loss in efficiency is counterbalanced to a large extent by the fact that the exhaust gases are at a much higher temperature (about 900° F at full load) so that they can be used in a waste heat boiler. Again considering Inuvik, we might be able to substitute a gas turbine generating system for the diesel generating system and part of the steam generating equipment at approximately the same efficiency.

At this point, we run into the second disadvantage: the steam boilers at Inuvik, as we have said, run on a residual oil, while gas turbines, although they can run on diesel oils or similar distillates, cannot at

present use the heavier residual oil with its corrosive elements. As has been mentioned above, there is a considerable saving in expense in the use of this residual oil, and, accordingly, it is difficult to see how gas turbine generators could prove very useful in the Mackenzie Delta under present conditions.

Atomic power is another means of generating electricity, and one which seems to sum up in its name much of the wonder of modern technology. Unfortunately it can be immediately ruled out in the present application on the basis of size. In the south, atomic power plants become competitive with other types of thermal generation only when the amount of electricity produced is in the range of hundreds of thousands of kilowatts. The foreseeable market for electric power in the entire Mackenzie Delta is, of course, nowhere near this level. The lack of economy of small atomic power plants can be seen in the results of a study prepared with specific reference to Frobisher Bay (47; although this study was done in 1960, technological advances made since then seem only to help in the design of much larger reactors). Among the conclusions of this study is the opinion that, under the most favourable circumstances, a five thousand kilowatt atomic plant might compare with a diesel plant if oil cost $0.28 per gallon or more; a twenty-five hundred kilowatt atomic plant might be competitive if oil cost $0.48 per gallon.

A third alternate way of generating electricity is through the direct conversion of heat to electric power. This has, as yet, been done on only a small scale, and does not seem to hold much promise for supplying the needs of even a small settlement. It might have application in a single camp; we shall ~~therefore~~ discuss ~~it~~ this in the next chapter.

Although alternative means of generating power thermally do not seem to lead to cheaper electricity, there are some means by which it might be possible to reduce its cost. It is obvious that substantial reductions in the cost of power are possible at present only if some degree of centralization can be produced. ~~Both~~ Neither the overhead in operating a power

plant nor the number of men required to operate it increases in direct proportion to the number of kilowatts generated. The extent of this is shown in estimates (48) on the size of operating crew needed for plants of different sizes: for a plant smaller than 250 to 300 kilowatts, three or four men are adequate; above this size, one should have five or six, and more men are needed only when the plant gets above 1000 kilowatts capacity. In other words, small diesel plants may spend considerably more on salaries and wages than on fuel; this is indeed the case in many of the settlements of the Northwest Territories*.

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* The followings are figures for the fiscal year 1963-64: The diesel plant at Ft. Smith (2250 kw capacity) spent $74,813 on salaries and wages against $85,419 on fuel; that at Ft. Simpson (1075 kw) $49,536 on salaries and wages and $25,487 on fuel; and that at Ft. Resolution (325 kw) $22,544 on salaries and wages and $8,519 on fuel (49).

The obvious way in which centralization could be effected is by constructing transmission lines between the various settlements. Admittedly, this would be an expensive undertaking; still, crude calculations - the only type possible because of the uncertainties involved - indicate that, with present usage, it might be competitive with present rates to furnish power to Aklavik over a transmission line from Inuvik, and that, if the Aklavik usage were doubled, it should probably be so. The situation is much less favourable with the other settlements, due to the greater distances and, at Ft. McPherson, the continuing need for some sort of local plant to heat the hostel. Nonetheless, the possibility is intriguing and deserves further investigation.

A more radical centralization scheme would include building a hydroelectric plant. Sources of hydroelectric power exist in the region (50); in addition to the savings in having a single plant, this would, of course, mean that the expense of the diesel fuel would be cut out. At present this is a comparatively small fraction of the total cost of electric

power (it contributes about $0.02/kwh at Inuvik and perhaps $0.03/kwh at Tuktoyaktuk), but with any reduction in overall price it would become more important, since it is a base price which can never be reduced with the current system.

Although hydroelectric power may be a long-term solution to the problem of expensive electricity in the region, the construction of the requisite dam alone would obviously be a great expense. It would probably be as much of a subsidization, although occurring all at one time, as the present scheme for direct payments to reduce the cost of power. Here again, however, it would still seem valuable to study the matter further so that a usable comparison between the two systems could be produced.

3. Water supply and sewage disposal.

In most temperate regions, small communities do not need a system of water supply and sewage disposal; individual wells and means of waste disposal such as septic tanks are adequate. In northern regions like the Mackenzie Delta the problem is vastly more complicated. One cannot, in practice, drill wells for water*, and so even the smallest settlement must

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* In principle, of course, one can drill through the permafrost layer; the Russians have done this on occasion (51) and have found the water so obtained to be heavily mineralized - for example, a sample from Noril'sk had 2700 ppm of dissolved minerals.

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depend on surface water, with its concomitant problems of contamination and transport. Septic tanks with leaching systems are not practicable due to the permafrost. Waste water accumulates during the winter months in grey glacier-like formations. Finally, one can not use conventional piped water supply and sewerage systems, for unheated, uninsulated buried pipes would quickly freeze.

In this field, then, the basic problem is that the community, no matter how small (and consequently, no matter how little money is available for

such purposes) is faced with providing water supply and sewage disposal services by means which are almost always unconventional and frequently may be very costly. This problem has three parts: obtaining water in sufficient quantity for the needs of the community, the ultimate sanitary disposal of wastes, and the provision of an economical system to make these facilities available to the inhabitants. For the sake of clarity, we shall discuss each of these in turn.

a. Water supplies. Fortunately, the Mackenzie River is sufficiently large and the population along it sufficiently small that it furnishes a handy and unpolluted source of water for the communities of the Delta; it would be strange if most of them did not use it in one way or another.

Inuvik and Ft. McPherson use lakes as reservoirs, but at Inuvik the lake is kept full by pumping water up from the river. Both these settlements have water treatment plants. Aklavik also uses a lake as a reservoir, but only in the summer. Here, the lake is flooded every spring by the river; again, there is provision for filtration and chlorinization, though its use seems rather intermittent (52). In the winter, ice blocks are cut from the river and used as a supply of water; this ice is also stored in ice-houses and used as a summer supply of drinking water for the government employees.

Arctic Red River and Reindeer Station use river water directly, though some thought has been given at the latter place to using a lake on the hill behind the settlement as a source of water for a pressure system. Finally, the situation at Tuktoyaktuk is quite similar to that at Aklavik. In summer, water is taken from a lake and chlorinated before distribution. In the winter, water for the government employees is taken from the harbour (although Tuktoyaktuk is on the ocean, it is sufficiently near the mouth of the Mackenzie that the harbour water gradually becomes fresh in the winter, when mixing of the water by the wind is prevented by the ice); the natives again cut ice.

In brief, availability of water is no problem at any of the settle-

ments, nor, in general, is treatment to ensure that it is safe for drinking purposes.

b. Waste disposal. The most sophisticated form of ultimate disposal of sewage used in the region is the sewage lagoon; even these are rather rudimentary in comparison with those used in southern Canada (53). Such lagoons are used at Inuvik and Tuktoyaktuk; essentially they are used as storage ponds, with periodic cleaning out under conditions that would not influence the settlement's water supply - at Inuvik during the spring floods, at Tuktoyaktuk by heavy storms.

At Ft. McPherson a lake is used for disposal purposes, with reliance put on dilution; Aklavik has a rudimentary form of lagoon, which again is flooded in the spring. In the winter sewage is disposed of at Aklavik by being put on the river ice and left until spring (54). The smaller settlements have no organized facilities.

Waste water disposal is a serious problem outside the central serviced areas of Inuvik and Ft. McPherson. Aklavik has a system of open drains, which furnish moderately satisfaction in the summer. In general, however, waste water is dumped on the ground. In the winter, as mentioned above, it freezes and accumulates, leading to the spring-time production of unsightly puddles which are gradually dispersed by rain.

This problem of waste water is obviously directly dependent on the problem of sewage collection; apart from it, we see that - again due to the isolated nature of the settlements - it is possible to dispose of sewage in a reasonably satisfactory manner. As Yates and Stanley point out (55) further study on the problems of sewage lagoons in the north would be useful for more rational engineering design, but under the circumstances present in the Mackenzie Delta this does not seem particularly pressing.

c. Water distribution and sewage collection. We are left with the problem of making the water conveniently available to the inhabitants and of providing for the easy removal of sewage and wastes. This is the most

difficult side of the whole question, and one which has, so far, resisted solution in a sufficiently cheap form to be of wide application. In northern Canada, there have been two general approaches to this problem: supplying water and removing sewage by truck or constructing an insulated system to which heat is supplied in some form and which contains both the water supply and sewerage systems. Both of these general approaches are in use in the Mackenzie Delta.

The more satisfactory of them is, obviously, the use of piping systems. For economic reasons, however, this is generally much harder to justify; as a result, the two systems of this type - the so-called "utilidors" at Inuvik and at Ft. McPherson - are limited in their extent and serve only the part of the towns used for governmental purposes. Since both these systems are above ground level, they form a highly visible sign of class distinction. The following description may show why they are so expensive and also some of the difficulties that arise in their use.

The Inuvik system is both the more extensive and the more complicated. As we have already observed, in it heat is supplied to the water and sewer pipes by enclosing them in an insulated box with the pipes containing the building heating water (Fig. 8). Although this system is expensive - the utilidor proper costs about $224 per foot (56) - it has worked quite well. Various technical problems, to be sure, have arisen. In particular, it was necessary to build the utilidor with the heating pipes above the water supply pipes in order to keep the drainage points on the buildings - and, consequently, the height of the piles on which they rest - as low as possible. In the winter, pronounced stratification of the air mass inside the utilidor takes place, with the colder air settling to the bottom. Furthermore, strong convection currents are set up in sloping sections, which frequent baffles cannot entirely stop. The immediate result of these was that the water supply and sewage pipes did not receive as much heat as expected, and it was necessary to remove insulation from the heating

pipes in places to keep the water pipes from freezing. A further consequence has been large losses of heat; under certain circumstances, it is estimated that 20% of the heat produced in the central plant is used in heating the utilidor (57).

A minor inconvenience of the Inuvik utilidor is that it is impossible to supply cold drinking water, particularly in the summer. This shortcoming is the subject of many complaints.

On the whole, though, this system works quite satisfactorily, particularly in the short sections ("utilidettes") which join the main structure to the individual buildings. These have their own source of heat and are not liable to freezing. This last is a particular drawback of the other utilidor system in the Delta, that at Ft. McPherson. Here we have a considerably less ambitious and cheaper venture. The utilidor (a typical cross-section is shown in Fig. 9) contains only pipes to supply water and remove sewage. The water supply line runs in a loop, through which water circulates continuously; in this way heat is supplied to keep the water and sewerage systems from freezing. The connecting lines to the houses, however, do not have an independent heat source, so it is possible that they will freeze if water is not used in a building and, consequently, there is no flow through them.

The alternate method of supplying water and removing sewage, trucking, is most developed at Tuktoyaktuk. There the government housing has individual pressure systems: each house has a 180 gallon water storage tank, which is filled twice a week and provides water at 20 to 40 psi pressure. There is also a 500 gallon waste tank in each system. Even this system, however, does not extend to the native population, but there are three 700 gallon water tanks in the settlement which, during the summer months, the Department of Northern Affairs keeps filled as public sources of water.

A more or less similar system is planned for Aklavik. At present there is only a summer water supply system: a run of 3" pipe, laid on

the surface, with taps at frequent intervals. This is fed, through a pressure tank, from the lake described above. In the winter the system is shut down; even so, considerable trouble has been had with crackage in the pipes (58). This is being refurbished, and it is currently planned to install water tanks in heated quarters at three points in the settlement to furnish a source of water during the winter.

In general, trucking water for the native population seems not to have been too successful, for they would rather get it themselves than pay for a truck to bring it. It is still used quite widely in the unserviced area of Inuvik, however; there there is also a provision of central pick-up points for the disposal of waste from chemical toilets. In Ft. McPherson, on the other hand, the only public supply of water is a tap at the central power house.

Apart from what has been described, sewage disposal is at a rudimentary level. The practice at Aklavik is perhaps typical: there it consists of lining bucket-type toilets with plastic garbage bags, and eventually tying these up and putting them with the other sewage. The use of these bags certainly cannot be criticized in that they make an unattractive job somewhat less so, but, as we shall remark later, their ultimate sanitary suitability is open to some question.

This description is sufficient to show the complexity of the whole question of water supply and sewage disposal. In the writer's opinion, it seems clear that the only long-term solution which will compare with southern facilities is the development of the cheapest possible piped systems. Trucking water has advantages, especially in the smaller settlements; but experience seems to be showing that the extra convenience this may bring to the native population is not considered by them to be worth any expense. There is some hope that year around running water and waste removal would not produce the same reaction.

There are several problems connected with the design of such piped systems, or utilidors. A large part of the design, of course, is dictated

by local conditions, such as the terrain on which the townsite lies (if one intends to use gravity flow sewers) or available sources of heating, so it is impractical to generalize too much. On the other hand, it is interesting to contrast the various types that have been tried and to see what might be of future use in the Mackenzie Delta.

By and large, practice in climates comparable with that of the Mackenzie Delta has been to put water supply and sewerage systems in the same container, usually insulated, and to supply heat, either to both lines, or to the water line alone; in this last case, enough heat must be transferred from one pipe to the other to keep it from freezing. Various sources of external heat have been used: at Inuvik, as we have seen, it is provided by the pipes which carry the building heating water; at Norman Wells (59) heat is similarly provided by a steam line. Elsewhere the pipes have been heated electrically (60).

A second approach is to heat the water at the input of the system; at Vorkuta and Noril'sk in the U.S.S.R. this is accomplished by using the cooling water from the power plants for the city water supply (61). Again, there are different means for ensuring continuous flow to keep the whole system above freezing. One is to bleed the system, as is done at Dawson (62), and, in the U.S.S.R., at Tiksi (63). Such a practice is inevitably more or less wasteful of water; at Tiksi 50% of the settlement's water supply is wasted through the drains.

A more economic system is to have a recirculating water line and to add heat in the supply plant as required. This is what has been done at Ft. McPherson. An interesting extension of this scheme is to have a recirculating system both in the water supply and sewerage systems, as is planned for installation at Frobisher Bay (64). There, it is planned to have septic tanks (which will have to be cleaned periodically) in each of the houses served, and to pump the effluent from them into the sewage line. The advantages of such a system are considerable: there will be no ne

to worry about adequate heat transfer to the sewer line; of more importance

for many applications, the need to design the sewerage system to allow gravity flow will be removed. The detailed behaviour of this system will inevitably have great influence on the design of future water and sewerage systems in the Canadian north.

Apart from this, though, there are various questions of immediate consequence for the Mackenzie Delta. One is the problem of ensuring sufficient heat gets to the sewer in a system where it does not contain its own heat. One solution to this might involve the use of thermal connections, such as metal straps, between pipes, though these would have to be used with metal pipes (or plastic-clad aluminum pipes); such a scheme would be useless with the transite pipes used at Inuvik. Another is the finding of means to reduce the stratification of the air in the utilidor at Inuvik - one answer to this, of course, is to fill sections of the utilidor entirely with insulation, as was planned for the utilidor extension at Norman Wells, though the thermal results of such an expedient are not clear. All these are aspects of the larger question of providing adequate heat transfer between the pipes of the utilidor with minimum losses to the exterior. Another side of this question is the search for cheaper insulating materials; insulating with moss has been suggested and is used in more southerly environments (65), and has been suggested, in combination with electric heating of the sewer, for Tuktoyaktuk (66), but the possible value of either of these in the Delta does not seem to have been critically investigated.

A second important question is the practicability of burying utilidors in soil conditions such as those of the Mackenzie Delta. There are considerable advantages in having the utilidor on or above the surface. In the first place, as we have seen, the ground in the region loses its bearing strength if thawed. It is, of course, possible to design a buried system in which the heat loss to the ground is so small that it would not disturb the permafrost conditions, but it seems never to have been tried; little, in fact, seems known about the rate at which pipes would lose h

under these conditions. A second cause of trouble with a buried system would be the insulation. This would be necessary, and there is the matter of preventing it from becoming water-logged. Expanded ~~polyethylene~~ polystyrene might be an aswer to this, but, again, its performance in actual practice is unknown. These are serious points of uncertainty; combine them with the ease of getting at a system like the present ones for extension or repair and we have ample justification for the current above-ground systems, which, it seems are also used by the Russians under similar conditions (67).

On the other hand, an underground system has aesthetic advantages and is more convenient in such matters as the extension of roads. It also would profit to a great degree from the insulating qualities of the ground. These advantages would seem large enough to make it worth while to re-examine the questions raised in the last paragraph and to see if, with present-day knowledge, it might not be possible to produce a usable underground system, and to compare such a system with above ground ones for cost.

Before we leave this part of our subject, we should return briefly to the use of plastic garbage bags in bucket-type toilets. The disadvantage of these lies purely in the fact that the plastic not only provides an impermeable container but also one which seems very long lived. Their use might therefore be a potential source of disease. For this or similar reasons, some trouble has been had with them at Rae (68). Their use has such obvious advantages, however, that it seems a search for some material which would serve as a toilet liner and yet not have the potential disease carrying ability would be extremely useful.

4. Housing.

Technological research has made great contributions to the problems of housing in the Mackenzie Delta, particularly in showing methods of construction on permafrost. There are other fields in which it still can be of great utility, though, as we shall see, the direct relation of th[illegible] to present conditions may be somewhat uncertain.

Speaking in broad terms, the technical problems of building construction in a region where permafrost is present are known and can be dealt with. As we have mentioned above, as long as the frozen soil remains frozen, we have no problem with bearing strength; it is only when it thaws that one runs into trouble. The solution to this is thus simply stated, regardless of the difficulties that may arise in its application: one maintains the ground as nearly as possible in its original state; in other words, do not damage the natural surface layer, if this can be done, and avoid having extraneous heat, as from a warm building, entering the ground.

Two ways have been used to accomplish these ends, both in the Mackenzie Delta and elsewhere. The more elegant is to support the building on piles. If these are set into the ground and allowed to "freeze in", ample bearing strength can be obtained. By leaving a free airspace between the bottom of the building and the ground the heat transferred between the two is diminished greatly. This method has been widely used in construction at Inuvik, apparently with virtually complete success. There has been a minimal amount of difficulty with the piles used in the construction* and none with building settling.

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* The few piles that have shifted seem either to have been in places where water could accumulate or in positions where they bore abnormally light loads, as in the utilidor system (69).

Setting piles is, however, an expensive procedure. An alternate and cheaper solution is to put a layer of some insulating material - typically a gravel pad - on top of the natural soil cover and use this as the foundation for the house. This method, of course, does not produce as great bearing strengths as piles do, but it is entirely adequate for small buildings, in particular low cost housing. For our present purposes, accordingly, we can consider the provision of suitable building foundations a minor matter. The design of large buildings is something else again and the detailed nature of the ground at the site must be considered -

but then the design of large structures is a problem in any part of the world.

Another broad technological problem in northern housing construction is that of avoiding the loss of heat wherever possible. The most straightforward approach to this is to avoid building individual houses and to combine dwellings as far as possible into apartment houses. By so doing the proportion of each unit which consists of outside wall is reduced, and, consequently, so is the amount of heat lost to the environment. It also becomes possible, in general, to use a more efficient heating plant.

Such an approach is, of course, used by the Russians in their northern cities; it is also common practice in military-type installations. It is doubtful how well it would work in any part of Canada; certainly at Inuvik, where there are apartments of varying sizes in the government housing, the single houses have a higher prestige value. The ghost of regimentation hangs over the draconic suggestion of combining the houses of each settlement into a few apartment buildings; it seems of little practical value. Some slight, but probably more acceptable, progress towards the same end can be made by making detailed arrangements of buildings in compact groups to take best advantage of winter sunlight and to afford the most protection in storms; again, a great deal of work on these lines has been done in the U.S.S.R. (see, for example (70)). This, however, belongs more to the field of town planning and is beyond the scope of the present paper.

The remaining way of reducing heat loss from buildings lies in their detailed design. In the building industry, the end result of such technological study has been, in the field of low-cost houses, to produce prefabricated buildings. In these attention has been paid to providing as good insulation in the walls and as tight windows as possible; in addition, the benefits of mass production can be turned to the production of a good quality product at the lowest possible cost. Such housing is extremely useful in most of the Canadian arctic, where building materials

are at a premium. Prefabricated houses can easily be imported by boat, or, if necessary, by air, and assembled and put into use with a minimum of labour. In the eastern and central arctic this seems the only way to provide low cost houses of good quality.

In the Mackenzie Delta, the situation is different; in particular, there is a fair supply of local timber ~~with~~ of suitable quality for such housing (71). Nonetheless, prefabricated houses seem generally preferred, particularly at Inuvik, and are again imported from the south. Presumably the reason for this is that in this way the owner gets a building which is better made and "tighter" with a minimum of effort; in other words, he is depending on the technical knowledge and experience available in the southern construction companies. Unfortunately this type of technology does not seem aimed at contributing in a broad way to the economy of the native inhabitants of the Mackenzie Delta.

The basic problem here seems the continuing encouragement of local construction of good quality; this lies much more in the fields of administrative direction and education than in that of technology; we shall accordingly limit ourselves to a few comments. One is to mention the building of log houses. This has already been tried in various settlements in the Delta but seems capable of wider use. Of course, insofar as it relates to technology at all, building log houses does so at a much more primitive level than the other subjects we have been discussing in this paper. About the only engineering statement it seems worth making about such buildings is that wood is a fairly good insulating material - it transmits heat only about two and a half to three times better than standard commercial products like rock wool. Thus logs, if thick enough, can furnish entirely satisfactory insulation. Log houses may be somewhat primitive in appearance, but if well built they are quite satisfactory for housing at about the lowest overall cost possible in the region; it seems unfortunate that more of an effort is not made to promote them.

Of course, local wood and a saw-mill are both available in the Delta,

and so frame houses can also be built locally. Here again the principles of construction are so well-established that they require no comment. In these regions, however, insulation is a virtual necessity in a frame building; again, this is quite standard, but represents an item which would have to be procured from the south. From time to time the question is brought up of using low density plastic polymers, such as foamed polystyrene or polyurethane, for insulation (72). Inch for inch, however, these do not give significantly better insulation than more standard materials, and so their only advantage would be a reduction in the weight that had to be shipped; it is doubtful if this could counterbalance the increased base cost. Thought also might be given to the possibility of transporting the insulation into the region in unpolymerized form and "foaming" it locally as needed.

The heat losses through windows and around doors can be large unless care is taken; again, suitable parts would have to be brought into the region or considerable attention paid in local construction if a usable building is to be obtained.

In general, nonetheless, the technological problems of low-cost housing in the Mackenzie Delta seem few and fairly easily disposed of; what is needed here/is not further study so much as continuing encouragement, the provision of local means of learning the trades involved as much as possible, and supervision to provide the best quality possible with the means at hand.

5. Transport.

We have already seen some of the effects of the Mackenzie Delta's isolation and location in the arctic, in the way they make both heating and the provision of electricity serious problems. The short summers and long winters and the great distance to centres of production combine again to make transportation another very difficult problem.

Transport is also a difficult matter to discuss in that it covers such a wide range. For clarity, we shall divide it into three parts

According to the distances involved: transport within a single settlement; transport within the Delta as a whole; and transport to and from the more heavily populated regions of Canada.

a. Transport within a settlement. The ability to bring heavy materials and equipment to every house in a town is such a fundamental requirement that we almost always take it for granted. Without it, we could preserve few of the benefits of communal living. If examples are necessary, we have the need of quickly getting fire equipment to a fire and the need of easy access to buildings to maintain their services (or, in the case of settlements in which trucks are used to haul water, to deliver water). The standard way of ensuring this ability is to build roads. Each of the communities in the Delta has some sort of road system (excepting Reindeer Station, which is little more than a row of houses along the river), but these systems are of widely varying usefulness.

Inuvik and, to a lesser extent, Ft. McPherson, are the only settlements with what could be called satisfactory road systems. In Inuvik this has taken place due to its position as governmental centre; the roads are gravel and kept in good repair. At Ft. McPherson a town plan was laid out in 1948 (73) and roads have been built according to it. As we have seen above, the nearest gravel to Ft. McPherson is the bed at Pt. Separation; this is too expensive for practical use in road building, and the roads at Ft. McPherson are surfaced with soft shale dug from a pit at the town. As Henoch says (74) "fortunately there are only a few vehicles in Fort McPherson".

Aklavik's roads are notorious. Again, there is a fairly satisfactory street plan. The roads, however, are only tracks in the silt; they are all right when the ground is frozen in winter or during dry periods in the summer. During the spring, and after any rain at all in the summer, they become extremely muddy and virtually useless. They also require a disproportionate amount of work. They only respect in which they merit any praise is the fact that they do reach almost all the buildings of

the settlement.

The situation at Tuktoyaktuk is almost the reverse. There is a certain amount of sand and gravel available there for building roads, although the present extent of the deposits is not presently known. Roads, however, have not been built. There is a road connecting the settlement with the airstrip and the DEW line station; this, fortuitously, runs past - or near - about half the houses of the settlement. Beyond this, construction has been haphazard. Again, a plan exists, with road allotments marked out; but, without the roads being physically there, no attention has been paid to the plan in building new houses. In addition, many of the houses are strung out along the bay at considerable distances from the existing road. The only sensible way of reaching these at present is by crossing the bay, by boat in the summer and on the ice in winter.

