International Council for the Exploration of the Sea

C.M.1989/C:6
Hydrography Committee

REPORT OF THE WORKING GROUP ON OCEANIC HYDROGRAPHY

Gothenburg, Sweden, 25-26 April 1989

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Report of the ICES Working Group on Oceanic Hydrography meeting in Göteborg 25-26 April 1989

1.& 2. OPENING AND LOGISTICS.

The meeting was hosted by Oceanografiska Institutionen, Göteborg and commenced on the morning of April 25th at the neighbouring "Sjöfartsmuseet". Participants are listed in annex A.

After a welcoming address by Johan Rodhe on behalf of the hosting institute and some practical information from the local organizer Artur Svansson, the draft agenda (Annex B) was introduced and adopted. The items specifically defined by the Council for this meeting (C.Res.1988/2:22) were:

a. Consider progress in the Greenland Sea Project, in NANSEN and in WOCE.

b. Consider operating procedures for CTD's and water bottles, including the accurate determination of dissolved oxygen concentrations.

c. Assemble and assess eastern boundary slope current transport measurements from West Africa to northern Norway.

3. HYDROGRAPHERS OPENING REMARKS.

The chairman asked the ICES Hydrographer to present the issues which the Secretariat would like the WG to consider. Dr. Dooley had prepared a note (Annex D) in which he emphasized especially the data management aspect of the three major programs, the GSP (Greenland Sea Project), the WOCE (World Ocean Circulation Experiment) and the NANSEN (North Atlantic Norwegian Sea ExchaNge) projects. In all of these the Service Hydrographique is to play some role, but especially for the NANSEN project the WG should define more clearly the input and expected output. The Hydrographer drew attention to the scope of existing data collection schemes, notably the TESAC and the ROSCOP. He urged for more input to these. Finally he reminded the WG members of the 1991 symposium on "Hydrobiological variability in the ICES area 1980-89". The chairman thanked Dr. Dooley for his introduction and noted that the points presented would be further discussed under the pertinent agenda items.

4. MEMBERSHIP.

Membership of the group was reviewed and it was noted that some items on the agenda could not be discussed in the detail originally intended due to lack of participation by certain key members. Regrets were expressed by several participants that the procedures for WG membership are not adhered to more regularly and that the information flow in some countries is poor leading to some confusion as to actual membership.

5. OPERATING PROCEDURES FOR CTD AND WATER BOTTLE OBSERVATIONS.

Concerning CTD data the group agreed that the procedures set out in the report of SCOR WG51 (Unesco Techn. Pap. in Mar. Sc. 54) gave an appropriate framework. The ICES intercomparison exercise on salinity bottles (ICES C.M. 1987/C:21) was mentioned as the appropriate guide for choosing salinity bottles for storage although on-ship analysis is required for the highest accuracies. The recent appearance of digital electronic thermometers and pressure sensors mounted on water bottles or rosettes were seen as a very useful check on the stability of CTD sensors. Especially for the electronic thermometers experience was very good although some battery troubles have been noted at low temperatures.

With respect to oxygen determination the group could not identify a suitable manual although guidelines are in preparation in the framework of JGOFS (Joint Global Ocean Flux Study) and WOCE. Standard texts on the subject are available, of course, but it was generally agreed that to acquire the accuracy of 0.01 ml/l possible special procedures had to be followed which require extensive training of technical staff. Van Bennekom (Netherlands) kindly offered to summarize procedures adopted by his own lab. These are included in the report as annex C.

The group discussed also the question of nutrient determination as nutrients often provide additional information on the origin and history of a water mass. It was noted that during standard hydrographical observations large amounts of water samples are collected and if storage of samples for later analysis ashore is worthwhile nutrient samples may be collected with little extra effort. The answers to this question seem to vary considerably, however, among experts and the group felt that it would be worthwhile if the WG on Marine Chemistry could establish guidelines for the conditions, under which nutrient samples can be stored, what storage procedures should be used and what accuracies can be obtained under different conditions. It was suggested that if possible the next meeting of the OHWG should overlap the meeting of the Marine Chemistry WG in March 1990 and be also in Copenhagen so that a joint meeting with that group or a subgroup of it could be arranged for a couple of hours discussion.

