

SCOR WORKING GROUP 10 (WITH IAPSO, ICES AND UNESCO)

OCEANOGRAPHIC TABLES AND STANDARDS

Report from Chairman

The eight meeting of the Joint Panel of Experts on Oceanographic Tables and Standards was held May 23–25 at the Woods Hole Oceanographic Institution, Woods Hole, Mass. to consider redefinition of salinity and progress toward a new equation of state for seawater. A complete report of the meeting has been submitted by Dr K. Grasshoff to SCOR, ICES, IAPSO and UNESCO.

A recommendation (Recommendation 1 - below) for a practical salinity scale, defining salinity in terms of conductivity using a potassium chloride standard, was drafted. Additional measurements necessary to complete the definition are underway. A subgroup meeting is scheduled for March 1978 in Miami to review the new data and to prepare final recommendations for the next meeting in Paris of the Joint Panel in September 1978. Travel funds for Dr F. Culkin (U.K.) and Dr A. Poisson (France) are requested to attend the March meeting in Miami.

A recommendation (Recommendation 2 - below) for a new equation of state has been drafted by the Joint Panel. Data sets suitable for defining the equation of state were identified. These will be used to develop the final version of the equation. A recent calibration of the deadweight piston gauge at W.H.O.I. yielded corrections to pressure that exceeded error limits and consequently required recalculation of the formulas for both pure and sea water. The additional computation is not expected to affect the schedule for preparation of the equation of state.

The next Joint Panel meeting is scheduled for *September 11–13, 1978* at UNESCO in Paris.

N.P. Fofonoff

WG 10 Recommendation 1/1977

Practical Salinity Scale (1978)

We recommend that:

- (1) Absolute salinity, symbol S_A , be defined as the ratio of mass of dissolved material to the mass of solution. In most cases this quantity cannot be measured directly and a practical salinity, symbol S , shall be defined for reporting oceanographic observations.
- (2) The practical salinity scale be based on a Standard Seawater having a fixed conductivity ratio at 15°C to a potassium chloride solution made by dissolving a known weight of this salt in a given weight of pure water. The Standard Seawater used to determine the above ratio will be obtained from the North Atlantic and have a chlorinity of 19.3740 ‰. This Standard Seawater will establish the 35.0000 ‰ point on the scale. The conductivity ratio (R_{15}) at 15°C of weight diluted or evaporated Standard Seawater to the

35.0000 ‰ standard will be measured. The equation of these weight diluted or evaporated salinities as a function of R_{15} will fix the practical scale.

- (3) For all seawaters other than Standard Seawater the practical salinity will be determined from the equation $S = F(R_{15})$ where

$$R_{15} = \frac{C(0, 15, S)}{C(0, 15, 35)}$$

and $C(0, 15, S)$ is the electrical conductivity of sample sea water at 15°C and atmospheric pressure. Thus all seawaters having the same value of R_{15} will have the same practical salinity.

- (4) Practical salinity be related to absolute salinity by an equation

$$S_A = a + bS$$

where the parameters a and b are dependent on the ionic ratios of the sample. For Standard Seawater $a = 0$, and $b = 1.00488$ approximately; any improvement in these values shall serve to change S_A not S . It is probable that “ a ” may be put equal to zero for nearly all water masses with negligible error.

- (5) Equations to convert observed values of conductivity ratios at temperature t and atmospheric pressure to practical salinities including the final form of the equation $S = F(R_{15})$ be formulated by March 1978. The equations and recommendations for practical implementation should be based on the observations of Bradshaw, Culkin, Dauphinee, Millero, Poisson, and such other investigators whose cooperation may be requested by the Panel. A meeting of the principals of at least one week, under the chairmanship of Lewis, is deemed necessary and should be funded.
- (6) The effects of pressure on the conductivity ratio should be the subject of a further meeting to take place as soon as possible after completion of new experiments by Bradshaw and Schleicher, hopefully by the end of 1978.
- (7) By June 1978 each batch of Standard Seawater be labelled with its value of R_{15} as well as chlorinity. The relationship

$$S = 1.80655 Cl$$

commonly used previously should no longer have any definitive value. Consequently any changes noted in the constant will not affect either parameter.

- (8) After endorsement of these proposals by the sponsoring organizations (UNESCO, ICES, SCOR, IAPSO) revision of the practical salinity scale should not be entertained except under most extra-ordinary circumstances. The relation $S = F(R_{15})$ will then define practical salinity and not be subject to changes in data fitting procedures or minor changes in the properties of Standard Seawater.

WG 10 Recommendation 2/1977

Equation of State of Seawater

After reviewing the available data sets and empirical formulae fitted to the individual sets, we note that existing formulae do not meet the requirements set by the Panel. Recent measurements by Bradshaw and Schleicher (1976) of thermal expansion and compression of pure and sea water and of sound speed by Chen and Millero (1976b) show that significant improvements can be made to the Chen/Millero formula as discussed at the seventh meeting of the Joint Panel at Grenble.

We recommend that:

- (1) The data sets consisting of the direct measurements of relative density using a magnetic float densimeter as obtained by Chen and Millero (1976a) and Millero, Gonzalez and Ward (1976), the direct measurements of thermal expansion and compression by Bradshaw and Schleicher (1976), and the sound speed measurements of Chen and Millero (1977) be adopted as the definitive data sets to calculate the coefficients of the equation of state of the general form adopted by Chen and Millero (1976a).
- (2) Other data sets be examined for consistency with the equation of state developed from the four above definitive data sets but not be used in the formulation of the equation.
- (3) The Panel does not endorse further measurements on the equation of state of pure water or seawater. The data sets selected appear to be of adequate precision and accuracy to meet the present and anticipated needs of oceanographers. The Panel recommends that the equation be considered definitive and should not be subject to minor modifications.
- (4) A working party consisting of Bradshaw, Chen, Fofonoff, Millero and Schleicher be formed to develop the equation of state from the selected data sets by March 1978. The working party will meet in Woods Hole or Miami to review the formulation and to draft a comprehensive paper to communicate the equation of state to the oceanographic community.

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