Thus we see that the settlements of the Delta are far from providing suitable, all-weather road networks. Considering their limited extent, it would not seem uneconomic to build such systems. Where sand are gravel are available, the technical problems can be quite easily solved; apart from the experience gained at Inuvik, the techniques of building roads on muskeg and permafrost have been extensively studied in connection with construction projects farther south (75). The situation at Aklavik, to be sure, presents serious problems. In this connection, the possible use of bonding agents (for example, soil cement (76)) to make a subgrade directly on the permafrost does not seem to have been studied. At first sight, this would seem a fruitful line for investigation. In general, a study of the relative costs of building different types of road for the settlements of the Delta should be both interesting and useful.

b. Transportation within the Delta. Beyond the limits of the individual towns conditions become quite different. The only roads of any extent are the one between the settlement of Tuktoyaktuk and the DEW line site, which we have already mentioned, and roads connecting Inuvik with the airport and with the naval station - perhaps fifteen miles in all. There

are no all weather roads between the settlements; the only "winter roads" or trails are the one between Ft. McPherson and Arctic Red River and one from Tuktoyaktuk to a fishing site at the Eskimo Lakes*. This lack, of

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* There are also the winter roads built by the oil companies; one of these connects the present oil drilling rig on Richards Island with an airstrip; another runs 30 miles from Ft. McPherson to a site in the Richardson Mountains. Both of these are probably fairly short-term undertakings, but they are useful in showing the difficulty of building and maintaining such roads in this region.

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course, is counteracted to a large extent by the river channels. These can be used by boats in the summer and as open trails in the winter; their disadvantage is that during freeze-up the ice is not sufficiently thick, and during break-up too soft, to allow surface travel with present-day vehicles. These two periods, taken together, total two months.

Light aircraft have greatly reduced the isolation of the settlements, particularly during break-up and freeze-up. Inuvik and Tuktoyaktuk have year-around airstrips, so it is always possible to get from one to the other, as long as the weather is good enough; given the choice between aircraft on floats, wheels, or skis, one can reach Aklavik and Ft. McPherson with only brief interruptions in the fall and spring; only Arctic Red River retains a certain degree of isolation during these periods.

Travel within the Delta falls into two main classes. One is that going strictly from one settlement to another; people do this to a considerable extent and there is also some haulage of freight. The second is the travelling the natives do in connection with hunting, fishing, and trapping.

Travel from settlement to settlement is mostly done by air, and follows a network radiating from Inuvik. This is supplemented by a small amount of surface travel between Inuvik and Aklavik, especially in the summer. A considerable amount of freight is also carried by air from Inuvik to the smaller settlements. Surface freighting within the Delta

is quite limited. There is at present a certain amount of lumber carried around the Delta by barge in the summer, and a very small amount of hauling done by Bombardier Sno-mobile in the winter. The main pattern of surface freight transport, however, is that connecting the Delta settlements more or less individually with the south by the river. This is due to the expenses of trans-shipment; rather than unloading goods in, say, Inuvik and then distributing them around the Delta, it is cheaper for barges to go to the different settlements individually.

Apart from these barges, surface travel within the Delta falls principally into our second class. There is a considerable amount of travel by the native inhabitants - people going to camps to fish or to hunt muskrat, going on a whale hunt, and so on. The traditionaly means of doing these was by canoe in the summer and dog team in the winter. Technology has influenced both of these forms of transport.

The older of these is the adoption of mechanical propulsion for boats. For the canoes and small boats that are common in the Delta, outboard motors are standard. Larger boats with inboard motors are also seen, primarily at Tuktoyaktuk; these are used for whaling.

More recently, mechanical competition has arisen for the dog team; the most widely used forms are the "Ski-doo" (a mechanized toboggan) and the larger "Sno-mobile", which is invariably called a "Bombardier" after the name of the firm that builds it. The "Ski-doo" is quite closely equivalent to a dog team; it can carry one, or possibly two, passengers, and can tow loads of up to 500 pounds on a well-packed trail (76). It has a one cylinder motor which drives an endless belt to furnish propulsion. These vehicles are quite popular at Tuktoyaktuk, which, as an estimate, there are about the same number of "Ski-doos" as dog teams (77; roughly speaking, two dozen of each). Inland, they are less popular - at present, there are only two or three at Aklavik, compared with -- dog teams. The reason for this lack of popularity is not immediately clear; one possibility is that the afforested parts of the Delta have, on the average, softer snow

and may therefore be less suitable for the vehicle.

The "Bombardier" is a larger, fully enclosed vehicle; it can carry approximately 2000 lbs. of cargo. Due to its size and high cost (about $5000 new), its use is not very widespread among the native population. Most of the vehicles of this type used in the Delta belong to the government, to the missions, or to organizations such as the Reindeer Project. There are only two privately owned ones at Aklavik and three at Tuktoyaktuk.

It would seem that both these vehicles are used mainly because of a lack of anything better. Both types are apt to have frequent mechanical trouble; in addition the "Bombardier" is expensive to run, since, under average operating conditions, it only goes 4 to 5 miles on a gallon of gas (78).

The problems presently faced in the Mackenzie Delta in the field of transportation are clear. First, surface transport in any form is not available during break-up and freeze-up; i.e., for about two months of the year. This is a serious matter, since, as we have seen, much of the native population is at present in camps on the Delta during these periods. Even with the decline in trapping, it seems that this situation will continue for many years, and, consequently, the writer feels that it is justified putting considerable effort in the search for some means of transport which can reduce the physical isolation of the camps during these times.

Second, with the possible exception of the dog team, the available forms of winter transportation are unreliable and uneconomic; dogs require a large expenditure of time in the summer in catching fish. This difficulty is reflected not only in the question of private transport during the winter; it also means that surface freighting is limited, economically, to the summer months alone.

During the past several years considerable hope has arisen that air-cushion vehicles would at least answer the problem of year around usability and might also prove more economic than light aircraft as a freight carrier. This matter has been discussed in detail elsewhere with emphasis

on basic points of feasibility (79). As presently built, however, air-cushion vehicles would suffer from a variety of technical problems in cold weather operation. Furthermore, it seems that such vehicles may be commercially feasible only in relatively large sizes; even with these operating and maintenance costs would be high with the craft in its present form. It is clear that further developmental work is necessary before such vehicles could see general use in the Mackenzie Delta.

Air-cushion vehicles remain, nonetheless, the most promising means of providing year around service in the region. As an academic matter, we may note that, if we do not insist on having transport during freeze-up and break-up, the question of carrying freight during the winter months is quite capable of solution. Winter roads, whether used by tractor trains or trucks, are quite a conventional form of transport both in northern Canada and in northern Russia (80). They have been successfully used in the part of the arctic we are concerned with (81). A scheme of winter roads linking the various settlements of the Delta has been proposed (82). Here is a situation in which the technical problems are, by and large, known. The difficulty is purely economic. Winter roads, in general, lead to expensive freighting; figures of $0.10 to $0.60/per ton-mile are common estimates for hauling over them by truck. The lower rates can be attained only if considerable effort is made in laying them out and in maintaining them so that trucks may travel at speeds of 30 to 40 mph. As we have seen, with present transportation problems there is little freight carried between the towns of the Delta - quite possibly not even enough to justify the maintenance, let alone the construction, of winter roads. In the future, of course, the pattern of supplying freight to the Delta may radically change, as would probably happen if a road were built to Ft. McPherson from the south. In this case the whole transport pattern within the Delta would also change, and a network of winter roads might find stronger economic justification.

The problem of cheap individual transport in the winter months is

more difficult. Over-snow vehicles have been extensively studied, particularly from the point of view of military applications (83); the basic principles for design are well known. There are a great number of military over-snow vehicles, but the majority are not available commercially; when they are, they are so high priced that few people could afford to own one. We are up against the economic law of supply and demand; the "Bombardier" remains in use not because it is particularly good, but because there is little competition in the civilian market. More hope might be had for the present popularity of vehicles like the "Ski-doo" in southern Canada leading to increased reliability and, overall, a more useful product for northern use. The fact that these are bought generally for short-term sporting use does not seem to encourage such a hope.

In general, the conclusions of this discussion on the problems of transport within the Delta can only be described as cheerless. The only prospective candidate for year-around surface transport in the region, the air-cushion vehicle, seems to require a great deal of improvement before it can be considered a useful vehicle; even then it promises to be expensive to operate. On the other hand, the availability of better individual transport for the winter months and of better surface freighting facilities is limited not so much by the need for further technological research as it is by the inevitable small demand produced by the natural conditions of the region.

c. Transport linking the Mackenzie Delta with the South. Here, of course, we have a comparatively economic means of moving freight in bulk: the Mackenzie River. Since the shipping season is short (late June to mid-September), freight rates are not as low as one commonly finds with water carriage. They range about $0.03 per ton-mile; products requiring special handling are, of course, more expensive; for example it costs $0.75 per hundredweight to ship oil from Norman Wells to Inuvik, or nearly $0.04 per ton mile. Such expense, of course, is hard to overcome in a situation where the barges and other equipment must lie idle for the greater part

of the year.

Air freight forms a way of supplementing service by barge, particularly in bringing perishable goods and things needed in a hurry into the region. There are three commercial flights a week between Edmonton and Inuvik, and occasional service to the Yukon. Wolferth (84) discusses the amounts of freight carried by barge and by air and the relations between them in some detail.

The disadvantages of having to bring as much as possible of the year's supplies into the settlements during the summer months are obvious. Large inventories must be kept on hand; this is an inflexible and costly procedure. Food is a particular problem. Fresh food must be brought in by air nine months of the year, and tends to be carried in that manner all year, due to the distance and/time required for barge shipping. Almost any unexpected failure of a piece of equipment requires air transport and, consequently, can be extremely costly and time consuming.

Current technological developments might reduce the cost of transporting particular items. One important example is oil; there is a device, the Dracone, which has been specifically developed for transporting liquids that float on water. It consists of a large sausage-like container of nylon, which can be filled with oil and towed behind a tug. When empty, it can be folded into a small volume and returned as deck cargo; this might be a considerable advantage in the present instance with the low loads carried on the barges going upstream from Inuvik. To form some idea of the sizes involved, a small Dracone carries 11,300 gallons. It is 5' in diameter and 101' 9" long, with an empty weight of 2,240 pounds (85). Obvious problems that might arise with one are the practicability of emptying it completely and that of towing one through any loose ice that might be encountered on the ocean.

In general, though, we are again faced with the problem of providing cheap, year around transport. One means of doing this that is suggested from time to time is the airship; there currently seems to be a revival

of interest in them in Russia (86). They are suggested as having particular promise for carrying building materials to isolated places and in various applications in forestry. Operating costs are estimated as roughly one third that of airplanes and three times that of road transport; this, of course, does not take the cost of building and maintaining the road into account.

Airships have, of course, been used several times in the arctic, most recently in a trip to Resolute Bay and Ice Island T3 in 1958 (87). Although their use is certainly possible in carrying freight to the Mackenzie Delta, they have several features which cause doubt about its economic practicibility. One is the need to fly at low altitude on long range flights, with attendent problems of icing in cold weather and - under overland conditions such as would prevail in any route to the Mackenzie Delta - of increased daytime air temperatures in warm weather. Second, due to their lower speed (the airship used in 1958 cruised at 40 to 43 kts), airships are more adversely affected by winds than are aircraft. Third, a fair degree of care is needed in preparing a landing strip and a mooring pole, and large ground handling crews are necessary; in 1958 crews of 37 were needed both at Churchill and at Resolute Bay. All things considered, the advantages to be gained by the use of airships seem very small.

Again, surface transport seems the chief competitor to aeroplanes for any year around purposes, and again trucks seem the logical answer. As we have noted, trucking costs are higher than shipment by barge, but the convenience gained goes far to make up the difference, as experience at Yellowknife has shown (88). Certainly the potentialities of a winter road joining the Delta with the south should be fully investigated. As a long term project, a road seems the most practical solution to many transport problems; winter roads could form a highly satisfactory supplement to the present summer-only service. As we have said above, however, these are economic problems rather than ones requiring technological development and so fall outside the province of the present study.

The main points emerging from this discussion can be briefly stated. On all levels, there is a need to study the economics of roads: within the settlements, the costs of providing satisfactory all weather roads deserve careful consideration; winter roads seem, for the present, the most logical answer for supplementing barge and aircraft service within the Delta and linking the Delta with the south. Any technical problems arising in building winter roads of good quality in the particular conditions of the Mackenzie Delta should, of course, be studied. On the whole, though, these problems seem quite well known; further technological research would, however, seem needed on the question of providing suitable streets for a settlement built, like Aklavik, on silt and fine sand, and without a local supply of sand and gravel.

Within the Delta there is a need for a vehicle that could provide reliable, year around transport between any two points. Though the air-cushion vehicle holds promise in doing this, as it is presently built it seems far away from being more than an experimental machine in these regions. It is also not obvious that the air-cushion principle furnishes the best answer to the combinations of ice and water found in the Delta. In addition, there is a need for a commercially built, reliable, cheap form of oversnow transport for individual use in the winter months.

6. Communications.

The entire field of communications has received intensive study during the present century. Isolated regions, in particular, have benefited, and the Mackenzie Delta is no exception. In general, the region has - or shortly will have - facilities quite comparable with those in the south.

One example of this is the telephone service linking the various settlements. At present, each settlement (except Arctic Red River, which is tied into Ft. McPherson) has its own automatic dial telephone system; there is an automatically controlled radio system connecting Inuvik, Aklavik, and Ft. McPherson, which will include Tuktoyaktuk in the Summer

of 1966. With the exception of minor interruptions, this system provides completely satisfactory service.

In 1966 Inuvik - and the other settlements of the Delta - will be linked to southern Canada by a telephone line. The capacity of this line - one pair of single conductor wires - is a good example of what modern communications technology can provide. The entire system can carry up to sixteen channels; from Inuvik there will be three toll circuits to Yellowknife and southern points in general, two to Norman Wells and one to Fort Good Hope; there will also be two program circuits to carry CBC radio programs, one circuit for air traffic control, and a voice frequency carrier telegraph circuit, which, in itself, can carry fifteen teletype circuits. This should remove a considerable part of the isolation of a region in which the only rapid means of communication with the south is, at present, radio-telegraphy*.

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* In any discussion of this land line someone, it seems, raises the question of why wires were used rather than a series of microwave repeaters, which could then carry television. It may not be amiss to observe that microwave systems are designed for bulk transmission; a single system can carry six channels, each with a capacity of six hundred voice channels - or over two hundred times the capacity of the system presently being built, which seems quite generous for the foreseeable needs of the region. A small microwave system - say one with sixty channels - which was designed for the needs of the area would not be large enough to carry television, which needs some six hundred channels. Apart from questions of over-design, there is also the element of cost: a microwave system would cost at least ten to twenty times what a land line does.

Another familiar facility in everyday life is the radio. The Mackenzie Delta has its own radio station, CHAK, at Inuvik, and almost every family has a radio. CHAK, in addition to more familiar types of programs, broadcasts messages to people in the outlying settlements and

on the delta three times a day; this makes up, to a certain extent, for the lack of a more widespread telephone service.

Apart from these, there is, among the governmental part of the population, a considerable reliance on two-way radio-telephone - for example, between the RCMP detchments, between the Inuvik hospital and the nursing stations throughout the Delta, and so forth. As is well known (89), radio telephony in the arctic is particularly subject to blackouts and fading; the services in the Mackenzie Delta are generally in the medium frequency range and are no exception. On the whole, though, they are adequate for the required reliability in communication.

The most desirable way in which communications techniques could improve life among the native population would seem to be the provision of emergency means of communication with isolated cabins, to which we shall return in the next chapter. By and large, problems associated with the settlements have been recognized and solved.

7. Food.

One of the most obvious ways in which life in the Mackenzie Delta does not compare with that in the south is in the matter of food. Even in summer, the variety of fresh vegetables in the stores is meagre; what is available is expensive and of poor quality. In winter the situation is worse. Meat is also expensive, especially outside of Inuvik; an exception to this is reindeer meat, which can be bought cheaply in the fall. All food prices are high.

Basically, of course, this situation arises from the fact that the Mackenzie Delta is too far north for dependable farming; vegetables have been grown, on a small scale, at Aklavik, Ft. McPherson, and Arctic Red River, and dairy cattle were kept at Aklavik during the war (90). Poor soils and short growing seasons tend to rule out any form of truck farming, though, and the labour involved and the availability of cheap forms of condensed and dried milk make dairy farming an uneconomical venture.

Nevertheless, it is interesting to note that there has been a

general decline in agriculture, not only in the Mackenzie Delta, but also in the whole Mackenzie River valley, during the last half century. In 1944, from Ft. Providence north, there were a total of between 50 and 60 acres of gardens and over 100 acres of farms (91); today it is difficult to find land actively under cultivation apart from a few acres at Ft. Simpson. In 1910 there is supposed to have been even more land cultivated than in 1944.

One reason for this decline may lie in what can presently be seen at Inuvik. Most civil service employees there either take the bulk of their food in standard government rations or buy it wholesale from Edmonton and have it shipped in by barge in the summer. In addition, the Inuvik Naval Base has fresh food flown in twice a month for its personnel and their dependents. The great majority of the white population, therefore, is not dependent on local markets for the greater part of their food. With the present low economic level of most of the native population, they buy only the bare minimum of food in the markets; thus the amount shipped in for the white population, which does not pass through the local shops, represents a sizeable fraction of all the imported food consumed in the region. Not only are food prices higher because of this lessened demand, but there is also hardly any incentive to experiment with agriculture.

Nonetheless, it is interesting to explore the various methods in which technology could help to reduce the cost of food. At the outset we note that these apply principally to meats and vegetables; bulk foods - flour, sugar, tea - which form a large part of the native population's purchases from the shops do not at present seem amenable to lowering of prices, except by a reduction in the costs of transport.

The first line of attack is the brute force method. This may most easily be summed up in the question: is it really impossible to grow sufficient foods of various types in the Delta to meet local needs? The answer to this is no; a gteat variety of vegetables have been grown there already. In northern Russia, great emphasis is put on self-sufficiency

in this respect, with a claimed large amount of success. The Russian experiments do not appear to be economical undertakings, though: they use greenhouses, and often a great deal of artificial light to lengthen the growing season. As an example, at Noril'sk 300 kwh per sq. metre of electric power (in addition to heating) were used to grow 23 kilograms of tomatoes per sq. metre - or about 6 kwh per pound of fruit (92). In a region of high electric rates this would obviously be impractical on a profit making basis. A more promising approach is the use of low grade heat from diesel generators to warm the ground in which vegetables are planted. Warming the soil has also been tried at Noril'sk (93) with a claimed tripling or quadrupling of the crop, reduction of the production cost by a factor of three to four, and the recovery of the capital expenditures in two to three years. The cost and feasibility of such a scheme might be worth investigating for the Mackenzie Delta, but, at first glance, it does not seem too promising; one complication would be, as the author of the Russian paper remarks, that "geocryological factors must also be considered in the design of soil-heating systems in open fields".

Second, we can attempt to cheapen the cost of bringing food into the Delta. One thing here is to reduce the costs of transport in general; this has been discussed in the preceding section. A second is to find the nearest place where vegetables can be imported on a profitable basis and import them from there. This would seem to be Ft. Simpson, some 600 miles up the river, where there was an Experimental Station of the Department of Agriculture for many years and where truck gardening on a moderate scale has recently been undertaken (94). Here, as to other places on the Mackenzie, it is presumably necessary to import fertilizer; still, one should expect the overall cost of the food from there, which need be brought only 600 miles to Inuvik, to be cheaper than that from Edmonton, which must be brought 1700 miles.

Importing food from Ft. Simpson, however, runs into a curious difficulty. The vegetables there normally ripen in late August or early

September. There is still ample time to transport them by barge to, say, Inuvik before freeze-up there - which, as we have seen, comes in late September or early October. The barges, however, come from Hay River, which is still 400 miles farther upstream than Ft. Simpson; the last barge trips to points north of Norman Wells leave Hay River in mid-August, and so are past Ft. Simpson before most of the vegetables are ripe. This type of problem can be solved; it is a question of economics and of investigating and developing markets.

A third way of reducing the cost of bringing food to the Delta is to lighten the load that is transported. One first thinks of dehydration to reduce the cost of food; this has long been used with such items as milk, orange juice, potatoes, and onions. A great deal else is also available in dehydrated form, but, in general, the market for foods of this type is so low that they cannot compete with other kinds; the added cost of production is more than the saving in freightage would be.

Another familiar way of lightening preserved foods is to freeze rather than can them, and so saving the weight of the container. The first question here is that of preserving the frozen foods after they arrive in the Delta; this we shall come to shortly. Second, we find that bringing frozen food to the Delta is an expensive process; it has to be carried by refrigerated truck to Hay River and then shipped on a refrigerated barge. As a result, it costs -- to bring 100 lbs. of frozen food to Inuvik. When we recollect that frozen foods are, even in the south, considerably more expensive than the same foods in cans, we see that the small saving in weight is not enough to give us a cheaper product in the Delta*.

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* In this context we must mention the possibility of preserving food by treatment with gamma radiation. This method has appeared promising for several years now; there is at present concern about long-term effects of such radiation in converting sugars into poisonous or carcinogenic substances. It is, of course, most useful for such products as meat a

butter; as such, it is not clear that it would have any effect on the economics of life in the Mackenzie Delta, particularly if large scale frozen food storage facilities became available.

The most satisfactory way of reducing the cost of food seems to be growing it as near as possible to the Delta. There is then the question of preserving it. The cheapest and on the whole most satisfactory method of doing this is freezing. At present there are, however, no generally available ways of keeping frozen foods. It is true that ice-caves, or holes dug into the permafrost, have been used, mainly for keeping fish, both in northern Canada and in northern Russia (95) for many years; more widespread use is advocated from time to time (96). Ice-caves have two drawbacks: they cannot absorb a large quantity of heat quickly and maintain a below-freezing temperature - in other words it is difficult to freeze a large quantity of food in them - and their lowest temperature can be no less than that of the ground where they are dug. As we have seen, at Inuvik the temperature several feet below the surface is of the order of 20° F; this is much too high for the long term storage of frozen foods, for which a temperature not above 0° F is recommended.

It would seem possible to solve this problem with a comparatively small amount of study and experimentation. One possibility could by the use of a completely passive system (97). This would take advantage of the fact that there are, in the Mackenzie Delta, sufficient days of below-zero weather to freeze some liquid, say a brine, whose freezing point was near that temperature. This could then be used as a heat sink for an insulated building for the warmer months of the year.

Another method worth consideration would be to use the ground as a heat sink to reduce the temperature of a storage plant to 20° F whenever necessary and then have a mechanical unit to chill it from there to 0° F.

The conclusions drawn from this discussion, then, are that it might well be possible to reduce the costs of vegetables and such items in t

Mackenzie Delta by combining its importation from some place, like Ft. Simpson, which is comparatively near the Delta and yet has a sufficiently warm climate to make fairly risk-free farming possible, with the development of local means of preservation, say by freezing. This deserves further study; furthermore, as we have said, the possibilities of artificially lengthening the growing season at places like Inuvik should be systematically investigated. Although large-scale farming there seems an unprofitable venture, this does not mean that the possibilities of growing food locally should be abandoned out of hand. They should, rather, be studied and encouraged to the fullest extent possible.

8. Medical services.

Considering the isolation of the Mackenzie Delta, the medical services available there seem, to a layman, to be of high quality. This isolation does, nonetheless, limit medical care in several ways. It is interesting to explore the usefulness of modern technology in counteracting this.

Medical care in the region is organized around a central hospital at Inuvik with satellite station - "nursing stations" - in the smaller settlements. The Inuvik hospital is, by southern standards, quite large for the region it serves - it has 100 beds for the approximately 7000 inhabitants of the Inuvik Zone*. It is modern and well-equipped: large rooms, good

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* The zone extends east to Paulatuk on the mainland and to Sachs Harbour on Banks Island, west to Herschel Island and Old Crow, and south to Ft. Norman and Ft. Franklin. It therefore comprises a much larger area than the Mackenzie Delta.

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laundry service, full x-ray facilities and a chemistry laboratory. One technical problem is southern hospitals, an adequate record facility, is somewhat less troublesome here, since the area served is so large that the native population generally remains inside it.

The nursing stations - within the area covered by this report there are three: Aklavik, Ft. McPherson, and Tuktoyaktuk - are each staffed by

one or two nurses, and also have comparatively full equipment, including x-ray apparatus. Due to the limited distances between the settlements of the Delta, it is possible to get seriously ill people to the hospital by aircraft on very short notice.

Broadly speaking, the advantages that technology can offer in such a situation are comprised in bringing this region into closer touch with the rest of the world. This, of course, is already done to a large extent: more seriously ill patients and some cases where diagnosis is difficult (a total of 43 for both categories in 1964 (98)) are taken by aircraft to the hospital at Edmonton. Technology can help, however, in making technical advice more quickly available. This might be done in several ways in a place like Inuvik. Due to the small size of the population, it is not feasible to have specialists of many types in residence; thus, there is no cardiologist, pathologist, nor radiologist in the region. When expert advice is needed in one of these fields - the interpretation of an obscure x-ray, for example, the photograph has to be sent to Edmonton by mail. This may mean up to a week's delay. Similar problems can arise in the interpretation of electrocardiograms and with biopsies.

The completion of the land line will offer possible help with many such problems. Specifically, electrocardiograms are now sent over telephone lines as a routine matter (99). The problem of transmitting x-rays is under study at the Walter Reed Army Medical Center in Washington, U.S.A. There they currently transmit x-rays over a closed-circuit television system linking various parts of the Medical Centre and some other hospitals in the area. No difficulties have yet been found either in resolution or in contrast. In principle, it is possible to transmit x-rays by a facsimile process; the advantage gained by television with its higher frequencies and broader bandwidth can be considered, in this instance, as the ability to transmit many pictures rapidly, which is not necessary in dealing with x-rays. There may be difficulties in using commercial equipment in thi

application; it is this question that is currently under study (100).