The question of oceanographic reference stations was addressed and the group agreed on a preliminary adoption of two fixed stations:

A: 71°N 4°E and B: 64°30 N 6°W

The first of these is used as a reference station in the Greenland Sea Project while the second one has been occupied within the NANSEN project and is very suitable for that programme. It is recommended that research vessels occupy these stations whenever they are in the vicinity *and report results of bottle observations (all measured parameters) to the Service Hydrographique.* The Hydrographer will compile and quality control these observations and make them available.

6. REVIEW OF INTERNATIONAL PROGRAMMES.

a. The Greenland Sea Project.

The status of the Greenland Sea Project was presented by Fahrbach and Meincke. They outlined the work that had already been completed, described future plans, and presented first results as follows:

> The Greenland Sea Project is an international programme to study water mass formation and circulation in the Greenland Sea area in relation to atmospheric forcing and sea ice conditions. The programme includes field work at sea, remote sensing and modelling efforts. Scientists of 11 nations are working in 34 projects which include large

scale hydrographic surveys, direct circulation measurements by moored current meter arrays, an acoustic tomography experiment and a number of small to meso scale process studies aiming at convective, frontal and air-ice-ocean interaction processes.

The project commenced in 1987. From summer 1988 to summer 1989 an intensive field phase is on its way. During this period 17 cruises provide data on the seasonal cycle of the water mass distribution in the Greenland Sea gyre and its boundaries which will allow a water mass census. Simultaneously 29 current meter moorings including a tomography array monitor the circulation.

First results of the CTD-survey in summer 1988 show the expected structure of the Greenland Sea gyre with a cold, relatively fresh and oxygen rich center as a consequence of water mass renewal in late winter. During fall exchange with the boundaries has lead to a slight warming, increase of salinity and decrease of oxygen. In February convection was observed down to 1000 m whereas in the deeper layers no significant change was encountered.

A current meter array moored on the East Greenland slope from summer 1987 to summer 1988 indicates significant interannual variability in the depth level of the Transitional Deep Water. The temperatures at 1300 m were 0.5°C colder in summer 1988 than in summer 1987. This correlates with CTD-surveys which revealed convection down to 1300 m in February 1988 but not in 1987.

After the present intensive field phase a moderate programme will be pursued to address interannual variability. It will be followed by a second intensive field phase with emphasis on remote sensing and sea ice work.

It was noted that the Service Hydrographique (S.H.) is to act as archive centre for the CTD data from the GSP and the group considered how this could be managed in the most effective way. On the suggestion of the ICES Hydrographer it was agreed that high resolution (1 db) data should be archived only in the format sent to ICES, but the S.H. would extract data at selected depths only (as specified in the guidelines of the 1984 Report on the WG on Marine Data Management, ICES C.M. 1984/C:29) for quality control and general distribution in a common format. Data should be distributed to third parties only on the approval of the originator.

b. The World Ocean Circulation Experiment.

The Working Group assessed the plans for WOCE especially with respect to the North Atlantic. The latest revisions of WOCE plans for that region were briefly reviewed by Meincke and other participants described their respective nations intended contribution to WOCE.

Rees (UK) informed the group about the progress of the WOCE Scientific Panel on Statistics (Bob Dickson). They have prepared a large volume of 2336 instrument years of current meter data (cf 454 years in 1981). He thanked everybody for their contributions and asked for updates of data to produce a 3rd volume during WOCE.

The group was informed of a planned Nordic joint contribution to WOCE which is seen as a continuation of the NANSEN project.

7. THE NANSEN PROJECT.

The NANSEN project (North Atlantic Norwegian Sea ExchaNge) has from its planning stage been an ICES project coordinated within this Working Group. In its continuation

most of the national programmes within that region will be regarded as components of WOCE, but it was agreed that it would still be fruitful to discuss the progress of that work within this group and that this should be one of the main tasks of the group. A review of cruises conducted and future plans was given by national representatives:

Becker (FRG). DHI carried out two cruises in the summer of 1987 and 1988 in the Iceland Basin. About 160 CTD stations (incl. silicate and oxygen) were worked. Unfortunately three moorings southeast of the Reykjanes Ridge were lost. Only three (out of 25) instruments were picked up by an Icelandic fisherman. The bottle data have been worked up, all sections are drawn and the CTD data will be worked up during 1989.

