

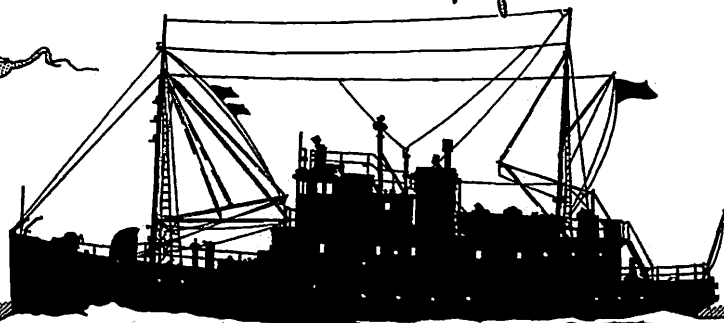
**DEPARTMENT OF
OCEANOGRAPHY
UNIVERSITY OF
WASHINGTON**

Technical Report No. 25

PLANKTON VOLUME DISPLACEMENT INDICATOR

**Office of Naval Research
Contract N8onr-520/III
Project NR 083 012**

**Reference 54-9
March 1954**



SEATTLE 5, WASHINGTON

UNIVERSITY OF WASHINGTON DEPARTMENT OF OCEANOGRAPHY
(Formerly Oceanographic Laboratories)
Seattle, Washington

PLANKTON VOLUME DISPLACEMENT INDICATOR

by

Herbert F. Frolander

Technical Report No. 25

Office of Naval Research
Contract N8onr-520/III
Project NR 083 012

Reference 54-9
March 1954

for Clifford A. Barnes
Richard H. Fleming
Executive Officer

ABSTRACT

An instrument is described for measuring displacement volumes of plankton in the laboratory. Due to more efficient draining, the volumes obtained are 30 to 40 percent lower than those achieved using the conventional methods.

Results are easily duplicated, requiring only 15 minutes for the complete operation.

Organisms are handled in a water medium--lessening the possibility of damage and allowing for future positive identification of specimens.

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
CONVENTIONAL METHOD OF ANALYSIS	1
Disadvantages to Conventional Method	2
METHOD OF ANALYSIS USED BY THE AUTHOR	3
The Instrument	3
Procedure in Analysis	6
Samples Analyzed from the Narragansett Bay Area	8
COMPARISON OF THE TWO METHODS	8
The Time Factor	8
Volume of Water Extracted	10
Preservation of Plankton Samples	10

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Diagram of plankton volume indicator	11
2	Plankton volume indicator assembled for operation	12
3	Comparison of plankton volumes determined by conventional draining method and vacuum filtering method	13

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Comparison of Volumetric Difference in Duplicate Analyses	9

INTRODUCTION

In an area new to an investigator initial studies of zooplankton populations often result in a considerable period of time being spent in learning the local species before he can recognize the animals on sight and carry out qualitative and quantitative counts of the population. It is recognized that in zooplankton analysis there may be large quantities of material to be handled and it is often desirable to gain as much information as possible in the shortest period of time. Preliminary investigations should be conducted in a manner that will leave the animals available and in good condition for both concurrent and more extended studies at a later date.

CONVENTIONAL METHOD OF ANALYSIS

Displacement volume analysis is a method that gives firsthand approximations; it is expedient, and many samples may be handled in a short period of time. A conventional method of doing such analyses is to pour the zooplankton catch into a shallow, fine mesh, cone-shaped net and let it drain for a period of time until water has ceased to drip. Additional water may be removed from the sample by blotting the net on paper. When additional blotting draws no additional water from the sample the plankton is then scraped from the net and added to a known volume of water contained in a graduated cylinder. The increased

volume registered in the cylinder is indicative of the displacement volume of the plankton.

DISADVANTAGES TO CONVENTIONAL METHOD

There are several disadvantages to the conventional method of analysis. These are:

1. The process of straining the water from the sample is rather slow, taking approximately 20 minutes for draining and blotting.
2. A certain number of animals are left behind in the meshes of the net when the catch is removed.
3. Some organisms are mashed or damaged by the scraping necessary to remove them from the net, making future identification sometimes impossible.
4. Organisms around the periphery of the mass being blotted tend to dry to a greater extent than the remainder and will float when they are added to the graduated cylinder of water, making estimation of volume difficult.
5. A large amount of water still remains in the interstices between the organisms when blotting no longer yields water from the sample.
6. A large quantity of blotting paper is consumed in the process.