In the future, it may be possible to use similar means to transmit images of slides in colour for pathology studies. Here the principal difficulty at present lies in keeping fidelity of colour and in being sure that the transmitted image is a true reproduction of the original. In time, this can be overcome; meanwhile, the ability to transmit x-rays would be a considerable advantage.

Another way of using technology to lessen isolation is already in use in the Mackenzie Delta: the nursing stations are in a radio net which links them with the Inuvik hospital. This, of course, could be extended, and radio contact could be set up between the hospital at Inuvik and one in Edmonton or elsewhere. On a smaller scale, this has been done in the rural district around Albany, New York, and in other places (101). This has proved a useful tool for post-graduate training, which, of course, is an important matter in medicine. The benefits of the interchange of information and experience possible with two-way radio communication have proved so great that, in one instance at least, television has been used (102), with a resulting increase in the amount of data that can be considered and discussed.

It would be interesting to investigate the value of such programs further. The end result of exploiting these and similar possibilities would be to provide improved medical service in the remote region of the Mackenzie Delta and, probably, to do this with reduced running expenses; both these are extremely desirable goals.

9. Conclusion.

The various suggestions for further study that have arisen in the course of this chapter will be summarized in the concluding chapter of this report. Here we may look at them from a general point of view. If we do so, a general pattern appears. Time and time again we have run into the point that life in the region is expensive, in one way or another, because of the small number of people there. This agrees with the

observation made earlier that the amenities of life we enjoy in more densely populated regions are cheap - or even available at all - because they can be produced, and used, in large quantities. Insofar as this problem can be solved in the Mackenzie Delta, the solution is clear: one must try to pull the settlements of the region together in as many ways as possible; one must also try to render the distribution of facilities within the area as cheap and as simple as possible.

There are, of course, various areas where specialized research is needed; determining the possibilities of extending the growing season or studying the difficulties to be encountered in an underground sewerage system are but two examples. The broad problem, though, is to accept the fact that the impetus of modern technology lies in taking advantage of the economies of large-scale production wherever possible. The Mackenzie Delta is a region where natural conditions force the dispersal of the population; to ensure its economic development from a technological point of view one must accept this dispersal and find ways of linking the settlements together so that the advantages of centralization can still be gained.

IV

So far we have discussed technology as it applies to living in the settlements of the Mackenzie Delta. This is not the whole story; as we have remarked earlier, a large part of the native population may spend months at a time living in camps away from these settlements. Although there is a decided trend toward living in the communities, any exploitation of the available renewable resources will continue to require, in the foreseeable future, some living in these isolated camps. In this chapter we shall very briefly discuss some possible ways in which technology might make such a life less laborious and less isolated.

The type of life - fishing and trapping - led at these camps relies on surface transportation. The problems involved here have already been discussed extensively. All we need now do/is remind the reader of the need, both of some sort of year around transport to relieve the isolation of these camps during freeze-up and break-up, and of a cheap, reliable form of mechanized winter transport.

Housing and heating are two other subjects we have already considered which can be applied equally well to individual living. Here we might only add that the physical structure of the Delta is such that one can get to almost every camp with a quite sizable boat if there were any desire to bring materials for building purposes.

Another subject of some interest is the provision of better water and sewage facilities at these camps. Water, as we have seen, is generally available throughout the region. Sewage and waste disposal at an isolated place are, naturally, far from the serious problem they are in the settlements of the Delta. Nonetheless, we might note that there are many schemes for individual sewage disposal systems which have been specifically designed for a northern environment (103). Some of these might be of use in making life at a camp more strictly comparable with that in a town.

Of more importance is the provision of electricity to one of th000172 isolated spots. Diesel or gasoline generators are, of course, available

in small sizes, but they are comparatively expensive to run. Apart from this there is, as we have mentioned, the intriguing possibility of using direct conversion of heat to electricity. By nature this is an inefficient process. The simplest devices - those operating on the thermo-electric principle - typically achieve efficiencies of one to two per cent; more sophisticated solid state devices (which produce power at a low voltage and require considerable ancillary apparatus to be useful) may reach, at present, 5% to 10%. The theoretical maximum efficiency obtainable is in the vicinity of 30% (104), which is no better than the diesel generators in the Delta communities, so this method is of little use there. But an individual cabin is another matter. It must be heated; a device which converts a small part of that heat to electricity would be a great boon. Simple calculations show that, on the basis of a 5% efficient system, a stove burning 2½ gallons of oil a day could produce 200 watts of electric power. This would not run mechanical equipment, but it would power an electric light and a radio or short-range transmitter. These alone would ease the isolation and laboriousness of the life, and a more detailed investigation of the practicability of such a system would be interesting.

The availability of such an independent supply of electricity would be useful in developing another means of reducing the isolation of these camps. This is the provision of some form of emergency communication. At present, if an emergency arises at a camp, it may well be virtually impossible to send out a message for help; it has been suggested (105) that as people tend to live more in settlements they grow less familiar with this side of living in isolation, and that this may be a contributing factor to the decline of trapping and the resultant decline in the cash economy of the Delta. Serious thought has been given to the problem of providing emergency radio communication elsewhere (106) but without conspicuous success.

A major problem is finding means of powering such emergency transmitters. Conventionally, this is done with batteries. The major fault

with batteries, of course, is that they cannot deliver much energy when they are cold; the shelf life is also diminished in cold weather. In other words, they are not suitable for providing emergency power in places that are unheated for long periods of time. Here a means for the direct conversion of heat to electricity would seem of great utility, for it would furnish a means of power that would only depend on getting the stove going, and would not deteriorate in cold weather.

A second problem that arises in such an emergency service is the choice of frequency to use. Almost every frequency is subject, in the arctic, to signal fading and periods of complete blackout (107). Here the Mackenzie Delta would seem to have a considerable geographical advantage. With the mountains and hills around the delta, it should be feasible to select a few sites which would allow line-of-sight communication with the whole area and use frequencies in the VHF range. This should provide minimal trouble with auroral disturbances.

In short, the most immediate ways in which technology could help life in camps in this region - apart from transport - seem to be the development of a cheap form of providing at least a small amount of electricity and, working with this, of providing some form of emergency communications. The above suggestions are obviously but one way of meeting these ends; the basic problem remains an interesting requirement for development.

V

In the last two chapters we have been concerned with the role of technology as an aid in providing the amenities of life. It can make at least an equal contribution in the exploitation of renewable resources; in a long-term view this is probably of greater importance. As we shall see, the situation in the Mackenzie Delta is such that one can give only an outline of these possible technological contributions. This is still worth doing briefly and forms the subject of the present chapter.

There are three basic renewable natural resources in the region: forests, wildlife, and fish. They are discussed in detail elsewhere (108); here we need only observe that, though the region has been known for its furs for many years, the fishing and especially the forests are of a fairly low grade in comparison with what is available in the south. Nonetheless, from the point of view of the economy of the region, one cannot afford to disregard any resource when there are so few, and it is necessary to study how each can be developed to the greatest extent possible.

The forests of the Mackenzie Delta are unpromising at first glance: the trees are small, grow fairly slowly, and due to the large number of branches near the ground, have many knots. They contain, however, the only substantial stands of timber north of the Liard River; as such, they are the nearest source of lumber not only for the Mackenzie Delta but also for much of the western arctic. Professional opinion (109) is that many of these trees, particularly around Ft. McPherson, are of commercial value, particularly, as we have mentioned before, for building low-cost housing.

The forestry problems of the area have not been studied at more than the most superficial level. It is commonly said that trees grow so slowly in this region that they cannot be considered a renewable resource, but this does not seem true*. At an optimistic current usage rate, it seems

*Thus, the approximate times needed for a spruce to grow to " DBH

(diameter at breast height) are: around Ottawa, 80 years; at the mouth of the Peace River, 110 years; and at Ft. McPherson, 170 years (110).

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that it would be quite easily possible to renew the trees harvested in the region.

The contribution of technology in this instance, as always, is subsidiary to basic research. In this case, very little is known of the factors influencing the growth of trees in the region. It is believed that a mossy cover inhibits the seeding of new trees (111), but the whole question is closely bound up with the highly debatable matter of what factors determine the exact location of the tree line (112). Clearly, studies have to be made first to ascertain the exact influence of the ground cover on the growth of trees; then technology can help in providing the most favourable conditions. With due care, there seems no reason why the forests of the upper Mackenzie Delta should not be used, and used with profit, for years to come.

The traditional means of exploiting the other resources are trapping and fishing. These are, in a sense, complimentary occupations. As is realized in the Soviet Union (113), it is necessary to combine such seasonal occupations to provide suitable year-around employment to compete with other wage-earning occupations. It would seem that the same practice should be encouraged in the Mackenzie Delta.

Trapping, of course, has been a traditional occupation for the last century; the most common fur-bearing animal is muskrat, with mink being of secondary importance (114). Other animals - lynx, beaver, marten - occur, but are rare. In recent years, with increased opportunities for wage employment, trapping has declined; nonetheless, it remains one of the principal means by which money is brought into the Delta.

There are two ways by which technology can help in producing, and maintaining, the maximum possible amount of income from trapping. First, it may be possible, by fairly simple means - building dams and the like -

to increase the number of muskrat living in the area. This possibility was suggested several years ago (115) but apparently has not been investigated further; indeed, present indications are that the muskrat population is decreasing even in face of the lessening number of animals trapped (116).

Second, efforts should be made to reduce the amount of labour associated with trapping. One way is by providing better means of transport, as has already been discussed. In the present connection this would allow a man to travel easier and farther in a day, and so to set more traps. Since muskrat caught in traps bring higher prices than those shot after breakup, this would result in an increase in income from trapping.

The present way of preparing pelts is quite primitive; they are often damaged or insuficiently cleaned. It might be possible to devise ways of improving this work. This again would lead to higher quality skins and at the same time lessen the labour spent on trapping.

In this connection one should mention the tannery which is to be built at Aklavik. This will primarily provide furs for local use, in handicraft work. It will have clear value in improving the cash basis of the local economy.

Finally, there are the fish. The fish of the rivers and lakes have been suggested as a source of income for years; experiments - not very successful - have been made in catching and processing whitefish for export (117).

Even more than with forests, the state of fish as a continuing resource is poorly known. Little, if any, work has been done on the vital question of how large a catch can be taken from either the fresh water or from the ocean.

The situation in the Mackenzie Delta seems similar to that with the great Russian rivers; there the importance of fisheries at the river deltas is stressed, although it is realized that they cannot compete in volum

with southern regions (118). One way in which technology can help is in modernizing methods of fishing; in the Mackenzie, as in Russia, these are still primitive. Another is in aiding to learn more of the detailed habits of the fish and so improving catching efficiency. Sonar is widely used in commercial fishing to locate schools of fish; another possibility is the use of divers or manned submersible vessels to help in this study.

It seems that within a very few years it should be possible to harvest fish scientifically as a continuing crop. First, of course, the amount that can be harvested without depletion of the stocks must be known, as also must be the most efficient way of maintaining this stock. Then technological aids may be developed to catch the desired number with a minimum of effort. The general approach may be seen in the case of tuna. Here it has been found that this species of fish tend to congregate over underwater hills where there is a natural flow of nutrient. As the tuna grow, they tend to move to a hill whose top is farther below the surface. They can be kept in the vicinity by improving the flow of nutrient; there are also grounds for expecting that within ten to twenty years it will be possible to keep them in electronic pens. If this can be done, and means can be devised for moving them from one pen to another, then we can hope to have commercial fishing in much the same way as, on a far smaller scale, trout are now raised in fish hatcheries.

It is, of course, open to question whether the Mackenzie Delta could support fisheries on the scale that such, presumably costly, equipment would require to be commercially feasible. Nonetheless the point remains clear: with detailed knowledge of the habits of the local fish, and by making use of techniques and approaches developed elsewhere, it may be possible, in the future, substantially to increase the income from fishing. This may well be the furthest off in time of any of the methods of exploiting resources we have mentioned, but it also may prove the most profitable.

VI

Throughout this report we have noted subjects that might provide interesting opportunities for further study. As a conclusion, we shall list these in one place. Most of them can be grouped under three general headings: studies where some technological research or development seems to be required; studies of matters where the technological problems seem fairly well understood but where the economic feasibility is of interest (these, of course, may require a minor amount of engineering experimentation to provide a sound groundwork for estimates); and subjects where basic scientific research seems needed.

In the first category, a few points have come up where existing technological research and development seem inadequate:

1) Certain points about insulation materials are not clear. It would be useful to know the long term properties of local mosses as insulators. Similarly, knowledge of the long term resistance of such materials as expanded polymerized plastics to moisture would be of value in the possible design of underground utilidors.

2) Experience seems to be lacking on ways of constructing paved roads on silt and permafrost, as occurs at Aklavik, with the use of a minimum of imported materials.

3) Development of a compact, reasonably efficient device to convert heat to electricity with a useful amount of power generated would be valuable.

4) Technological aids to the exploitation of the renewable resources are needed. This would include possible ways of increasing the muskrat population, ways of encouraging the growth and seeding of trees, and ways of increasing the efficiency of catching fish.

5) The extent of the problems facing the use of waste heat to warm the ground for agricultural purposes would be fully investigated.

6) Oversnow and year-around vehicles form a continuing and difficult

subject for technological research.

Second, we have subjects where the emphasis is primarily on the economics of the situation:

7) The practicability and usefulness of freezing plants, either passive or using the ground as a heat sink, should be studied.

8) The benefits and disadvantages of the use of electric transmission lines between some or all of the settlements should be investigated more fully.

9) The long term potentialities of a hydro-electric installation should be studied.

10) The costs and probable effects of a network of roads or winter roads within the region, as well as those of a road or winter road giving access to the region from the south, should be considered in some detail.

Third, we have come across two main fields where basic research is needed:

11) Forestry. The mechanisms influencing the seeding of trees are not fully understood. This, as we have seen, seems closely bound up with the question of the detailed action of a moss cover on a forest.

12) Fish. Detailed knowledge of the extent of the stocks of fish, their rate of reproduction, and their habits are essential to any sensible attempt to exploit them.

Finally, there are, as always, a few subjects which do not fit into the above scheme, but still deserve further consideration:

13) It would be interesting to investigate the possibilities of the improved communications facilities that will soon become available to improve medical services.

14) Ways should be found to encourage the local market for fresh food; and

15) Means should be sought to encourage local housing construction.

Such a list is, of course, not complete, and the subjects mentioned are of vastly differing importance. It serves, however, to indicate the variety of problems and the degree of imagination required in the man who has the spirit to help develop a region as fascinating and as forbidding as the Canadian Arctic.

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

P.A/9V 5-66

CHIEF, WELFARE DIVISION

Ottawa 4, April 13, 1966.

Noted Reply sent 28-4 JPW

our file / notre dossier 1009-3-16

your file / votre dossier

M.D.R.P. - Preliminary Phase Reports

You will see from the attached memorandum dated April 6th from the Northern Co-Ordination and Research Centre that we are asked to comment on the draft reports of the four studies undertaken last summer in connection with the preliminary phase of the Mackenzie Delta Research Project. I have sent three of these reports to Industrial and Engineering Divisions for comment and I would like to have your comments on the fourth which is entitled "Community Structure - Inuvik - Summer 1965" and is attached.

Would you please have this report read in your Division keeping in mind the questions asked by Mr. Kerr, and let me have your comments if at all possible by April 21st.

Director

CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

Ottawa 4, April 6, 1966.

our file / notre dossier

your file / votre dossier

C. M. BOLGER,
NORTHERN ADMINISTRATION BRANCH

M.D.R.P. - Preliminary Phase Reports

Previous to the Research Planning Conference of February 28 and March 1, preliminary draft copies of reports for the four studies undertaken last summer were sent to you. Before final editing and publication of these reports, it would be very helpful to us if we could receive from the Branch any comments about them you wish to make regarding particularly:

(a) The validity of quantitative or qualitative data presented.

(b) Areas of the reports needing explanatory expansion (within the limits of the data available).

(c) Any references to family or personal matters which you feel might be unfair or misleading.

I shall be getting in touch with you shortly to arrange to discuss further the ways in which our research can better assist northern administration.

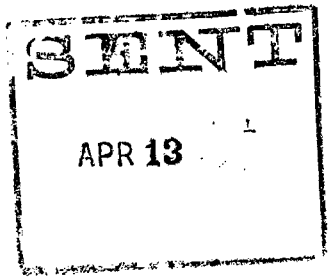
A. J. Kerr
for Chief,
Northern Co-ordination and
Research Centre.

PA/79
13-4
R.D.

1009-3-16

MR. A.J. KERR
NORTHERN CO-ORDINATION AND
RESEARCH CENTRE

Ottawa 4, April 13, 1966.



Research Planning Conference -
February 28 and March 1

Thank you for your memorandum of April 6 and the accompanying copy of the minutes of this meeting. I have no comments to offer other than to tell you that those Branch officers who were able to attend the conference found it extremely useful. I am only sorry that because I had to chair a week-long series of meetings commencing February 28 with the Commissioner of the Yukon Territory and his Advisory Committee on Finance, I was unable to spend very much time at your Research Planning Conference. I sincerely hope that another time I will be able to take a greater part in the discussions.

C.M. Bolger,
Assistant Director

C.M. Bolger/rd/d

BF 20-4-66 CMB

CHIEF, INDUSTRIAL DIVISION

Ottawa 4, April 13, 1966.

1009-3-16

M.D.R.P. - Preliminary Phase Reports

You will see from the attached copy of a memorandum dated April 6th from Mr. Kerr of the Northern Co-Ordination and Research Centre that he would like to have our comments on the draft reports of the four studies undertaken last summer in connection with the preliminary phase of the Mackenzie Delta Research Project. We should have your comments on two of these reports and your comments as well as those of the Chief Engineer on a third report. All three reports are attached as follows:

1. Domestic Economy of the Native Peoples,
   Mackenzie River Delta, N.W.T.
   by Derek G. Smith

2. The Mackenzie Delta -
   Its Economic Base and Development
   by John Wolforth

3. Technology and the Mackenzie River Delta
   by Paul Fenimore Cooper, Jr.

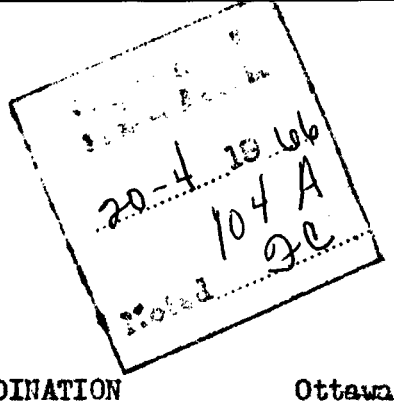
Would you please arrange to have these reports read carefully in your Division with Mr. Kerr's questions in mind and let me have your comments if at all possible by April 21st. I would ask that you give priority to the third paper entitled "Technology and the Mackenzie River Delta" so that you could pass it to Mr. Yates for comments by the Engineering Division which I would like to have by April 21st. I am sending a copy of this memorandum to Mr. Yates so that he will be expecting to receive the paper from you.

C.M. Bolger

Director

/rd/d

c.c. Chief, Engineering Division

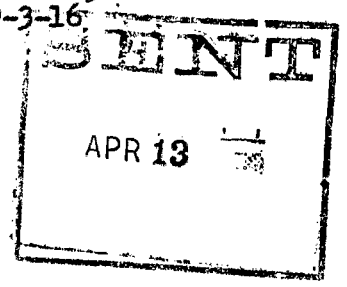


R.F.
20-4-66
C.M.B.

CHIEF, NORTHERN CO-ORDINATION
AND RESEARCH CENTRE

Ottawa 4, April 13, 1966.

1009-3-16



M.D.R.P. - Preliminary Phase Reports

Thank you for your memorandum of April 6 in which you said that before final editing and publication of the four studies carried out last summer you would like to have our comments particularly in respect of the three items you listed.

I am asking the Divisions concerned to re-read the reports with your questions in mind and I will hope to have their comments for you within a week or ten days. I will write you again at that time.

C.M. Bolger/rd/d

Director

RF
20-4
CMB

CHIEF, WELFARE DIVISION

Ottawa 4, April 13, 1966.

1009-3-16

M.D.R.P. - Preliminary Phase Reports

You will see from the attached memorandum dated April 6th from the Northern Co-Ordination and Research Centre that we are asked to comment on the draft reports of the four studies undertaken last summer in connection with the preliminary phase of the Mackenzie Delta Research Project. I have sent three of these reports to Industrial and Engineering Divisions for comment and I would like to have your comments on the fourth which is entitled "Community Structure - Inuvik - Summer 1965" and is attached.

Would you please have this report read in your Division keeping in mind the questions asked by Mr. Kerr, and let me have your comments if at all possible by April 21st.

C.M. Bolger/rd/d

Director

Anthropologists + Sociologists + Geographers
+ others are discussing - natural resources
such as fish, merchants, residents and
yet there is no one here from Canada Land
Wildlife Service, Dept of Fisheries
Forestry officers.

Mr Wolfard - UBC - made comment that
there was an input of $200,000 for welfare
annually in the delta which he considered
very high. How many people does this cover
How many communities.
How much per person -

Physical Resources
Biological process
Human processes.

RESEARCH DESIGN - MACKENZIE DELTA RESEARCH PROJECT

The Project is planned in three stages:

STAGE I - EXPLORATORY

In Stage I it was planned to probe into problem areas which previous research had indicated to be significant, and to explore where little information was available. The specifics of the planning of this phase are outlined in the paper "Mackenzie Delta Research Project - Preliminary Phase." The four research reports, of which draft copies have been provided, will represent the results.

STAGE II - PREPARATORY

In Stage II it is planned to use the insights developed in Stage I to identify more precisely and to explore in depth the key areas necessary to provide an understanding of the social, psychological, economic, and physical situation in the Delta.

STAGE III - ANALYSIS AND APPLICATION

In Stage III it is planned to study government programs in the Delta, with reference to the program goals (explicit and implicit), the means employed (their adequacies and inadequacies), the definition of new goals derived from a greater understanding of the Delta environment and people, and the formulation of effective means of achieving them.

In greater detail, the studies listed below are planned as the constituent parts of Stage II -

(1) A study of the motivations and perceptions of native people in the rapidly changing socio-economic environment of the Delta.

This study will utilize the theoretical framework developed by Smith in his Stage I study. The approach which he developed, and which is described in some detail in the draft copy of this Preliminary Phase report, is very close to the approach advocated by Hughes (in "Under Four Flags") as showing most promise for providing an understanding which would be useful in the development of administrative policy.

(2) A study of sub-groups among the native people of the Delta.

Mailhot suggests in her study of Inuvik that although a certain "unity" developed in a stress situation which polarized "native" versus "white" interests, there was considerable evidence of tension between sub-groups in the local community. Clairmont and others have also noted this, and it would appear that the chances for success in any community development program would be greatly improved by a foreknowledge of community sub-groups, and their inter-relations.

(3) A study of culture-change problems in the Delta as they are perceived by transient white residents.

The attitudes of transient southerners will continue to be a very important element in the Delta environment, and will continue to influence the process of change among native people. In order to assess the limitations and possible directions which change may take, a systematic knowledge of transients' interests, attitudes and beliefs about the local people is necessary.

(4) An expanded study of the Delta resources base

The start made with Wolforth's report, based on his field research of last summer, needs to be expanded to provide more data and analysis of the resources of the area.

A division of labor with the Area Survey Officer of Industrial Division can be arranged with mutual agreement. A possible arrangement might be that the area survey officer focus his efforts on analysis of specific industrial projects, while the N.C.R.C. researcher directs his efforts toward the collection and analysis of more general background information.

(5) A study of the mental health of native people in the Delta.

Comparative data pertaining to the mental health of a group will provide an index of the stress developed in a social-change situation, and can indicate the social and psychological cost or gain when people must re-orientate themselves toward new goals and means. The possibility of undertaking this study depends on whether the services of a suitable research scientist can be obtained.

(6) A study to isolate and evaluate the social and physical components significant for town-planning in the Delta.

This study will be an exploratory undertaking in which the findings of other Delta research, either completed or in progress, will be applied in the development of a town-planning approach fitted to northern needs.

SUGGESTED PROBLEMS FOR RESEARCH IN THE MACKENZIE DELTA

An invitation to submit suggestions was sent to each of the major organizations operating in the Delta. Their replies are listed in full or in summary form below:

1. The Northern Administration Branch

   (a) Welfare Division

      (i) A study of attitudes of Indians, Eskimos and others towards the various income maintenance programs with particular reference to the differences in attitudes towards social assistance and other programs.

      (ii) A study of the aspirations and economic prospects of school children in the Delta from Grade 7 upward. How do they see themselves fitting into the economic life of northern Canada? Do they anticipate moving south to larger centres of population and do they feel they can cope with such a move?

      (iii) Basic research to reveal essential characteristics of delinquency and crime in the Delta. Characteristics should have reference to the incidence of delinquency and crime over a two-year period by:

         (a) age group;

         (b) level of academic achievement;

         (c) employment or occupation;

         (d) ethnic status;

         (e) type of offence;

         (f) previous convictions;

         (g) community of residence; and

         (h) previous imprisonment.

   (b) Education Division

      (i) To examine how appropriate are existing school programs in the following detail:

         (a) The consistency of the programs, aims and objectives with socio-economic needs and aspirations.

         (b) The validity of the program content in relation to its aims and objectives.

         (c) The effectiveness of methods and instructional materials.

         (d) The capacity for program expansion and reform.

(ii) To investigate how much the Delta people value education and what kind of attitudes they have towards schools. Further to determine how parental attitudes and values affect school performance.

(iii) To investigate how far present programs meet the educational and vocational needs of girls and young women in the Delta.

(iv) To investigate how southern Canadians adapt themselves to northern living.

(v) To study the characteristics of teachers who succeed best in the northern setting and to establish criteria for improved selection of teachers.

