

MATAMEK CONFERENCE ON BIOLOGICAL CYCLES

REPORT BY

ELLSWORTH HUNTINGTON

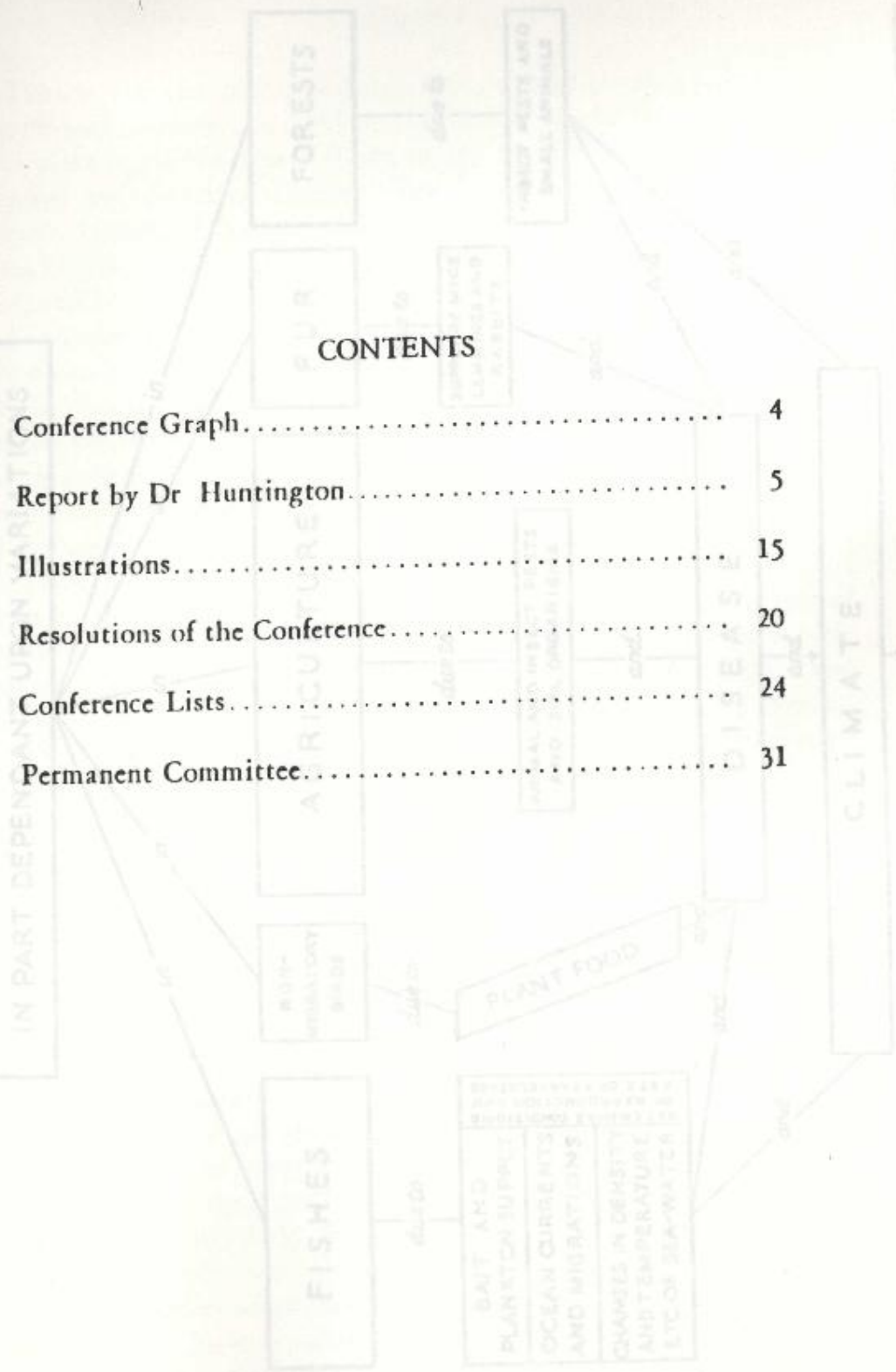
YALE UNIVERSITY

In collaboration with an
Editorial Committee, and
approved by the Conference

MATAMEK FACTORY
CANADIAN LABRADOR

1932

FLUCTUATIONS IN HUMAN PROSPERITY
IN PART DEPENDENT UPON VARIATIONS



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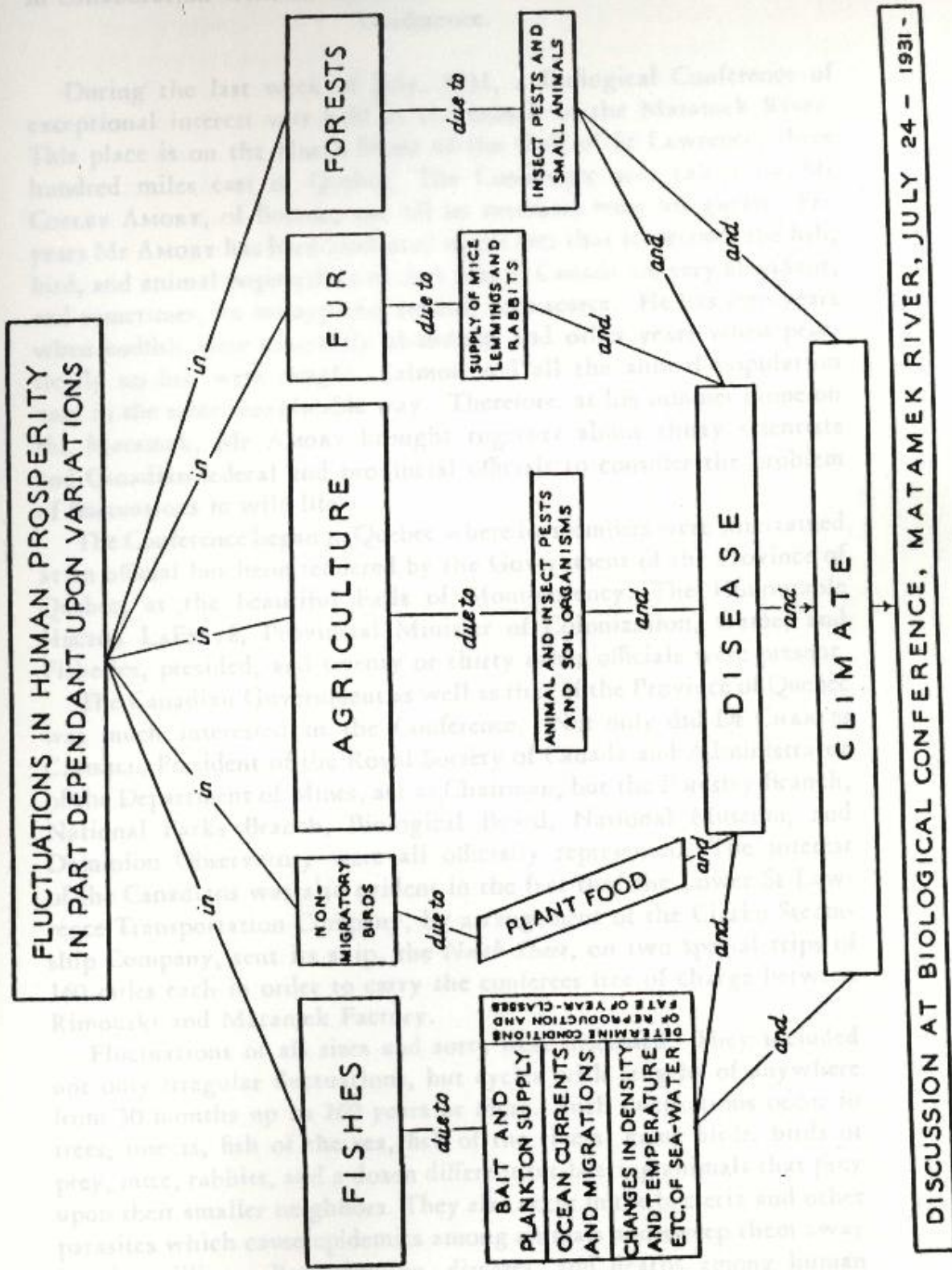
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DISCUSSION AT BIOLOGICAL CONFERENCE, MAYAMA RIVER, JULY 24, 1931