In light of these difficulties an instrument has been devised by the author to make displacement volume estimations of zooplankton, designed to eliminate as many of the above disadvantages as possible.

METHOD OF ANALYSIS USED BY THE AUTHOR

This new instrument was designed to make quantitative analyses for volume of plankton of the type usually taken with the Clarke-Bumpus Sampler in neritic water. The principal difference in method is in the draining of the water from the plankton sample. Here, a principle of vacuum extraction is utilized as opposed to the conventional draining method.

THE INSTRUMENT

The instrument consists of two principal parts, each of which have been constructed from Pyrex glass. Assembled, the instrument is in the form of a funnel and a calibrated chamber separated from an evacuation device by a filter-stopcock assembly. The calibrated chamber has been divided in the middle to allow for the removal of the sample from the filter after each analysis. Principal sections have been formed from standard parts but technical modification and piecing are required to complete the instrument. See Figure 1.

The funnel (1) is joined to the upper half of the chamber by a constricted tube. This upper half fits by means of a standard taper fit (2) to the bottom half of the chamber. The ground surface of the

The reference notations refer the reader to standard parts as used by the author. All references are from the Corning Glass Works, Laboratory Glassware, Catalogue No. LP28.

	<u>Number</u>	<u>Type</u>	<u>Code Word</u>
(1)	9480	Tube, Filter	FYPAS
(2)	6560	Ground Joint, Full Length, Inner Part Only, § Interchangeable	EUSQC

upper half of the chamber has been shortened to 2.7 centimeters to obtain the total desired volume of the chamber. The lower half of the chamber has been constructed from a Gooch-type crucible (3) fitted with a fritted glass filter disc with a pore diameter of 40 microns. The Gooch crucible has been heated, flared and ground to fit the upper half of the chamber. The lower part of the crucible has been fused onto a standard stopcock (4). All necessary dimensions are shown on Figure 1. It should be observed that if sizes are varied, the air chamber between the filter and stopcock should not be made larger. With the dimensions given, no water will pass through the filter with the valve closed, but should a larger air pocket be made, this may present a problem.

This entire assembly is attached by means of a rubber stopper to a standard Fisher Filtrator. The graduated cylinder is placed inside the filtrator. The complete assembly is pictured in Figure 2.

Grease Seal

The two chamber halves must be given an airtight grease seal (5). In greasing the taper on the upper chamber. half, grease is applied in small quantities around the upper part of the taper using a minimum quantity so that no grease may be allowed to enter the chamber when

	<u>Number</u>	<u>Type</u>	<u>Code Word</u>
(3)	32960	Crucible, Gooch Type, Low Form, With Fritted Disc	GYDAG
(4)	7280	Stopcock, Straight Bore, With Solid § Stopper	EYVQD
(5)	Lubriseal, distributed by the Arthur H. Thomas Company, has been used by the author.		

the two halves are forced together. The entry of grease into the chamber is a disadvantage for the following reasons.

1. Excess grease forced into the chamber will allow organisms to adhere to it and thus tend to result in the loss of specimens from the particular sample as well as permit possible contamination of future samples.
2. Large amounts of grease can cause a perceptible difference in the volume of the chamber once it has been calibrated.

Calibration

The instrument constructed by the author has an approximate volume of 48 cubic centimeters. For calibration of the exact volume of the chamber a convenient level may be selected and marked on the constriction above the chamber. With the stopcock closed, water is added to fill the chamber up to the calibration mark. If too much water is added so that the level rises above the calibration mark, the excess water may be drawn off with a syringe adapted to the purpose (6). The stopcock must be kept closed during this time to prevent any water from seeping through the fritted glass disc and

(6) The syringe should be fitted with a filter to prevent animals from being drawn off with the water during actual analyses. The author has used a glass tubing into which a screen plug of mesh diameter 175 microns has been fitted. The upper end of the glass tubing was flared to retain a rubber syringe bulb. It is believed that a finer mesh screen plug would not be necessary. One of the most obvious devices for drawing off liquid, the filter stick (*) with a pore diameter of 14 microns proved unsatisfactory.