(vi) To inquire into the value of the community school concept as applied in a Delta setting.

(a) To conduct a survey to ascertain the specially talented in music, drama and the fine arts among the Delta people.

(vii) To investigate how pupil residence programs can be improved so that

(a) optimum educational gains can be derived from a pupil's stay-in-residence.

(b) adequate provision can be made for age and sex differences.

(viii) To conduct operational surveys to obtain factual information on such topic areas as

(a) the educational background of adults 16 years of age and over,

(b) home and family life - conditions of living, privacy, patterns of spending, - including credit buying, leisure time activities,

(c) community services for leisure time activities,

(d) incidence of alcholism,

(e) problems of delinquency and crime prevention.

(ix) To study the role of the community teacher in northern settlements and to determine the kind of professional training which will best prepare teachers for northern service.

(x) To conduct a census of exceptional children and young adults including the gifted, the handicapped, and the delinquent, and to recommend appropriate educational programs designed especially to serve their needs.

(xi) To inquire into patterns of success or failure of individuals of different racial origins in the various school and vocational education programs.

(xii) To investigate the employment history of school and vocational education graduates and drop-outs.

(xiii) To conduct a survey with the object of relating employment prospects of the area to the educational and training needs of the population.

(xiv) To investigate the impact of education on the population mobility of the Delta area.

(xv) To isolate and study factors which tend to promote adjustment of Delta native peoples to a wage economy.

(xvi) To develop tests to assist in evaluating the effectiveness of the curricula in the Delta area.

(xvii) To explore the need for a school calendar based on the seasonal nature of northern activities.

(xviii) To make a comparative study of educational programs for northern native peoples in Canada, U.S.S.R., U.S.A., and Greenland.

(xix) To investigate a rationale of transportation systems in the Delta having regard to the economy, maximum service from outside agencies, development of special areas of industry, and problems of community resettlement.

2. The Commissioner of the Northwest Territories

(i) The changing aspirations of native people and the factors related.

3. The Co-operative Union of Canada

(i) It was suggested that a special emphasis be placed on the problem of developing means to foster and encourage self-sufficiency and self-determination.

4. The Anglican Bishop of the Arctic

(i) The distinction between Indian and Eskimo culture and psychology

(ii) An assessment of the influence of transient whites on native people.

5. The Roman Catholic Vicar Apostolic of the Mackenzie

(i) The distinction between Delta eskimos of eastern and those of western origin.

6. Canadian Wildlife Service

(i) An assessment of the future role of wildlife in the Delta's economy.

(ii) The motivation of Delta residents to better use wildlife resources.

CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

PA/76
See reply
13-4
R.D.

Ottawa 4, April 6, 1966

our file / notre dossier NR 2/7-1

your file / votre dossier

1009-3-16

C.M. BOLGER
NORTHERN ADMINISTRATION
BRANCH

I wish to express my personal thanks, as well as thanks on behalf of Northern Co-ordination and Research Centre for your advice and help at the Research Planning Conference of February 28 and March 1.

For your information I am attaching a copy of the minutes. Any "follow-up" remarks or comments you may wish to make will be received with gratitude.

A.J. Kerr
for Chief
Northern Co-ordination
and Research Centre

Encl. -

Ref. to date
- request comments
to attend
the session

MACKENZIE DELTA RESEARCH PROJECT - PLANNING CONFERENCE

A meeting of university scientists, together with government scientists and administrators, was held on February 28 and March 1, 1966, in Room 1403 South, Centennial Tower, Ottawa, to discuss reports of previous field work and proposals for future research in connection with the Mackenzie Delta Research.

PRESENT:

Mr. A.J. Kerr (Chairman)
Northern Co-ordination and Research Centre,
Department of Northern Affairs and National Resources

Mr. C. Aasen
Faculty of Engineering
University of Waterloo

Mr. G. Angers
Industrial Division
Department of Northern Affairs and National Resources

Dr. R.A. Armstrong
Northern Health Services
Department of National Health and Welfare

Dr. A. Balikci
Department of Anthropology
University of Montreal

Mr. D. Bissett
Industrial Division
Department of Northern Affairs and National Resources

Mr. W. Bock
Education Division
Department of Northern Affairs and National Resources

Mr. C.M. Bolger
Assistant Director, Northern Administration Branch
Department of Northern Affairs and National Resources

Dr. N. Chance
Department of Sociology and Anthropology
McGill University

Dr. P.F. Cooper
Peabody Museum
Salem, Massachusetts

Mr. J. Cox
Engineering Division
Department of Northern Affairs and National Resources

Dr. R. Dailey
Department of Anthropology
University of Toronto

Dr. D. Damas
National Museum of Canada

Dr. J.B. Ellis
Faculty of Engineering
University of Waterloo

Dr. D. Foote
Department of Geography
McGill University

Mr. J.H. Gordon
Assistant Deputy Minister
Department of Northern Affairs and National Resources

Mr. R. Hill
Northern Co-ordination and Research Centre
Department of Northern Affairs and National Resources

Dr. C. Hobart
Department of Sociology and Anthropology
University of Alberta - Edmonton

Dr. J.J. Honigmann
Institute for Research in Social Science
University of North Carolina

Mr. C.T. Hyslop
Assistant Director, Northern Administration Branch
Department of Northern Affairs and National Resources

Dr. Diamond Jenness

Mr. F.J. Neville
Welfare Division
Department of Northern Affairs and National Resources

Mr. G. Rancier
Department of Northern Affairs and National Resources

Mr. G. Richardson
Indian Affairs Branch
Department of Citizenship and Immigration

Mr. G.W. Rowley
Secretary, Advisory Committee on Northern Development
Department of Northern Affairs and National Resources

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Mr. W.F. Shepherd
Welfare Division
Department of Northern Affairs and National Resources

Dr. R. Slobodin
Department of Sociology and Anthropology
McMaster University

Dr. D. Smith
Peabody Museum
Harvard University

Mr. J. Wolforth
Department of Geography
University of British Columbia

Mr. W. Wright
Faculty of Engineering
University of Waterloo

Mr. G.F. Parsons (Secretary)
Northern Co-ordination and Research Centre
Department of Northern Affairs and National Resources

I. INTRODUCTORY REMARKS

1. Mr. A.J. Kerr explained that the provisional design of the Mackenzie Delta Research Project called for research to be undertaken in three stages over a period of three years. The first stage was completed in 1965, when a research team of specialists in anthropology, economic geography, and physics was recruited by the Northern Co-ordination and Research Centre and sent to the Delta to undertake preliminary studies as a basis for further, more intensive research. The purpose of the conference was to discuss the reports resulting from the first phase, to seek suggestions and recommendations for the future planning of the Project, and to examine the best means for co-ordinating this research with research planned by other organizations and individuals.

2. Mr. J.H. Gordon outlined the basic aims and objectives of the Mackenzie Delta Research Project. Essentially, these were to provide the Government with a better understanding of the needs and aspirations of the native peoples of the area and the opportunities open to them, and to determine the best means to involve them in identifying and solving their own problems, and in managing their own affairs. The Department of Northern Affairs and National Resources was seeking concrete recommendations and proposals which could be put into effect, if only as pilot projects, in the shortest possible time following the presentation of the research findings.

This was the first time that the Department had attempted to gather together an interdisciplinary team of scientists to concentrate on the problems of a single geographic region. The Mackenzie Delta area had been chosen for special attention at this time because it was broadly representative of environmental, social, and economic conditions in both the Arctic and Sub-Arctic of Canada. He called on those present for suggestions as to the kinds of studies that might usefully be undertaken, and the agencies that should be asked to participate.

II. DISCUSSION OF PRELIMINARY PHASE REPORTS

3. Mr. Kerr noted that copies of reports based on preliminary field work in the summer of 1965 had been distributed to participants at the conference. He called on those who had performed field research to discuss briefly their work, and invited the other participants to comment and ask questions after each presentation.

(a) The Mackenzie Delta - Its Economic Base and Development - by J. Wolforth

4. Mr. J. Wolforth said that during approximately three months in the field, he had concentrated on gathering basic data with respect to demographic change, wage employment, freight movements, exploitation of renewable resources with special reference to trapping and fur trading, and other related matters. There was need for further research on employment, population movements, natural resources, and the economic impact of policies which have guided commercial, industrial, and governmental activities in the area. These and other recommendations had been included in his report.

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5. Dr. J. J. Honigmann observed that within a brief period of field work, Mr. Wolforth had gathered a great deal of basic information which should prove useful in planning future research.

6. Dr. D. Foote agreed, and said the report raised some interesting questions which should be answered. It was necessary to learn more precisely the nature and extent of the Delta's renewable resources, and to determine the size of the human population which these resources could support. The answers to such questions called for basic biological research, and he asked if there were plans to incorporate biological studies in the Mackenzie Delta Project.

7. Mr. Kerr said biologists now stationed at Inuvik were conducting studies on muskrat productivity, but they were not actually involved in the Project. He agreed that the advice of biologists from the Canadian Wildlife Service and other agencies should be sought.

8. Mr. Gordon said that studies of the kind suggested by Dr. Foote should be done in connection with studies of the efficiency of harvesting methods now employed.

9. Dr. Hobart said there was a need for information about the economic aspirations of the Delta people. This would provide a basis for predicting the numbers of people who might participate in future resource harvesting, and should be correlated with information on available resources.

10. Mr. Kerr said that investigation of economic aspirations had been incorporated in the existing research design.

11. Dr. Foote suggested that if other government agencies were not in a position to assist in gathering the kinds of biological data needed, then the Northern Co-ordination and Research Centre should consider engaging biologists to work on the Mackenzie Delta Project's interdisciplinary team. The overall objective was to provide information which would permit flexibility in decision-making. Therefore, it seemed necessary to conduct investigations into biological, human biological, and cultural processes, and to combine knowledge of these three processes in such a way as to provide guidelines to the administration.

12. Mr. Kerr agreed in principle, but indicated that there were limitations to the scale on which the Mackenzie Delta Project could be operated. He asked for suggestions as to how such research problems might be approached, within the limits of the scale of operations.

13. Mr. D. Bissett thought that a wealth of data already existed from past biological studies. These data were available from such agencies as the Fisheries Research Board and the Canadian Wildlife Service. In order to acquire and use this existing information, it was only necessary to establish effective liaison with the relevant agencies.

14. Dr. Foote suggested that the Northern Co-ordination and Research Centre might consider hiring someone to compile existing biological data.

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15. Dr. Honigmann pointed out that geography and anthropology were essentially synthesizing disciplines, and suggested that professionals in these fields should be in a position to bring together biological and cultural data, and to identify and interpret relationships between them in a manner meaningful to administrators.

16. Dr. R.A. Armstrong suggested that modern data processing methods could be usefully employed in correlating the kinds of data under discussion. The Department of National Health and Welfare could provide data on health conditions in the Mackenzie Delta, and they might be able to process this information by computer.

(b) Technology and the Mackenzie River Delta

by Dr. P.F. Cooper

17. Mr. Kerr explained that the objectives of Dr. Cooper's preliminary research had been to identify some of the probable limitations and directions of technological development, and to examine some of the means by which technology might contribute to better resource utilization and better living standards.

18. Dr. Cooper said that in the course of his research, he had reached certain conclusions which ran parallel to points already made by other conference participants. These included the pressing need to bring together knowledge already available, and the need for more information on how resources are exploited at present, how to exploit them more fully in future, and what proportion of the population might be expected to benefit from fuller exploitation. In considering ways to improve living standards, it was important to bear in mind that providing better technical facilities to more people would mean concentrating the population in larger communities. Such a development seemed to conflict with proposals for better harvesting of renewable resources, which called for a dispersal of the population. There seemed to be no easy solution to this dilemma, although it might be possible to improve transportation to the resource areas, and to reduce the cost of living in towns.

19. Mr. Kerr said Dr. Cooper's study indicated that radical technological developments could not be expected to change economic and living standards in the foreseeable future. Life could be made easier for the native peoples of the north by more effective use of local resources and/or further subsidization.

20. Mr. Wolforth thought that future exploitation of oil and natural gas resources offered about the only possibility for dramatic change, and asked if Dr. Cooper had obtained any information about this.

21. Dr. Cooper said he did not think that the development of oilfields would provide large-scale, continuing employment for the native population.

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22. Mr. Gordon agreed, and thought that perhaps increased Territorial revenues would constitute the main advantage to the development of any petroleum reserves in the area.

23. Mr. W. Bock said the extension of winter roads into the Delta might reduce transportation costs.

24. Dr. Cooper said he had been told by Mr. R.A. Hemstock of the Imperial Oil Company that freight haulage by winter roads could cost up to twenty times as much as barge transportation in summer, because roughness imposed low speeds, reduced loads, and increased maintenance.

25. Mr. Gordon suggested that increased use of winter roads could reduce the need for maintaining large inventories in some areas.

26. Mr. R. Hill said that roads could have important social benefits by increasing population mobility and reducing the isolation between settlements.

27. Mr. Hyslop said the Department of Northern Affairs and National Resources had embarked on a long-term road building program which included plans for a road to Inuvik and other parts of the Delta area. A continuing effort was being made to reduce the costs of electric power, and a new Eskimo housing program was planned.

28. Dr. Cooper noted that in the past there had been relatively little effort to adapt technological innovations to northern conditions. Perhaps the time had come to look more closely at the special needs of the north and to create a new technology more suitable to the area. It seemed unwise to depend solely on research by private industry, since the techniques which industry might be expected to develop would be directed more towards large scale production for a mass market, than to meeting the specialized needs of a small population in regions like the Mackenzie Delta.

29. Mr. Gordon said there was a need for research into problems of industrial employment. There was an assumption that the onus was entirely on the native peoples to adapt, and that industry need not make any adjustments to the needs and cultural attributes of the people. Some industries had shown a willingness to experiment in making certain special provisions for Indian and Eskimo employees, but there was danger of conflict with the labour unions. A report from a research group might help to persuade industry of the need to make further adjustments.

30. Dr. Honigmann said that he had observed certain informal adaptations on the part of employers at Frobisher Bay. It was possible that there had been more adaptation by industry than was immediately apparent.

31. Dr. Slobodin agreed, and thought there had been both conscious and unconscious adjustments to the work attitudes and skills of local labour forces in the north.

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32. Mr. G. Anders said research on questions of native employment had been conducted in several African countries, including Rhodesia and Zambia, and that it might be useful to examine these research findings.

(c) Domestic Economy of the Native Peoples, Mackenzie River Delta, N.W.T.

by D.G. Smith

33. Mr. D.G. Smith explained that the central aim of his study had been to analyse in a preliminary way the difference between economic expectation and economic realization among native people in the region. His study indicated that, in spite of ethnic and other differences, the people of the Delta constituted in many ways a single community within a more or less distinctive environment. He had found it useful to distinguish three broad categories of people: those living on the land, those living in settlements but dependent partly on the land and partly on casual employment, and those living in settlements as full-time wage earners. The second group appeared to be subject to the most economic frustration, while the third had come closest to bridging the gap between economic expectation and realization. He suggested that intensive study of group relations, attitudes, aspirations, and values was necessary to provide a "practical" understanding of the people. His preliminary work had, he thought, shown how an intensive study should be organized.

34. Dr. R. Dailey asked if excessive use of alcohol was an important factor in preventing the people from realizing their economic aspirations. If so, patterns of liquor consumption should be investigated.

35. Mr. Smith thought that drinking was a significant factor. Some people appeared to spend a large proportion of their available cash on liquor, not only for their own consumption but to "treat" their friends. However, with so many inter-related aspects of social life in the Delta requiring investigation, he wondered if it would be advisable to spend a large proportion of the time available for field work on this specific question.

36. Dr. Hobart thought there was a need for more information on the symbolic significance of drinking behaviour, because this behavior was closely connected with the ways in which individuals and groups identified and defined themselves and their relations with others, both native and white. Knowledge about these matters might provide guidelines for administrative action designed to reduce excessive drinking.

37. Dr. Honigmann said that research into questions of economic frustration presented problems of methodology. Formal interviewing seemed to be the best method for obtaining systematic results, but native people were suspicious and felt threatened by interviews, and were reluctant to submit to them.

38. Mr. Smith agreed, and said that people had become evasive when he asked them direct questions. However, during prolonged, informal contact people frequently would comment about their attitudes and aspirations.

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39. Dr. Hobart suggested there were ways in which such data could be gathered systematically. He cited current experiments with thematic aperception tests, in which subjects are invited to participate in a "game", giving their interpretations of pictures which the interviewer showed to them. Again, it might be possible to bring groups together to discuss a hypothetical question or problem. However, it was true that the success of such methods depended on the prior establishment of rapport between investigator and subjects.

40. Dr. N. Chance agreed that with the proper approach, it was possible to pose hypothetical questions to informants, without approaching directly their attitudes and beliefs. This technique permitted them to respond hypothetically, without appearing to expose themselves. His own research group had had some success along these lines during field work with Indians in northern Quebec.

41. Dr. Slobodin considered that extensive knowledge of the people and their language was necessary before attempting to gather data on their motivations and values. There was a temptation for anthropologists to avoid learning native languages when working in an area like the Mackenzie Delta, where so many of the people spoke English. As a result, investigators sometimes failed entirely to identify many important aspects of social life. Time spent learning the language also served to establish rapport with the people, since it gave them the opportunity to exercise some measure of control in their relations with the anthropologist, who must assume the role of "subordinate" in the learning process.

42. Dr. Chance said that without knowledge of the local language it was far more difficult to study motivation than to study social structure. For this reason, anthropologists often tended to concentrate on structural studies.

III. DISCUSSION OF FUTURE RESEARCH PLANS

43. Mr. Kerr noted that a number of general suggestions for further research had been made already, including suggestions on research methodology. It was necessary now to discuss specific details of the research design for the Project, as tentatively outlined in a paper which had been distributed before the Conference. Stage II, to be undertaken in 1966, would use the insights developed in Stage I to identify more precisely and to explore in depth certain key aspects of the social, psychological, economic, and physical situation in the Delta. In Stage III, existing government programs would be examined, and suggestions made for their improvement and the possible implementation of new programs, on the basis of research findings.

Specifically, the studies proposed in Stage II included the investigation of:

(a) motivation and perception of the native people;

(b) relations between sub-groups in the native population;

(c) mental health as index of stress in a social change situation

(d) culture change problems as perceived by whites;

(e) availability and use of local resources;

(f) problems of town planning.

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In addition to the studies proposed in the research design for Stage II, a number of research suggestions had been received from government and non-government agencies operating in the Delta. These included requests from the Welfare and Education Divisions of the Northern Administration Branch for research on delinquency and crime, attitudes toward social assistance, the aspirations and economic prospects of school children, attitudes toward education, teacher recruitment, and a variety of related topics. Conference participants were invited to comment on the plans for Stage II, and to offer suggestions on the best way to integrate these plans with the immediate research needs of the administrators in the fields of welfare and education.

44. Dr. Balikci said the studies proposed in Stage II were fragmented and seemed to bear little relationship to one another. However, most of the studies would involve consideration of ecological factors. He suggested that a comprehensive ecological study could subsume and give an overall perspective to research problems of narrower scope, and thought that such a study should be given first priority.

45. Dr. Chance suggested that while ecological factors were important to consider, they were not sufficient in themselves to explain social processes in a situation where native peoples were experiencing a widening range of choice in their actions. In such a situation, motivations and self-perceptions became increasingly significant areas for study.

46. Dr. Honigmann said that ecological factors were not being ruled out, but could be taken into account in motivational studies.

47. Dr. Slobodin said some of the studies proposed for Stage II would require lengthly periods of field work. Ideally, one year should be allowed for field work on the mental health study, and one year for the study of motivation.

48. Mr. Kerr asked if it was necessary or advisable to undertake the broader and more theoretically oriented studies planned for Stage II, before investigating the relatively specialized and narrowly defined problems of immediate interest to the Welfare and Education Divisions.

49. Dr. Slobodin suggested that the answers to research problems posed by the administration should come out of broader studies.

50. Dr. Honigmann noted that the motivational study proposed for Stage II raised "umbrella-type" questions which subsumed the questions formulated by the Welfare Division. However, it did not seem necessary to pursue the broader problems first. To answer the Welfare Division's questions called for the examination of those questions specifically.

51. Dr. Chance said that he was in favour of undertaking basic research first, but agreed that it was not necessary. It was possible from the start to focus either on "pure" research problems or on "practical" administrative problems.

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In addition to the studies proposed in the research design for Stage II, a number of research suggestions had been received from government and non-government agencies operating in the Delta. These included requests from the Welfare and Education Divisions of the Northern Administration Branch for research on delinquency and crime, attitudes toward social assistance, the aspirations and economic prospects of school children, attitudes toward education, teacher recruitment, and a variety of related topics. Conference participants were invited to comment on the plans for Stage II, and to offer suggestions on the best way to integrate these plans with the immediate research needs of the administrators in the fields of welfare and education.

44. Dr. Balikci said the studies proposed in Stage II were fragmented and seemed to bear little relationship to one another. However, most of the studies would involve consideration of ecological factors. He suggested that a comprehensive ecological study could subsume and give an overall perspective to research problems of narrower scope, and thought that such a study should be given first priority.

45. Dr. Chance suggested that while ecological factors were important to consider, they were not sufficient in themselves to explain social processes in a situation where native peoples were experiencing a widening range of choice in their actions. In such a situation, motivations and self-perceptions became increasingly significant areas for study.

46. Dr. Honigmann said that ecological factors were not being ruled out, but could be taken into account in motivational studies.

47. Dr. Slobodin said some of the studies proposed for Stage II would require lengthly periods of field work. Ideally, one year should be allowed for field work on the mental health study, and one year for the study of motivation.

48. Mr. Kerr asked if it was necessary or advisable to undertake the broader and more theoretically oriented studies planned for Stage II, before investigating the relatively specialized and narrowly defined problems of immediate interest to the Welfare and Education Divisions.

49. Dr. Slobodin suggested that the answers to research problems posed by the administration should come out of broader studies.

50. Dr. Honigmann noted that the motivational study proposed for Stage II raised "umbrella-type" questions which subsumed the questions formulated by the Welfare Division. However, it did not seem necessary to pursue the broader problems first. To answer the Welfare Division's questions called for the examination of those questions specifically.

51. Dr. Chance said that he was in favour of undertaking basic research first, but agreed that it was not necessary. It was possible from the start to focus either on "pure" research problems or on "practical" administrative problems.

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52. Mr. Kerr noted that several references had been made to the difficulty of undertaking motivational studies, and asked if it was feasible to investigate such questions as the aspirations of school children, within the time available.

53. Dr. Hobart did not think that a study of school children's aspirations would be unduly difficult. It would be advisable to ask how realistic were the aspirations of these children, and what were the aspirations of the parents for them.

54. Dr. Honigmann said that the studies proposed by the administration served to alert those planning research to the need to include a wider range of age groups in the research design. Of the studies suggested by Welfare Division, that concerned with delinquency and crime seemed the easiest to handle.

55. Mr. F.J. Neville said that the Welfare Division favoured research which would show whether or not its existing programs met present needs, and which would provide suggestions for the development of new programs. The Division needed reliable information as soon as possible for the solution of practical problems. A correction program was being developed at the present time, geared to the rehabilitation of offenders. To implement such a program, it was necessary to have information about attitudes toward crime, attitudes toward rehabilitation, and related matters. However, this was only one of the problem areas which concerned the administration, and concern was not focused solely or even primarily in the Mackenzie Delta. A system of priorities should be established for conducting research, based on the relative degrees of urgency of the various problems requiring investigation. In planning research, there was a need for more liaison among the various units of the Department.

56. Mr. G. Rancier agreed that the administration needed answers to its questions fairly soon. Decisions had to be made as to the advisability of training natives for employment in the south, and encouraging industry to establish in the north. The administration preferred to operate on the basis of scientific information, but it could not wait for years for that information.

57. Mr. C.M. Bolger said that administrators did not expect the Mackenzie Delta Research Project to provide pat answers to all the questions they had presented. However, there was a need for the problems defined by the research planners to be reconciled in some way with those defined by the administrators.

58. Mr. Kerr agreed that a balance must be struck between the demands of basic research and the need for answers which could be applied relatively quickly. It seemed in order to study the specific research problems of the administration within the framework of the larger questions included in the present research design. He stressed that the entire Delta Project was strongly oriented toward research which could be applied administratively. It was proposed that Stage III would involve the local people, including members of the local administration, working in teams to devise means by which the previous research findings could be employed in the formulation of policy. He invited suggestions on the best means for planning research which would lead to the implementation of findings.

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59. Dr. J.B. Ellis suggested involving administrators in the actual research process, rather than inviting them to participate in implementation after the research was completed. The former approach would be more likely to encourage receptiveness to the recommendations arising from research.

60. Mr. Wolforth noted that research was proposed at two levels--the so-called "pure" and "applied". If the aim was to facilitate immediate applications on a local scale, then it was best to involve local field administrators. However, if long-term policy changes of more than local significance were anticipated, then high-level administrators should be involved.

61. Dr. Honigmann thought that senior administrators were more interested in co-operating with research workers.

62. Dr. Balikci agreed, and expressed the opinion that local administrators were less likely to have an appreciation of the broad problems which had to be faced in the north as a whole.

63. Mr. Bock pointed out that the Department's operations were being increasingly decentralized, and more local administrators were becoming involved in the making of important decisions. Change would come largely through recommendations made by local administrators, and through demands of the local people as they became more aware of the alternatives open to them. It was a mistake to think that all policy was initiated in Ottawa.

64. Mr. Kerr thought that it was important to involve the people who implement policies at the working level, in addition to the native peoples who are affected by those policies. If the local administrator were shown that the social scientist had a contribution to make, he would be likely to co-operate.