DISCUSSION AT BIOLOGICAL CONFERENCE, MATAMEK RIVER, JULY 24 - 1931 -

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During the last week of July, 1931, a Biological Conference of exceptional interest was held at the mouth of the Matamek River. This place is on the North Shore of the Gulf of St Lawrence, three hundred miles east of Quebec. The Conference was called by Mr COPLBY AMORY, of Boston, and all its members were his guests. For years Mr AMORY has been interested in the fact that sometimes the fish, bird, and animal populations of that part of Canada are very abundant, and sometimes, for no apparent reason, very scarce. He has seen years when codfish were extremely abundant, and other years when practically no fish were caught. Salmon and all the animal population vary in the same inexplicable way. Therefore, at his summer home on the Matamek, Mr AMORY brought together about thirty scientists and Canadian federal and provincial officials to consider the problem of fluctuations in wild life.

The Conference began in Quebec where its members were entertained at an official luncheon tendered by the Government of the Province of Quebec, at the beautiful Falls of Montmorency. The Honourable HECTOR LAFERTÉ, Provincial Minister of Colonization, Game, and Fisheries, presided, and twenty or thirty other officials were present.

The Canadian Government as well as that of the Province of Quebec was much interested in the Conference. Not only did Dr CHARLES CAMSBLI, President of the Royal Society of Canada and Administrator of the Department of Mines, act as Chairman, but the Forestry Branch, National Parks Branch, Biological Board, National Museum, and Dominion Observatory were all officially represented. The interest of the Canadians was also evident in the fact that the Lower St Lawrence Transportation Company, by arrangement of the Clarke Steamship Company, sent its ship, the *North Shore*, on two special trips of 160 miles each in order to carry the conferees free of charge between Rimouski and Matamek Factory.

Fluctuations of all sizes and sorts were discussed. They included not only irregular fluctuations, but cycles with lengths of anywhere from 30 months up to 260 years or more. Such fluctuations occur in trees, insects, fish of the sea, fish of the rivers, game birds, birds of prey, mice, rabbits, and a dozen different fur-bearing animals that prey upon their smaller neighbors. They also occur in the bacteria and other parasites which cause epidemics among animals and sweep them away by the millions. Reproduction, diseases, and deaths among human beings also came in for discussion. Agricultural fluctuations and even

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meteorological cycles were suggested as causes of the cycles in plants, animals, and man.

Somewhat to the surprise of the Conference the main discussion did not center around the well known sunspot cycle of eleven years, but around shorter cycles of four years and especially nine or ten. The four-year cycle was described by PROFESSOR ALFRED O. GROSS, of Bowdoin College, as being well shown by the migrations of the snowy owl into New England. Mr CHARLES ELTON, of Oxford, England, described the same cycle in far northern mice, lemmings, and Arctic ptarmigan, and also in the Arctic fox and snowy owl which feed upon these lesser types of animals. He states that similar cycles occur in Britain, and also in Norway where lemming migrations have been known for hundreds of years. In still another region, Alberta, Professor WILLIAM ROWAN, of the University of Alberta, has found a similar four-year cycle in mice and probably shrews.

The regular course of events seems to be that the mice, lemmings, and ptarmigan increase enormously in numbers for a season or two. Foxes, owls, and other creatures are thus provided with abundant food. They, too, increase so fast that the number of skins brought in to the Hudson's Bay Company may be many times as great at one phase of the cycle as at another. Then there comes a change so sudden that the members of the Conference call it the "crash". The rodents and game birds begin to die by the thousand or million. Some of them, such as the lemmings, also migrate long distances, only to meet death in some other region. The creatures that have been feeding on them soon become hungry. They, too, begin to die, or else migrate to even greater distances. Snowy owls, for example, are described by Dr W. REID BLAIR, of the New York Zoological Society, and by Professor GROSS as moving from Canada to southern New England and New York by the thousand. They generally perish, for they do not appear to return north, and they cannot breed so far south. A similar cycle of increase and sudden decrease was described by Mr ALDO LEOPOLD, of Wisconsin, as occurring among the red grouse of Scotland, but there the period is six years instead of four.

The most remarkable feature of the Biological Conference was the great amount of evidence as to a cycle of nine or ten years. Mr LEOPOLD described such a cycle among the grouse and rabbits of Wisconsin and neighboring Lake states. In the United States as a whole his figures seem to show that the increase and sudden decrease of these same animals takes more nearly ten years, but further work may show that the two periods are really the same. One most interesting feature of the grouse is that those which live in the central and most favorable habitats apparently do not suffer violent fluctuations in numbers. The sufferers are those on the edges, which happen also to be the parts less densely populated by man. The findings of Mr LEOPOLD are con-

firmed by those of Professor GROSS who has studied the grouse in its more eastern habitat. Among the rabbits of Canada, however, Mr ELTON finds no evidence that fluctuations are less marked in the central area than on the margins. In fact the opposite may be true, but all Canada is marginal in the sense that it is subject to great extremes of climate.

From the other side of the continent Professor ROWAN, of the University of Alberta, presented evidence that in the plains around Edmonton a cycle of almost ten years is evident in grouse, some other non-migratory birds, and rabbits, and also in their enemies such as the coyote and other fur bearers. Farther north in Canada the voluminous records of the Hudson's Bay Company have given Mr ELTON abundant data which show a cycle of about ten years, or more exactly 9.7, in hares, muskrats, grouse, lynx, red fox, marten, wolf, mink, and goshawks. The extraordinary thing about all this is not merely that many different animals show the same periodicity, but that the same period occurs in the far northwest of Canada, and all the way south into the United States. The increase or decrease in the animal population appears to begin in the far north and to work its way southward and eastward, reaching southern Canada after about three years. In spite of this the period of ten years or a little less is constant in each region.

Still more astonishing are the results of Professor A. G. HUNTSMAN, of the University of Toronto, and of Professor E. B. PHELPS, of Columbia University, and Professor D. L. BELDING, of Boston University Medical School. Using the records of the commercial catch of salmon in the bays along the coast of New Brunswick, Professor HUNTSMAN found indications that the salmon come and go in periods of 9.6 years. Professors PHELPS and BELDING used the very careful records of the salmon caught by the members of the exclusive Ristigouche Club in the Restigouche River in Quebec and New Brunswick. Each angler there religiously records the weight and size of his fish and the number of days spent in fishing. Thus it is easy to calculate the daily number of fish per rod or angler for each of the last fifty years. There, too, the fish appear in great abundance every ten years, but sink to smaller numbers in the interim. Curiously enough it is not because large or small numbers are hatched in special years, although such may be the case. The greatest immediate cause of the change in numbers from year to year appears to be something which happens when the smolt, or young salmon, enter the sea.

From far away on the other side of the continent the measurement of the annual rings of growth in the giant sequoias of California, by Professor ELLSWORTH HUNTINGTON, of Yale University, supplies still another type of evidence of this same cycle of about ten years. Thus once in ten years or less something seems to happen which causes an

mon cause, even though the agricultural depression resulting from the droughts may not be the immediate cause of the panics. The Conference made no attempt to solve such problems as this. It was, however, impressed by the fact that droughts, panics, and agricultural depression not only show greater regularity than the sunspot cycles, but seem to have a periodicity twice that of the very regular cycles found in sequoia trees, rabbits, grouse, foxes, salmon, and many other animals.