	<u>Number</u>	<u>Type</u>	<u>Code Word</u>
(*)	39535	Tube, Immersion, With Fritted Disc	HEJOF

accumulating below the disc above the stopcock as this will cause error in the calibrated volume.

With the water level at the calibration mark the stopcock is then opened to allow the water to drain into a graduated cylinder below. The aspirator is then turned on to evacuate the chamber and speed the draining process. The order of operations is important. The aspirator should always be run at the same speed.

Several such runs should be made to adequately calibrate the chamber. This same procedure must be observed in actual analysis of samples.

Cleaning

The instrument may be thoroughly cleaned with any standard cleaning solvent.

PROCEDURE IN ANALYSIS

Zooplankton samples to be analyzed should have enough water siphoned off to make the total volume of animals and water less than the volume of the calibrated chamber, so that subsequent rinsing of the sample jar to obtain all specimens will yield a volume of water which will not exceed the calibrated level of the chamber (7). A quantity of the original sample water should be set aside from the original decanting of the sample to be used in rinsing the instrument

(7) The most satisfactory device for reducing the initial volume of water with the sample has been a stainless steel porous metal filter stick with an approximate pore diameter of 20 microns. The slightest back pressure completely frees the filter surface of animals.

after the analysis. The plankton and remaining water is then stirred and the whole transferred to the chamber by means of a large mouth pipette having a bulbous enlargement in the glass portion. Care must be taken to eject the sample as a stream through the narrow constriction into the calibrated chamber. Just pouring the sample into the upper funnel will result in a massing of the plankton at the top of the constriction and failure to get the animals down into the calibrated chamber.

The actual operation of the instrument follows the technique outlined under "Calibration." Filtration time was standardized at 5 minutes. The difference in volume between the volume of water removed from the sample and the known volume of the calibrated chamber indicates the displacement volume of the zooplankton.

Once the analysis is completed, the upper half of the chamber is removed and rinsed back into the sample bottle. The zooplankton will be present on the filter surface in the lower half of the chamber as a small wad and may be removed by tilting this half of the chamber over the sample bottle and directing a jet stream of clear sample water from a narrow opening of a large pipette into the tilted chamber half. The chamber can thus be completely rinsed and the analysis completed without ever handling the organisms with any kind of scraping instrument or in a manner other than in a water medium. The instrument should be well rinsed in tap water after completion of each set of duplicate analyses to insure lack of contamination between different samples.

SAMPLES ANALYZED FROM THE NARRAGANSETT BAY AREA

Samples used in testing the instrument were those collected on a weekly basis over a two-year period, 1950 and 1951, off the Rhode Island coast in the Narragansett Bay area and southwest of Point Judith, R. I., in connection with work done at the Narragansett Marine Laboratory, University of Rhode Island. The results of comparison of differences in duplicate analyses, based on total catch, are summarized in Table 1. Since each haul was run twice and every sample analyzed, a total of 235 hauls are represented by the analysis of 470 samples. Duplicate runs were made on all samples analyzed by the author and it was found possible to reproduce results with a high degree of accuracy.

The bulk of the water mass present in most of the samples drained within 10 to 15 seconds with all removable water usually being drained in 3 minutes. Samples with much fine material such as phytoplankton, detritus, etc., may require up to 5 minutes draining time. A very few samples with fine material took up to a minute for the initial water to drain before air was sucked through the filter disc.

COMPARISON OF THE TWO METHODS

A summary of the advantages of using this new technique of plankton volume estimation is presented below.

THE TIME FACTOR

The complete handling of two analyses of a single sample takes approximately 15 minutes as compared to 20 minutes for a single analysis

TABLE 1

COMPARISON OF VOLUMETRIC DIFFERENCE IN DUPLICATE ANALYSES
Based on Total Catch Measured in Plankton Volume Displacement Indicator^a