65. Dr. Hobart considered that the problem of administrative involvement, and of ensuring the "feedback" of information from researcher to administrator, was essentially a problem for those familiar with government organization. The feedback process could not be left to work informally, but must be built into the research design. It might be useful to appoint a committee to give careful consideration to general problems of collaboration between researchers and administrators. In this connection, a program of "action research" might be considered. There were receptive people at both the policy level and the local administrative level, and it seemed necessary to co-operate with both groups.

66. Dr. Chance said that his own research group, in working on a prolonged study of community development projects in Indian communities, met periodically with an advisory board consisting of government administrators. These meetings permitted a frank exchange of views, and a full accounting of research findings and future research plans. A similar arrangement might work in the Delta Project.

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67. Dr. Dailey suggested that researchers might provide administrators with a series of interim progress reports.

68. Dr. Foote said that it might be advisable to keep the local native peoples informed about the objectives of research, and to make them aware of the need for accurate information. If the people could be made to understand and appreciate that research findings might lead to the improvement of policies affecting them, they would be willing to co-operate with field investigators. Their confidence and co-operation might be gained by regularly feeding information to the opinion leaders in the Delta, and by employing native personnel to gather basic data.

69. Dr. Slobodin agreed in principle, but said that many people might not understand the information given to them, and some information might be resented. As the number of researchers increased in the north, the problem of their reception by local people became increasingly important. The question of feeding back research information to native groups was complicated, and required careful examination.

70. Mr. Kerr called for comments on the proposals for Stage III of the research. It was intended to form a team composed of researchers, together with administrators in education, welfare, and related fields. This group would co-operate in working out experimental applications of the research findings, and in making recommendations for policy change.

71. Dr. Honigmann said that the questions to be answered in Stage III should be built into the design for Stage II. Furthermore, it might be a mistake to separate Stages II and III. These phases overlapped and ran parallel to one another. There was a need to collaborate with administrators in Stage II as well as in Stage III.

72. Dr. Dailey agreed that the two phases should be combined in some way. It seemed necessary for questions of analysis and application to be considered at both stages.

73. Mr. Kerr agreed in principle that some merging of the two stages would be desirable. However, it was not clear how this could be accomplished in practice.

74. Mr. Kerr called on Messrs. C. Aasen and W. Wright to discuss their proposal for the study of an approach to regional planning in the Delta.

(Item 6, Stage II, in paper describing the research design)

75. Mr. Wright said it was Mr. Aasen's and his thesis that, through the development of adequate predictive models, a consistent program for regional planning could be achieved. The aim was to provide guidelines for future research and to develop a conceptual framework for planning, taking into account all possible environmental, physical, economic, social, and social psychological variables which might

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influence planning. Although Mr. Aasen and he were not in a position to examine in detail a large number of variables in a wide variety of disciplines, they hoped to perform a synthesizing function with the help of the specialists in several disciplines who would constitute the research team. Their first interest was in gathering data for their theses for the Master's Degree, but they hoped that their research could be integrated with the program for the Delta.

76. Mr. Wright's presentation was discussed at length. In the opinion of some participants, the proposal was considered too ambitious and perhaps unmanageable in its present form. However, a number agreed that with further refinement, and some scaling down of the objectives, the proposed research might make a useful contribution to knowledge of the Delta.

IV. DISCUSSION OF THE CO-ORDINATION OF THE MACKENZIE DELTA RESEARCH PROJECT WITH RESEARCH PLANNED BY OTHER ORGANIZATIONS AND INDIVIDUALS.

77. Dr. Honigmann said that he was planning to undertake a comparative study of Indians and Eskimos in Arctic and sub-Arctic towns in Canada. He was interested in studying the responses that people made to their social and economic opportunities, and the normal and deviant culture patterns in northern towns. He proposed to consider the town as a socializing environment, and as a stimulus to new forms of behaviour and to the making of new choices and decisions. He would look for patterns of response among different groups with respect to the use of alcohol, the opportunities for education and vocational training, and other matters. The next step would be to formulate hypotheses which might be useful in explaining the responses observed. The research was intended primarily to produce hypotheses, rather than to test hypotheses. A graduate student was doing research along these lines in Schefferville for a period of six months, and several graduates would be going to Churchill in the summer of 1966. Dr. Honigmann planned to go himself to Inuvik in the spring of 1967 for about seven months. There he would compare his findings with the results of his earlier work at Frobisher Bay, and probably would return later to Frobisher Bay.

78. Mr. Kerr asked Dr. Honigmann to comment on the possibilities for co-ordinating his work with that of the Delta Project.

79. Dr. Honigmann said that he welcomed the opportunity to co-ordinate his work with that of the Northern Co-ordination and Research Centre, and to incorporate in his own research questions which might be of practical significance to the Department. He had no specific suggestions for liaison at this time, but planned to do preliminary work in Ottawa, when he would be pleased to consult with the Centre. However, he did not wish to duplicate the work of other investigators, and was prepared to consider studying some town other than Inuvik, or to otherwise change his plans as a result of the conference discussions.

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80. Mr. Anders suggested that Dr. Honigmann might consider studying Yellowknife.

81. Mr. Rancier agreed with this suggestion, adding that Dr. Honigmann's proposed study of Churchill also could be valuable to the Department.

82. Dr. Armstrong expressed interest in Dr. Honigmann's proposals, and invited him to visit the Department of National Health and Welfare during the course of his work in Ottawa. That Department was planning a variety of research projects in the north, including the investigation of general health patterns, pneumonia among Eskimos, epidemiology among Indians, and dietary studies. All these projects should be co-ordinated in some way with Dr. Honigmann's research.

83. Mr. Kerr asked Dr. Balikci and Dr. Chance for suggestions for the co-ordination of departmental research in the Delta with social research being undertaken or planned at their respective universities.

84. Dr. Balikci said that an important concern of the Department of Anthropology at the University of Montreal was the training of graduate students for northern research. Hopefully, a PHD program would begin within two years, and students were available at the present time to participate in the Delta Project.

85. Dr. Chance said that at McGill University, all available anthropology students with interests in northern research were participating in the current series of studies of Cree Indians in northern Quebec, under his direction. However, by 1967 some McGill students might be available to participate in research sponsored by the Northern Co-ordination and Research Centre. His students were taking courses in social theory related to problems of development, and one course requirement was participation in an ongoing program of applied research in this field. One objective of the training program was to prepare social scientists for work in government. His Cree studies, under ARDA sponsorship, were directed at such problems as economic and geographic mobility, adjustment to new kinds of employment, motivation and perception, and factors which stimulated or inhibited political awareness and political involvement. At the same time, ongoing community development programs were being evaluated. These studies had a direct bearing on the kinds of issues that were being explored in the Mackenzie Delta. He expressed interest in co-operation and liaison with the Department of Northern Affairs and National Resources, and other government agencies.

86. Dr. Foote reported that he was embarking on a study of whale hunting in Norway, and might do similar research on resource exploitation in Labrador. Other studies in progress or planned by his

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group, included investigation of the fishing industry in West Greenland, and resource harvesting in both coastal and inland areas of Alaska. Hopefully, the data gathered would be relevant to economic patterns in other northern areas.

87. Mr. Rancier said the Education Division was sponsoring or involved in several ongoing studies, some of which were being undertaken by graduate students in education. These included an historical study of relations between church and state in Eskimo education, and a study of art as a means of communication with school children whose native language was not English. Other projects were focused on programmed learning, standardization of intelligence tests, and related problems.

88. Mr. Anders said the Industrial Division was continuing its series of area economic surveys, and would be paying particular attention to the Mackenzie region. Studies were planned for the Delta, and for the Fort Rae - Lac la Martre area. It was hoped that by 1967 or 1968, area economic surveys would have been completed in all parts of the north, after which regional planning studies might be undertaken.

89. Mr. Bissett said that his area survey in the summer of 1966 would take in the Delta and adjacent territory, including Fort McPherson and Arctic Red River.

90. Mr. W.F. Shepherd said the Welfare Division had no research projects under way at the present time. However, there were plans to recruit an officer to educate natives in the use of alcohol, and this person might undertake research somewhere in the Mackenzie District.

91. Mr. G. Richardson said the Indian Affairs Branch had no research plans for the Delta. However, there was a possibility that research might be undertaken among the Dogrib Indians in the vicinity of Fort Rae.

92. Mr. Kerr invited general comments and suggestions for the improvement of liaison and research co-ordination.

93. Dr. Slobodin suggested that each university scientist present might provide a brief written statement of his future plans to the Northern Co-ordination and Research Centre.

94. Mr. Wolforth expressed the fear that there might be duplication of research effort in the Mackenzie Delta. One way to avoid this might be the immediate preparation of a bibliography showing work already completed in the area.

95. Mr. Kerr said the NCRC was planning to engage an experienced bibliographer to prepare a core bibliography which could then be circulated to give agencies and individuals a chance to suggest additions.

96. Dr. Honigmann said there had always been informal liaison among professionals engaged in northern research. However, there was a need for systematic distribution of research information from a central point, and perhaps the NCRC was in the best position to do this by the periodic publication of a mimeographed newsletter.

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97. Dr. Hobart agreed with the need for a newsletter summarizing research recently completed, under way, and planned. This would be a valuable co-ordinating tool, particularly if it were published in the spring, prior to the period of summer field work. The N.C.R.C. could undertake publication as part of its co-ordination function. Any newsletter should be concerned with research throughout the Canadian north, and not confined to material pertaining to the Mackenzie Delta.

98. Mr. Wolforth suggested that information and news of the Mackenzie Delta Project might be gathered and distributed by the staff of the Inuvik Research Laboratory.

99. Mr. Kerr said that there would be administrative problems in publishing a newsletter, among them the problem of staff shortage in the N.C.R.C. He asked if it might be possible to use some existing publication to circulate information on northern research.

100. Dr. Hobart said that it might be possible to include a newsletter in the Canadian Journal of Economics and Political Science. However, this would mean limiting coverage to the human sciences.

101. Dr. Balikci considered that a newsletter was vitally important, and should be published twice each year. The National Museum produced a newsletter in simple form which had been very useful, and might serve as a model.

102. Dr. Dailey said that a permanent committee might be set up to direct publication of the newsletter, and to advise generally on matters of research co-ordination.

103. Mr. Kerr suggested that those individuals and agencies who were interested in a newsletter might be asked to submit information for publication in a simplified, standard form, which then could be reproduced in Ottawa with a minimum of effort. There was no question that a newsletter would be valuable, but a number of administrative factors would have to be considered before the N.C.R.C. could make any commitment.

V. FINAL ASSESSMENT AND DISCUSSION OF POSSIBILITIES FOR A FUTURE MEETING

104. Dr. Honigmann said that he had found the conference most helpful and informative, and suggested that another meeting might be held in future as a means to ensure further co-ordination of research.

105. Dr. Chance expressed satisfaction with the conference.

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106. Dr. Balikci suggested that such meetings be held at least once and preferably twice each year.

107. Dr. Slobodin suggested that November might be a better time of year for the next conference, since it would provide more time for planning research projects to be undertaken the following summer.

108. Mr. Kerr said that it would be administratively difficult to arrange meetings twice a year, and that a conference in November or even December would not permit time for researchers to submit reports of their field work during the previous summer.

109. Dr. Hobart thought that a meeting could be useful even if reports had not been submitted previously.

110. Dr. Dailey suggested that field workers might present a one or two-page summary of their findings in time for an autumn meeting.

111. Dr. Ellis suggested that in future meetings, the participants be divided in small groups to discuss specifically defined problems, after which each group could report to the conference as a whole.

112. Mr. Kerr noted that there seemed to be general agreement on the need for another meeting. However, it was not possible at this point to decide on the most feasible time. The opinions on timing would have to be assessed in the light of the administrative problems involved, and other factors. He thanked the participants for their many valuable suggestions for improving the co-ordination of research, and for developing the research design of the Mackenzie Delta Project. These suggestions would be considered carefully, and incorporated in the research plan where this seemed desirable and feasible.

March, 1966
Department of Northern Affairs
and National Resources

G.F. Parsons
Recording Secretary.

CANADA

Department of Northern Affairs and National Resources Deputy Minister

Ministère du Nord canadien et des Ressources nationales Sous-ministre

C.T. HYSLOP,
NORTHERN ADMIN. BRANCH

Ottawa 4, April 6, 1966.
our file / notre dossier 2/7-1
your file / votre dossier

1009-3-16

I wish to express my personal thanks, as well as thanks on behalf of Northern Co-ordination and Research Centre for your advice and help at the Research Planning Conference of February 28 and March 1.

For your information I am attaching a copy of the minutes. Any "follow-up" remarks or comments you may wish to make will be received with gratitude.

A.J. Kerr,
for - Chief,
Northern Co-ordination and
Research Centre.

Enclosure

MACKENZIE DELTA RESEARCH PROJECT - PLANNING CONFERENCE

A meeting of university scientists, together with government scientists and administrators, was held on February 28 and March 1, 1966, in Room 1403 South, Centennial Tower, Ottawa, to discuss reports of previous field work and proposals for future research in connection with the Mackenzie Delta Research.

PRESENT:

Mr. A.J. Kerr (Chairman)
Northern Co-ordination and Research Centre,
Department of Northern Affairs and National Resources

Mr. C. Aasen
Faculty of Engineering
University of Waterloo

Mr. G. Angers
Industrial Division
Department of Northern Affairs and National Resources

Dr. R.A. Armstrong
Northern Health Services
Department of National Health and Welfare

Dr. A. Balikci
Department of Anthropology
University of Montreal

Mr. D. Bissett
Industrial Division
Department of Northern Affairs and National Resources

Mr. W. Bock
Education Division
Department of Northern Affairs and National Resources

Mr. C.M. Bolger
Assistant Director, Northern Administration Branch
Department of Northern Affairs and National Resources

Dr. N. Chance
Department of Sociology and Anthropology
McGill University

Dr. P.F. Cooper
Peabody Museum
Salem, Massachusetts

Mr. J. Cox
Engineering Division
Department of Northern Affairs and National Resources

Dr. R. Dailey
Department of Anthropology
University of Toronto

Dr. D. Damas
National Museum of Canada

Dr. J.B. Ellis
Faculty of Engineering
University of Waterloo

Dr. D. Foote
Department of Geography
McGill University

Mr. J.H. Gordon
Assistant Deputy Minister
Department of Northern Affairs and National Resources

Mr. R. Hill
Northern Co-ordination and Research Centre
Department of Northern Affairs and National Resources

Dr. C. Hobart
Department of Sociology and Anthropology
University of Alberta - Edmonton

Dr. J.J. Honigmann
Institute for Research in Social Science
University of North Carolina

Mr. C.T. Hyslop
Assistant Director, Northern Administration Branch
Department of Northern Affairs and National Resources

Dr. Diamond Jenness

Mr. F.J. Neville
Welfare Division
Department of Northern Affairs and National Resources

Mr. G. Rancier
Department of Northern Affairs and National Resources

Mr. G. Richardson
Indian Affairs Branch
Department of Citizenship and Immigration

Mr. G.W. Rowley
Secretary, Advisory Committee on Northern Development
Department of Northern Affairs and National Resources

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Mr. W.F. Shepherd
Welfare Division
Department of Northern Affairs and National Resources

Dr. R. Slobodin
Department of Sociology and Anthropology
McMaster University

Dr. D. Smith
Peabody Museum
Harvard University

Mr. J. Wolforth
Department of Geography
University of British Columbia

Mr. W. Wright
Faculty of Engineering
University of Waterloo

Mr. G.F. Parsons (Secretary)
Northern Co-ordination and Research Centre
Department of Northern Affairs and National Resources

I. INTRODUCTORY REMARKS

1. Mr. A.J. Kerr explained that the provisional design of the Mackenzie Delta Research Project called for research to be undertaken in three stages over a period of three years. The first stage was completed in 1965, when a research team of specialists in anthropology, economic geography, and physics was recruited by the Northern Co-ordination and Research Centre and sent to the Delta to undertake preliminary studies as a basis for further, more intensive research. The purpose of the conference was to discuss the reports resulting from the first phase, to seek suggestions and recommendations for the future planning of the Project, and to examine the best means for co-ordinating this research with research planned by other organizations and individuals.

2. Mr. J.H. Gordon outlined the basic aims and objectives of the Mackenzie Delta Research Project. Essentially, these were to provide the Government with a better understanding of the needs and aspirations of the native peoples of the area and the opportunities open to them, and to determine the best means to involve them in identifying and solving their own problems, and in managing their own affairs. The Department of Northern Affairs and National Resources was seeking concrete recommendations and proposals which could be put into effect, if only as pilot projects, in the shortest possible time following the presentation of the research findings.

This was the first time that the Department had attempted to gather together an interdisciplinary team of scientists to concentrate on the problems of a single geographic region. The Mackenzie Delta area had been chosen for special attention at this time because it was broadly representative of environmental, social, and economic conditions in both the Arctic and Sub-Arctic of Canada. He called on those present for suggestions as to the kinds of studies that might usefully be undertaken, and the agencies that should be asked to participate.

II. DISCUSSION OF PRELIMINARY PHASE REPORTS

3. Mr. Kerr noted that copies of reports based on preliminary field work in the summer of 1965 had been distributed to participants at the conference. He called on those who had performed field research to discuss briefly their work, and invited the other participants to comment and ask questions after each presentation.

(a) The Mackenzie Delta - Its Economic Base and Development -

by J. Wolforth

4. Mr. J. Wolforth said that during approximately three months in the field, he had concentrated on gathering basic data with respect to demographic change, wage employment, freight movements, exploitation of renewable resources with special reference to trapping and fur trading, and other related matters. There was need for further research on employment, population movements, natural resources, and the economic impact of policies which have guided commercial, industrial, and governmental activities in the area. These and other recommendations had been included in his report.

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5. Dr. J.J. Honigmann observed that within a brief period of field work, Mr. Wolforth had gathered a great deal of basic information which should prove useful in planning future research.

6. Dr. D. Foote agreed, and said the report raised some interesting questions which should be answered. It was necessary to learn more precisely the nature and extent of the Delta's renewable resources, and to determine the size of the human population which these resources could support. The answers to such questions called for basic biological research, and he asked if there were plans to incorporate biological studies in the Mackenzie Delta Project.

7. Mr. Kerr said biologists now stationed at Inuvik were conducting studies on muskrat productivity, but they were not actually involved in the Project. He agreed that the advice of biologists from the Canadian Wildlife Service and other agencies should be sought.

8. Mr. Gordon said that studies of the kind suggested by Dr. Foote should be done in connection with studies of the efficiency of harvesting methods now employed.

9. Dr. Hobart said there was a need for information about the economic aspirations of the Delta people. This would provide a basis for predicting the numbers of people who might participate in future resource harvesting, and should be correlated with information on available resources.

10. Mr. Kerr said that investigation of economic aspirations had been incorporated in the existing research design.

11. Dr. Foote suggested that if other government agencies were not in a position to assist in gathering the kinds of biological data needed, then the Northern Co-ordination and Research Centre should consider engaging biologists to work on the Mackenzie Delta Project's interdisciplinary team. The overall objective was to provide information which would permit flexibility in decision-making. Therefore, it seemed necessary to conduct investigations into biological, human biological, and cultural processes, and to combine knowledge of these three processes in such a way as to provide guidelines to the administration.

12. Mr. Kerr agreed in principle, but indicated that there were limitations to the scale on which the Mackenzie Delta Project could be operated. He asked for suggestions as to how such research problems might be approached, within the limits of the scale of operations.

13. Mr. D. Bissett thought that a wealth of data already existed from past biological studies. These data were available from such agencies as the Fisheries Research Board and the Canadian Wildlife Service. In order to acquire and use this existing information, it was only necessary to establish effective liaison with the relevant agencies.

14. Dr. Foote suggested that the Northern Co-ordination and Research Centre might consider hiring someone to compile existing biological data.

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15. Dr. Honigmann pointed out that geography and anthropology were essentially synthesizing disciplines, and suggested that professionals in these fields should be in a position to bring together biological and cultural data, and to identify and interpret relationships between them in a manner meaningful to administrators.

16. Dr. R.A. Armstrong suggested that modern data processing methods could be usefully employed in correlating the kinds of data under discussion. The Department of National Health and Welfare could provide data on health conditions in the Mackenzie Delta, and they might be able to process this information by computer.

(b) Technology and the Mackenzie River Delta

by Dr. P.F. Cooper

17. Mr. Kerr explained that the objectives of Dr. Cooper's preliminary research had been to identify some of the probable limitations and directions of technological development, and to examine some of the means by which technology might contribute to better resource utilization and better living standards.

18. Dr. Cooper said that in the course of his research, he had reached certain conclusions which ran parallel to points already made by other conference participants. These included the pressing need to bring together knowledge already available, and the need for more information on how resources are exploited at present, how to exploit them more fully in future, and what proportion of the population might be expected to benefit from fuller exploitation. In considering ways to improve living standards, it was important to bear in mind that providing better technical facilities to more people would mean concentrating the population in larger communities. Such a development seemed to conflict with proposals for better harvesting of renewable resources, which called for a dispersal of the population. There seemed to be no easy solution to this dilemma, although it might be possible to improve transportation to the resource areas, and to reduce the cost of living in towns.

19. Mr. Kerr said Dr. Cooper's study indicated that radical technological developments could not be expected to change economic and living standards in the foreseeable future. Life could be made easier for the native peoples of the north by more effective use of local resources and/or further subsidization.

20. Mr. Wolforth thought that future exploitation of oil and natural gas resources offered about the only possibility for dramatic change, and asked if Dr. Cooper had obtained any information about this.

21. Dr. Cooper said he did not think that the development of oilfields would provide large-scale, continuing employment for the native population.

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22. Mr. Gordon agreed, and thought that perhaps increased Territorial revenues would constitute the main advantage to the development of any petroleum reserves in the area.

23. Mr. W. Bock said the extension of winter roads into the Delta might reduce transportation costs.

24. Dr. Cooper said he had been told by Mr. R.A. Hemstock of the Imperial Oil Company that freight haulage by winter roads could cost up to twenty times as much as barge transportation in summer, because roughness imposed low speeds, reduced loads, and increased maintenance.

25. Mr. Gordon suggested that increased use of winter roads could reduce the need for maintaining large inventories in some areas.

26. Mr. R. Hill said that roads could have important social benefits by increasing population mobility and reducing the isolation between settlements.

27. Mr. Hyslop said the Department of Northern Affairs and National Resources had embarked on a long-term road building program which included plans for a road to Inuvik and other parts of the Delta area. A continuing effort was being made to reduce the costs of electric power, and a new Eskimo housing program was planned.

28. Dr. Cooper noted that in the past there had been relatively little effort to adapt technological innovations to northern conditions. Perhaps the time had come to look more closely at the special needs of the north and to create a new technology more suitable to the area. It seemed unwise to depend solely on research by private industry, since the techniques which industry might be expected to develop would be directed more towards large scale production for a mass market, than to meeting the specialized needs of a small population in regions like the Mackenzie Delta.

29. Mr. Gordon said there was a need for research into problems of industrial employment. There was an assumption that the onus was entirely on the native peoples to adapt, and that industry need not make any adjustments to the needs and cultural attributes of the people. Some industries had shown a willingness to experiment in making certain special provisions for Indian and Eskimo employees, but there was danger of conflict with the labour unions. A report from a research group might help to persuade industry of the need to make further adjustments.

30. Dr. Honigmann said that he had observed certain informal adaptations on the part of employers at Frobisher Bay. It was possible that there had been more adaptation by industry than was immediately apparent.

31. Dr. Slobodin agreed, and thought there had been both conscious and unconscious adjustments to the work attitudes and skills of local labour forces in the north.

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32. Mr. G. Anders said research on questions of native employment had been conducted in several African countries, including Rhodesia and Zambia, and that it might be useful to examine these research findings.

(c) Domestic Economy of the Native Peoples, Mackenzie River Delta, N.W.T.

by D.G. Smith

33. Mr. D.G. Smith explained that the central aim of his study had been to analyse in a preliminary way the difference between economic expectation and economic realization among native people in the region. His study indicated that, in spite of ethnic and other differences, the people of the Delta constituted in many ways a single community within a more or less distinctive environment. He had found it useful to distinguish three broad categories of people: those living on the land, those living in settlements but dependent partly on the land and partly on casual employment, and those living in settlements as full-time wage earners. The second group appeared to be subject to the most economic frustration, while the third had come closest to bridging the gap between economic expectation and realization. He suggested that intensive study of group relations, attitudes, aspirations, and values was necessary to provide a "practical" understanding of the people. His preliminary work had, he thought, shown how an intensive study should be organized.

34. Dr. R. Dailey asked if excessive use of alcohol was an important factor in preventing the people from realizing their economic aspirations. If so, patterns of liquor consumption should be investigated.

35. Mr. Smith thought that drinking was a significant factor. Some people appeared to spend a large proportion of their available cash on liquor, not only for their own consumption but to "treat" their friends. However, with so many inter-related aspects of social life in the Delta requiring investigation, he wondered if it would be advisable to spend a large proportion of the time available for field work on this specific question.

36. Dr. Hobart thought there was a need for more information on the symbolic significance of drinking behaviour, because this behavior was closely connected with the ways in which individuals and groups identified and defined themselves and their relations with others, both native and white. Knowledge about these matters might provide guidelines for administrative action designed to reduce excessive drinking.

37. Dr. Honigmann said that research into questions of economic frustration presented problems of methodology. Formal interviewing seemed to be the best method for obtaining systematic results, but native people were suspicious and felt threatened by interviews, and were reluctant to submit to them.

38. Mr. Smith agreed, and said that people had become evasive when he asked them direct questions. However, during prolonged, informal contact people frequently would comment about their attitudes and aspirations.

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39. Dr. Hobart suggested there were ways in which such data could be gathered systematically. He cited current experiments with thematic aperception tests, in which subjects are invited to participate in a "game", giving their interpretations of pictures which the interviewer showed to them. Again, it might be possible to bring groups together to discuss a hypothetical question or problem. However, it was true that the success of such methods depended on the prior establishment of rapport between investigator and subjects.