Rees (UK). In June 1988 7 out of 8 moorings were recovered from a section across the Denmark Strait (2 c.m. on each mooring). Another 8 moorings were relaid with 3 c.m. each (lowest meter in bottom 50m), thermistor chains and Seacat logger. These will be recovered and relaid in June 1989. The section will be occupied until 1992 if losses do not exceed 50% per deployment. CTD section along mooring line. This is only possible with the help of FRG (Meincke) ship time.

During this summers cruise Andy Watson (PML) and possibly an assistant funded by MOD(N) will be measuring chemical tracers e.g. Freon 113 and CCl_4 (Carbon tetrachloride) which will allow identification of water mass age back to the 1920's. We regard links with Nordic WOCE as crucial due to its "upstream location" and need for mutual data exchange. Therefore if other investigators wish to add extra instruments to the line (at their own expense if lost) to look at a different angle from our own they are very welcome. e.g. Peter Lundberg may be modelling the overflow.

Ellett (UK). Current meter records from three depths were obtained between 6 September 1987 and 10 June 1988 at a position south of Faroe Bank in 710 m depth. At a nearby position in 900 m depth records were obtained between 2 March and 10 June 1988 at two depths. In spring and early summer a greater westward flow of mixed Atlantic and Norwegian Sea water was found at mid-depths than in the autumn and winter.

CTD surveys in the region between the Wyville Thomson Ridge, the Ymir Ridge and Faroe Bank were made during 6-17 September 1987 and during 9-14 June 1988. CTD sections were made across the Faroe Bank Channel and SE & NW from Faroe Bank in September 1987, and SE & SW from Faroe Bank in June 1988.

Van Aken (Netherlands). This summer (1989) the Dutch will carry out a high resolution hydrographic survey at 20°W from 60°N to the Icelandic coast. Also a current meter mooring will be deployed. For 1990 and 1991 more extensive surveys and moorings in the Iceland Basin are planned.

Svansson (Sweden). The Oceanographical Institute in Göteborg has been involved especially in the Overflow problem, Borenäs-Lundberg: JPO 1988: On the deep-water flow through the Faroe Bank Channel and is also involved in a Nordic project on biological hydrography (Westerberg) around the Faroe Islands.

Østerhus (Norway). During the R/V Håkon Mosby cruise in May 1988, 132 CTD stations were taken. The cruise was a joint cruise with

BIOFAR (Nordic project to study the benthic fauna around the Faroe Islands). In 1989 a joint NANSEN/BIOFAR cruise will be carried out from May 25 to June 8 to the region around the Faroes. In 1990 a 3-4 week long cruise (partly together with BIOFAR) is planned. The physical part will mainly be carried out in the region North and Northeast of the Faroe Islands.

Hansen (Faroes). The Faroe Islands have initiated a programme of 3 standard sections to be occupied (CTD and ADCP) at least four times a year. In addition two hydrographic cruises were made in 1988 one in May concentrating on the region southwest of the Faroe Plateau and the other in August on the southwestern Norwegian Sea. Both these cruises are related to investigations on blue whiting and are part of a long series which will be continued.

In future the standard sections will be a component of the planned Nordic WOCE programme and will be complemented by moored instruments.

The group expressed satisfaction with the high level of activity within the NANSEN project but hoped that in future meetings a more complete representation could be had from all nations working in the area. The group expressed regret on the lack of information on Sovjet investigations in the area which are known to be comprehensive.

As requested by the ICES Hydrographer the data management aspects of NANSEN were discussed thouroughly. As for GSP data it was agreed that the CTD data should be quality controlled and made available in a common format at "water bottle equivalent depths". Dr. Dooley reminded participants that almost no ROSCOP forms for NANSEN cruises had been received by the Secretariat and he drew attention to the newly implemented PC based input system for ROSCOP's which was demonstrated during the meeting. The group agreed that ROSCOP forms for all NANSEN cruises should be completed and sent directly to the Secretariat before July 1. Based on the response of that, the Service Hydrographique has prepared a listing of NANSEN cruises which is included as annex E.

