Comments on Veronis' Paper, "On Properties of Seawater Defined by Temperature, Salinity, and Pressure"[1]

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Veronis (1972: 227), in the above paper, has stated that "The quantity that is orthogonal to potential-density curves in the $\theta S[T-S]$ plane is suggested as a useful variable to complement the information contained in potential density." He denotes this quantity with τ.

Regarding Dr. Veronis' paper, I have the following comments to make, particularly on the question of the above-mentioned orthogonal variable τ and concerning the footnote on page 229 of his paper.

The variable τ, isopleths of which, on the T–S plane, are orthogonal to the isopleths of density, ϱ, was proposed by me 10 years ago (Mamayev 1962) but has not been referred to by Veronis (1972). This variable has been denoted by me as γ. My paper (1962) demonstrates the existence of the line integral along the T–S curve in the T–S plane; and this integral is shown to be equal to the definite integral of the main part of the vertical stability, E. Somewhat the same integral appears in Veronis (1972: 250). The existence on the T–S plane of the function $\gamma(T, S)$, orthogonal to the $\varrho(T, S)$, is shown to be the sequence of the existence for the T–S plane of the equations:

$$\frac{\partial \varrho}{\partial S} = \frac{\partial \gamma}{\partial T}, \qquad \frac{\partial \varrho}{\partial T} = -\frac{\partial \gamma}{\partial S}, \tag{1}$$

formally analogous to the well-known Cauchy-Riemann equations (Mamayev 1962: 349). I have written these equations correctly (Mamayev 1962) but

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they have been discussed erroneously. Also, re-evaluation of their physical meaning is presented in § 27 of my monograph (Mamayev 1970: 120), neither referred to by Veronis. The function ϱ is called an isopycnal potential, its orthogonal function γ—as a function of density flux in this context.

The theoretical problem, first stated by me in 1962, was developed further, especially in my above-mentioned monograph (1970), in Chapter IV: "T–S diagram and its properties." In addition to other pertinent matters, one finds there:

— The derivation of γ (pp. 119–122); Veronis' derivation of τ is analogous to my derivation of γ. Note that Veronis' formula (7) directly follows, passing (6), from formulas (1) above.

— fig. 4.5 (p. 123) shows orthogonal curves on the T–S plane; fig. 1 in Veronis (1972) is similar.

— comparison of the T–S plane with the plane field of the nonvortex motion (or with the thermal field) (ibid).

— an indication of the existence of the ϱ–γ plane (p. 141), denoted by Veronis as the $\tau\sigma_\theta$ plane; and an indication of the possibility of transforming the T–S plane into the ϱ–γ plane.

These comments on Veronis' (1972) paper are sufficient without details.

On the other hand, Veronis' paper has suggested to me that I should have mentioned in both my works (1962, 1970) that eqs. (1) above are written for the dimensionless T–S plane and that all of the discussions in § 27 (also in § 31) in Mamayev (1970) are applicable to the dimensionless T–S plane.

Veronis' paper is very interesting, especially because he has applied the theoretical problem to oceanic conditions, but it is unfortunate that he overlooked the earlier published works on the same subject.

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Editor's Note. In a letter to me dated 1 September 1972, Dr. Veronis regretted his unawareness of Dr. Mamayev's papers and was most apologetic for the oversight. He wrote: "In my several talks on this paper and on the significance of τ, I never heard anyone mention Dr. Mamayev or his work, so I

suppose that many others are also ignorant of the Russian literature." Similarly, none of the reviewers of Dr. Veronis' paper has mentioned Dr. Mamayev's work to me.

This is undoubtedly another of the many instances when important literature has been overlooked as a result of language barriers. Dr. Mamayev's comments are well taken and emphasize the need for continued efforts to improve our scientific communication.

14 September 1972. *Yngve H. Olsen.*