40. Dr. N. Chance agreed that with the proper approach, it was possible to pose hypothetical questions to informants, without approaching directly their attitudes and beliefs. This technique permitted them to respond hypothetically, without appearing to expose themselves. His own research group had had some success along these lines during field work with Indians in northern Quebec.

41. Dr. Slobodin considered that extensive knowledge of the people and their language was necessary before attempting to gather data on their motivations and values. There was a temptation for anthropologists to avoid learning native languages when working in an area like the Mackenzie Delta, where so many of the people spoke English. As a result, investigators sometimes failed entirely to identify many important aspects of social life. Time spent learning the language also served to establish rapport with the people, since it gave them the opportunity to exercise some measure of control in their relations with the anthropologist, who must assume the role of "subordinate" in the learning process.

42. Dr. Chance said that without knowledge of the local language it was far more difficult to study motivation than to study social structure. For this reason, anthropologists often tended to concentrate on structural studies.

III. DISCUSSION OF FUTURE RESEARCH PLANS

43. Mr. Kerr noted that a number of general suggestions for further research had been made already, including suggestions on research methodology. It was necessary now to discuss specific details of the research design for the Project, as tentatively outlined in a paper which had been distributed before the Conference. Stage II, to be undertaken in 1966, would use the insights developed in Stage I to identify more precisely and to explore in depth certain key aspects of the social, psychological, economic, and physical situation in the Delta. In Stage III, existing government programs would be examined, and suggestions made for their improvement and the possible implementation of new programs, on the basis of research findings.

Specifically, the studies proposed in Stage II included the investigation of:

(a) motivation and perception of the native people;

(b) relations between sub-groups in the native population;

(c) mental health as index of stress in a social change situation

(d) culture change problems as perceived by whites;

(e) availability and use of local resources;

(f) problems of town planning.

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In addition to the studies proposed in the research design for Stage II, a number of research suggestions had been received from government and non-government agencies operating in the Delta. These included requests from the Welfare and Education Divisions of the Northern Administration Branch for research on delinquency and crime, attitudes toward social assistance, the aspirations and economic prospects of school children, attitudes toward education, teacher recruitment, and a variety of related topics. Conference participants were invited to comment on the plans for Stage II, and to offer suggestions on the best way to integrate these plans with the immediate research needs of the administrators in the fields of welfare and education.

44. Dr. Balikci said the studies proposed in Stage II were fragmented and seemed to bear little relationship to one another. However, most of the studies would involve consideration of ecological factors. He suggested that a comprehensive ecological study could subsume and give an overall perspective to research problems of narrower scope, and thought that such a study should be given first priority.

45. Dr. Chance suggested that while ecological factors were important to consider, they were not sufficient in themselves to explain social processes in a situation where native peoples were experiencing a widening range of choice in their actions. In such a situation, motivations and self-perceptions became increasingly significant areas for study.

46. Dr. Honigmann said that ecological factors were not being ruled out, but could be taken into account in motivational studies.

47. Dr. Slobodin said some of the studies proposed for Stage II would require lengthly periods of field work. Ideally, one year should be allowed for field work on the mental health study, and one year for the study of motivation.

48. Mr. Kerr asked if it was necessary or advisable to undertake the broader and more theoretically oriented studies planned for Stage II, before investigating the relatively specialized and narrowly defined problems of immediate interest to the Welfare and Education Divisions.

49. Dr. Slobodin suggested that the answers to research problems posed by the administration should come out of broader studies.

50. Dr. Honigmann noted that the motivational study proposed for Stage II raised "umbrella-type" questions which subsumed the questions formulated by the Welfare Division. However, it did not seem necessary to pursue the broader problems first. To answer the Welfare Division's questions called for the examination of those questions specifically.

51. Dr. Chance said that he was in favour of undertaking basic research first, but agreed that it was not necessary. It was possible from the start to focus either on "pure" research problems or on "practical" administrative problems.

...8

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52. Mr. Kerr noted that several references had been made to the difficulty of undertaking motivational studies, and asked if it was feasible to investigate such questions as the aspirations of school children, within the time available.

53. Dr. Hobart did not think that a study of school children's aspirations would be unduly difficult. It would be advisable to ask how realistic were the aspirations of these children, and what were the aspirations of the parents for them.

54. Dr. Honigmann said that the studies proposed by the administration served to alert those planning research to the need to include a wider range of age groups in the research design. Of the studies suggested by Welfare Division, that concerned with delinquency and crime seemed the easiest to handle.

55. Mr. F.J. Neville said that the Welfare Division favoured research which would show whether or not its existing programs met present needs, and which would provide suggestions for the development of new programs. The Division needed reliable information as soon as possible for the solution of practical problems. A correction program was being developed at the present time, geared to the rehabilitation of offenders. To implement such a program, it was necessary to have information about attitudes toward crime, attitudes toward rehabilitation, and related matters. However, this was only one of the problem areas which concerned the administration, and concern was not focused solely or even primarily in the Mackenzie Delta. A system of priorities should be established for conducting research, based on the relative degrees of urgency of the various problems requiring investigation. In planning research, there was a need for more liaison among the various units of the Department.

56. Mr. G. Rancier agreed that the administration needed answers to its questions fairly soon. Decisions had to be made as to the advisability of training natives for employment in the south, and encouraging industry to establish in the north. The administration preferred to operate on the basis of scientific information, but it could not wait for years for that information.

57. Mr. C.M. Bolger said that administrators did not expect the Mackenzie Delta Research Project to provide pat answers to all the questions they had presented. However, there was a need for the problems defined by the research planners to be reconciled in some way with those defined by the administrators.

58. Mr. Kerr agreed that a balance must be struck between the demands of basic research and the need for answers which could be applied relatively quickly. It seemed in order to study the specific research problems of the administration within the framework of the larger questions included in the present research design. He stressed that the entire Delta Project was strongly oriented toward research which could be applied administratively. It was proposed that Stage III would involve the local people, including members of the local administration, working in teams to devise means by which the previous research findings could be employed in the formulation of policy. He invited suggestions on the best means for planning research which would lead to the implementation of findings.

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59. Dr. J.B. Ellis suggested involving administrators in the actual research process, rather than inviting them to participate in implementation after the research was completed. The former approach would be more likely to encourage receptiveness to the recommendations arising from research.

60. Mr. Wolforth noted that research was proposed at two levels--the so-called "pure" and "applied". If the aim was to facilitate immediate applications on a local scale, then it was best to involve local field administrators. However, if long-term policy changes of more than local significance were anticipated, then high-level administrators should be involved.

61. Dr. Honigmann thought that senior administrators were more interested in co-operating with research workers.

62. Dr. Balikci agreed, and expressed the opinion that local administrators were less likely to have an appreciation of the broad problems which had to be faced in the north as a whole.

63. Mr. Bock pointed out that the Department's operations were being increasingly decentralized, and more local administrators were becoming involved in the making of important decisions. Change would come largely through recommendations made by local administrators, and through demands of the local people as they became more aware of the alternatives open to them. It was a mistake to think that all policy was initiated in Ottawa.

64. Mr. Kerr thought that it was important to involve the people who implement policies at the working level, in addition to the native peoples who are affected by those policies. If the local administrator were shown that the social scientist had a contribution to make, he would be likely to co-operate.

65. Dr. Hobart considered that the problem of administrative involvement, and of ensuring the "feedback" of information from researcher to administrator, was essentially a problem for those familiar with government organization. The feedback process could not be left to work informally, but must be built into the research design. It might be useful to appoint a committee to give careful consideration to general problems of collaboration between researchers and administrators. In this connection, a program of "action research" might be considered. There were receptive people at both the policy level and the local administrative level, and it seemed necessary to co-operate with both groups.

66. Dr. Chance said that his own research group, in working on a prolonged study of community development projects in Indian communities, met periodically with an advisory board consisting of government administrators. These meetings permitted a frank exchange of views, and a full accounting of research findings and future research plans. A similar arrangement might work in the Delta Project.

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67. Dr. Dailey suggested that researchers might provide administrators with a series of interim progress reports.

68. Dr. Foote said that it might be advisable to keep the local native peoples informed about the objectives of research, and to make them aware of the need for accurate information. If the people could be made to understand and appreciate that research findings might lead to the improvement of policies affecting them, they would be willing to co-operate with field investigators. Their confidence and co-operation might be gained by regularly feeding information to the opinion leaders in the Delta, and by employing native personnel to gather basic data.

69. Dr. Slobodin agreed in principle, but said that many people might not understand the information given to them, and some information might be resented. As the number of researchers increased in the north, the problem of their reception by local people became increasingly important. The question of feeding back research information to native groups was complicated, and required careful examination.

70. Mr. Kerr called for comments on the proposals for Stage III of the research. It was intended to form a team composed of researchers, together with administrators in education, welfare, and related fields. This group would co-operate in working out experimental applications of the research findings, and in making recommendations for policy change.

71. Dr. Honigmann said that the questions to be answered in Stage III should be built into the design for Stage II. Furthermore, it might be a mistake to separate Stages II and III. These phases overlapped and ran parallel to one another. There was a need to collaborate with administrators in Stage II as well as in Stage III.

72. Dr. Dailey agreed that the two phases should be combined in some way. It seemed necessary for questions of analysis and application to be considered at both stages.

73. Mr. Kerr agreed in principle that some merging of the two stages would be desirable. However, it was not clear how this could be accomplished in practice.

74. Mr. Kerr called on Messrs. C. Aasen and W. Wright to discuss their proposal for the study of an approach to regional planning in the Delta.

(Item 6, Stage II, in paper describing the research design)

75. Mr. Wright said it was Mr. Aasen's and his thesis that, through the development of adequate predictive models, a consistent program for regional planning could be achieved. The aim was to provide guidelines for future research and to develop a conceptual framework for planning, taking into account all possible environmental, physical, economic, social, and social psychological variables which might

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influence planning. Although Mr. Aasen and he were not in a position to examine in detail a large number of variables in a wide variety of disciplines, they hoped to perform a synthesizing function with the help of the specialists in several disciplines who would constitute the research team. Their first interest was in gathering data for their theses for the Master's Degree, but they hoped that their research could be integrated with the program for the Delta.

76. Mr. Wright's presentation was discussed at length. In the opinion of some participants, the proposal was considered too ambitious and perhaps unmanageable in its present form. However, a number agreed that with further refinement, and some scaling down of the objectives, the proposed research might make a useful contribution to knowledge of the Delta.

IV. DISCUSSION OF THE CO-ORDINATION OF THE MACKENZIE DELTA RESEARCH PROJECT WITH RESEARCH PLANNED BY OTHER ORGANIZATIONS AND INDIVIDUALS.

77. Dr. Honigmann said that he was planning to undertake a comparative study of Indians and Eskimos in Arctic and sub-Arctic towns in Canada. He was interested in studying the responses that people made to their social and economic opportunities, and the normal and deviant culture patterns in northern towns. He proposed to consider the town as a socializing environment, and as a stimulus to new forms of behaviour and to the making of new choices and decisions. He would look for patterns of response among different groups with respect to the use of alcohol, the opportunities for education and vocational training, and other matters. The next step would be to formulate hypotheses which might be useful in explaining the responses observed. The research was intended primarily to produce hypotheses, rather than to test hypotheses. A graduate student was doing research along these lines in Schefferville for a period of six months, and several graduates would be going to Churchill in the summer of 1966. Dr. Honigmann planned to go himself to Inuvik in the spring of 1967 for about seven months. There he would compare his findings with the results of his earlier work at Frobisher Bay, and probably would return later to Frobisher Bay.

78. Mr. Kerr asked Dr. Honigmann to comment on the possibilities for co-ordinating his work with that of the Delta Project.

79. Dr. Honigmann said that he welcomed the opportunity to co-ordinate his work with that of the Northern Co-ordination and Research Centre, and to incorporate in his own research questions which might be of practical significance to the Department. He had no specific suggestions for liaison at this time, but planned to do preliminary work in Ottawa, when he would be pleased to consult with the Centre. However, he did not wish to duplicate the work of other investigators, and was prepared to consider studying some town other than Inuvik, or to otherwise change his plans as a result of the conference discussions.

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80. Mr. Anders suggested that Dr. Honigmann might consider studying Yellowknife.

81. Mr. Rancier agreed with this suggestion, adding that Dr. Honigmann's proposed study of Churchill also could be valuable to the Department.

82. Dr. Armstrong expressed interest in Dr. Honigmann's proposals, and invited him to visit the Department of National Health and Welfare during the course of his work in Ottawa. That Department was planning a variety of research projects in the north, including the investigation of general health patterns, pneumonia among Eskimos, epidemiology among Indians, and dietary studies. All these projects should be co-ordinated in some way with Dr. Honigmann's research.

83. Mr. Kerr asked Dr. Balikci and Dr. Chance for suggestions for the co-ordination of departmental research in the Delta with social research being undertaken or planned at their respective universities.

84. Dr. Balikci said that an important concern of the Department of Anthropology at the University of Montreal was the training of graduate students for northern research. Hopefully, a PHD program would begin within two years, and students were available at the present time to participate in the Delta Project.

85. Dr. Chance said that at McGill University, all available anthropology students with interests in northern research were participating in the current series of studies of Cree Indians in northern Quebec, under his direction. However, by 1967 some McGill students might be available to participate in research sponsored by the Northern Co-ordination and Research Centre. His students were taking courses in social theory related to problems of development, and one course requirement was participation in an ongoing program of applied research in this field. One objective of the training program was to prepare social scientists for work in government. His Cree studies, under ARDA sponsorship, were directed at such problems as economic and geographic mobility, adjustment to new kinds of employment, motivation and perception, and factors which stimulated or inhibited political awareness and political involvement. At the same time, ongoing community development programs were being evaluated. These studies had a direct bearing on the kinds of issues that were being explored in the Mackenzie Delta. He expressed interest in co-operation and liaison with the Department of Northern Affairs and National Resources, and other government agencies.

86. Dr. Foote reported that he was embarking on a study of whale hunting in Norway, and might do similar research on resource exploitation in Labrador. Other studies in progress or planned by his

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group, included investigation of the fishing industry in West Greenland, and resource harvesting in both coastal and inland areas of Alaska. Hopefully, the data gathered would be relevant to economic patterns in other northern areas.

87. Mr. Rancier said the Education Division was sponsoring or involved in several ongoing studies, some of which were being undertaken by graduate students in education. These included an historical study of relations between church and state in Eskimo education, and a study of art as a means of communication with school children whose native language was not English. Other projects were focused on programmed learning, standardization of intelligence tests, and related problems.

88. Mr. Anders said the Industrial Division was continuing its series of area economic surveys, and would be paying particular attention to the Mackenzie region. Studies were planned for the Delta, and for the Fort Rae - Lac la Martre area. It was hoped that by 1967 or 1968, area economic surveys would have been completed in all parts of the north, after which regional planning studies might be undertaken.

89. Mr. Bissett said that his area survey in the summer of 1966 would take in the Delta and adjacent territory, including Fort McPherson and Arctic Red River.

90. Mr. W.F. Shepherd said the Welfare Division had no research projects under way at the present time. However, there were plans to recruit an officer to educate natives in the use of alcohol, and this person might undertake research somewhere in the Mackenzie District.

91. Mr. G. Richardson said the Indian Affairs Branch had no research plans for the Delta. However, there was a possibility that research might be undertaken among the Dogrib Indians in the vicinity of Fort Rae.

92. Mr. Kerr invited general comments and suggestions for the improvement of liaison and research co-ordination.

93. Dr. Slobodin suggested that each university scientist present might provide a brief written statement of his future plans to the Northern Co-ordination and Research Centre.

94. Mr. Wolforth expressed the fear that there might be duplication of research effort in the Mackenzie Delta. One way to avoid this might be the immediate preparation of a bibliography showing work already completed in the area.

95. Mr. Kerr said the NCRC was planning to engage an experienced bibliographer to prepare a core bibliography which could then be circulated to give agencies and individuals a chance to suggest additions.

96. Dr. Honigmann said there had always been informal liaison among professionals engaged in northern research. However, there was a need for systematic distribution of research information from a central point, and perhaps the NCRC was in the best position to do this by the periodic publication of a mimeographed newsletter.

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97. Dr. Hobart agreed with the need for a newsletter summarizing research recently completed, under way, and planned. This would be a valuable co-ordinating tool, particularly if it were published in the spring, prior to the period of summer field work. The N.C.R.C. could undertake publication as part of its co-ordination function. Any newsletter should be concerned with research throughout the Canadian north, and not confined to material pertaining to the Mackenzie Delta.

98. Mr. Wolforth suggested that information and news of the Mackenzie Delta Project might be gathered and distributed by the staff of the Inuvik Research Laboratory.

99. Mr. Kerr said that there would be administrative problems in publishing a newsletter, among them the problem of staff shortage in the N.C.R.C. He asked if it might be possible to use some existing publication to circulate information on northern research.

100. Dr. Hobart said that it might be possible to include a newsletter in the Canadian Journal of Economics and Political Science. However, this would mean limiting coverage to the human sciences.

101. Dr. Balikci considered that a newsletter was vitally important, and should be published twice each year. The National Museum produced a newsletter in simple form which had been very useful, and might serve as a model.

102. Dr. Dailey said that a permanent committee might be set up to direct publication of the newsletter, and to advise generally on matters of research co-ordination.

103. Mr. Kerr suggested that those individuals and agencies who were interested in a newsletter might be asked to submit information for publication in a simplified, standard form, which then could be reproduced in Ottawa with a minimum of effort. There was no question that a newsletter would be valuable, but a number of administrative factors would have to be considered before the N.C.R.C. could make any commitment.

V. FINAL ASSESSMENT AND DISCUSSION OF POSSIBILITIES FOR A FUTURE MEETING

104. Dr. Honigmann said that he had found the conference most helpful and informative, and suggested that another meeting might be held in future as a means to ensure further co-ordination of research.

105. Dr. Chance expressed satisfaction with the conference.

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106. Dr. Balikci suggested that such meetings be held at least once and preferably twice each year.

107. Dr. Slobodin suggested that November might be a better time of year for the next conference, since it would provide more time for planning research projects to be undertaken the following summer.

108. Mr. Kerr said that it would be administratively difficult to arrange meetings twice a year, and that a conference in November or even December would not permit time for researchers to submit reports of their field work during the previous summer.

109. Dr. Hobart thought that a meeting could be useful even if reports had not been submitted previously.

110. Dr. Dailey suggested that field workers might present a one or two-page summary of their findings in time for an autumn meeting.

111. Dr. Ellis suggested that in future meetings, the participants be divided in small groups to discuss specifically defined problems, after which each group could report to the conference as a whole.

112. Mr. Kerr noted that there seemed to be general agreement on the need for another meeting. However, it was not possible at this point to decide on the most feasible time. The opinions on timing would have to be assessed in the light of the administrative problems involved, and other factors. He thanked the participants for their many valuable suggestions for improving the co-ordination of research, and for developing the research design of the Mackenzie Delta Project. These suggestions would be considered carefully, and incorporated in the research plan where this seemed desirable and feasible.

March, 1966
Department of Northern Affairs
and National Resources

G.F. Parsons
Recording Secretary.

1009-3-16

CANADA

Department of Northern Affairs and National Resources Deputy Minister

Ministère du Nord canadien et des Ressources nationales Sous-ministre

Ottawa 4, April 6, 1966.

C. M. BOLGER,
NORTHERN ADMINISTRATION BRANCH

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your file / votre dossier

1009-1-16

M.D.R.P. - Preliminary Phase Reports

Previous to the Research Planning Conference of February 28 and March 1, preliminary draft copies of reports for the four studies undertaken last summer were sent to you. Before final editing and publication of these reports, it would be very helpful to us if we could receive from the Branch any comments about them you wish to make regarding particularly:

(a) The validity of quantitative or qualitative data presented.

(b) Areas of the reports needing explanatory expansion (within the limits of the data available).

(c) Any references to family or personal matters which you feel might be unfair or misleading.

I shall be getting in touch with you shortly to arrange to discuss further the ways in which our research can better assist northern administration.

A. J. Kerr
for Chief,
Northern Co-ordination and
Research Centre.

[redacted]

PA/ 24-2 LD

Mr Bolger 1009-3-16

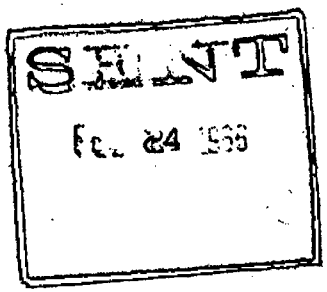
NORTHAD FTSM

NANR OTT

FEB 24/66

ADMINISTRATOR OF MACKENZIE

FT SMITH



D 16 REFERENCE YOUR SA 232 CONFERENCE AT NCRC CENTENNIAL TOWER OTTAWA NCRC WILL PAY BOCK'S EXPENSES

DIRECTOR

NORTHERN ADMIN BRANCH

NANR OTT

CALL MEMO
MESSAGE

FOR – POUR

FROM – DE Rose Kerr

OF – DE

☑ PLEASE CALL / PRIÈRE D'APPELER
☐ WILL CALL AGAIN / DOIT RAPPELER
☐ VISITED YOU / EST VENU POUR VOUS VOIR
☐ WANTS TO SEE YOU / DÉSIRE VOUS VOIR

PHONE NO. / Nº DE TÉLÉPHONE	EXTENSION / EXTENSION POSTE	OPERATOR NO. / TÉLÉPHONISTE Nº

SYSTEM: GOVT. ☐ DND / MDN ☐ LOCAL ☐ RÉSEAU: GOUV.

CITY – VILLE

MESSAGE NCRC will pay Bock's expenses

CALL RECEIVED BY – MESSAGE REÇU PAR | TIME–HEURE A.M. P.M. | DATE

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3.30
PM.

FEB 23 1966

NANR OTT

NORTHAD FTSM

FEBRUARY 23/66

DIRECTOR

NORTHERN ADMIN BRANCH

SA 232 REURLET FEBRUARY 17 RESEARCH PLANNING CONFERENCE NCRC, BOCK LEAVING INUVIK FRIDAY. ADVISE LOCATION OF CONFERENCE AND WHETHER EXPENSES ISSUED BY NCRC.

ADMAC

Ken
2-6097.

NANR OTT

NORTHAD FTSM

1004-3-16

CANADA

Department of Northern Affairs and National Resources Deputy Minister

Ministère du Nord canadien et des Ressources nationales Sous-ministre

Director, Northern
Administration Branch

E5-0524
P.A. 3,366

Ottawa 4, February 24, 1966.

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Mackenzie Delta Research Project - Planning Conference

Attached you will find the following materials for preparatory study:

(a) An outline of the plan of the Preliminary Phase.

(b) Copies in draft form of the four reports prepared after the Preliminary Phase plan was implemented.

(c) A list of persons who will be attending the conference.

(d) A proposed agenda for the conference. This will be discussed at the first meeting and may be adjusted.

It was originally planned to include with the above items the plan for future research to be undertaken on the project. A summary of suggestions received from government and other organizations regarding research which might be usefully undertaken, was also to be included. I regret that they cannot be attached, but they will be distributed to conference participants at the first meeting.

Because Ottawa is familiar to most conference participants, it is assumed that they will be making their own arrangements for accommodation, and we will not make hotel reservations unless requested.

I look forward to seeing you.

A. J. Kerr,
for Chief,
Northern Co-ordination
and Research Centre.

Kerr/ls

MACKENZIE DELTA RESEARCH PROJECT - PLANNING CONFERENCE

Location - Executive Board Room,
15th Floor - Centennial Tower,
400 Laurier Avenue,
Ottawa 4, Ontario.

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PROVISIONAL AGENDA

Monday, Feb. 28

A.M. 9:30 - 12:15

Discussion of Phase I
(Preliminary Phase) reports.

P.M. 2:00 - 5:00

Discussion of Phase II and III plans.

Tuesday, March 1

A.M. 9:30 - 12:15

Discussion of the co-ordination
of M.D.R.P. research with
research planned by other
organizations and individuals.

P.M. 2:00 - 5:00

Review and Final Assessments.

MACKENZIE DELTA RESEARCH PROJECT - PLANNING CONFERENCE

PARTICIPANTS AND OBSERVERS (Revised List)

✓ = present

✓ Dr. R. Slobodin,
Department of Sociology and Anthropology,
McMaster University,
Hamilton, Ontario

✓ Dr. John J. Honigmann,
Institute for Research in Social Science,
University of North Carolina,
Chapel Hill, North Carolina

✓ Dr. Norman Chance,
Department of Sociology and Anthropology,
McGill University,
Montreal, P.Q.

✓ Dr. Charles Hobart,
Department of Sociology and Anthropology,
University of Alberta - Edmonton

✓ Dr. Donald Foote,
Department of Geography,
McGill University,
Montreal, P.Q.

✓ Dr. Robert Dailey,
Department of Anthropology,
University of Toronto

✓ Dr. Asen Balikci,
Department of Anthropology,
University of Montreal

Dr. Frank Vallee,
Department of Sociology and Anthropology,
Carleton University,
Ottawa, Ontario

✓ Mr. John Wolforth,
Department of Geography,
University of British Columbia,
Vancouver, B.C.

✓ Mr. Derek Smith,
Peabody Museum,
Harvard University,
Cambridge, Mass.