The evidence as to still larger cycles is scanty, but this may be due mainly to the absence of long records. Professor EIDMANN thinks that the noxious insects in the forests of Germany wax and wane in cycles of about thirty years. Professor ROWAN finds a cycle of 34 years in the ducks, crows, magpies, and lake levels of Alberta. The Brückner cycle of 30 or more years is also found by Dr DELURY in several series of meteorological data and in the growth of trees. The salmon statistics studied by Professor HUNTSMAN seem to show a cycle of 48 years. Still longer cycles are suggested by the rings of growth of trees, but these fall beyond the scope of the present Conference.

So far as the length of cycles is concerned the results may be summed up as follows: There is fairly abundant evidence as to a four-year cycle, the length of which seems to be exactly four years. A cycle of six years is suggested but not confirmed. A cycle of between nine and ten years, on the other hand, is very strongly indicated. It is often called a ten-year cycle, but the most accurate determinations suggest that the true length is nearer nine and one-half years. A cycle of perhaps 18.6 years appears to be at least as widespread and definite as the four-year cycle. As to the larger cycles no data for gauging their importance were forthcoming at the Conference.

The causes of cycles in animals appeared to the Conference to be divided into three groups; biological, meteorological, and astronomical. The first includes food, reproduction, parasitic insects, and diseases, especially those of bacterial origin; the second, or meteorological group, needs no definition; the third group may be briefly discussed before we turn to the others. It was dealt with chiefly by Dr DELURY. He holds that the chief causes of climatic variation are partly solar and partly lunar. The Conference seemed to feel that while terrestrial climatic fluctuations are probably due to solar variations, such fluctuations are probably due to other astronomical causes as well as to the variations which manifest themselves as sunspots. One of the strongest impressions of the whole Conference was that all sorts of cyclic phenomena must be controlled though not necessarily caused by some outside force which dominates all forms of life. If these are solar forces, they manifest themselves as sunspots, prominences, faculæ, the solar constant, electro-magnetic activity, and perhaps still other phenomena. These presumably lead to both meteorological and organic phenomena on the earth. If lunar forces have any effect

in producing cycles, they presumably act through the tides, which in turn give rise to oceanic currents and upheavals of cold water from below. These are supposed to alter the atmospheric pressure and thus cause winds, storms, rain, and changes of temperature.

No one at the Conference seemed to entertain much doubt that migrations of animals and variations in their numbers are often due to the food supply. Some of the most clear-cut examples are the migrations of the snowy owls when the supply of mice runs short after a period of great abundance. It is almost equally clear that the extraordinary variations in the numbers of rabbits, muskrats, and other rodents from one extreme of the ten-year cycle to the other are one of the main causes of variations in the numbers of foxes, lynxes, mink, and other fur-bearing animals. Mr ELTON's curves showing the numbers of skins of such animals brought in to the Hudson's Bay Company posts give good indication that the ups and downs of the fur bearers follow closely on those of their prey, although the maximum number of the furs of carnivores is brought into the market a year after the maximum of rabbits. It was also made clear by various members of the Conference that sea animals wander about in huge numbers in response to variations in their food supply. One of the most interesting of such wanderings is the migration of the sperm whales described by Dr CHARLES TOWNSEND, of the New York Aquarium. The small crustaceans and other minute forms of life upon which these huge animals feed are abundant only in summer. Therefore, in order to obtain the barrels and barrels of food which form their meals, the whales each year wander back and forth over routes six or eight thousand miles long. During our summer they are in the northern hemisphere, and during the southern summer in the southern hemisphere.

Such annual migrations, however, were only an incidental feature of the discussions. The main interest in the wanderings of animals centered around those which occur during longer periods. These generally represent great changes in the total number of living animals. But the fish of the sea, as Dr HARRY M. KYLB, of Glasgow, pointed out, show different phenomena from the animals of the land in this respect. Their numbers may vary enormously, but the fact that the fishermen do not catch the normal quantity of fish in any given year does not necessarily mean that there are fewer fish than usual in the sea. The ocean is so huge that the best food supply, or the best spawning grounds, may lead the fish to concentrate in parts of the ocean where there is commonly little fishing. Consequently the various conditions under which the fishermen do their work must be taken into account as well as the variable causes affecting the number of fish that hatch and survive. In other words the optimum years for the fisheries are by no means necessarily the optimum years for the fish.

In spite of the importance of the food supply there appeared to be a strong feeling that other causes of variations in the numbers of animals deserve more attention than is commonly given them. One such cause is the rate of reproduction. Mr ELTON stated that the number of young snowshoe rabbits and other animals born in the average litter apparently tends to increase in certain years and to decrease when scarcity of food and other causes lead to a reduction in the number of animals. Professor HUNTINGTON showed that even in man the rate of reproduction is very closely correlated with climatic conditions. A rapidly increasing race like the Japanese would decline in numbers if the relative rates of deaths and of conceptions resulting in living births stayed steadily at the levels of September when health and vigor are at a minimum. Professor ROWAN presented experimental evidence suggesting that the same thing is true among birds. By altering the conditions of light and temperature he has induced birds to breed in midwinter. Dr KYLB and Professor HUNTSMAN made it clear that reproduction in fish and other sea animals responds with equal readiness to changes in temperature.

One of the facts which the layman is only beginning to realize is the enormous number of parasitic worms and insects which infest most forms of animals, as well as plants. The importance of this in plants was explained by Professor EIDMANN in respect to the forests of Germany. He believes that the growth of trees is influenced quite as much by insects as by the climatic factors of temperature and rainfall. The insects themselves, however, are very closely dependent upon these same climatic factors. Thus the rate of growth of the trees is the composite result of the effect of climate upon the tree itself plus its effect upon the insects. Professor GROSS illustrated the same thing in respect to animals by means of the parasitic insects and worms which infest the organs of the grouse. Professor ROWAN showed how the reverse effect is obtained by removing ticks or other infestations, and allowing an infested animal to regain its strength.

In the production of cycles among animals an even greater part seems to be played by bacterial parasites and the diseases to which they lead than by the larger parasites. This was especially well illustrated by Professor R. G. GREEN, of the University of Minnesota, in his discussion of tularæmia, a disease of rabbits and grouse. He demonstrated clearly that during the last rabbit cycle in Minnesota the "crash" when the animals suddenly died off was due to a very virulent form of this bacterial disease. The disease is carried by ticks, which also infest grouse. Professor GREEN's findings have resulted in the theory that when the rabbit population begins to decline the tularæmia bacteria are extremely virulent, while the proportion of old and immune rabbits is very small. Hence millions of rabbits die, for the mortality is almost one hundred per cent. The ticks which they carry fall to the

ground, but soon find new hosts in other rabbits and grouse, thus spreading the disease. For some unknown reason, however, the virulence of the tularæmia bacteria decreases rapidly. After the epidemic it becomes so low that as young are born from the surviving rabbits they do not die from the disease, but have a non-fatal form of the disease which makes them immune. Thus there arises a group of immune rabbits, some of which survive the next epidemic and carry on the race.

Another epizootic disease which received considerable attention was encephalitis in dogs, foxes, and other fur-bearing animals. This disease, as was shown by Messrs GREEN, ELTON, and ANDERSON, behaves somewhat like rabies, except that the affected animals do not bite. Here, unlike the case of tularæmia, we have a disease in which the resistance of the animal has a great effect in determining the occurrence and virulence of the disease. In tularæmia the parasitic bacteria are so virulent at the time of their main onset that practically all affected animals die no matter how strong they may have been.

