

Note on Cooperative Research Projects

During the last few years, while the writer has served as professor of meteorology at the University of Stockholm, attempts have been made in Sweden to develop an informal type of international cooperation in meteorological research, similar to that which flourished in Europe before the outbreak of the Second World War, but at the same time adapted to meet the needs of the vastly enlarged scope and responsibilities of the meteorology of today.

In these efforts the writer has been able to enlist the administrative and financial support of the Swedish Institute for Cultural Exchange with Foreign Countries and of the University of Chicago; through the latter institution liberal additional financial contributions have been obtained. It is the purpose of this note to comment on some problems which have to be solved before a suitable permanent pattern of cooperative research efforts can be established, and to review briefly the Stockholm program.

It is a truism, repeated almost *ad nauseam*, that the winds blow and the storms move without regard for political boundaries. It is somewhat less self-evident but equally important from the point of view of applied meteorology that different portions of the earth's atmosphere may influence each other, over such long distances and with such a speed that even the rapid transport of atmospheric properties by the strong winds aloft must be considered inadequate as an explanation for the observed interactions. For these reasons it is now fairly generally admitted that it is impossible to isolate certain portions of the atmosphere and to analyze them as if they were mechanically or thermally closed systems. This indivisibility of the atmosphere and its problems makes meteorology a particularly interesting field in which to experiment with the

organization of cooperative research projects on an international basis.

It is probable that meteorologists would have been slow in recognizing the indivisibility of the atmosphere if they had not had at their disposal a worldwide grid of daily observations from the upper atmosphere where obscuring local influences are much less marked than at the ground. It is certain that these data would not yet have been available if the operational service demands of commercial and military aviation had not made it possible to obtain the funds with which to organize an observational program on a nearly global scale.

Under the circumstances stated above it has been a relatively easy task, even in these politically troubled times, not only to maintain observation posts in all parts of the world, but also to build up an efficient and truly international scheme for the exchange of weather observations and forecasts on a global basis. Any one-sided interference with this free flow of information would lead to reprisals and might thus be to the disadvantage of everybody and to the gain of no one.

This principle appears to be quite clearly recognized even by the many non-professional managers who now gradually are taking over the mounting administrative burdens of the applied meteorological service organizations. This is demonstrated by the fact that a financially extremely well-supported International Bureau now is being set up, under the World Meteorological Association, to facilitate the flow of daily weather observations.

While thus the managerial aspects of applied meteorology seem to be taken care of in a satisfactory manner, very little has been done to provide adequate and reasonably well-distributed facilities for the organization of cooperative research teams in basic meteorology, in spite of the fact that with-

out such organized cooperation the central area of our science easily might degenerate into a hollow weather reporting and collecting system.

Most of those scientific problems which arise out of our recognition of the indivisibility of the earth's atmosphere are of such a complex nature and of such a broad scope that they cannot be studied successfully except through the efforts of well-integrated research teams in which various branches of meteorology are adequately represented and for which adequate facilities have been made available. In the United States there are several examples of basic problems studied successfully by such well-equipped teams, for instance the physical structure of thunderstorms, and the nature of the prevailing circulation of the atmosphere; in the adjacent field of oceanography one might refer to the recent, beautifully organized and executed synoptic survey of the Gulf Stream. It should not be denied that just in the United States, where this technique of cooperative research seems to have reached its fullest development, teams sometimes have been organized around meaningless problems or have outlined their usefulness. However, equivalent amounts of waste motion may be found also in countries adhering to more traditional forms of research organization. Furthermore, research teams are readily dissolved or regrouped to meet changing requirements; in this way the entire scientific body acquires a highly desirable flexibility to which there is no counterpart in the older forms of research organization.

In spite of the demands for cooperative research effort and team work which spring from the nature of the world-wide meteorological problems themselves one finds, with few exceptions that the pattern of European meteorology of today is the same as the pattern of a few decades ago. At those universities where meteorology is represented at all, a lone professor, with one or two assistants, is supposed to keep up with, and contribute to, the advance of the whole broad front of the science. His nearest colleagues, in the official national meteorological office are most likely overburdened with administrative and service problems and have to concentrate on day-by-day tasks. Thus even the few opportunities which do exist for the development of a stimulating milieu and a cooperative research program in fundamental meteorology are not always utilized, to the serious disadvantage of both the academic and the applied meteorologist.