Miss Jose Mailhot,
University of Montreal (unable to attend)

✓ Dr. P.F. Cooper, Ottawa

A representative from the directorate,
Northern Administration Branch — T. Nyskop

Chief of the Industrial Division,
Northern Administration Branch — Don Bissett
G. Anders
Gordon Rancier

Chief of the Education Division,
Northern Administration Branch

Chief of the Welfare Division,
Northern Administration Branch — Bill Shepherd

Chief of the Engineering Division,
Northern Administration Branch

Mr. Bill Bock,
Field Officer, Inuvik Region,
Northern Administration Branch

Mr. Don Bissett,
Area Survey Officer,
Northern Administration Branch

Mr. Walter Rudnicki,
Director of Planning,
Indian Affairs Branch,
Department of Citizenship and Immigration

Mr. Roy Young,
Chief - Resources Division,
Indian Affairs Branch

Mr. George Richardson,
Research and Survey Section,
Resources Division,
Indian Affairs Branch

Dr. R. A. Armstrong,
Chief, Northern Health Services,
Department of National Health and Welfare

Dr. David Damas,
Anthropologist,
National Museum

Dr. Martin O'Connell,
Research Director,
Indian - Eskimo Association

Mr. Walter Wright - (Graduate students studying at the University of Waterloo)

Mr. Clarence Aasen

MACKENZIE DELTA RESEARCH PROJECT--PRELIMINARY PHASE

A decision to develop a comprehensive and integrated research program in the Mackenzie Delta was made in September 1964. The purpose of the program was to isolate and analyze social and economic conditions which impede native peoples from participating in northern development and to assess the extent to which they are making effective adjustment to changes brought about by government and commercial expansion in the north. After discussion between Mr. J.H. Gordon , Mr. Rowley and Mr. Valentine, this program was included in the N.C.R.C. estimates for 1965-66.

Before such a program can be carefully formulated, some preliminary field work must be done in order to provide the general background data necessary to establish the location of key areas for detailed investigation during the next phase of the program. Plans for the preliminary phase of the project to be undertaken this year, leading up to a detailed and comprehensive research plan for the 1966-67 year, are listed below:

ACTION 1 - A preliminary field research program will be organized and will include the projects following:

(a) A socio-economic study of the basic structure of the community of Inuvik. Analysis would include consideration of elements such as:

- leaders and patterns of leadership (i.e., who the leaders are, and how they lead)

- decision-making (i.e., where decisions are made, factors inhibiting or promoting decision-making by local people)

- fragmentation in the community (i.e., sub-groups, their origins and their organization, their relations with each other)

- ethnicity and its meaning in Inuvik (i.e., what advantages and disadvantages does "Eskimoness" pose to an Eskimo in Inuvik).

Basic information about the structure of the other communities in the Delta is available, since they are former fur-trade settlements, not essentially different from other such settlements in the Mackenzie, whose patterns of organization have been described. Inuvik, however, represents a different ecological orientation with a good many elements whose inter-relationships have not been analyzed.

...2

(b) A socio-economic study of subsistence patterns in the Delta, to outline and analyze the problems related to the time-lag between the acquisition of new needs and the means to fulfil them. Social scientists who have worked in the Delta recently (Clairmont and Hobart) imply that this is the key to understanding most of the social problems in the area today. These scientists suggest that for native people of the area, a noticeable gap between the "level of economic expectation" and "the level of economic realization" is closely connected with increased delinquency, illegitimacy, problem drinking, etc. Analysis will include consideration of:

- origins of new "needs" (Where do they come from, and how are they fostered?)
- How wide is this "gap" between levels of expectation and realization? (By how much are people missing "the good life" as they understand it?)
- What are the group and sub-group differences with reference to the width of this "gap"?
- Are there predictable trends in this problem area?

(c) A study of the Delta by an economic geographer to produce an "outline map" of the economy of the area. This would include basic information about:

- historical background with reference to socio-economic change
- statistics of settlement populations, past and present
- resources and economic activities
- present source of income in the Delta
- differences in levels of income in various sectors of the population.

Such an "outline map" or compilation and elementary analysis of the economic and geographic facts of life in the Delta will provide essential information for <u>any</u> planning there, for research or other purposes. This study will be undertaken in close co-operation with the Industrial Division of the Northern Administration Branch.

...3

(d) A study by a physical scientist to survey the technological possibilities of reducing the cost of living in the Delta. This initial study will be undertaken by a non-specialist physical scientist who can consider all possibilities without predisposition towards any one. His report will provide a basis for determining where later specialized research is likely to be most useful, and would include consideration of:

- the basic needs of the area from a technological viewpoint
- past and present techniques of coping with these needs
- present and future developments in technology which are relevant to Delta problems
- the most promising possibilities for specialized research.

ACTION 2 - Agencies within the Department and within the Northern Administration Branch itself, together with other appropriate federal agencies working in the north (i.e., R.C.M.P., Department of National Health and Welfare) will be invited to submit opinions about research needed and which we should incorporate into our integrated program to get underway a year from now. When feasible, given our research objectives and conceptual framework, such suggestions will be incorporated.

ACTION 3 - An advisory panel in this research program will be organized. The membership of the panel will be determined in consultation with Mr. Rowley and Mr. Gordon. I suggest that it could be a group consisting of some social scientists with special northern experience (i.e., Dr. Vallee, Dr. Honigmann), and some Departmental officials.

ACTION 4 - A provisional research plan for the following year will be prepared in detail. Prior knowledge and experience of research staff in the Centre, suggestions obtained in response to ACTION 2, and experience and information gained from the studies done in ACTION 1, will all be drawn upon. On completion, it will be duplicated and copies mailed to members of the research panel for study.

ACTION 5 - A conference of the research panel will be organized for the purpose of modifying and adjusting this provisional research plan. From the comments and analyses of panel members, a final plan for research will be constructed. I suggest that a tentative date for this conference might be the end of January 1966.

ACTION 6 - Researchers to do the work outlined in the plan forthcoming from ACTION 5 will be engaged.

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

PA 842-66 MB

DIRECTOR

Ottawa 4, February 22, 1966.

our file / notre dossier 1009-3-16

your file / votre dossier

Planning Conference for Mackenzie Delta Research Project

In reply to your memorandum of February 17, I have arranged for Mr. G. Anders and Mr. D. Bissett of our Area Economic Survey Unit to attend the meeting on February 28 and March 1.

J.W. Evans,
Chief,
Industrial Division

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

MR. ~~EVANS~~
MR. YATES
MR. NEVILLE
MR. THORSTEINSSON

Ottawa 4, February 17, 1966.

our file / notre dossier 1009-3-16
your file / votre dossier

Planning Conference for Mackenzie Delta Research Project

The attached copy of a memorandum from Mr. A.J. Kerr of the Northern Co-ordination and Research Centre will be self-explanatory. A representative of the Engineering Division would be welcome along with the Chiefs or representatives of the other Divisions mentioned. It would be appreciated if Mr. Evans could arrange to have Mr. Bissett attend, as requested.

Would you please let me know the name of your proposed representative for this Conference.

Director

mr Flook OK
may we discuss
& think mr Anders and
mr Bissett should attend.

21/2/66.

CANADA

Department
of Northern Affairs
and National Resources Deputy Minister

Ministère
du Nord canadien et
des Ressources nationales Sous-ministre

Ottawa 4, February 10, 1966.
our file / notre dossier
your file / votre dossier

Mr. C. Bolger,
Assistant Director,
Northern Administration Branch

Following our conversation may I extend a formal written invitation to our Research Planning Conference (Monday February 28, and Tuesday March 1).

We will expect from the branch:

Yourself or, hopefully, some other representative from the directorate if you are unable to attend.

Chief of the Industrial Division or a representative

Chief of the Education Division or a representative

Chief of the Welfare Division or a representative

A field officer from the Inuvik region (Mr. Bill Bock).

I believe it would be very helpful if we could also include Mr. Don Bissett, the area survey officer, who is studying the delta region.

You will be receiving further information and pre-conference study materials in the near future.

A. J. Kerr,
for Chief,
Northern Co-ordination and
Research Centre

Kerr/ml

Discussed with Mr Kerr.
He would welcome representation from the Engineering Division also.

15.2.

(70)

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

Noted V JGN PAPmP

Ottawa 4, February 17, 1966.

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MR. EVANS
MR. YATES
MR. NEVILLE
MR. THORSTEINSSON

Planning Conference for Mackenzie Delta Research Project

The attached copy of a memorandum from Mr. A.J. Kerr of the Northern Co-ordination and Research Centre will be self-explanatory. A representative of the Engineering Division would be welcome along with the Chiefs or representatives of the other Divisions mentioned. It would be appreciated if Mr. Evans could arrange to have Mr. Bissett attend, as requested.

Would you please let me know the name of your proposed representative for this Conference.

C. W. Lyslop

Director

CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

Ottawa 4, February 10, 1966.

our file / notre dossier.

your file / votre dossier

Mr. C. Bolger,
Assistant Director,
Northern Administration Branch

Following our conversation may I extend a formal written invitation to our Research Planning Conference (Monday February 28, and Tuesday March 1).

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Yourself or, hopefully, some other representative from the directorate if you are unable to attend.

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You will be receiving further information and pre-conference study materials in the near future.

A. J. Kerr,
for Chief,
Northern Co-ordination and
Research Centre

Kerr/ml

Discussed with Mr Kerr.
He would welcome representation
from the Engineering Division also.

15.2.

Write Division
phone
appt.

PA/77
17-2-66
MB
1009-3-16

ADMINISTRATOR OF THE MACKENZIE

Ottawa 4, February 17, 1966.

Planning Conference for Mackenzie
Delta Research Project

The attached copy of a memorandum dated February 10 from Mr. A.J. Kerr of the Northern Co-ordination and Research Centre will be self-explanatory. When you were here during the Northwest Territories Council Session, we spoke of the desirability of having the Inuvik Regional Office represented at this planning conference and you promised to look into this matter to see if arrangements could be made for Mr. Bock or another Inuvik delegate to attend.

Please let me know what arrangements are being made.

G.W. Lyslo

Director

C.M. Bolger/lj

PA/6/2 -66
1-2 113

MR. EVANS
MR. YATES
MR. NEVILLE
MR. THORSTEINSSON

Ottawa 4, February 17, 1966.

1009-3-16

Planning Conference for Mackenzie
Delta Research Project

The attached copy of a memorandum from Mr. A.J. Kerr of the Northern Co-ordination and Research Centre will be self-explanatory. A representative of the Engineering Division would be welcome along with the Chiefs or representatives of the other Divisions mentioned. It would be appreciated if Mr. Evans could arrange to have Mr. Bissett attend, as requested.

Would you please let me know the name of your proposed representative for this Conference.

C.W. Lyslop

Director

C.M. Bolger/lj

PA/99
17-2-66
MB

CHIEF, NORTHERN CO-ORDINATION
AND RESEARCH CENTRE

Ottawa 4, ~~February 16, 1966.~~
1009-3-16

Attention: Mr. A.J. Kerr

Planning Conference for Mackenzie
Delta Research Project

Thank you for your memorandum of February 10 on this subject. We discussed the Conference by telephone and you agreed that a representative of our Engineering Division would also be welcome. I am asking those Division Chiefs concerned to arrange to be present or to be represented and I am asking Mr. Evans to arrange for the attendance of Mr. Bissett. A memorandum is going today to the Administrator of the Mackenzie to confirm that Mr. Bock or another Inuvik representative will be here.

We will try to arrange for a representative from the Directorate to attend at least part of the time but this may be difficult because Commissioner Cameron and the Financial Advisory Committee and the Yukon Council will be in Ottawa for sessions throughout the week of February 28 to March 4.

We will look forward to receiving additional information about the conference as well as the study materials you mentioned.

G.W. Lyslo

Director

C.M. Bolger/lj

CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

Ottawa 4, February 10, 1966.

our file / notre dossier 1008-3-16.

your file / votre dossier Feb 10/66

Mr. C. Bolger,
Assistant Director,
Northern Administration Branch

Following our conversation may I extend a formal written invitation to our Research Planning Conference (Monday February 28, and Tuesday March 1).

We will expect from the branch:

Yourself or, hopefully, some other representative from the directorate if you are unable to attend.

Chief of the Industrial Division or a representative

Chief of the Education Division or a representative

Chief of the Welfare Division or a representative

A field officer from the Inuvik region (Mr. Bill Bock).

I believe it would be very helpful if we could also include Mr. Don Bissett, the area survey officer, who is studying the delta region.

You will be receiving further information and pre-conference study materials in the near future.

A. J. Kerr,
for Chief,
Northern Co-ordination and
Research Centre

Kerr/ml

Discussed with Mr Kerr.
He would welcome representation from the Engineering Division also.

15.2.

write Division please

A.J. KERR
N.C.R.C.

Ottawa 4, October 8, 1965.

1009-3-16

Mackenzie Delta Research Project - Research Suggestions

In my memorandum of September 21, I told you that I expected to be able to provide shortly some additional suggestions from our Education Division for research to be undertaken as part of the Mackenzie Delta Research Project.

I now attach a copy of a list of items just received from the Chief of the Education Division. You will see that some of these items duplicate those in the statement attached to your memorandum of June 17, and there is at least one duplication with the items I sent you on September 21. Nevertheless, I am sending you the complete list so that you may study it in conjunction with the suggestions you will have received from all sources.

Mr. Thorsteinsson observes that a number of problems in this list would, in his opinion, constitute valid subjects for theses in the field of northern education for masters and doctoral candidates. In respect of other items with a relatively large educational significance, we would expect that only competent educationists would be invited to undertake the work.

Director

C.M. Bolger/lj

Pt 1-19 7a 61

CANADA

Department of Northern Affairs and National Resources Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales Direction des régions septentrionales

1009-3-16

DIRECTOR

Ottawa 4, September 21, 1965.

our file / notre dossier

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Mackenzie Delta Research Project
Suggested Research Problems
ACTION 2

In annex to this memorandum is a list of 19 research problems having a bearing on education in the Mackenzie Delta. We judge these research problems would merit investigation and would yield results which would have a practical import. For this reason, we suggest that they be incorporated in the Mackenzie Delta Research Project.

A number of these problems would constitute valid theses subjects in the field of northern education for masters and doctoral candidates at the universities. A proviso of certain others which have a relatively greater educational significance would be that only highly competent educationists would be invited to conduct such studies.

B. Thorsteinsson,
Chief

mémo à suivre

SUGGESTED RESEARCH PROBLEMS

1. To examine how appropriate are existing school programs in the following detail:

   (a) The consistency of the programs, aims and objectives with socio-economic needs and aspirations.

   (b) The validity of the program content in relation to its aims and objectives.

   (c) The effectiveness of methods and instructional materials.

   (d) The capacity for program expansion and reform.

2. To investigate how much the Delta people value education and what kind of attitudes they have towards schools. Further to determine how parental attitudes and values affect school performance.

3. To investigate how far present programs meet the educational and vocational needs of girls and young women in the Delta.

4. To investigate how southern Canadians adapt themselves to northern living.

5. To study the characteristics of teachers who succeed best in the northern setting and to establish criteria for improved selection of teachers.

6. To inquire into the value of the community school concept as applied in a Delta setting.

6. (a) To conduct a survey to ascertain the specially talented in music, drama and the fine arts among the Delta people.

7. To investigate how pupil residence programs can be improved so that

   (a) optimum educational gains can be derived from a pupil's stay-in-residence.

   (b) adequate provision can be made for age and sex differences.

8. To conduct operational surveys to obtain factual information on such topic areas as

   (a) the educational background of adults 16 years of age and over,

   (b) home and family life - conditions of living, privacy, patterns of spending, - including credit buying, leisure time activities,

   (c) community services for leisure time activities,

...2

(d) incidence of alcholism,

(e) problems of delinquency and crime prevention.

9. To study the role of the community teacher in northern settlements and to determine the kind of professional training which will best prepare teachers for northern service.

10. To conduct a census of exceptional children and young adults including the gifted, the handicapped, and the deliquent, and to recommend appropriate educational programs designed especially to serve their needs.

11. To inquire into patterns of success or failure of individuals of different racial origins in the various school and vocational education programs.

12. To investigate the employment history of school and vocational education graduates and drop-outs.

13. To conduct a survey with the object of relating employment prospects of the area to the educational and training needs of the population.

14. To investigate the impact of education on the population mobility of the Delta area.

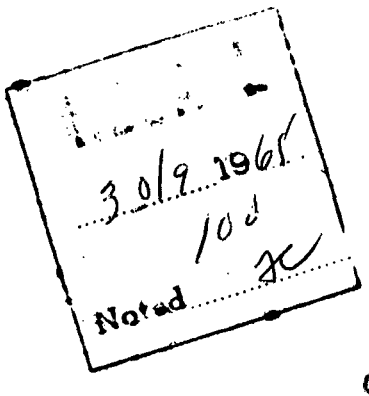
15. To isolate and study factors which tend to promote adjustment of Delta native peoples to a wage economy.

16. To develop tests to assist in evaluating the effectiveness of the curricula in the Delta area.

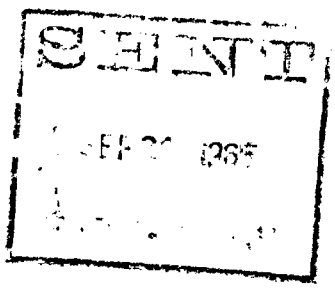
17. To explore the need for a school calendar based on the seasonal nature of northern activities.

18. To make a comparative study of educational programs for northern native peoples in Canada, U.S.S.R., U.S.A., and Greenland.

19. To investigate a rationale of transportation systems in the Delta having regard to the economy, maximum service from outside agencies, development of special areas of industry, and problems of community resettlement.



B.F. 8-10
C.M.B.



A.J. KERR
N.C.R.C.

Ottawa 4, September 21, 1965.

1009-3-16

Mackenzie Delta Research Project - Research Suggestions

This will refer to your memorandum of June 17, 1965, with which you sent us an outline of the proposed Mackenzie Delta Research Project and asked for suggestions from us for research which could be usefully undertaken as part of the project. We have been discussing this matter with officers of several Divisions of the Branch and because we are keenly interested in the research project as you outlined it and while we have not yet had suggestions from all the disciplines concerned, I thought I would give you an interim reply.

I understand from the Chief of the Industrial Division that his Division has been working in close co-operation with the N.C.R.C. in devising the project and he has, therefore, no further suggestions to make at this time. I expect that the Education Division will have some suggestions and I will hope to be able to send you these shortly.

In so far as the Welfare Division is concerned, the following items are suggested as possible features of the research project:

1. A study of attitudes of Indians, Eskimos and others towards the various income maintenance programs with particular reference to the differences in attitudes towards social assistance and other programs.

2. A study of the aspirations and economic prospects of school children in the Delta from Grade 7 upward. How do they see themselves fitting into the economic life of northern Canada? Do they anticipate moving south to larger centres of population and do they feel they can cope with such a move?

3. Basic research to reveal essential characteristics of delinquency and crime in the Delta. Characteristics should have reference to the incidence of delinquency and crime over a two-year period by:

   (a) age group;

   (b) level of academic achievement;

C.M. Bolger/lj

... 2

(c) employment or occupation;

(d) ethnic status;

(e) type of offence;

(f) previous convictions;

(g) community of residence; and

(h) previous imprisonment.

Because of the action proposed in 1(d) of the paper, which accompanied your memorandum of June 17, our Engineering Division is concerned with the proposed Delta Research Project and is keenly interested in the matter of practical research into such matters as low-cost utilidor systems for water and sewer, low-cost shelter, etc. Before commenting, however, on this aspect in detail, we would like to have available the results of the survey you are having carried out under Item 1(d).

Finally, we want to express our interest in sharing in the advisory panel to be organized under your proposed Action 3. We trust that the Northern Administration Branch will have ample opportunity to provide representatives to take part in the work of this panel. The disciplines immediately concerned are Welfare, Education, Industrial and Engineering, but the project is of the greatest importance to the whole Branch and we would like to work closely with N.C.R.C. in pursuing it.

Director

c.c. Mr. G.W. Rowley

NORTHERN ADMINISTRATION BRANCH

TEMPORARY FILE

FILE NO. 1009-3-16

TEMP. FILE NO. 7538

SUBJECT Mackenzie Delta Research Project

MAIN FILE IS CHARGED TO Do 14/9/65

REFERENCE				DISPOSAL			
REFERRED TO	REMARKS	DATE	INITIALS	DATE OF P.A. OR T.	DATE OF B.F.	INITIALS	REGISTRY INSPECTION
(Lm&B) Do	15/9/65 264 BF	22/9/65	JC.	22-5			SEP 22 1965

23/9/65 JC.

C.M. Bolger.

NA -CR-10

1009-3-16

BF 22/9

Mr Badger

SENT SEP 15 1965

RECALL 22/9/65 264 Noted

NORTHAD FTSM

NANR OTT

SEPTEMBER 15/65

ACTING ADMINISTRATOR OF THE MACKENZIE

FORT SMITH NWT

D 39 REFERENCE MY MEMORANDUM JUNE 28TH REGARDING MACKENZIE DELTA RESEARCH PROJECT AND YOUR INTERIM REPLY OF JULY 29TH HAVE YOU ANY SUGGESTIONS TO OFFER REGARDING RESEARCH TO BE UNDERTAKEN IF NOT WE WILL GO AHEAD WITH DISCUSSIONS WITH THE NORTHERN COORDINATION AND RESEARCH CENTRE STAFF

DIRECTOR

NORTHERN ADMINISTRATION BRANCH

Memo sent NCRC 21-9

NANR OTT

CANADA

Department of Northern Affairs and National Resources Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales Direction des régions septentrionales

DIRECTOR

Ottawa 4, September 7, 1965

our file / notre dossier 1009-3

your file / votre dossier

Mackenzie Delta Research Project

In your memorandum of June 28, which I, unfortunately, seem to have mislaid, you asked for my suggestions for items of research that might be undertaken as part of the Mackenzie Delta Research Project.

On re-reading Mr. Kerr's memorandum of June 17, I do not think there is too much that I can offer at this stage in the project. Presumably, out of Action 1 (d) will come some ideas as to where research is most needed. It is probable that many of these ideas will coincide with those for which we have frequently mentioned the need for practical research. Examples might be

(a) the development of low-cost utilidor systems for water supply and sewage disposal,

(b) individual low-cost sewage disposal systems suitable for use in permafrost areas,

(c) low-cost shelter,

(d) means of reducing the cost of generating electricity and heating.

Unfortunately, in my experience to date, research organizations have a tendency only to consider what might be called pure or basic research as opposed to practical research. It is because of this that organizations such as the N.R.C. have done little to develop actual working prototypes of individual sewage disposal systems, low-cost utilidors, prototype experimental housing, etc. They have tended instead to concentrate on more abstract matters.

I do not intend to imply that the research carried out by these organizations is valueless, since it is in fact essential to any later development, but I do believe we lack greatly an intermediate stage between what might be considered basic research and full production. In other words, the prototype or experimental stage.

....2

We attempt, in a small way, to carry out such practical research but we would be able to pursue these efforts much more strongly and with more success, were we to have the support of a basic research organization such as the N.C.R.C. This particular project in the Mackenzie Delta might serve as a foothold in which to get this kind of support.

Although I have mentioned above a number of the things on which some practical research is needed, I think that we should possibly wait until the completion of Action 1 of the research project before putting forward specific projects that might be considered under the heading of Action 2. I would like to see, for example, what comes out of Action 1 before trying to decide what should go into Action 2. It might be appropriate, however, to suggest that the field of practical research and experimentation not be neglected in the second phase of this project.

A.B. Yates,
Chief,
Engineering Division

CANADA

Department of Northern Affairs and National Resources Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales Direction des régions septentrionales

DIRECTOR

Ottawa 4, September 2, 1965.

our file / notre dossier

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Mackenzie Delta Research Project

By memorandum dated June 28, you asked for a list of research suggestions to be submitted to the Northern Co-ordination and Research Centre for inclusion in their research program in the Mackenzie Delta. The Welfare Division submitted a number of suggestions for research projects in the past two years and I understand some work on Eskimo adoption customs was done in 1964.

-- I attach a list of research suggestions in the field of social welfare.

F. J. Neville,
Chief,
Welfare Division

Nothing from
K-1 - spoke to B.J - 7-9.
E-1 (but see McKay memo) - asked BJ + follow up on 7-9-65
answers -
from N-1 - with ; to support
AOM - complaints only
W-1 - useful suggestions

SUGGESTED RESEARCH PROJECTS TO BE UNDERTAKEN BY N.C.R.C.

1. A study of child raising customs and practices of Indians, Eskimos and Metis with particular reference to the rights and responsibilities of other family members with respect to children and the rights and responsibilities of other community members toward children.

2. A study of adoption practices among Indians and Metis.

3. A study of attitudes of Indians, Eskimos and others toward the various income maintenance programs, with particular reference to the differences in attitudes toward social assistance and other programs.

4. A follow-up study of all northern patients admitted to hospitals for treatment of disabling conditions (polio, paraplegia, amputations, muscular dystrophy, etc.) from 1960 to 1965.

5. A study of the aspirations and economic prospects of Eskimo school children from Grade seven upward. Having completed part or all of elementary and secondary education how do they see themselves fitting in to the economic life of northern Canada? Do they anticipate moving south to larger centres of population and do they feel they can cope with such a move?

6. Basic research to reveal essential characteristics of delinquency and crime in the north. Characteristics to have reference to:

   a) incidence of delinquency and crime in the Northwest Territories and Yukon over past two-year period by:

      i) age groups
      ii) level of academic achievement
      iii) employment or occupation
      iv) ethnic status
      v) type of offense
      vi) previous convictions
      vii) community
      viii) previous incarceration

7. Basic research should reveal attitudes about and understanding of local offenders to probation, confinement in a prison or correctional institution, responsibility for maintenance and well-being of dependents of imprisoned offenders, and type of program required in correctional institutions.

Document not relevant to immediate application to the Mackenzie Delta.

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

RECALL
30-8-1965
142
Noted

DIRECTOR

Ottawa 4, August 9, 1965.

our file / notre dossier 1009-3-16
your file / votre dossier

Mackenzie Delta Research Projects

This refers to your memorandum of June 28 concerning the research project being carried out by Northern Co-ordination and Research Centre in the Mackenzie Delta.

