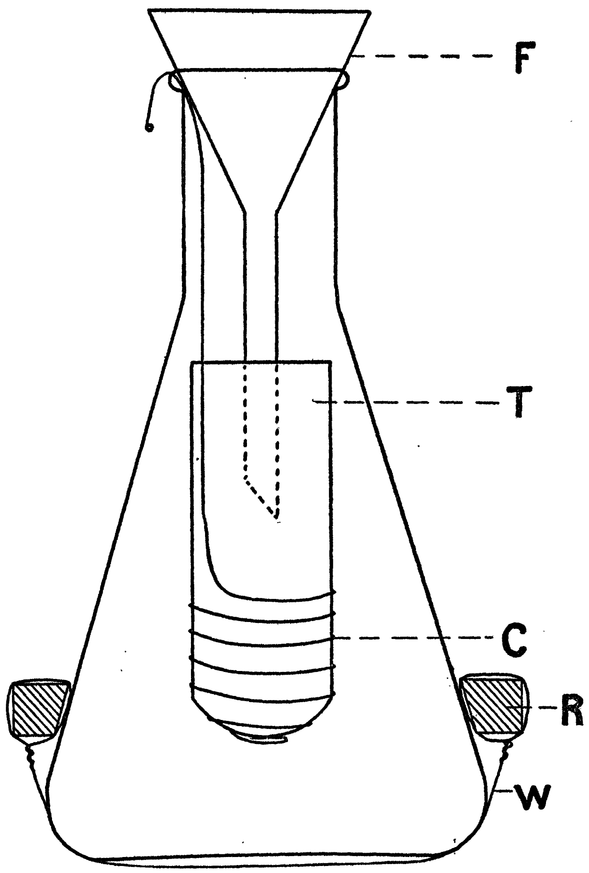

"F"—funnel. "T"—thimble. "C"—coil. "R"—ring. "W"—wire.

vessel for the reduction of Fehling's solution in a hot water bath. The handling of ordinary containers while hot during filtration is difficult and uncertain. Comfortable and safe manipulation of the flask by the ring "handle" is possible almost immediately after removal from the bath, if the flask is set into cold water, or held under the tap for a few seconds. Rinsing with hot water is accomplished with equal ease and safety. Nearly six hundred sugar determinations have been run without a single loss when this special "ringed flask" was used.

CHARLES F. ROGERS

DEPARTMENT OF BOTANY,
COLORADO AGRICULTURAL COLLEGE,
FORT COLLINS, COLORADO

SPECIAL ARTICLES

CORRECT VELOCITIES FOR ECHO SOUNDING IN THE PACIFIC OCEAN

SPECIAL Publication No. 108, United States Coast and Geodetic Survey, "Velocity of Sound in Sea Water," gives tables from which may be derived, by a method described in the publication, the proper velocity of sound to use in echo sounding, provided that the temperature and salinity of the water are known.

If we know the average annual conditions of temperature and salinity for any ocean for all depths, tables can be prepared which indicate regions throughout which the same velocities can be used for given depths without introducing material error. Determination of the extent of such regions and the velocities to be used in each is the purpose of this paper. The results show that the information can be given in a simple and easily used table for the entire Pacific Ocean.

Information as to mean annual temperature at the surface and at various depths was obtained from the publication "Die Warme Verteilung in den Tiefen des Stillen Ozeans" by Gerhardt Schott and Fritz Schu. The information was amplified from the Report of the Scientific Results of the Challenger Expedition, Physics and Chemistry, Vol. 1. Information regarding salinity was obtained from an atlas of thirty-one maps published by the Deutsche Seewarte in 1896 and from the Challenger report just mentioned.

For convenience, a map of the North Pacific was selected which gave the outlines of the land and meridians and parallels 10° apart. At each intersection the average temperature for each two hundred fathoms layer was entered and also the proper salinity to use, the same salinity being used for all depths. Seasonal changes of temperature were neglected, as these affect only the two upper layers and the second layer but slightly. While the variation of temperature at the surface during the season is considerable in the temperate zones, the average temperature of the upper layer does not vary much.

With the temperature and salinity fixed for each layer, the proper velocity for any desired depth was obtained from the tables of Special Publication No. 108, applying the adiabatic correction. The velocities were tabulated for 600 fathoms, 1,200, etc., to 5,400 fathoms, the greatest depth known.

The form of table adopted as most convenient was not a velocity table, but a percentage correction table. In practically all echo sounding now being carried on, all soundings are computed for a standard velocity and all that is needed is the correction to apply for the proper velocity. The percentage of correction to be applied is equal to the proper velocity divided by the standard velocity, minus one. Thus, if standard velocity is 800 fathoms per second and proper velocity is 824 fathoms per second, the percentage of correction is 3.0. The United States Navy and the Coast and Geodetic Survey have adopted the above named standard velocity of 800 fathoms (4,800 feet) per second. So long as the standard velocity is less than any adopted proper velocity, the correction is additive.