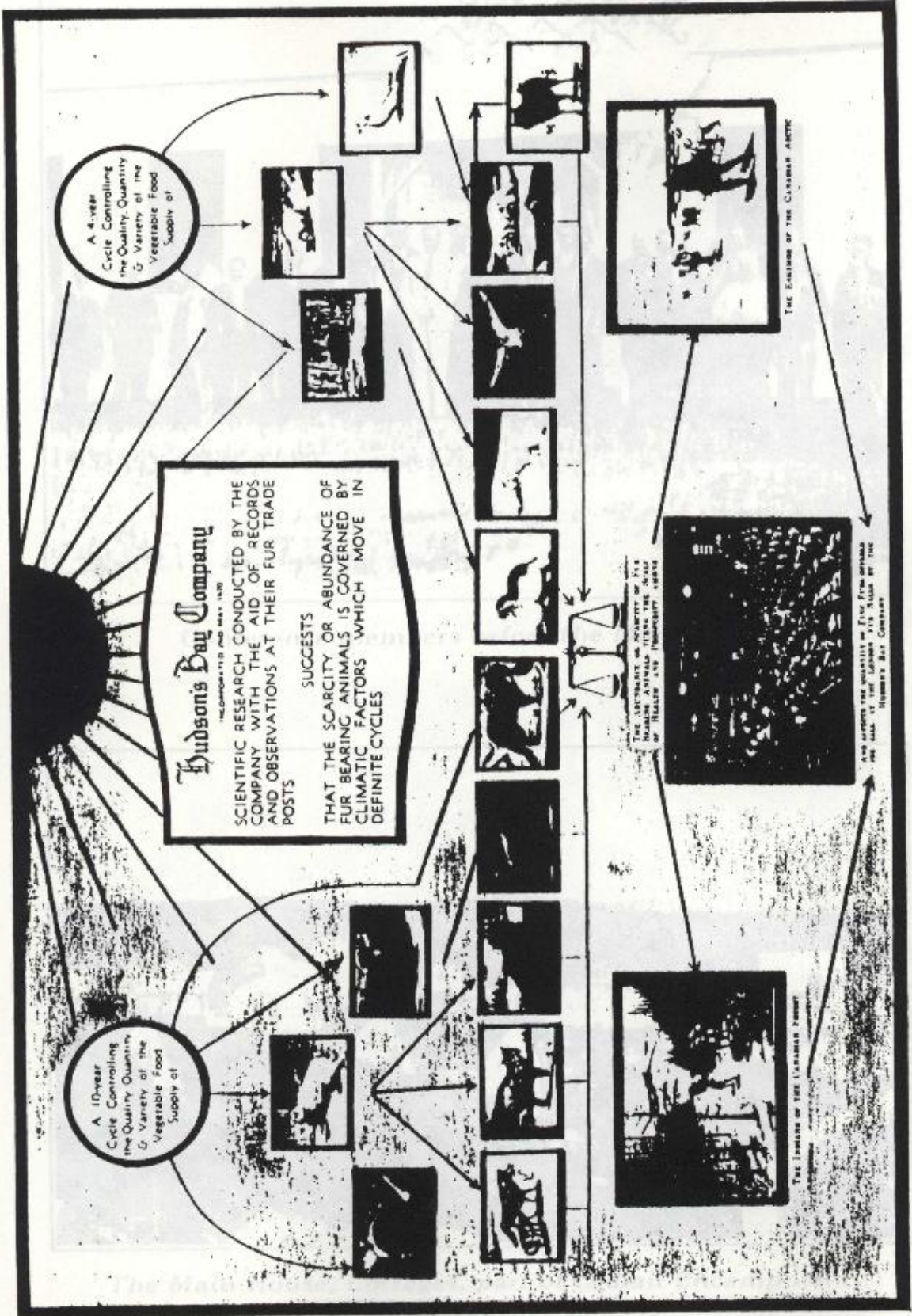
Such facts as these precipitated a lively discussion as to the relative importance of changes in the virulence of the parasites compared with changes in the degree of resistance of the host. The conclusion seems to be that there is no general rule. Under certain conditions and with certain diseases the power of a disease varies in close harmony with the general health of the animals which it attacks. Under other circumstances a more virulent parasite may be so strong that no animal can resist it. But all organisms from bacterial parasites to whales appear to pass through cycles of strength and weakness arising from the combined effects of food, conditions of reproduction, parasites, and the immediate climatic environment.

The features of the climatic environment most frequently discussed at Matamek were naturally temperature and rainfall. Throughout the Conference it was universally recognized that all forms of life have certain limits of temperature, and that between these limits lies an optimum or most favorable condition. According to Professor HUNTINGTON this optimum in man varies not only with the age of the individual, but also from one function to another. Thus physical and mental activity have different optima of temperature. The optimum for reproduction may be still different, as was shown by Dr KYLB and others. Rainfall was not much discussed, although its importance was frequently recognized in discussing the food supply.

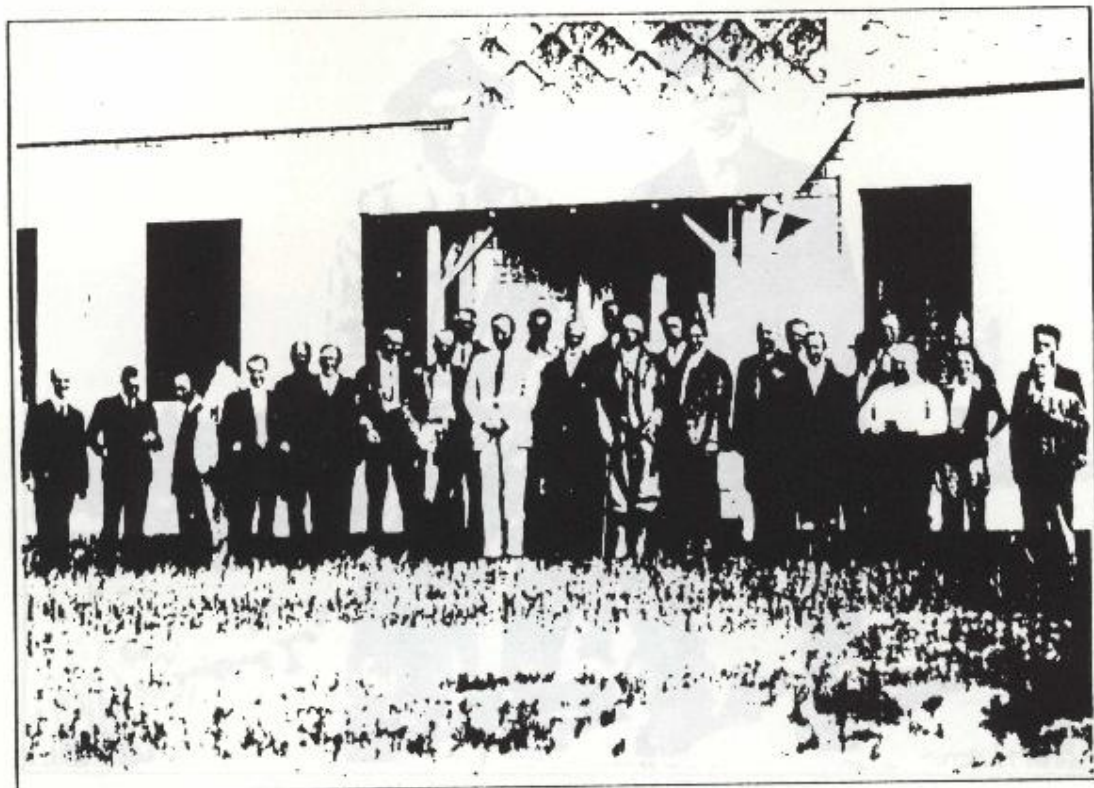
Three other atmospheric conditions were also brought to the attention of the Conference. One of these was ultra-violet light which was discussed mainly by Dr DELURY and Professor ROWAN. The latter explained to the Conference certain very interesting experiments now in progress which seem to show that the effect of ultra-violet light upon reproduction in birds is striking.

abundant as ever, and perhaps more so. Dr KYLE's explanation is that the fishing removes the old fish which consume much food, but nevertheless grow slowly. Where the fish are young, a given supply of food produces a maximum amount of growth and thus a maximum supply of food for man. From this standpoint fishing is like agriculture; that is, human activity leads to an optimum condition for man by reason of the rapid growth of the fish. Professor J. R. DYMOND, of the University of Toronto, stated that the same rule applies in the case of several fresh water fishes.