We have been in touch with Northern Co-ordination and Research Centre on this matter and they are aware that the Industrial Division will begin an economic survey in the Delta this summer. Mr. Don Bissett, one of our regular survey officers, will begin a reconnaissance survey about the middle of August and will carry this through to a full-scale survey in 1966.

Mr. Bissett and Mr. John Woolforth, a member of the Northern Co-ordination and Research Centre team, have thoroughly discussed their respective programs and have exchanged terms of reference. This close co-operation should result in some very worthwhile work being done in the Delta over the next two years.

J. W. Evans,
Chief,
Industrial Division

CHIEF, EDUCATION DIVISION

Ottawa 4, July 29, 1965.

630-1
1009-3-16

N.C.R.C. - Mackenzie Delta Research Project
as Related to Adult Education

I am very much interested in the N.C.R.C. Mackenzie Delta Research Project and feel the Education Division should make a definite submission to the N.C.R.C.

The outline for Action 1 (see memoranda June 28 and June 17 and Kerr to Mr. Gordon, May 19) planned for this summer will cover many aspects of the information needed for adult education programming. Could we obtain copies of the questionnaires being used this summer or more details of the plan for Action 1? We would be in a better position to relate it to our specific needs and suggest the gaps for inclusion in Actions 4 and 5, which serve to develop the detailed plan for the collection of overall data under Action 6.

Because of the importance of education and schooling, I feel that we should ask for sessions with the researchers during Actions 4, 5, and 6, at which the Chiefs of Sections, and others on staff involved in developing programs, would discuss the overall research program.

If we do succeed in making arrangement for the Chiefsof Sections and others to meet with the researchers, I feel we should be willing to spend some time preparing for the meeting. We should have consolidated our ideas, developed them on research principles and know why we are requesting the data. This would involve the Chief meeting as a committee in advance.

There is frequently considerable delay between the collection of data and the publishing of the report - a gap of years may occur. Because of the importance of data pertaining to Education and the time lag that, by necessity, exists in obtaining staff and finances for programs, I feel the Education Division should make an arrangement with N.C.R.C. to have access to the research data before the report is published. There may be considerable argument against this but likewise there can be a good case put up for it.

I am concerned about the information the data team in the Delta this summer may gather on the program being conducted under the name of Adult Education. We could get just as unfavourable comments and conclusions as in the Glassco Commission report. We do not have an adult educator on the staff of the Mackenzie

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P.I. McKay/nt/H

District. The program is merely a stop gap. Those who participate in Inuvik are mainly the "whites" who feel the need of something and miss the opportunity that was available to them in southern Canada before going north. I would like to make a strong plea for inclusion of a statement regarding the difficulties encountered year after year in our attempts to obtain approval of staff to conduct and supervise adult education programs. This should also contain a brief outline of some of the plans which have been proposed such as; leadership training, group studies of problems and problem solving, special consideration and analysis of the needs of young adults, an educational program related to housing, and the many facets of home and family living, literacy as it pertains to work and daily living and the many others.

Data on the following may be forthcoming in the preliminary studies, if not it should be considered for the final stage, Action 6. I have not had sufficient time to develop each under objectives and justification but this could be done, if you agree it is pertinent to adult education. The following is only a partial list:

Educational Background of Adults i.e. 16 years and over

Year Commencing school
Grade commencing school
Grade reached on school leaving
Number of years since leaving school
Schools attended
Special training since leaving school - (further developed)

Literacy

Ability to read and write in vernacular
Vernacular language and dialect
Use of English as a second language - spoken, reading and/or writing
Books in the home - used by whom, adults - children
Magazines purchased - or otherwise received
Newspapers read

Home and Family Life

House - ownership, renting, buying, social assistance
No. of rooms - bathroom facilities
No. living in house
Sexes and ages
Family group
Additional persons and kinship, if any
Family earners
Earnings
Household furnishings
No. sleeping in each bed
Heating
Lighting - type, adequacy for reading and study
Leisure time activities conducted in home
Privacy

. . . 3

Occupation and Related Information

Occupation of Head of Family
Occupations of members of family
Earnings
No. using bank
Any other form of saving
Relation of educational background to job opportunities,
seasonal, permanent, promotion, etc.
Interest in specialized adult classes for up-grading
Reasons for leaving jobs

Community Services for Leisure Time Activities

Type of Services - cost of participating
Use of library, etc.
Participation in voluntary organization
Voluntary organizations and analysis of membership, etc.
Participation in leisure time activities

Adults Attitude towards School and Schooling

Education of children, achievements
Attitude towards teachers -
how often meet teacher or talk with teacher
how often adults go to talk to teachers about children
attitude of adults towards discipline in school
Membership in Home and School
The School as an adult centre, participation in any planned activities

Cultural

Cultural aspects - those valued
- those willing to discard
- those in conflict

Crafts
Native dances
Art
Clothing
Feast days and ceremonies
Traditional - tools
- boats
- hunting techniques
Use of library
Films

Miscellaneous

Use of alcohol - attitude towards
Adults appreciation of children's health - breakfast
- regular meals
- common drinking utensil
- oven and use

Large purchases made during year
Use of mail orders

. . . 4

Musical instruments in home -
ability to play a musical instrument - type -
record player in home and records prefered
Radios in homes and program preference
Buying habits - selection based on price, quantity or appearance
Credit buying - ability to meet payments
Eye sight and hearing defects if any
Handicapped persons - type of
Status symbols

Young Adults

Special consideration should be given to this group, i.e. 16 yrs. to 25 yrs. of age; while many of the headings listed above would provide information relating to them, the research team may not get a true picture of the young adult and his problems. Many of them leave home in the summer and may just "float" or may secure seasonal employment. They may return home in the winter and live "off" the family.

There has been an increase in the number of young adults who have "brushes with the law". This might be reviewed as to frequency of offenders, patterns or trends and attitude of young adults to the law and jail terms.

I would like to have this question of young adults considered by a committee from Curriculum, Vocational Education, and Adult Education.

I would appreciate your comments on my above suggestions and direction as to any further development you require.

Frances I. McKay.
Frances I. McKay,
Chief, Adult Education Section

NORTHERN ADMINISTRATION BRANCH

TEMPORARY FILE

FILE NO. ~~1009-30~~ TEMP. FILE NO. 1009-3 S-210

SUBJECT

Commission of Enquiry Re Form of Govt. for the N.W.T.

MAIN FILE IS CHARGED TO Hodgkinson 4-8-65

REFERENCE				DISPOSAL			
REFERRED TO	REMARKS	DATE	INITIALS	DATE OF P.A. OR T.	DATE OF B.F.	INITIALS	REGISTRY INSPECTION
Do	29-2-65 7989	9-3-65	DHA.	Transcribed & Filed			AUG 10 1965
		10, 8					

R. J. Orange.

NA -CR-10

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

DIRECTOR

Fort Smith, July 29, 1965

our file / notre dossier 1009-30

your file / votre dossier

Mackenzie Delta Research Project

Attached is a copy of a letter from T.H. Butters, Regional Administrator, Inuvik which is in reply to your memorandum of June 28, 1965.

R.J. Orange,
Administrator of the Mackenzie.

CANADA

Department of Northern Affairs and National Resources Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales Direction des régions septentrionales

DIRECTOR

Fort Smith, July 29, 1965

our file / notre dossier 1009-30
your file / votre dossier

Mackenzie Delta Research Project

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R.J. Orange,
Administrator of the Mackenzie.

CANADA

partment of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

Inuvik, N.W.T., July 17, 1965.

ADMINISTRATOR OF THE MACKENZIE

1009-3

our file / notre dossier

your file / votre dossier

Mackenzie Delta Research Project

I acknowledge with thanks your memorandum of July 5 to which was attached the Director's memorandum of June 28 and a copy of Mr. A.J. Kerr's memorandum of May 19 to Mr. J.H. Gordon, Assistant Deputy Minister of our Department.

I will attempt to provide you with the comments you require pertinent to the program outlined under the heading "Action to".

As an interim comment on the research projects generally, may I draw to your attention the very, very inadequate communications between the practising administrator and the field researcher. I believe there is much to be gained by the representatives of both disciplines if complete and unimpeded communication is actively sought after and encouraged. My comment, while a generalization, stems from a specific situation. The two members of Mr. Kerr's party were on the scene before we received any indication that such a program was to be carried out. I believe the success of such studies and surveys depends a great deal on the co-operation and assistance that can be and always has been provided by departmental personnel in the north. I suggest it is a matter of little effort to make the information available to field staff in good time. Your memorandum was received on July 7, about three weeks after the first members of the research team appeared in the settlement. I suggest too that these people should come equipped with identification, terms of reference although they may be very vague and nebulous, and letters from the Director advising that we may open our files and confidential material to assist them in their studies. Surely this is not asking too much.

During Mr. A.J. Kerr's recent visit to the delta, I discussed this matter with him and pointed out that such preliminary action is not only expected as a courtesy but is also part of the cultural mores of our rather strange social organization.

I regret if the foregoing has taken on the colour of a complaint, but I strongly believe in the importance of the type of study that has been suggested and is being carried out by Mr. Kerr and his researchers and so feeling deplore omissions in preliminary work which although small could render the final report something less than complete.

T.H. Butters,
Regional Administrator.

A-13
July 22/65

1003-20-1
B3

1008-30

Hodgkinson 4-8

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

DIRECTOR

RECALL
15/6 1965
218.
Noted

Ottawa 4, July 6, 1965.

our file / notre dossier 1009-3-1/6

your file / votre dossier

Mackenzie Delta Research Project -
Research Suggestions

I have read your memorandum of June 28 on this subject. I will be sending you our suggestions for research in the Mackenzie in the near future. The Welfare Division submitted a list of research requirements to NCRC almost two years ago. We will review these, revise and add to them as required.

I thought you would be interested in knowing that I visited the Inuvik Research Laboratory during my visit to the Mackenzie. I had seen the building before from the outside but had not been through it. I was very impressed by the program of the centre. Mr. Hill, the Manager, seems very competent. He knows what he is doing, is able to explain it lucidly and has accomplished a tremendous amount in the 18 months he has been there.

On the way into the Mackenzie I met Dr. D. Russell, the new palaeontologist, and Mr. H. Scherman, his technical adviser, from the National Museum. Both of the men were on their way to investigate the fossil remains of several early marine animals found about 35 miles from the mouth of the Anderson River. Dr. Russell appeared to no little about the Research Laboratory at Inuvik. Since he was chartering from Yellowknife, he did not get to the centre, although a week or so later while on site he had to look to the Laboratory for logistic support. I got the impression that scientists at the Museum are not familiar with the valuable service the Inuvik Laboratory can and does offer. I will mention this to Mr. Kerr for what it is worth.

At the Laboratory I met the two young social anthropologists who are conducting the initial study referred to in Mr. Kerr's memorandum of May 19th under Action 1. One is an M.A. graduate, the other a student of the University of Montreal. The senior of the two, Miss Mailhot, expressed concern over the study and the short time allowed for its completion, i.e. four months. Miss Mailhot felt it should have been undertaken by a team of

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sociologists (4-6) over a period of six months or more. After listening to her description of what has to be studied, I am inclined to agree. However, Mr. Kerr was slated to visit the Laboratory a week or so later and I believe she was going to take the matter up with him.

F.J. Neville,
Chief,
Welfare Division

Samuelsen - copies 7.
6/7/65

CANADA

Department of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

MR. EVANS
MR. NEVILLE
MR. THORSTEINSSON
MR. YATES

Ottawa 4, June 28, 1965.

our file / notre dossier 1009-3-16
your file / votre dossier

Mackenzie Delta Research Project -
Research Suggestions

May I draw your attention to Mr. A.J. Kerr's memorandum of June 17 to Mr. Bolger and to his memorandum of May 19 to Mr. Gordon outlining this project. The purpose of the project, which is of considerable interest to everyone in the Northern Administration Branch, is outlined in the first paragraph of the memorandum of May 19. I expect that the Branch will become thoroughly involved in the future phases of this project, starting with the heading called "ACTION 2" on page four of Mr. Kerr's memorandum.

With the findings from the preliminary research to be carried out this summer, together with suggestions from agencies having an interest in the welfare of the people in the Mackenzie Delta, a program of intensive investigation and analysis of key problems is to be planned. Would you please, therefore, give this matter some thought and let me have your suggestions for items of research that should be undertaken as part of this project. I would like to have your suggestions in this regard by July 31.

Director

CANADA

Department
of Northern Affairs
and National Resources Deputy Minister

Ministère
du Nord canadien et
des Ressources nationales Sous-ministre

Ottawa 4, June 17, 1965.

MR. C. BOLGER

MACKENZIE DELTA RESEARCH PROJECT -
RESEARCH SUGGESTIONS

Last year, it was decided that the Northern Co-ordination and Research Centre would develop a comprehensive research program in the Mackenzie Delta to assess the extent to which the people native to the area are effectively adjusting to changes in their environment, and to isolate and analyze the social and economic conditions which hamper them from fully participating in the development of the North.

The preliminary phase of this program has gotten under way this summer, and it is hoped that the results will provide a basis for a general understanding of the socio-economic functioning of the Delta region. Using the findings of this preliminary research, together with suggestions from agencies which have an interest in the welfare of the Delta people, a program of intensive investigation and analysis of key problems is to be planned.

It is in connection with this need for suggestions about research that I am writing to you. Whatever suggestions you can submit will be gratefully received.

A.J. Kerr:gc

A.J. Kerr,
Northern Co-ordination
and Research Centre.

COPY

Ottawa 4, May 19, 1965.

MR. J.H. GORDON
Assistant Deputy Minister

Mackenzie Delta Research Project - Preliminary Phase

A decision to develop a comprehensive and integrated research program in the Mackenzie Delta was made in September 1964. The purpose of the program was to isolate and analyze social and economic conditions which impede native peoples from participating in northern development and to assess the extent to which they are making effective adjustment to changes brought about by government and commercial expansion in the north. After discussion between yourself, Mr. Rowley and Mr. Valentine, this program was included in the N.C.R.C. estimates for 1965-66.

Before such a program can be carefully formulated, some preliminary field work must be done in order to provide the general background data necessary to establish the location of key areas for detailed investigation during the next phase of the program. Plans for the preliminary phase of the project to be undertaken this year, leading up to a detailed and comprehensive research plan for the 1966-67 year are listed below:

ACTION 1 - A preliminary field research program will be organized and will include the projects following:

(a) A socio-economic study of the basic structure of the community of Inuvik. Analysis would include consideration of elements such as:

- leaders and patterns of leadership (i.e., who the leaders are and how they lead)

- decision-making (i.e., where decisions are made, factors inhibiting or promoting decision-making by local people)

- fragmentation in the community (i.e., sub-groups, their origins and their organizations, their relations with each other)

- ethnicity and its meaning in Inuvik (i.e., what advantages and disadvantages does "Eskimoness" pose to an Eskimo in Inuvik).

Basic information about the structure of the other communities in the Delta is available, since they are former fur-trade settlements, not essentially different from other such settlements in the Mackenzie, whose patterns of organization have been described. Inuvik, however, represents a different ecological orientation with a good many elements whose interrelationships have not been analyzed.

...2

(b) A socio-economic study of subsistence patterns in the Delta, to outline and analyze the problems related to the time-lag between the acquisition of new needs and the means to fulfil them. Social scientists who have worked in the Delta recently (Clairmont and Hobart) imply that this is the key to understanding most of the social problems in the area today. These scientists suggest that for native people of the area, a noticeable gap between the "level of economic expectation" and "the level of economic realization" is closely connected with increased delinquency, illegitimacy, problem drinking, etc. Analysis will include consideration of:

- origins of new "needs" (Where do they come from, and How are they fostered?)
- How wide is this "gap" between levels of expectation and realization? (By how much are people missing "the good life" as they understand it?)
- What are the group and sub-group differences with reference to the width of this "gap"?
- Are there predictable trends in this problem area?

(c) A study of the Delta by an economic geographer to produce an "outline map" of the economy of the area. This would include basic information about:

- historical background with reference to socio-economic change
- statistics of settlement populations, past and present
- resources and economic activities
- present source of income in the Delta
- differences in levels of income in various sectors of the population.

Such an "outline map" or compilation and elementary analysis of the economic and geographic facts of life in the Delta will provide essential information for <u>any</u> planning there, for research or other purposes. This study will be undertaken in close co-operation with the Industrial Division of the Northern Administration Branch.

...3

(d) A study by a physical scientist to survey the technological possibilities of reducing the cost of living in the Delta. This initial study will be undertaken by a non-specialist physical scientist who can consider all possibilities without predisposition towards any one. His report will provide a basis for determining where later specialized research is likely to be most useful, and would include consideration of:

- the basic needs of the area from a technological viewpoint
- past and present techniques of coping with these needs
- present and future developments in technology which are relevant to Delta problems
- the most promising possibilities for specialized research.

ACTION 2 - Agencies within the Department and within the Northern Administration Branch itself, together with other appropriate federal agencies working in the north (i.e., R.C.M.P., Department of National Health and Welfare) will be invited to submit opinions about research needed and which we should incorporate into our integrated program to get underway a year from now. When feasible, given our research objectives and conceptual framework, such suggestions will be incorporated.

ACTION 3 - An advisory panel in this research program will be organized. The membership of the panel will be determined in consultation with Mr. Rowley and yourself. I suggest that it could be a group consisting of some social scientists with special northern experience (i.e., Dr. Vallee, Dr. Honigmann), and some Departmental officials.

ACTION 4 - A provisional research plan for the following year will be prepared in detail. Prior knowledge and experience of research staff in the Centre, suggestions obtained in response to ACTION 2, and experience and information gained from the studies done in ACTION 1, will all be drawn upon. On completion, it will be duplicated and copies mailed to members of the research panel for study.

...4

May 19, 1965.

ACTION 5 - A conference of the research panel will be organized for the purpose of modifying and adjusting this provisional research plan. From the comments and analyses of panel members, a final plan for research will be constructed. I suggest that a tentative date for this conference might be the end of January 1966.

ACTION 6 - Researchers to do the work outlined in the plan forthcoming from ACTION 5 will be engaged.

A. J. Kerr,
for Chief,
Northern Co-ordination
and Research Centre.

CANADA

[redacted]partment of Northern Affairs and National Resources — Northern Administration Branch

Ministère du Nord canadien et des Ressources nationales — Direction des régions septentrionales

MR. EVANS
MR. NEVILLE
MR. THORSTEINSSON
MR. YATES

Ottawa 4, June 28, 1965.

our file / notre dossier 1009-3
your file / votre dossier

Mackenzie Delta Research Project - Research Suggestions

May I draw your attention to Mr. A.J. Kerr's memorandum of June 17 to Mr. Bolger and to his memorandum of May 19 to Mr. Gordon outlining this project. The purpose of the project, which is of considerable interest to everyone in the Northern Administration Branch, is outlined in the first paragraph of the memorandum of May 19. I expect that the Branch will become thoroughly involved in the future phases of this project, starting with the heading called "ACTION 2" on page four of Mr. Kerr's memorandum.

With the findings from the preliminary research to be carried out this summer, together with suggestions from agencies having an interest in the welfare of the people in the Mackenzie Delta, a program of intensive investigation and analysis of key problems is to be planned. Would you please, therefore, give this matter some thought and let me have your suggestions for items of research that should be undertaken as part of this project. I would like to have your suggestions in this regard by July 31.

Director

Accusé réception 15
Réponse de J. Evans -
9-8-65. A.

[redacted]

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ADMINISTRATOR OF THE MACKENZIE

Ottawa 4, June 28, 1965

1009-3/1-16

31-7.

Mackenzie Delta Research Project

-- I am sending you herewith a copy of a memorandum dated May 19, 1965 from Mr. A.J. Kerr of the Northern Co-ordination and Research Centre to Mr. Gordon outlining plans for the preliminary phase of the Mackenzie Delta research project. The purpose of this project is set out in the first paragraph of Mr. Kerr's memorandum of May 19.

-- I am sending you also a copy of a memorandum from Mr. Kerr to Mr. Bolger, dated June 23, listing the persons selected to undertake the four projects listed in the memorandum of May 19. The people concerned with projects (a) and (b) have already gone to Inuvik, and you may expect that Mr. Woolforth and Dr. Cooper will go to Inuvik in early July.

I am sorry that we did not send you information about this project at an earlier date, but we have just now received the details ourselves. We are most interested in this project, and I expect that the Branch will be involved in the development of future phases such as those contemplated on page four of the memorandum of May 19. I would be particularly interested in the views you may have on the kind of research which should be undertaken as part of the integrated program mentioned under the heading "Action 2" on page four of that memorandum.

I will look forward to receiving your comments on this subject.

Director

C.M. Bolger:JL:D

CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

Ottawa 4, June 23, 1965.

MR. BOLGER

Mackenzie Delta Research Project - Preliminary Phase Researchers

Further to our telephone conversation and my memorandum of June 17 with preliminary phase plans appended, the persons selected to undertake the four projects listed in ACTION 1 are as follows:

Project (a) - Miss José Maillot, a graduate student in Anthropology at the University of Montreal. Accompanying her is Miss Constance Rous, a junior student from the University of Montreal, whose expenses are being met by the Committee on Arctic Studies of the University of Montreal.

Project (b) - Mr. Derek Smith, a graduate student in Anthropology at Harvard University.

Project (c) - Mr. John Woolforth, a graduate student of Geography at the University of British Columbia.

Project (d) - Contractual arrangements have not as yet been completed with Dr. P.F. Cooper, Jr., a physical scientist, but it is expected that he will be undertaking this study shortly.

A.J. Kerr:gc

A.J. Kerr,
Northern Co-ordination
and Research Centre.

401-9-1

NORTHERN ADMINISTRATION BRANCH

To: Mr Carter - Mr Bilger

Please:

- ☐ APPROVE
- ☐ SIGN
- ☐ NOTE AND FILE
- ☐ NOTE AND RETURN
- ☐ NOTE AND FORWARD TO: _____
- ☐ COMMENT
- ☐ SEE ME ahead
- ☐ PHONE ME
- ☐ REPLY DIRECT
- ☐ REPLY DIRECT, COPY TO ME

Rawlins - go ahead JKE 21/6

Please Prepare:

- ☐ FINAL REPLY
- ☐ DRAFT REPLY
- ☐ MEMO
- ☐ FOR SIG. OF _____
- ☐ DUE BY _____
- ☐ CONSULT WITH _____

Thank Maddeaux for Mr Carter

REMARKS:

you will probably want to read this. If you will then return to me, I propose to

① send a copy to Dr Smith with my about this summer's activities in the Delta

② circularize Ind. Welfare & Educ Progs for ideas re research —

FROM _____ DATE 21-

000290

3 copies attached

CANADA

Department of Northern Affairs and National Resources — Deputy Minister

Ministère du Nord canadien et des Ressources nationales — Sous-ministre

Ottawa 4, June 17, 1965.

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1009-3
M2

MR. C. BOLGER

MACKENZIE DELTA RESEARCH PROJECT -
RESEARCH SUGGESTIONS

Last year, it was decided that the Northern Co-ordination and Research Centre would develop a comprehensive research program in the Mackenzie Delta to assess the extent to which the people native to the area are effectively adjusting to changes in their environment, and to isolate and analyze the social and economic conditions which hamper them from fully participating in the development of the North.

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A.J. Kerr:gc

A.J. Kerr,
Northern Co-ordination
and Research Centre.

Encls.--2

Hold for memo from research & date to travel Mackenzie - requested of Mr Kerr by phone PM June 2 mod.

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COPY

Ottawa 4, May 19, 1965.

MR. J.H. GORDON
Assistant Deputy Minister

Mackenzie Delta Research Project - Preliminary Phase

A decision to develop a comprehensive and integrated research program in the Mackenzie Delta was made in September 1964. The purpose of the program was to isolate and analyze social and economic conditions which impede native peoples from participating in northern development and to assess the extent to which they are making effective adjustment to changes brought about by government and commercial expansion in the north. After discussion between yourself, Mr. Rowley and Mr. Valentine, this program was included in the N.C.R.C. estimates for 1965-66.

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...2

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- Are there predictable trends in this problem area?

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- statistics of settlement populations, past and present

- resources and economic activities

- present source of income in the Delta

- differences in levels of income in various sectors of the population.

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...3

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- past and present techniques of coping with these needs
- present and future developments in technology which are relevant to Delta problems
- the most promising possibilities for specialized research.

ACTION 2 - Agencies within the Department and within the Northern Administration Branch itself, together with other appropriate federal agencies working in the north (i.e., R.C.M.P., Department of National Health and Welfare) will be invited to submit opinions about research needed and which we should incorporate into our integrated program to get underway a year from now. When feasible, given our research objectives and conceptual framework, such suggestions will be incorporated.

ACTION 3 - An advisory panel in this research program will be organized. The membership of the panel will be determined in consultation with Mr. Rowley and yourself. I suggest that it could be a group consisting of some social scientists with special northern experience (i.e., Dr. Vallee, Dr. Honigmann), and some Departmental officials.

ACTION 4 - A provisional research plan for the following year will be prepared in detail. Prior knowledge and experience of research staff in the Centre, suggestions obtained in response to ACTION 2, and experience and information gained from the studies done in ACTION 1, will all be drawn upon. On completion, it will be duplicated and copies mailed to members of the research panel for study.

ACTION 5 - A conference of the research panel will be organized for the purpose of modifying and adjusting this provisional research plan. From the comments and analyses of panel members, a final plan for research will be constructed. I suggest that a tentative date for this conference might be the end of January 1966.

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May 19, 1965.

ACTION 6 - Researchers to do the work outlined in the plan forthcoming from ACTION 5 will be engaged.

A.J. Kerr,
for Chief,
Northern Co-ordination
and Research Centre.