The percentages of correction were compiled on a similar map to that used for temperature and salinity. The next operation was to determine the extent of the region for which the same table might be used without introducing appreciable error.

Inspection of the map showed that for all intersections from and including 30° N. to the equator there was little departure from the mean value for the entire region. Mean percentages of correction were adopted for each layer and the rule was adopted that in general the range of the corrected sounding should not exceed five fathoms on either side of the mean. Further inspection showed that for all intersections on parallels 40° and 50° N. a second table would suffice. A still different table was found necessary for the north part of Bering Sea, deep portion approximately in Lat. 60° N. These three tables with interpolation between them cover the entire North Pacific except the adjacent seas on the west side and the shoal portion of Bering Sea.

The area of the South Pacific was then examined, selecting the extreme conditions in each region. It was found that the table for the tropical region could be extended to 40° S.; that the table for 40–50° N. applies to 50° S. and that a fourth table was needed for 60° S. The tables follow:

Fathoms	Table 1 60° N	Table 2 50–40° N, 50° S	Table 3 30° N to 40° S	Table 4 60° S
600	0.0	0.6	2.0	0.0
1,200	0.5	1.0	1.7	0.1
1,800	1.1	1.5	2.0	0.7
2,400	1.9	2.0	2.5	1.5
3,000	2.5	2.6	3.0	2.1
3,600	3.2	3.3	3.6	2.7
4.200	3.9	4.0	4.2	3.5
4,800	4.5	4.6	4.9	4.1
5,400	5.1	5.2	5.4	4.7

In order that interpolation may be easy, and only one table be needed, the information has been rearranged in Table 5.

Examples of use of table: At 35° N., 140° W. an echo sounding of 2,923 fathoms was obtained using standard velocity. Interpolating in the above table we get correction percentage of 2.7. Correction is $29.23 \times 2.7 = 79$ fathoms. Correct sounding is 3,002 fathoms.

24° N., 141° E. unreduced sounding 5,200 fathoms. Table gives 5.2. Correction is 270 fathoms and correct sounding 5,470.

TABLE 5

PERCENTAGES OF CORRECTION TO BE APPLIED TO ECHO SOUNDINGS

Lat.	Depth in fathoms 600	1,200	1,800	2,400	3,000	3,600	4,200	4,800	5,400
60° N	0.0	0.5	1.1	1.9	2.5	3.2	3.9	4.5	5.1
55	0.3	0.8	1.3	2.0	2.6	3.2	4.0	4.6	5.2
50–40	0.6	1.0	1.5	2.0	2.6	3.3	4.0	4.6	5.2
35	1.3	1.4	1.7	2.2	2.8	3.4	4.1	4.8	5.3
30° N–40° S	2.0	1.7	2.0	2.5	3.0	3.6	4.2	4.9	5.4
45° S	1.3	1.4	1.7	2.2	2.8	3.4	4.1	4.8	5.3
50	0.6	1.0	1.5	2.0	2.6	3.3	4.0	4.6	5.2
55	0.3	0.5	1.1	1.7	2.3	3.0	3.7	4.3	4.9
60	0.0	0.1	0.7	1.5	2.1	2.7	3.5	4.1	4.7

For the benefit of those who wish to use meters and a different standard value, Table 6 has been prepared, giving the computed velocities in fathoms and meters corresponding to the percentage corrections in Tables 1 to 4.

TABLE 6

Depth Fathoms	Meters	Table 1 Fathoms	Meters	Table 2 Fathoms	Meters	Table 3 Fathoms	Meters	Table 4 Fathoms	Meters
600	1,097	799	1,461	805	1,472	815	1,492	799	1,461
1,200	2,194	804	1,471	808	1,478	813	1,488	801	1,465
1,800	3,292	809	1,479	812	1,485	815	1,492	806	1,474
2,400	4,389	815	1,491	815	1,492	820	1,500	812	1,485
3,000	5,486	820	1,499	821	1,501	824	1,507	817	1,494
3,600	6,584	826	1,511	826	1,511	828	1,515	822	1,504
4,200	7,681	831	1,519	833	1,522	833	1,524	828	1,515
4,800	8,778	836	1,529	837	1,530	839	1,534	833	1,522
5,400	9,875	841	1,537	842	1,539	844	1,542	838	1,532

Salinities used: 34 was used from 30° N. to 40° S., except 33 at 20° N. from 160° to 130° W., and at 10° N. from 140° to 120° W. For all other areas, salinity 33 was adopted. Error introduced by this practice is small.