There are of course exceptions to this state of affairs. The brilliant achievements of the meteorologists assembled in Bergen, Norway, shortly after

the end of the first World War were the result of effective collaboration within a team of high-spirited young men working under the protection and guidance of V. Bjerknes. Even today, there are a few countries in Europe which appear to have solved quite successfully the problem of creating a milieu in which team work and bold joint attacks on basic problems may be undertaken. Nevertheless, these cases are exceptions; most European research meteorologists still work in an isolation which is highly detrimental to the advance of the science.

Under these circumstances the individual research worker is likely to select some special problem which can be isolated to such an extent that it may be investigated by a single person. In the past this policy has often resulted in contributions of a fundamental nature, but may just as likely lead the investigator onto a side track well removed from the central problems of world-wide meteorology. It hardly needs to be stressed that no one can assert in advance the ultimate significance of the heroic tasks which isolated investigators may set for themselves. What can be asserted, however, is that in the absence of organized group activity certain central fields in our science necessarily must remain uncultivated.

In many cases the isolated academic worker seeks to affiliate himself with some institution abroad where the opportunity exists to work in a larger milieu and where he has the opportunity to receive and give stimulation through contact with a large number of colleagues in his own and adjacent fields. This latter process has already led to an irreversible drain of highly competent research workers from some of the smaller countries of Europe into the insatiable research laboratories of a few of the larger and scientifically more well-situated countries.

The emphasis that has been placed above on the importance of group activity in research does not imply any underestimate of the fundamental role of the individual. On the contrary it has been demonstrated over and over again that the talented research worker normally contributes most effectively when he is in the position to test his ideas in daily contact with a group of interested colleagues. We are frequently concerned with questions of interpretation of the processes we observe in the atmosphere. In such studies it is hardly possible to establish the ultimate value of a view point or method of description except by demonstrating its fertility when applied over a broad range of phenomena. For indirect testing of this type group discussions are nearly indispensable.

On top of the particular difficulties which are associated with the "normal" isolation of most academic meteorologists in the smaller European countries, meteorology on our continent still suffers from the consequences of the last war and from the curtains that then were lowered between the fighting countries. No one who has glanced through and compared a few issues of the resurrected journals of Central Europe with, for instance, the corresponding British or American publications can fail to get the impression that they represent entirely different worlds, in spite of the indivisibility of the atmosphere with which they deal.

There are good physical geographical reasons why American, Central and North European meteorologists to a very considerable extent should occupy themselves with different manifestations of atmospheric behaviour, though one might deplore the fact that theories based on the study of phenomena of a distinctly regional character not infrequently have been presented with claims of universal validity. It is more disturbing, however, when one finds identical phenomena described in completely different terms, and without reference to work done on the same problem by groups in other countries.

Restrictions on travel and on the exchange of publications, as well as language barriers, have contributed to the present state of affairs, but one can hardly escape the impression that national prejudices, as a result of the last war, have been stimulated to a pitch probably seldom reached before among scientific workers. A distinct improvement is now noticeable but at times it has seemed as if our science were cultivated by a number of national olympic teams pitted against each other in rather furious competition.

In our science, as in all other intellectual activities, diversity is essential to progress. No one in his right senses would wish to see meteorology become an All-American or an All-European affair. To derive the maximum benefit and enjoyment from this diversity it is of course necessary to develop a healthy appetite for a varied intellectual diet. Once this attitude has been established, tact and mutual respect in our international scientific relations will follow by themselves and one of the greatest obstacles to interaction and free flow of information between the different national groups is removed. Certainly there is no reason for responsible research workers in our field to let pride, or other causes such as differences in language, drive them to help the many eager hands who are attempting to lower war time curtains right in our midst.

