

Cartwright suggested (with approval of Hansen and others) that a fair-sized area of the North Atlantic could be surrounded by boundary measurements in the not too distant future. The work in UK and France was a starting point, and could be continued via Iceland and Greenland to Canada, while lines defined by Madeira - St. Johns or Dakar - Natal were also conceivable. Such an area could provide a useful testing ground for numerical models, theories of dissipation etc., besides being invaluable for world-ocean studies.

Munk mentioned the pressure records his group would be making in an open North Atlantic area as part of the MODE project; also probable deep sea tidal work by Miller in the Pacific.

Radok mentioned investigations under the ice of Ross Sea, planned for 1975-76, in which his group may participate with the Scott Polar Research Institute.

### 3.8 Coordinated testing program

All members with working instruments agreed to a joint open sea comparison test to be planned for mid 1973 (after MODE and not August). The location had to be easily accessible, and a steep shelf or island, where deep and shallow meters could be tested in close proximity, was recommended. The site and other logistics will be decided at a future meeting. Meanwhile, the primary logistic of 'booking' a suitably sized ship will be pursued by (i) Hyacinthe, (ii) Cartwright. If these two fail, Voit offered to find a Russian ship. Members will be informed of progress, and of the date of the preliminary meeting.

### 3.9 Change of officers

Walter Munk announced his wish to be relieved as Chairman, while continuing of course to serve as a member of the Working Group. He proposed David Cartwright as his successor, and that the post of Chairman should in any case be rotated at about 5 year intervals. This motion was seconded by Dohler and approved unanimously. Members expressed their appreciation of Walter Munk's service as the first Chairman of WG 27.

ANNEX VI

## REPORT ON SCOR WORKING GROUP 28 AIR-SEA INTERACTION MEETING IN MOSCOW, 1 and 7 AUGUST 1971

The following members, or representatives thereof, participated: H. Charnock (Chairman), S.A. Kitaigorodskii (rep. A.S. Monin), J. Namias, C.H.B. Priestley, R.W. Stewart, S.S. Zilitinkevich, K. Bryan and P. Welander were unable to attend. The following observers were present: Brocks, Burt, Busch, Coantic, Dobryshman (WMO), Foster, Kraus, Lacombe, Malone, Mitsuta, Miyake, Munn, Pond, Roth, Taylor, Zwang.

### 1. Matters arising from previous meeting

It was reported that an Air-Sea interaction symposium was in progress at the XV General Assembly of IUGG. It was noted that many of the papers were concerned with small-scale motion in the air over the sea; for future symposia an effort would be made to attract papers on a broader spread of topics, including more work on the upper layers of the ocean.

It was reported that further instrument inter-comparison trials had taken place at Tsimlyansk, USSR, between Australian, Canadian, Soviet and United States scientists. These had again proved valuable but further work was desirable especially on humidity instruments. There also appeared to be a growing need for comparison of instruments used in aircraft.

It was agreed that on future occasions it was desirable that information was exchanged and that others involved were consulted before results were presented or published.

It was suggested that a land-based instrument comparison trial be held in Australia in June, July and August, perhaps in 1974. This would involve the estimation of heat flux and evaporation as well as stress; the need for analysis on site was recognized.

A comparison of aircraft turbulence sensing instruments was proposed for 1973. This could take place in Canada and be restricted to the lowest 1000 m of the atmosphere. A small group (Munn(Convenor), Miyake, Warner and Zwang) were asked to consider this possibility and make suggestions for implementing it.

(NOTE: the following resolution was subsequently passed by IUGG - The IUGG recognizing the great value of the international comparisons made of turbulence instruments at Vancouver and Tsimlyansk and appreciating the need for further development in preparation for GARP and related programmes, recommends that further comparisons be arranged, emphasizing the importance of humidity sensors and of airborne instruments.)

## 2. Membership

It was reported that the membership of Messrs Bryan and Zilitinkevich, who had been coopted at the request of the JOC for GARP, would be ratified by IAMAP and IAPSO at their plenary session.

H. Charnock was re-elected as Chairman but gave notice that he would resign this office at the next meeting. The offices of Secretary and Treasurer were not filled.

(NOTE: at the subsequent meeting of IAMAP and IAPSO the membership of the Joint Committee was agreed as: K. Brocks, C.H.B. Priestley, J. Namias, S.S. Zilitinkevich (IAMAP); K. Bryan, H. Charnock, R.W. Stewart, L.R. Zwang (IAPSO).

## 3. The transfer of gases between the ocean and the atmosphere, especially H<sub>2</sub>O and CO<sub>2</sub>

At the 10th SCOR General Meeting the following recommendation was made to the Joint Committee (which also joins SCOR WG 28):

"It was recommended that the working group give special attention to the question of direct eddy flux measurements of the water vapor transport. The adequacy and intercomparability of existing instrumentation should be evaluated, as should the distribution of measurements needed to establish reliable estimates of evaporation for any place on the surface of the world ocean."

The need for instrumental comparisons was readily agreed; the necessary action has already been agreed (see 3 above).

It was, however, unlikely that the necessary equipment would ever be useable routinely from merchant vessels. It would probably be used to establish relations between more easily observed elements which could then be used to make the estimates of evaporation needed.