To show that the error involved in using the tables for the large regions adopted is not great, Table 7 was prepared. The equatorial region is selected as it has a greater range than the others. The reason that the departure from the mean is different for the maximum and minimum is that a much smaller region is affected by the minimum. The departure from the mean is much smaller than the extreme values given for all but a small part of the total area.

TABLE 7

	Velocity		Percentage of correction			Maximum difference from adopted value	
Depth in fathoms	Maximum	Minimum	Maximum	Minimum	Adopted	Per cent.	Fathoms
600	819	809	2.4	1.1	2.0	0.9	5
1,200	816	811	2.0	1.4	1.7	0.3	4
1,800	817	814	2.1	1.7	2.0	0.3	5
2,400	821	818	2.6	2.3	2.5	0.2	5
3,000	825	823	3.1	2.9	3.0	0.1	3
3,600	830	828	3.7	3.5	3.6	0.1	4
4,200	835	833	4.4	4.1	4.2	0.2	8
4,800	839	838	4.9	4.8	4.9	0.1	5
5,400	844	841	5.5	5.1	5.4	0.3	16

As a test of this method, twenty-two soundings in the Pacific shown on page 22, Special Publication No. 108, were computed, using Table 5, and the results compared with those based on observed temperatures and salinities. The soundings ranged from 736 to 3,472 fathoms. The greatest difference was six fathoms and the average difference for the twenty-two, 2.5 fathoms without regard to sign. In six cases there was exact agreement.

N. H. HECK
JERRY H. SERVICE

UNITED STATES COAST AND
GEODETIC SURVEY

THE IMPORTANCE OF MINUTE CHEMICAL CONSTITUENTS (INFINIMENT PETITS CHIMIQUES[1]) OF BIOLOGICAL PRODUCTS: NICKEL, COBALT AND INSULIN[2]

AT the end of the last century it was considered that plants and animals were composed of an association, under different forms more or less complicated, of about a dozen elements—carbon, hydrogen, oxygen, nitrogen, sulfur, phosphorus, chlorine, potassium, sodium, calcium, magnesium and iron.

Later, due to refinements of analytical chemistry, about an equal number of other elements were found in the organs of living species of plants and animals. Consequently, there may now be added to the above list silicon, boron, titanium, arsenic, iodine, bromine, fluorine, manganese, aluminium, zinc, copper, nickel and cobalt.

The proportion of the various elements which enter into the composition of an organism differs greatly according to whether they belong to the first list or to the second. Those of the former, aside from iron, are very much more abundant than those of the latter list, and make up more than 99.9 per cent. of the total weight of the substance, while iron and the elements of the second list make up the balance. That is to say, there are present only extremely small proportions of these latter elements.

The first eleven elements exercise an essentially plastic rôle in that they enter into the composition of the protoplasm, the nucleus and the cell walls, the reserve materials, the internal or external skeleton, the dissolved substances which maintain the rigidity of soft tissues, etc. Their utility is apparent at the first examination.

This is not the case with the other elements. On account of the very small quantities present, they can not, *a priori*, play the rôle of plastic elements, and the idea has been frequently expressed that they are of no physiological interest. Numerous and very careful experiments during the last dozen years have shown, on the contrary, that certain of these elements play a very important part as catalyzers of metabolism.

In 1912 I had the honor of presenting a paper at the Congress of Applied Chemistry held at New York,[3] in which this conception was developed, especially from the point of view of agriculture. I described my personal researches in which the intervention of manganese in the catalytic oxidation provoked by laccase was shown, and, furthermore, that manganese must be included among the elements necessary for vegetable growth. An application of these experiments has been the employment of manganese as a fertilizer.

Addressing myself to-day to a group particularly interested in questions of therapeutic chemistry, I wish to present the recent work which I have undertaken with some of my collaborators upon the importance of nickel and of cobalt in biology.

Following the discovery with M. Mokragnatz in 1922 of the presence of small quantities of nickel and of cobalt in all samples of arable soil which were examined,[4] we sought to ascertain whether these two

[1] The expression "infiniment petits chimiques" has a definite sense in French which can not be exactly translated into English. "Infiniment petits" was adopted by Pasteur and his associates to indicate microbes which were infinitely small living organisms responsible for profound changes. M. Bertrand by the modification "chimique" limits the application of the term to those chemical elements or complexes which, in extremely minute amounts, are responsible for a great variety of reactions occurring in biochemical systems.

[2] Address delivered by the director of the Biological Chemical Laboratory of the Pasteur Institute, of Paris, at the meeting of the American Chemical Society, on September 9, 1926.

[3] Transactions Eighth International Congress of Applied Chemistry, Vol. XXVIII, p. 30.

[4] Bull. Soc. Chim. de France, [4] *31*, 1330 (1922); *37*, 326 (1925).