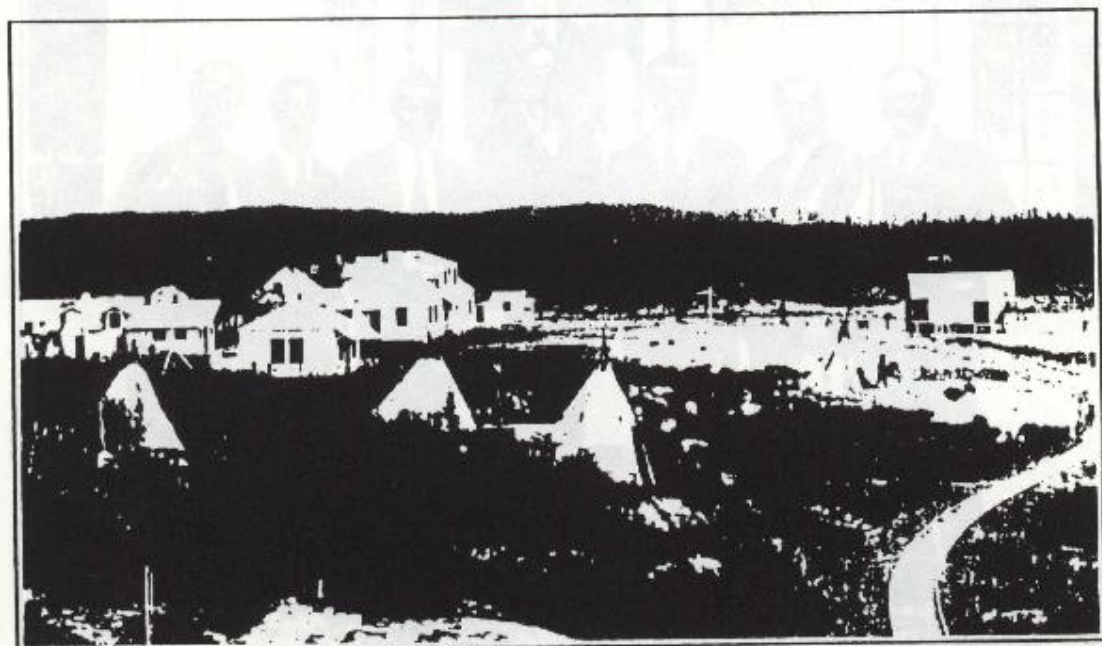
A general review of the mammals of the world, by Mr H. E. ANTHONY, of the American Museum of Natural History of New York, illustrates some of the main conclusions of the Conference as to the distribution of cycles. In a broad way the land mammals of the earth are at a minimum in the great tropical forests. There, too, so far as our present information goes, such animals are least subject to cycles. This may be because of the general scarcity of mammals in those areas, and also because the environment is so uniform that there is apparently little reason for great changes in numbers. Outside of such forests lie tropical regions where there is more grass and smaller trees. There the mammals increase greatly in numbers and we have such areas as the famous game regions of Africa. In such areas the number of animals is often incredibly large. As yet we have no definite evidence as to whether the fluctuation in numbers is correspondingly great, even though the variations from wet seasons to dry are extreme. In higher latitudes, as has already been implied, there are likewise certain rather steady areas such as the eastern United States where many animals live under conditions which approach the optimum and where extremely harmful variations in climate are comparatively rare. Thus in such regions the cycles in animal numbers are mild. In the marginal regions, however, such as the drier and colder parts of the continents, it requires only a slight departure of the climate from its normal condition to produce great changes in the food supply and in the conditions of reproduction and bacterial infection. Thus in those regions animals increase enormously at certain times and then decline with a crash. The same contrast between areas of relative uniformity and variability is perhaps seen in the cod, plaice and salmon. The cod and plaice, even though the fishermen can not find them, appear to be numerous at all times and may suffer relatively little from cyclic variations in numbers. This may be because they inhabit a relatively uniform region where the temperature and food supply vary but little. The salmon, on the contrary, because of its habit of coming to the rivers to spawn, occupies a marginal area. Not only is it subject to great variations in most of the conditions which control its numbers, but when the smolt pass from fresh water to the salt sea, they are subject to an environmental change unknown to the purely marine fish.



Graph prepared by the Hudson's Bay Company, showing the relationship between wild life fluctuations and human prosperity



Conference members before the Main House



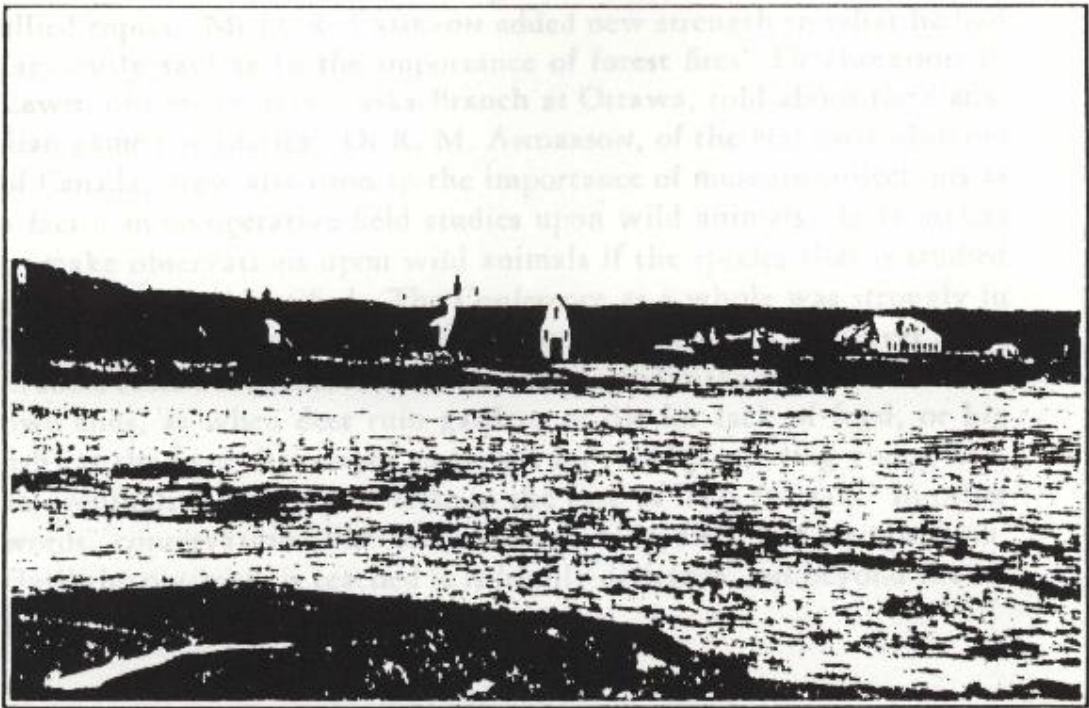
*The Main House, Cottages, part of Indian Encampment,
the Fish House and Railway*



Dr Camsell and Mr Amory



*Agenda Committee, Matamek Factory, July, 1931
Mr Burgess, Dr Rowan, Mr Carrier, Mr Amory, Mr Elton,
Dr Kyle, Dr Gross*



Matamek Factory from across the estuary of the Matamek River



A family of Matamek Indians

The Conference closed with a general session on conservation and allied topics. Mr D. R. CAMBRON added new strength to what he had previously said as to the importance of forest fires. Dr HARRISON F. LEWIS, of the National Parks Branch at Ottawa, told about the Canadian game sanctuaries. Dr R. M. ANDERSON, of the National Museum of Canada, drew attention to the importance of museum collections as a factor in co-operative field studies upon wild animals. It is useless to make observations upon wild animals if the species that is studied is not properly identified. The Conference as a whole was strongly in favor of intelligent conservation. It was pointed out, however, that in some cases our conservation measures go so far that they defeat their own ends, as when deer ruin gardens or die for lack of food, or big fish eat the food that ought to be left for rapidly growing young fish, an eventuality unlikely to arise in the case of land animals. In other words, conservation, like almost everything else, has an optimum. Until the optimum is reached it is highly desirable, but beyond that it goes too far.