The chairman reminded group members of the decision to send current meter data to BODC (former MIAS) for archiving and cited a letter from BODC noting that only UK data had so far been received. A preliminary inventory of NANSEN current meter data received had been prepared by BODC and was circulated.

8. THE EASTERN BOUNDARY SLOPE CURRENT.

Measurements of the eastern boundary slope current west of the British Isles were reviewed by Ellett (UK). He drew attention to recent papers on the subject, especially Huthnance, J.M., 1986. The Rockall slope current and shelf edge processes. Proc. R. Soc. Edinb., 88B, 83-101. He summarized them briefly as increasing current speeds going northward along the slope, but with fairly constant transport values on the order of 1-2 Sv south of the Wyville Thomson Ridge area from which point the transport increases. He reviewed also results from satellite tracked drogues which, with a few notable exceptions, confirmed the picture of a more or less continuous slope current along the slope from the Porcupine Bank area to the Norwegian Trench where drogue tracks follow the topography into the North Sea. He showed also drogue tracks along the Norwegian slope which again were closely bottom trapped.

Blindheim (Norway) showed hydrographic sections along the Norwegian coast which clearly indicated the slope current and cited current meter results on a section from Bear Island to Northern coast of Norway with transport values into the Barents Sea on the order of 3 Sv all of which would however not be slope current transport. He mentioned current measurements and hydrographic investigations further south along the coast, but concluded that a more intensive observational effort was needed to obtain reliable

transport estimates in this region of the slope current.

Rees (UK) discussed results from measurements on the Porcupine Slope and from the NEADS 6 Array. Both positions have strong vertical structure in the mean flow. However there does seem to be a fundamental difference in the processes leading to this situation. At the Porcupine rise the mid-depth variability is uncorrelated with that above or below. This is possibly due to slope generated or modified eddies (Prof. Thorpe at SUDO is looking at slope generated eddies). The NEADS 6 array is remote from the slope and the low frequency variability is coherent throughout most of the depth. Eastward flow at the surface may be possibly reinforcing the slope current.

Concerning the southern part of the slope current from West Africa to the Porcupine Bank area the group was aware of measurements having been done and being planned but did not feel adequately represented to assess transport values for this region. An increasing interest in this problem was mentioned and the group felt it worthwhile to continue the discussion of the slope current problem at its next meeting hoping for a wider representation.

In connection with measurements of currents on slopes the group discussed the difficulty of obtaining long timeseries in these important regions due to fisheries. Moored upward looking ADCP's (Acoustic Doppler Current Profilers) seem a good alternative in some regions, but in areas with bottom trawling they also are fished. The possibility of ADCP's mounted on "trawl resistant frames" sitting on the bottom should be further researched technically, but the lack of a similar instrument for remote temperature profiling is seen as a severe drawback.

9. REVIEW OF NATIONAL PROGRAMMES AND PLANS.

Most of the investigations having been done or being planned fall within the headings already discussed, but the group was informed about the following additional work.

Rees (UK). Tracks of deep SOFAR floats have produced 5500 float days on the Iberian Abyssal Plain and 5600 float days on the Madeira Abyssal Plain, the longest being 1350 days and 1200 days respectively. Estimates of Kinetic Energy, Lagrangian Integral Time Scale and diffusivity have been made for the two regions. Comparison with Taylors dispersion agree well on the Iberian Abyssal Plain where the mean movement of the cluster of floats is small. The dispersion at long time scales (>500 days) becomes constant as the floats reach the edges of the basin. Dispersion on the Madeira Abyssal Plain does not agree as well with Taylor dispersion at medium time scales as the centre of the cluster moves NW.

Svansson (Sweden). Sweden is engaged in work in the Arctic area: a) Björk: A model of the stratification of the Arctic Ocean, b) Larsson-Sehlstedt: Barents Sea studies as part of Norwegian PROMARE, c) Plans are progressing on an expedition with the new Swedish ice-breaker Odin in 1991. During the spring of 1989 the new selfcontained profiling instrument GISMO, constructed by Schaffer, has been used on board "Meteor" in the subtropical Atlantic.

Østerhus (Norway). Norway is working with Sovjet in a Sovjet Norwegian Oceanographic Program (SNOP). This programme involves 5 institutions: The Arctic Antarctic Research Institute in Leningrad, and 4 Norwegian Institutions; The Norwegian Meteorological Institute, Norwegian Polar Research Institute, The Institute of Marine Research, Bergen and the University of Bergen. The Norwegian Research Council for Science and Humanities (NAVF) coordinates the Norwegian effort.