It has been customary to look upon language as a means of communications. In later years it has acquired another and more sinister role, that of a shield behind which to hide one's own contributions or, in other cases, one's unwillingness to look into the achievements of other language groups. Even within the relatively small and culturally fairly homogeneous area of Central and Western Europe much harm is being done by this viewpoint on language. Some of the damage might be overcome if one recognizes the simple fact that by adopting as an auxiliary the language of the other fellow you deprive him of exclusive control of his language and change it from a shield to its rightful role of a means of (international) communication.

There are of course basic language difficulties which can not be solved by such a simple adaptation on the part of the European groups. There is for instance every reason to expect, during the next few years, an extremely vigorous development of Chinese meteorology and, as a result, many significant realistic contributions from that part of the world. Fortunately, the new generation of Chinese meteorologists has already shown its willingness to adopt English as an auxiliary language, to the benefit of us all.

From what has been said above it is clear that many difficult questions have to be tackled before we can hope to solve even the regional problem of establishing a permanent workable pattern for European cooperation in basic meteorological research. Nevertheless, the attempt must be made. Many of the more significant contributions to meteorology during the last decade have been made by Europeans who have been given the opportunity, for instance in the United States or in other parts of the world, to operate in and on groups capable of responding to stimuli, and equipped with the necessary physical resources. Our task must be to attempt to organize such groups on our continent, to help us tap the talent which now to a large extent is wasted because it is scattered ineffectively over the continent.

After more than twenty years of work with such research groups in the United States the author of this note feels a deep gratitude for the escape from pomposity and for the opportunities to intellectual development that work with an imaginative and intellectually courageous American team brings with it. However, during such a long stay on the other side of the Atlantic, one gradually begins to think of Europe as somewhat of a cultural unit and one learns to look at this continent with a perspective

which would be hard to acquire from our side of the water. It is not unreasonable to demand that persons who have had the privilege of working on both continents must take over a heavy share of the responsibility for a satisfactory solution of the problems here discussed. This does not mean that European science, with its long and valuable traditions, should be blindly americanized. The European chinashop is a delicate one and must be handled with a great deal of care if we want to avoid serious damage to its antiques.

The European scientist frequently occupies an enviable position *sine cura* as far as his responsibilities to society are concerned. His cares and worries, of which there are many, have to do with an entirely different problem, the inadequacy of the resources at his command. On both sides of us basic science has been organized much more completely into service for the community. Fortunately the applied research problems in which society is vitally interested, and the central problems of world-wide meteorology, are largely identical or at least overlapping. Hence it would seem wise to organize our research in such a manner that we are capable of tackling these problems before they are rammed down our throats.

The very modest meteorological "seminar" activities that have been conducted in Stockholm since the autumn of 1947 to meet the needs reviewed above, had as their initial goal the reestablishment of normal working relations between scientists in some of the war-scarred countries of Central Europe and their colleagues in Sweden. This activity was in fact a small part of a much larger program with similar aims set up by the Swedish Institute for Cultural Exchange with Foreign Countries, and supported by grants from the Swedish Government. It soon became apparent that much could be gained by a considerable broadening of the objectives of this program. Thus the important basic contributions to meteorology made in Great Britain and the United States during the last war were inadequately known on the Continent, and the civilian meteorological community in America and Western Europe was certainly only vaguely conscious of the interesting lines of research followed in Central Europe. Even the contact between individual countries on the Continent suffered from antagonisms and barriers erected during the war. It was therefore decided to combine the invitations to our central European guests with similar invitations to scientists from other parts of Europe and North America, to permit an informal exchange of in-

formation in a friendly setting of absolute equality which would foster mutual respect for the intellectual activities of the different groups thus brought together.

In 1950 additional funds were obtained through an agreement with the University of Chicago and it was then possible to continue and to expand the program initiated by the Swedish Institute. In this manner meteorologists from fourteen different countries have been brought together in Stockholm. It has been our desire to keep the groups small and the discussions informal, to permit a maximum amount of personal contact. It is nevertheless our hope to add in a significant manner to the number of countries successively drawn into these group discussions, but in order to avoid complications resulting from language difficulties it will be necessary to proceed quite slowly with this expansion.