WHEREAS the personal qualities of heart and mind have encouraged and inspired the deliberations of the Conference;

THEREFORE it is resolved that the Conference do express to Mr. ANONY deep appreciation of his essential contribution to the success attending his efforts.

II

WHEREAS the Government of the Dominion of Canada has contributed materially to the achievements of the Conference through the interest and help of its Ministers and particularly through the unfailing attention of The Right Honourable Sir GEORGE PERCY, Honorary Chairman of the Conference, as well as through the part taken in the sessions by its official delegates and especially by Dr CHARLES CAMPBELL, Deputy Minister of Mines and President of The Royal Society of Canada, who has so ably presided over its deliberations;

THEREFORE it is resolved that the Conference do express deep appreciation of the interest of the Dominion Government, and the hope that the stimulation of interest in cyclical fluctuations in plant and animal life may have a practical bearing on the solution of many Canadian economic problems.

MATAMEK CONFERENCE ON BIOLOGICAL CYCLES

RESOLUTIONS

Eleven resolutions, prepared by the Resolutions Committee of the Conference, were submitted to the Conference at its evening session, Friday, July 31st, 1931. Upon regular motion, duly seconded, each resolution the text of which follows was adopted unanimously by the Conference.

I

WHEREAS Mr COPLEY AMORY, in consequence of his deep interest in the fluctuations of animal and plant life and especially their relation to the economic prosperity of the Labrador region, has convened a conference of scientists interested in cyclical phenomena, and has generously provided every convenience for the conduct of the meetings as well as for the comfort and recreation of the members amid the unique surroundings of his Matamek home, and

WHEREAS his personal qualities of heart and mind have encouraged and inspired the deliberations of the Conference;

THEREFORE it is resolved that the Conference do express to Mr AMORY deep appreciation of his essential contribution to the success attending its efforts.

II

WHEREAS the Government of the Dominion of Canada has contributed materially to the achievements of the Conference through the interest and help of its Ministers and particularly through the unfailing attention of The Right Honourable SIR GEORGE PERLBY, Honorary Chairman of the Conference, as well as through the part taken in the sessions by its official delegates and especially by Dr CHARLES CAMSELL, Deputy Minister of Mines and President of The Royal Society of Canada, who has so ably presided over its deliberations;

THEREFORE it is resolved that the Conference do express deep appreciation of the interest of the DOMINION GOVERNMENT, and the hope that the stimulation of interest in cyclical fluctuations in plant and animal life may have a practical bearing on the solution of many Canadian economic problems.

III

WHEREAS the Government of the Province of Quebec generously encouraged and materially supported the organization of the Matamek Conference on Biological Cycles, 1931, and in other ways contributed to its success;

THEREFORE it is resolved that the Conference do express deep appreciation of the interest in its purpose and activities displayed by the PROVINCIAL GOVERNMENT, particularly in the encouragement of the Honourable L.-A. TASCHEBAU, Premier, in the hospitality extended through the Honourable HECTOR LAFRÉTE, Minister of Colonization, Game and Fisheries, and in its representation at the opening session by the Honourable ADÉLARD GODBOUT, Minister of Agriculture, and other Government representatives and officials.

IV

WHEREAS the CLARKE STEAMSHIP COMPANY LIMITED and LA CIE DE TRANSPORT DU BAS SAINT-LAURENT, LIMITÉE, in consequence of their deep interest in economic conditions in the Canadian Labrador, have generously provided transportation for the members of this Conference to and from Matamek Factory;

THEREFORE it is resolved that the Conference do express to the CLARKE STEAMSHIP COMPANY LIMITED and to LA CIE DE TRANSPORT DU BAS SAINT-LAURENT, LIMITÉE, through their respective presidents, Mr DESMOND A. CLARKE and M. J.-A. BRILLANT, the appreciation of its members for the courtesies extended and the hope that its deliberations may present a better understanding of the problems of the North Shore and their most effective solution.

V

WHEREAS the HUDSON'S BAY COMPANY has made available for study by Mr CHARLES ELTON its records covering fur catches in Canada for many years past and has provided facilities in the Company's organization for the collection of statistical material bearing on cyclical fluctuations in animal life, and

WHEREAS the researches based upon this material have been in large part responsible for recent developments in interest in such phenomena leading to the calling of this Conference;

THEREFORE it is resolved that the Conference do express deep appreciation of the importance of this work which the HUDSON'S BAY COMPANY has initiated and the hope that it may be continued.

VI

RESOLVED that the Matamek Conference on Biological Cycles desires to place on record its appreciation of the importance of the work undertaken by Professor R. G. GREEN on diseases of wild animals, realizing that his paper before this Conference represented the most important single contribution to the advancement of knowledge in cyclical phenomena in animal life, opening as it did new directions of attack upon the problem; and do express the hope that the UNIVERSITY OF MINNESOTA will continue and expand this type of fundamental research.

VII

RESOLVED that the Matamek Conference on Biological Cycles desires to place on record its appreciation of the importance of the work of Professor WILLIAM ROWAN both in collecting basic data on periodic fluctuations in animal life in Alberta, which region is an exceptionally favourable locality for the study of cyclical phenomena, and in undertaking experimental analyses of the factors involved; and hopes that the UNIVERSITY OF ALBERTA will continue its support of these important studies of such great potential value to the attack on the fundamental biological problems.

VIII

RESOLVED that the Matamek Conference on Biological Cycles, being impressed with the great value of the intensive research being carried on by Professor A. O. GROSS upon the diseases and fluctuations in number of the Ruffed Grouse, do express the hope that this type of investigation may be vigorously carried forward in the future because of the fundamental character of such work.

IX

RESOLVED that the Matamek Conference on Biological Cycles do express to Lieutenant-Colonel FRANK M. STANTON, Honorary Secretary to the Conference, its genuine appreciation of his unremitting zeal and good judgment in promoting the interests of the Conference through advice and assistance to the Chairman and thereby in serving the welfare of the people of the Canadian Labrador.

X

RESOLVED that the Matamek Conference on Biological Cycles do express deep appreciation of the interest of many scientific institutions,

government bodies, and other organizations, and individuals, in the problems of cyclical fluctuations as shown in the sending of delegates to this Conference, in assisting in its organization, and in otherwise contributing to the advancement of knowledge of these phenomena, and

It is further resolved that the Secretary of the Conference is hereby instructed to forward a copy of this resolution to the following:

NEW YORK ZOOLOGICAL SOCIETY, THE AMERICAN MUSEUM OF NATURAL HISTORY, SMITHSONIAN INSTITUTION, CARNEGIE INSTITUTION OF WASHINGTON, NEW ENGLAND RUFFED GROUSE INVESTIGATION AND MASSACHUSETTS FISH AND GAME ASSOCIATION, RESTIGOUCHE RIPARIAN ASSOCIATION, THE HONOURABLE HUDSON'S BAY COMPANY, SPORTING ARMS AND AMMUNITION MANUFACTURERS' INSTITUTE, CHARLES V. SALE, Esq., CANADIAN NATIONAL RAILWAYS;

YALE UNIVERSITY, UNIVERSITY OF MINNESOTA, UNIVERSITY OF TORONTO, ECOLE D'ARPENTAGE ET DE GÉNIE FORESTIER DE L'UNIVERSITÉ LAVAL, FORSTLICHE HOCHSCHULE, ROYAL ONTARIO MUSEUM OF ZOOLOGY;

DOMINION DEPARTMENTS OF FISHERIES, INTERIOR, MINES, and TRADE AND COMMERCE, HIS MAJESTY'S LOYAL OPPOSITION in the Dominion Parliament, NATIONAL MUSEUM OF CANADA, NATIONAL PARKS BRANCH, BIOLOGICAL BOARD OF CANADA, DOMINION OBSERVATORY, FOREST SERVICE, NATIONAL DEVELOPMENT BUREAU OF CANADA;

PROVINCE OF QUEBEC DEPARTMENTS OF COLONIZATION, GAME AND FISHERIES, LANDS AND FORESTS, and AGRICULTURE, PROVINCIAL FOREST SERVICE, FISH AND GAME BRANCH, MARITIME FISHERIES SERVICE.