This raised two general needs; for the improvement of ships' routine meteorological observations and for more work on the complicated processes which occur at the interfacial layer between the atmosphere and the ocean.

Various means for filling these general needs were discussed. The WMO and its CMM were continually trying to improve the quality of observations from merchant vessels. But ships were becoming more automated and some new development was becoming necessary. Even this would not produce observations outside shipping lanes. The possibility of satellite observations

depended on an increased knowledge of the interfacial layer as well as of suitable sensors.

It was recognised that water vapour was not the only gas whose exchange between sea and air was important, carbon dioxide, lead tetraethyl and others were of concern. They would be considered by SCOPE and other international bodies.

It was agreed that work on these problems would be stimulated wherever possible and that at a joint meeting of IAMAP and IAPSO (now fixed for 14th - 25th January 1974 in Melbourne) one session should be devoted to discussing the mechanisms involved in the exchange of gases between the atmosphere and the ocean.

4. Air Sea Interaction in relation to ocean circulation projects

This was discussed briefly but it was agreed to defer detailed consideration to the next meeting when it was hoped Dr. Byran would report on recent developments. The question of monitoring the results was important and there was a brief discussion of the MODE and Polygon projects.

5. Air Sea Interaction in relation to GATE, GARP and other Meteorological projects

The detailed plans for GATE would not be available until the end of 1971, and it was agreed that Dr. B.J. Mason, Chairman of the Tropical Experiment Board, should be invited to present an account of its present status.

(NOTE: Dr. Mason presented his account at a subsequent meeting, attended also by SCOR WG 21 and 34. It became clear that a coordinated oceanographic project, using all the ships, would probably prejudice the meteorological objective. There would be an opportunity to do some oceanographic work but detailed planning could not be done until the GATE plans became firmer. The collaboration of oceanographers would be sought by publication of a general account of the proposed GATE project in oceanographic journals. The air sea interaction aspects were important: it was thought they should deal with interactions which affected synoptic developments rather than with small-scale near-surface motions. Much depended on decisions about the station keeping required of ships, the navigational aids available for windfishing, etc.)

As regards GARP, little progress had been made since the last meeting in specifying the need for buoys. Various prototypes were being constructed in several countries. Professor Stewart reported that the University of British Columbia was collaborating with the French EOLE Project in studying the satellite location of drifting buoys. Concern was expressed that the IRIS system was being abandoned but no definite information was available. The general view was that satellite interrogation of buoys would prove desirable but that to transmit only the sea surface temperature would not be adequate.

Professor Zilitinkevich reported that he has accepted an invitation from the Joint Organizing Committee for GARP to provide a review on air sea interaction in connection with GARP.

Dr. Mitsuta spoke briefly about the 1974 AMTEX project to study air sea interaction when cold air flows south over Japanese waters. The importance of this and other area studies was recognised and it was agreed that they should be fully supported.

(NOTE: the following resolution was subsequently passed by IUGG - The IUGG recognizing the great importance of boundary layer phenomena to the development of the GARP project and to ocean circulation projects and being aware of the value of international studies of regions of particular significance, recommends that such studies be supported, especially those concerned with

- 1) air mass modification in the Sea of Japan
- 2) wind/wave interaction in the North Sea and
- 3) boundary layer interaction in the Atlantic Ocean)

6. Air-land interaction in relation to GATE, GARP and other meteorological projects

This was discussed only briefly. Dr. Priestley reported on Australian work on this aspect. The views of the JOC for GARP were not yet clear. Nothing had been done about a network to monitor the radiation surplus or to assess surface wetness.

7. Air-surface interaction in relation to seasonal and long term development

This was acknowledged to be related to questions, discussed earlier, of the increased density and improved accuracy of observations, especially over the ocean. There seemed little hope of explicit modelling but the reality of the so-called tele-connection was now in little doubt. Dr. Dobryshman reported that the WMO Historical Sea Surface Temperature Project was still active.

8. Survey of relevant research activity

It did not seem necessary, or desirable, to produce a comprehensive survey of relevant research activity. Air-sea interaction was not a well-defined subject but had ramifications into most aspects of meteorology and oceanography. It was thought that the Joint Committee could most usefully concern itself with the interaction of the atmospheric and oceanic boundary layers.

9. Status report on WWW and IGOSS

Dr. Dobryshman, though not an official WMO representative, spoke briefly about WWW, which was progressing satisfactorily and referred to various reports of progress which were available from WMO. The development of IGOSS had apparently been temporarily halted pending a more realistic specification of a practicable system.

10. Date of next meeting

It was agreed that the next meeting should be held in January 1974 during the joint meeting of IAMAP and IAPSO which it is hoped will take place in Melbourne, Australia, in January 1974.

Recommended subjects for symposia at that meeting are:

The determination and prediction of sea surface temperature  
Exchange of gases between atmosphere and ocean  
Meso-scale structure of the atmospheric and oceanic boundary layer  
The role of air sea interaction in synoptic and climatic development

The Joint Committee expressed its thanks to their Soviet hosts for allowing the meeting in Moscow University.