In the SNOP program there are plans for cooperation in both field work and numerical modelling in Arctic oceanography.

Until now only the field programme has gained significant momentum. In 1989 there are plans for more than 100 days ship time, mostly in the northern Barents Sea including a 2000 tons Sovjet icebreaker for 60 days. The main goal is to study exchange processes between the Barents Sea and the Arctic Basin. Plans include deploying about 15 current meters for one year in the straits between Svalbard and Franz Josef Land in 1989-90. 2 water level recorders will be deployed, and probably 2 upward looking echosounders to study the ice transport.

The field effort will continue at the same level until 1992, which is the end of the program period planned so far.

10.& 11. SECRETARIAT MATTERS.

The WG inventory was introduced by the ICES Hydrographer. A preliminary version of the next edition was distributed to the group. This edition is planned to be distributed in July 1989 and Dr. Dooley asked that participants send to ICES as soon as convenient any changes, deletions or additions. It was mentioned that, although the inventory was originally implemented by the OHWG and updated by the chairman of the group, in later years S.H. had taken on this job. A number of entries not related to Oceanic Hydrography had been included in a Shelf Seas section of the inventory. The group stated its satisfaction with the form of the inventory and the procedure.

Also the Hydrographer drew attention to the TESAC system mentioned in his introduction (annex D) especially the availability of data from Ocean Weather Ship Charlie within that system.

13. NEXT MEETING.

The Group agreed that the meeting had given useful insights into the items on the agenda, but as many of the items were in phases of intensive ongoing research it would be necessary to continue the discussion on these subjects. Concerning operating procedures for obtaining accurate dissolved oxygen concentrations and other chemical parameters of direct use to physical oceanography a closer communication with the Marine Chemistry Working Group was considered very desirable.

An additional item for the next meeting arose out of remarks (e.g. from Ellett and Blindheim) that mean salinity values in the Rockall Trough and in oceanic areas off the Norwegian coast have been declining during recent years to levels approaching those found during the "Midseventies anomaly" although still somewhat higher. Considering the great biological significance which has been attached to that event it was felt wise to monitor the salinity and review recent measurements at the next WG meeting.

Also the group felt that it would be timely again to consider intercalibration schemes for salinity measurement.

Consequently the group agreed to the following recommendations for the next meeting:

Recommendations:

The Working Group on Oceanic Hydrography should meet at ICES Headquarters for two days to:

a. Review the status and results of the NANSEN project and coordinate further observational efforts within that project.

b. Review plans and results of the Greenland Sea Project and WOCE.

c. Assemble and assess eastern boundary slope current transport measurements from West Africa to northern Norway and coordinate further observational work.

d. In collaboration with the Marine Chemistry Working Group or a subgroup of it to consider operating procedures for accurate measurement of dissolved oxygen and for the determination of other chemical parameters of direct interest to physical oceanography e.g. nutrients and Carbondioxide.

e. To evaluate the time trends in salinity in oceanic areas in recent years in relation to the "Mid-seventies anomaly".

f. To discuss intercalibration schemes for salinity measurements in the ICES area.

The meeting was closed at 1700 on 26th April 1989 by the chairman who thanked the host institute, and especially Dr. Svansson, for their hospitality and for the comfortable arrangements for the meeting.

Annex A.

List of participants at the Oceanic Hydrography WG meeting April 1989

Artur Svansson, Sweden
Eberhard Fahrbach, FRG
Johan Blindheim, Norway
Ken McLean, UK
Jon Rees, UK
Hendrik M. van Aken, Netherlands
David Ellett, UK
Jens Meincke, FRG
Harry Dooley, ICES
Bertil Håkansson, Sweden
Svein Østerhus, Norway
Johan van Bennekom, Netherlands
Gerd Becker, FRG
Bogi Hansen, Faroes

Annex B.

Agenda for the Oceanic Hydrography WG meeting April 1989.