CLARKE- BUMPUS NET NO.	STATION NO. ^b	NO. OF HAULS ^c	NUMBER OF ANALYSES IN DUPLICATE	COMPARATIVE SAMPLE VOLUMES (In cubic centimeters)			
				Difference in dup.anal.	Avg.vol. of all	Max.vol. of single sample	Min.vol. of single sample
6	A	53	35	0.0	1.8	9.1	0.3
			14	0.1	3.4	8.5	0.2
			4	0.2	1.6	3.0	0.5
	B	77	45	0.0	3.4	8.1	0.2
			21	0.1	3.1	6.3	0.2
			10	0.2	3.7	5.9	1.5
1			0.3	—	—	—	
14	A	50	31	0.0	1.4	5.1	0.1
			18	0.1	1.0	5.6	0.1
			1	0.2	—	—	—
	B	55	32	0.0	0.8	3.2	0.1
			22	0.1	0.8	2.2	0.1
			1	0.2	—	—	—

^a All samples taken at approximately 1-week intervals between 25 July 1950 and 27 December 1951.

^b Station A — Lat. 41°19.8' N. Long. 71°31.4' W.

Station B — Lat. 41°29.7' N. Long. 71°24.9' W.

^c Oblique, of 20-minute duration, bottom to surface.

by the conventional method. Three minutes are usually sufficient to remove all the water that will come out of a sample by the vacuum method as compared to 20 minutes for the conventional draining method. See Figure 3.

VOLUME OF WATER EXTRACTED

Approximately 30 to 40 per cent more water is removed by the vacuum method than by the gravity draining method. See Figure 3.

PRESERVATION OF PLANKTON SAMPLES

Damage to organisms or their loss is minimized because they are always handled in a water medium and the samples may be used for any future extended studies involving positive identification and accurate counts. Thus, one can obtain a rapid and reasonably accurate approximation of volumes of plankton in an area and then proceed later to a more detailed analysis.