XI

WHEREAS *The New York Times*, recognizing the importance of the purposes and the scope of the Matamek Conference, assigned to cover all of its sessions a special correspondent whose despatches, appearing in *The New York Times* and *The Gazette* of Montreal, adequately and intelligently reported the proceedings of the Conference, and

WHEREAS certain other newspapers, to wit *The Montreal Daily Star*, *La Presse* of Montreal, and *Le Soleil* of Quebec, sent representatives to cover the opening sessions of the Conference;

THEREFORE it is resolved that the Matamek Conference on Biological Cycles do express appreciation of the interest and efforts of the Press, and in particular of the above mentioned papers.

MATAMEK CONFERENCE ON BIOLOGICAL CYCLES, 1931

OFFICERS

The Rt Hon. SIR GEORGE PERLBY, Honorary Chairman

Mr COPLEY AMORY, Chairman, Permanent Committee

Dr CHARLES CAMSELL, Chairman of Sessions

Dr W. REID BLAIR, Chairman, Editorial Committee

Professor A. G. HUNTSMAN, Chairman, Resolutions Committee

Mr THORNTON W. BURGESS, Chairman, Reception Committee

Lieut.-Colonel FRANK M. STANTON, Honorary Secretary

Mr ALFRED C. DOBELL, K.C., Honorary Counsel

Mr LOUIS CARRIER, Honorary Librarian

Miss RUTH VANE STILES, Recording Secretary

Sessions in Matamek Factory, Canadian Labrador

July 23rd to August 1st, 1931

MATAMEK CONFERENCE ON BIOLOGICAL CYCLES, 1931

ATTENDING MEMBERS

- COPLEY AMORY, A. B.** (Harvard), F.R.G.S.
1811, Q Street, Washington, D.C.
- RUDOLPH MARTIN ANDERSON, Ph.D.** (Iowa)
Chief, Division of Biology, National Museum of Canada, Ottawa, Ont.
- HAROLD ELMER ANTHONY, B.S., M.A.** (Columbia)
Curator, Department of Mammalogy, The American Museum of
Natural History, New York, N.Y.
- DAVID LAWRENCE BELDING, M.A., M.D.** (Harvard)
Professor of Pathology and Bacteriology, Boston University School
of Medicine, Boston, Mass.
- Colonel WILLIAM REID BLAIR, D.V.S., LL.D.** (McGill)
Professor of Comparative Pathology, New York University
Director, New York Zoological Park, New York, N.Y.
- THORNTON WALDO BURGESS**
Naturalist, 61, Washington Road, Springfield, Mass.
- DONALD ROY CAMERON, B.A.** (McGill), B.Sc.F. (Toronto), M.E.I.C.
Associate Director of Forest Service, Department of the Interior,
Ottawa, Ont.
- CHARLES CAMSELL, A.B.** (Harvard), LL.D. (Queen's), F.G.S.A., M.E.I.C.
President, The Royal Society of Canada
Deputy Minister of Mines, Ottawa, Ont.
- LOUIS CARRIER**
Special Correspondent, *The New York Times*
La Canada, 33, St James Street West, Montreal, Que.
- AUREL MACEDON COMSIA** (Graduate, Schemnitz Forestry School, Hungary)
627, Milton Street, Montreal, Que.
- RALPH EMBRSON DELURY, M.A., Ph.D.** (Toronto)
Assistant Director, Dominion Observatory, Ottawa, Ont.
- ALFRED C. DOBBLI, K.C.**
Honorary Counsel to the Conference
71, St Peter Street, Quebec, Que.
(Unable to attend; present at Provincial luncheon)

JOHN RICHARDSON DYMOND, M.A. (Toronto)
Associate Professor of Systematic Zoology, University of Toronto
Assistant Director, Royal Ontario Museum of Zoology, Toronto, Ont.

HERMANN A. EIDMANN, Dr. phil.
o.ö. Professor der Zoologie, Forstliche Hochschule, Hann.Münden,
Germany

CHARLES SUTHERLAND ELTON, M.A. (Oxon.)
University Demonstrator in Zoology, Oxford University
Director, Bureau of Animal Population, Department of Zoology and
Comparative Anatomy, University Museum, Oxford, England

FRANCIS M. GIBAUT
Provincial Superintendent of Maritime Fisheries, Quebec, Que.
(Unable to attend; present at opening)

ROBERT GLADDING GREEN, A.M., M.D. (Minnesota)
Professor of Bacteriology and Immunology, University of Minnesota,
Minneapolis, Minn.

ALFRED OTTO GROSS, A.B. (Illinois), Ph.D. (Harvard)
Professor of Biology, Bowdoin College, Brunswick, Me
Director, New England Ruffed Grouse Investigation, Boston, Mass.

JOHAN HJORT, Ph.D., Sc.D., F.R.S.
Vice-President, Conseil International pour l'Exploration de la Mer
Director of the Biological Laboratory and Professor in the University
of Kristiania, Oslo, Norway
(Unable to attend; contributed a paper)

ELLSWORTH HUNTINGTON, M.A. (Harvard), Ph.D. (Yale)
Research Associate in Geography, Yale University, New Haven, Conn.

ARCHIBALD GOWANLOCK HUNTSMAN, B.A., M.B. (Toronto), F.R.S.C.
Professor of Marine Biology, University of Toronto
Director, Atlantic Biological Station, St Andrews, N.B.

REMINGTON KELLOGG, A.M. (Kansas), Ph.D. (California)
Research Associate, Carnegie Institution of Washington
Assistant Curator, Division of Mammals, United States National
Museum, Smithsonian Institution, Washington, D.C.
(Unable to attend; contributed a paper)

HARRY MACDONALD KYLE, D.Sc. (St Andrews)
Marine Biologist, 41, Clouston Street, Glasgow N.W., Scotland

ALDO LEOPOLD

Game Investigator, Sporting Arms and Ammunition Manufacturers' Institute, 404, University Avenue, Madison, Wis.

HARRISON FLINT LEWIS, M.A. (Toronto), Ph.D. (Cornell)

Chief Federal Migratory Bird Officer for the Provinces of Quebec and Ontario, National Parks Branch, Ottawa, Ont.

HANS MAYER-WEGELIN, Dr. oec. publ.

o.ö. Professor der Forst Wissenschaft, Forstliche Hochschule, Hann. Münden, Germany

The Rt Hon. SIR GEORGE HALSEY PERLBY, K.C.M.G., B.A. (Harvard)

Member of Parliament for Argenteuil; Senior Minister of State, Canada
(Unable to attend)

EARLE BERNARD PHELPS, B.S. Chem. (M.I.T.)

Professor of Sanitary Science, College of Physicians and Surgeons, Columbia University, New York, N.Y.

WILLIAM ROWAN, M.Sc. (Toronto), Ph.D. (London), F.Z.S.

Professor of Physiology and Zoology, University of Alberta, Edmonton, Alta.

Lieutenant-Colonel FRANK M. STANTON

Treasurer, Clarke Steamship Company Limited

Honorary Secretary to the Conference; 65, The Esplanade, Quebec, Que.
(Unable to attend; present at opening)

CHARLES HASKINS TOWNSEND, Sc.D. (Washington and Jefferson)

Director, New York Aquarium, New York, N.Y.

PRESENT AT SESSIONS

The following were present at some or all of the sessions, either for factual questioning or as observers or visitors:

IVERS S. ADAMS

President, Moisie Salmon Club Inc., Moisie, Canadian Labrador
and 512, Beacon Street, Boston, Mass.

RAOUL BOIS

Agent, Labrador Fisheries, Ltd, Seven Islands, Canadian Labrador

JOHN A. BOURGET

Fisheries Inspector, Cape Cove, County Gaspé, Que.