1. Welcoming address by the host institute.
2. Logistics of the meeting (Svansson).
3. Hydrographer's opening remarks.
4. Review of WG membership.
5. Operating procedures for CTD and water bottle observations.
6. Review of international programmes:
   The Greenland Sea Project (GSP).
   The World Ocean Circulation Experiment (WOCE).
7. The NANSEN project. Results, plans, data management.
8. The Eastern Boundary Slope Current.
9. Review of national programmes and plans.
10. Update of WG inventory.
11. Secretariat matters.
12. Any other business.
13. Place, time and topics for next meeting.

Annex C.

HIGH PRECISION DETERMINATION OF DISSOLVED OXYGEN.

The use of a photometric endpoint determination in our experience increased the precision of the Winkler technique with a factor of about 5 relative to the classical endpoint of iodine-starch, determined by eye.

In both cases good laboratory practice, consisting of a large number of small tricks is important, although the importance of these tricks of course increases with increasing precision of the endpoint. A list of in our experience important points follows; the list is of course subject to additions and changes, according to other people's experience.

1. Taking samples and handling prior to titration.
2. Reagents.
3. Titration procedure and endpoint detection.
4. Blanks, titer and calculation.

1. Use 100 ml narrow mouth bottles of borosilicate glass with normalized ground stoppers and calibrated volumes (20°C). Fill as soon as possible from the cast, tubing reaching to the bottom of the oxygen bottle. Flush at least 3 times by overflow, check for bubbles. Add the reagents immediately from the best available quality dispensers using narrow tips (eg insert a smaller bore tubing, which is periodically cleaned). Fix the stopper and the bottle with rubber bands and shake well, at once and again after about 5-10 min. Store the bottles under water in the thermostated room where the titration is to be performed. Speed is needed to be able to carry out corrections for temperature change; the in situ temperature from the cast is taken for these corrections; this may mean for deep samples in the tropics that reagents are added after filling each bottle.

2. We use for reagent A 600 g $MnCl_2.4H_2O$ per liter and 250 g NaOH + 350 g KI per liter for reagent B. Both reagent quality and filtered through GFC. The mixture of NaOH and KI has a better stability than the components; they are dissolved separately, mixed, brought to volume and filtered.

3. Titrations are carried out within 1-2 days after sampling. Acidify the bottle with 0.75 ml 20N H_2SO_4, add a small stirrer magnet and titrate with 0.2-0.3 N thiosulfate, from a 1 ml motor driven burette (eg Metrohm nr 665). The titer of the thio is adjusted to the expected oxygen concentrations in that way that about 70% of the burette volume is used for an O_2%=100. The capacity of the bottle mouth is sufficient to allow for the added reagents and the stirrer and nothing of the bottle content has to be removed. The endpoint is detected photometrically with light of 350 $\pm$ 10 nm (interference filter). During the last 1-2% of the titration 6-12 combinations of extinction and titrant volume are recorded and these data points are extrapolated to zero extinction. The linear correlation coefficient of these data is a good measure of the quality of the endpoint (>0.995, often >0.999). It is of course most easy to feed photometer and burette readings into a computer.

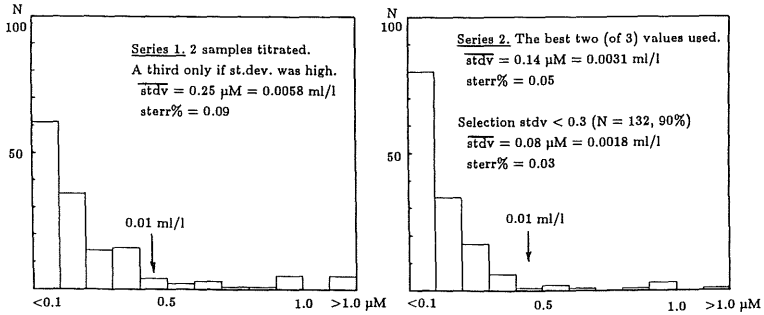
4. The blank is predominantly determined by JO_3^- in sea water; good quality reagents hardly have a blank. If reagents contain reducing components, prepare new reagents. The blank due to iodate and possible oxidizing components in the reagents is determined by first adding H_2SO_4 to the sample and then NaOH-KJ (no precipitate is formed), note the photometer reading (S1), add a small amount of excess thio, photometer reading S2 and add excess of KJO_3, photometer reading S3. The extinction (Ext=-log((S1-S3)/(S2-S3))) of the "reversed mode sample" is too low to allow for the extrapolation procedure and with the procedure above the extinction can be related to a volume of thio. Blanks are

<0.2%. The titer is determined with suprapur KJO_3 solution, concentration determined by weight. Averages of about 10 determinations should give a precision of better than 1 in 2000.