Three conferences with a fairly well-defined program were organized during the last few years. In May 1949, in cooperation with the Geographic Institute of the University of Stockholm, then under the direction of professor Hans W:son Ahlmann, and with the Swedish Geophysical Society, a conference on the structure of the general circulation of the atmosphere and on the problem of postglacial climatic fluctuations was arranged, in which not only meteorologists but also botanists, glaciologists, geologists and geographers took part. A somewhat smaller group met again in May 1950 to continue the discussions of these problems. Finally, in June 1951 a last conference was arranged during which problems of cyclone and jet stream structure were considered as well as certain aspects of the general circulation, particularly in low latitudes.

The relations between meteorologists in the south and in the far north of Europe are not nearly as intimate as one might wish. A first small step towards the establishment of real cooperation with Italian meteorologists was taken when it was arranged to have a Scandinavian representative take part in the First International Congress on Alpine Meteorology arranged by prof. M. Bossolasco in Milano during the autumn of 1950. We expect to develop much more fully the contacts then established.

It is quite evident that meetings of the type discussed above are of great value in bringing about diffusion of information, but they do not eliminate the need for the organization of facilities where meteorologists from different countries would have the opportunity to work together, over longer periods of time, on projects of a joint nature.

The organization of one or several large institutes with permanent staff positions open to foreigners would not be an adequate answer to this problem. Such a solution would again contribute to the drain of talent away from some of the smaller European countries which deserve a better fate since they in the past have contributed so much to the evolution of modern meteorology.

It seems more desirable to set up one or several regional institutions with rotating, overlapping staffs, to which scientific workers from different countries may be sent or invited for participation, over limited periods of time, in certain broad scientific projects. With the help of the institutions from which the collaborating scientists are sent, such a system of rotating assignments would reduce the cost of operations and would furthermore eliminate the otherwise very real danger that the institution be looked upon as a comfortable place of retreat.

Basic research institutions of the kind envisioned above must be built around individuals, not set up as paper schemes. Studies are now being conducted by UNESCO to determine the advisability of organizing international scientific laboratories, and in a few cases these explorations have advanced quite far: thus the organization of an International Computing Center appears to have been accepted in principle. However, it is important to bear in mind that such a center to a very large extent must function as a technical service organization. In our case we are faced with the necessity of creating, not only facilities but also leadership for joint research tasks which under the changing conditions of our science no longer can be undertaken on a purely national basis. This demands an institution of a far more personal character than one would find in a scientific organization charged primarily with house keeping or service functions. Thus there are no precedents to guide us and we must experiment until a satisfactory solution has been found.

A modest experiment of this type will be conducted in Stockholm during the coming academic year (1951-1952). Eight or ten young scientists,

representing half a dozen different countries, will be brought together to work as a team on a few basic problems which now occupy the foreground in meteorology. Thus the aerological and theoretical description of the large-scale flow patterns in the atmosphere will receive much attention. If possible, a small experimental weather service will be set up to serve as a "clinic" and as a testing ground for theoretical atmospheric models developed by the members of our group.

It should be quite evident from what has been said earlier that the organization of similar experiments elsewhere on our continent and dealing with other aspects of meteorology would be highly desirable. Taken together these experiments should help us to arrive at a reliable answer to the pressing problem of how to provide the best setting for European meteorological research. It is at any rate certain that conclusions drawn from experiences gained with such teams will be far more dependable than any set of abstract recommendations as to how our research work should be organized.

It is also fairly evident that the limited objectives of the Stockholm research team are distinctly different from those important responsibilities which the World Meteorological Organization would wish to assign to any technical bureau which might be set up under its auspices. Experience has shown that the various national weather services represented in the latter organization are likely to profit more from properly staffed and equipped independent research teams organized and operated in academic settings outside the regular government services than from any attempt to conduct the required research within the rigid framework of the official government meteorological bureaus. In a similar way one might reasonably conclude that the World Meteorological Organization is likely to profit more by fostering the organization of independent units or teams to conduct its research than by attempting to enter directly into research operations.

Stockholm in July 1951

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