P. F. COLLIER

Director, Gulf Pulp & Paper Company, Clarke City, Canadian Labrador

WILFRID GALLIENNE

Trader, Moisie, Canadian Labrador

Captain JOHN HEARN

Master, Canadian Government Ice-breaker *Mikula*, Quebec, Que.

MALCOLM HOLLIDAY

Fisheries Inspector, Moisie, Canadian Labrador

Capitaine ANTOINE LEBVESQUE

Supervisor, Matamek Factory, Canadian Labrador

WILLIAM CHARLES NEWBURY

Fishery Supervisor, Hudson's Bay Company, Montreal, Que.

PETER WRIGHT

Forest Ranger, Pigou, Canadian Labrador

PRESENT AT OPENING

A number of friends of the Conference journeyed from Quebec to Matamek in order to be present at the official opening in Matamek Factory, Thursday afternoon, July 23rd. Among those who came to Matamek for his purpose were:

The Honourable J.-ADÉLARD GODBOUT, docteur en sciences agric. (Laval)
Professeur de zootechnie spéciale et d'appréciation animale à l'École
d'Agriculture de Sainte-Anne-de-la-Pocatière, Université Laval
Minister of Agriculture, representing the Government of the Province
of Quebec

L. D'ANJOU

Director, La Cie de Transport du Bas Saint-Laurent, Limitée, Rimouski, Que.

JULES-A. BRILLANT

President, La Cie de Transport du Bas Saint-Laurent, Limitée, Rimouski, Que.

AMÉDÉE CARON, K.C.

Member of Legislative Assembly for the Magdalen Islands, Rimouski, Q.

LÉON CASGRAIN, K.C.

Member of Legislative Assembly for Témiscouata, Rivière-du-Loup, Q.

DESMOND A. CLARKE

President, Clarke Steamship Company Limited, Quebec, Que.

- J.-ARTHUR DESJARDINS**
 Director, La Cie de Transport du Bas Saint-Laurent, Limitée, Matane, Q.
- J.-E.-E. DUBÉ**
 Mayor of Rivière-du-Loup, Que.
- P.-EMILE GAGNON, LL.L., K.C.**
 Rimouski, Que.
- J.-ANTONIO GRENIER, B.A., LL.L.**
 Deputy Minister of Agriculture, Quebec, Que.
- LOUIS-J. MOREAULT, M.D.**
 Member of Legislative Assembly for Rimouski, Rimouski, Que.
- LOUIS-ARTHUR RICHARD, docteur en droit**
 Professeur titulaire de législation forestière à l'Ecole d'Arpentage et
 de Génie Forestier, Université Laval
 Deputy Minister of Colonization, Game and Fisheries, Quebec, Que.

PROVINCIAL LUNCHEON

Among the guests present at the official luncheon tendered to the members of the Conference by the Government of the Province of Quebec, at Kent House, Montmorency Falls, on Wednesday, July 22nd, were the following:

- The Honourable HECTOR LAFERTÉ, LL.L. (Laval), K.C.**
 Minister of Colonization, Game and Fisheries, representing the
 Government of the Province of Quebec
- J.-A. BEAUCHESNE, N.P.**
 Secretary, Fish and Game Branch, Department of Colonization, Game
 and Fisheries, Quebec, Que.
- JOSEPH-ADOLPHE BELLISLE**
 Provincial Superintendant of Fish and Game, Quebec, Que.
- CHARLES-E. CANTIN**
 Member of Legislative Assembly for Saint-Sauveur, Quebec, Que.
- The Honourable FRANK CARREL, D.C.L. (Bishop's)**
 Member of Legislative Council for Gulf Division
 President, The Chronicle Telegraph Publishing Co.; Ltd, Quebec, Que.
- DESMOND A. CLARKE**
 President, Clarke Steamship Company Limited, Quebec, Que.
- OSCAR DROUIN, K.C.**
 Member of Legislative Assembly for Quebec East, Quebec, Que.

ARTHUR LAVIGNE

Senior Clerk, Fish and Game Branch, Department of Colonization,
Game and Fisheries, Quebec, Que.

R. H. NISBET

Executive in charge of Woodlands, Price Bros, Ltd, Quebec, Que.

GUSTAVE-CLODOMIR PICHÉ, M.A., ingénieur-forestier (Laval)

Professeur titulaire de sciences forestières à l'École d'Arpentage et de
Génie Forestier, Université Laval
Chief of Provincial Forest Service, Quebec, Que.

Lieutenant-Colonel JOHN HERBERT PRICE, M.C.

President, Price Bros, Ltd, Quebec, Que.

LOUIS-ARTHUR RICHARD, docteur en droit

Deputy Minister of Colonization, Game and Fisheries, Quebec, Que.

The Honourable ALFRED-VALÈRE ROY, M.D.

Member of Legislative Assembly for Levis, Levis, Que.
now Member of Legislative Council for La Durantaye Division

JOSEPH-O. SAMSON

Member of Legislative Assembly for Quebec Centre, Quebec, Que.

A.-RENÉ SOULARD

Chief of Administrative Service, Department of Colonization, Game
and Fisheries, Quebec, Que.

BERTRAM WILLIAM TAYLOR, M.Sc. (McGill)

Provincial Director of Fish Culture, Biological Building, McGill
University, Montreal, Que.

Members of Conference present at Provincial luncheon: Dr ANDERSON,
Mr ANTHONY, Professor BELDING, Dr BLAIR, Mr CAMERON, Dr CAMSELL
(and Miss ISABEL CAMSELL), Mr COMSIA, Dr DELURY, Mr DOBELL, Professor
DYMOND, Professor EIDMANN, Professor GREEN, Professor HUNTINGTON,
Mr LEOPOLD, Professor MAYER-WEGELIN, Professor PHELPS, Lieutenant-
Colonel STANTON; Mr BOURGET, Captain HEARN

The Press: ALAN STEWART ISLES, representing *The New York Times*;
JOHN BIRD, *The Montreal Daily Star*; EWART E. DONOVAN, *The Gazette*,
Montreal; DAMASE POTVIN, *La Presse*, Montreal; M. DUMAS and M. DUTIL,
Le Soleil, Quebec; Mr GREEN *The Chronicle Telegraph*, Quebec; ALFRED
HARDY, *L'Action*, Quebec; M. OUELLETTE, *L'Événement*, Quebec; Mr
ROBERTS, *The Montreal Daily Star*

MATAMEK CONFERENCE ON BIOLOGICAL CYCLES

PERMANENT COMMITTEE

THE Rt HON. SIR GEORGE HALSEY PERLEY, K.C.M.G., B.A.
Senior Minister of State, Canada

THE HON. HECTOR LAFERTÉ, LL.L., K.C.
Minister of Colonization, Game and Fisheries, Province of Quebec

CHARLES CAMSELL, B.A., LL.D.
President, The Royal Society of Canada
Deputy Minister of Mines, Canada

PATRICK ASHLEY COOPER
Governor, Honourable Hudson's Bay Company

HENRY FAIRFIELD OSBORN, LL.D., Sc.D.
President, The American Museum of Natural History

MADISON GRANT, A. B., LL.B.
President, New York Zoological Society

SIR GEORGE GARNBAU, B. ès Sc.Ap., Ing.Civ., LL.D., Chev.Lég.d'H.
Professor of Analytical Chemistry, Laval University
Member, National Research Council, Canada

ELLSWORTH HUNTINGTON, M.A., Ph.D.
Research Associate in Geography, Yale University

W. REID BLAIR, D.V.S., LL.D.
Director, New York Zoological Park

COPLBY AMORY, A.B., F.R.G.S.
Chairman, Permanent Committee

LOUIS CARRIER
Secretary, Permanent Committee

Summer address: Matamek Factory, Canadian Labrador

Winter address: 1811, Q Street, Washington, D.C.

or: P. O. Box 173, Station B, Montreal, Que.