In the calculations the expansion of bottle and contents from in situ temperature to standard temperature (20°C) is taken into account. When data are to be reported in uM/kg, the amount of seawater in the bottles is calculated from the density at in situ temperature.

The photometric endpoint and the endpoint by eye require skilled technicians; the former method is not less work, but it is more "objective" because not just one reading is used for the endpoint and the precision is higher. We usually take samples in triplicate, titrate 2 and if they differ more than 0.10%, titrate the third. Using this procedure, a skilled technician attains a precision of 0.03 to 0.05% (for the 90% best values, equivalent to .002 to .003 ml/l of oxygen; see figure). We believe that precisions of 0.01 ml/l, as stated during the meeting of the ICES Oceanic Hydrography WG to be attainable with eye endpoints are obtained after screening of outliers. In our experience the statistical precision of the method with eye endpoint, taking the best of 3 duplicates is about 0.4% (personal communication H.M. van Aken and M.W. Manuels).

The high precision procedure has been applied successfully to obtain day/night rhythms, where relative precision is the most important. An example of the application of the method to the entire water column of the Norwegian Sea/North Atlantic is given in the figure. In view of possible time trends in deep waters, the absolute accuracy is the key factor. Then, the error in the titer should be added.



Statistical analysis of automated photometric Winkler titrations from cruise to the North Atlantic Sept. 1987. N_{tot}=146. Sampling in triplicate. Operators F.Wetsteyn and R.Kloosterhuis.

Literature:

Tijssen, S.B., 1981. Anmerkungen zur photometrischen Winkler- Sauerstoff- titration und ihre anwendung zur Schätzung der Primärproduktion im Meer. In: III Internationales hydromikrobiologisches Symposium. Smolenice, 3-7 Juni 1980, 343-353. Veda, Verlag der slowakischen Akademie der Wissenschaften, Bratislava.

Texel, 16 May 1989
S.B. Tijssen
A.J. van Bennekom

Annex D.

ICES Oceanic Hydrography working Group

25-26 April 1989, Gothenburg

Remarks on Agenda relevant to Secretariat activities

1. GSP, NANSEN and WOCE.

GSP:

Council approval was received for ICES to act as archive centre for the CTD data from the GSP (C.Res 1988/4.11). As yet no data or information have been received. I understand that GSP also wishes the Secretariat to coordinate a 1st level inventory of data (Sort of ROSCOP but a bit more) and PC version of ROSCOP form, which allows for the bit more sent to Boulder with JM for feedback purposes in February. No feedback so far received.

NANSEN:

This has been a bit of a dead duck so far as the approved ICES commitment is concerned. The attached shows station positions so far received (Osterhuis and Hansen data). Some errors in data which need sorted (also attached). No information on any NANSEN cruise in the way of ROSCOP etc been sent in, which makes it rather difficult to know what resources have to be committed to this effort. Need this working group to tell me now what is coming, and make a clear statement about what has to be done with it, and in what format, otherwise competition from other activities may well force a default on this commitment.

I propose that redistribution of data occurs in received formats for high resolution data, but merged low resolution data sets will be prepared in any case, in ICES (what else?) format. The Group may wish to consider ways of presenting these data, and this may include the Luytens/Stommel system for example. On this

latter point, the Group may wish to consider the present developments concerning PC-oriented atlas systems which seem admirably suitable for Oceanic applications.

WOCE:

Jens Meincke reported on this topic at last year's Statutory meeting. He remarked in particular that ICES should keep up its offer to assist WOCE in some way in the sphere of data management and quality control. JB may however wish to report the reaction to this received at the Paris WOCE planning meeting, at which he represented ICES. However I understand that there may now be some interest in "rolling in" the SH into the WHP machinery to provide advice on data quality.

The WG may also wish to consider what advice may be given to the Committee concerning the labelling of northern seas work as WOCE, eg Scandinavian activities in GSP. Should others working in similar waters, such as NMFS and NOAA also be brought under this label?

4. Other Matters.

a. TESAC

In July 1987 the first attempts to get together TESAC North Atlantic data were made at the request of the NANSEN group. Amazingly this has still not been possible, although an agreement has now been made with DHI. Attached is a list of stations which have been submitted there during 1988. The main attraction, which comprises 90% of the data, is mainly Soviet sections and Charlie data, but note the relative sparcity north of Charlie. The TESAC system is still grossly under-used by most non-Soviet nations, a point which the WG members should note.

b. Data and information exchange.

The SH regional data and information service does not get very much support from most members of this WG. Maybe you can be tempted with the new look ROSCOP form, or maybe even the electronic version of it. If you use the latter, then you need write nothing except the label on a floppy diskette!

c. ICES meetings/symposia.

Members may wish to note that the new chairman of the Hydrography Committee is Dr Brosin of Warnemuende, GDR. Last year's stat meeting considered 7 scientific presentations concerning Oceanic Hydrography (including 1 poster). These papers dealt with various aspects of the oceanography of NA, and included descriptions of processes based on evaluation of water mass characteristics and the statistics of current measurements. One particular paper (C12) was concerned with the statistical analysis of 40 years of T,S data off Newfoundland which showed this area to be governed by differential inputs of water types from the Arctic and Atlantic.

The closing data for contributions to the next Statutory Meeting is the end of this month (but stretchable in special circumstances). At the time of writing, the number of titles so far received is 2 (neither of relevance to oceanic hydrography).

A Symposium on "Hydrobiological variability in the ICES Area 1980-89" is to be held at Mariehamm in June 1991, under the convenorship of Bob Dickson. One of the excuses for this symposium was the cessation of publication of Annales Biologiques. As many of the past and present members of the WG were staunch allies of this publication, Bob will be looking for a lot of support and interest from this group.

Harry Dooley/23 April 1989

Annex E

NANSEN Cruises submitted on ROSCOP forms to ICES as from August 1989

Country	Dates	Ship	ID	Yr
Denmark (Faroe Islands)	25 Apr 04 May	Magnus Heinason (OW2252)	014	86
Denmark (Faroe Islands)	05 Jun 14 Jun	Magnus Heinason (OW2252)	015	86
Denmark (Faroe Islands)	07 Aug 19 Aug	Magnus Heinason (OW2252)	016	86
Denmark (Faroe Islands)	24 Apr 04 May	Magnus Heinason (OW2252)	013	87
Denmark (Faroe Islands)	03 Jul 14 Jul	Magnus Heinason (OW2252)	014	87
Denmark (Faroe Islands)	26 Aug 08 Sep	Magnus Heinason (OW2252)	015	87
F.R. Germany	02 Jul 14 Aug	Gauss 2 (DBBX)	051	87
Iceland	03 Sep 22 Sep	Bjarni Saemundsson	011	87
Netherlands	11 Sep 05 Oct	Tydeman	026	87
Norway	16 Mar 11 Apr	Eldjarn	003	87
Norway	28 Jul 16 Jul	G.O.Sars	043	87
Norway	17 Aug 03 Sep	G.O.Sars	044	87
United Kingdom	09 May 05 Jun	Challenger	029	87
United Kingdom	19 Jun 20 Jul	Cirolana	084	87
United Kingdom	04 Aug 24 Aug	Frederick Russell	034	87
United Kingdom	27 Aug 19 Sep	Frederick Russell	013	87
United Kingdom	17 Jun 07 Jul	Scotia	044	87
United Kingdom	09 Sep 29 Sep	Scotia	047	87
Denmark (Faroe Islands)	24 Apr 02 May	Magnus Heinason (OW2252)	005	88
Denmark (Faroe Islands)	20 May 31 May	Magnus Heinason (OW2252)	006	88
Denmark (Faroe Islands)	12 Aug 27 Aug	Magnus Heinason (OW2252)	007	88
United Kingdom	24 Feb 07 Mar	Challenger (GPIU)	002	88
United Kingdom	06 Jun 23 Jun	Challenger	039	88
United Kingdom	23 Oct 06 Nov	Gorsethorn	044	88