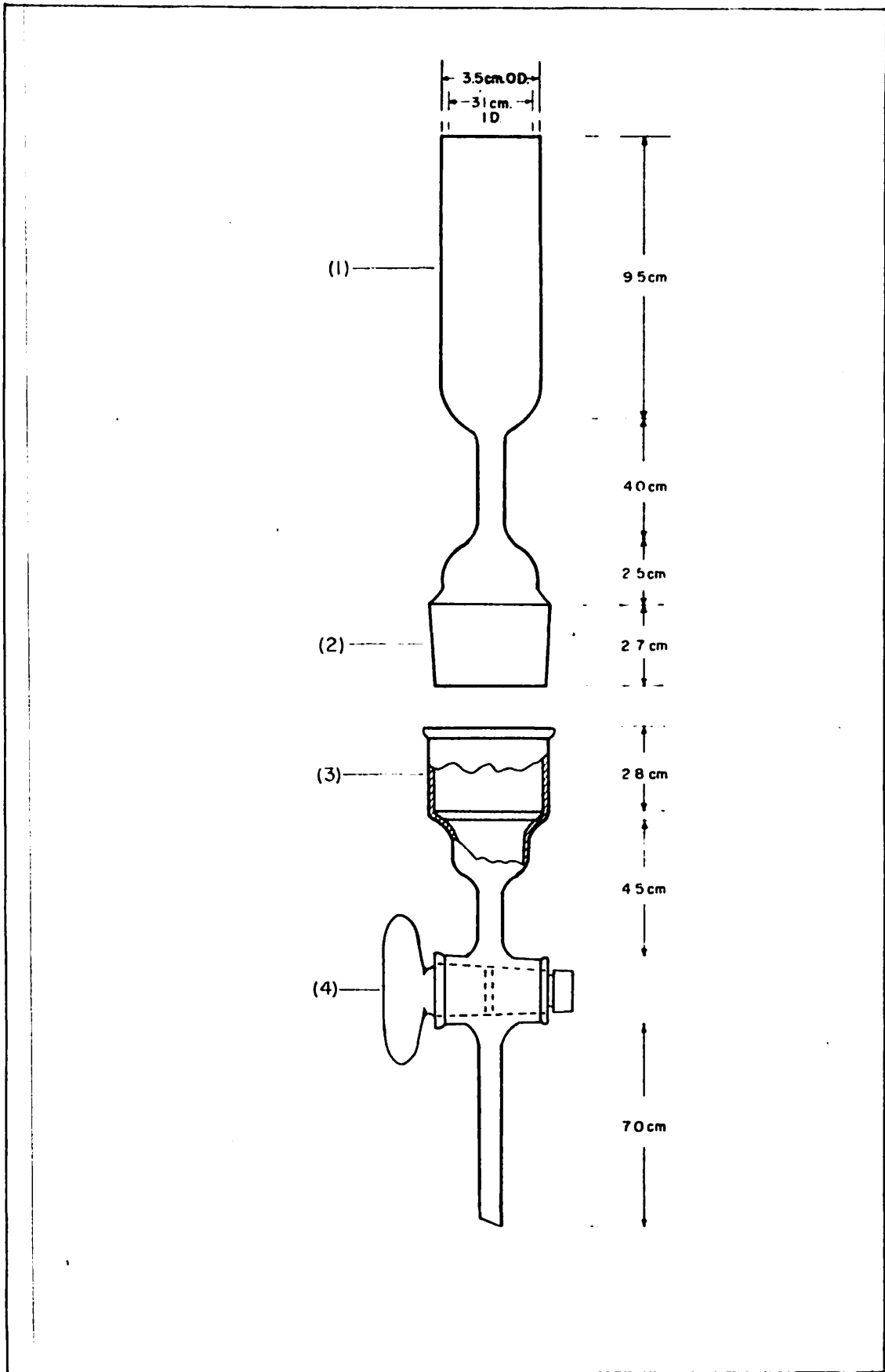


FIGURE 1. Diagram of plankton volume indicator.

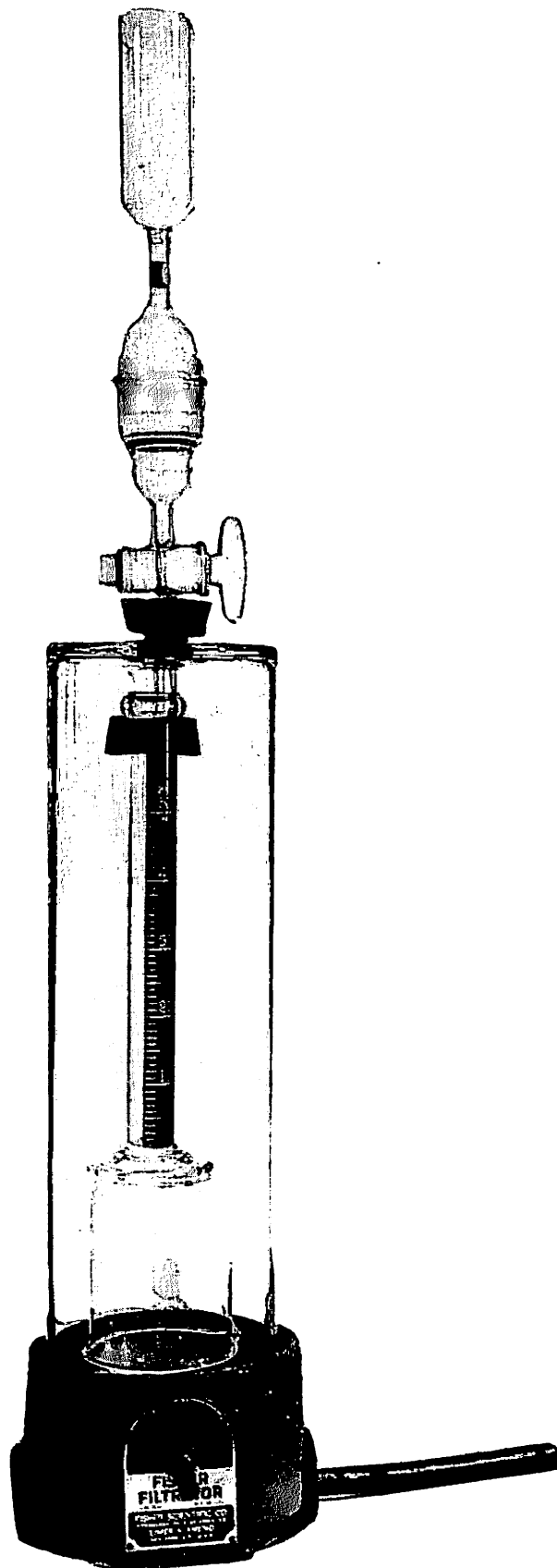


FIGURE 2. Plankton volume indicator assembled for operation.

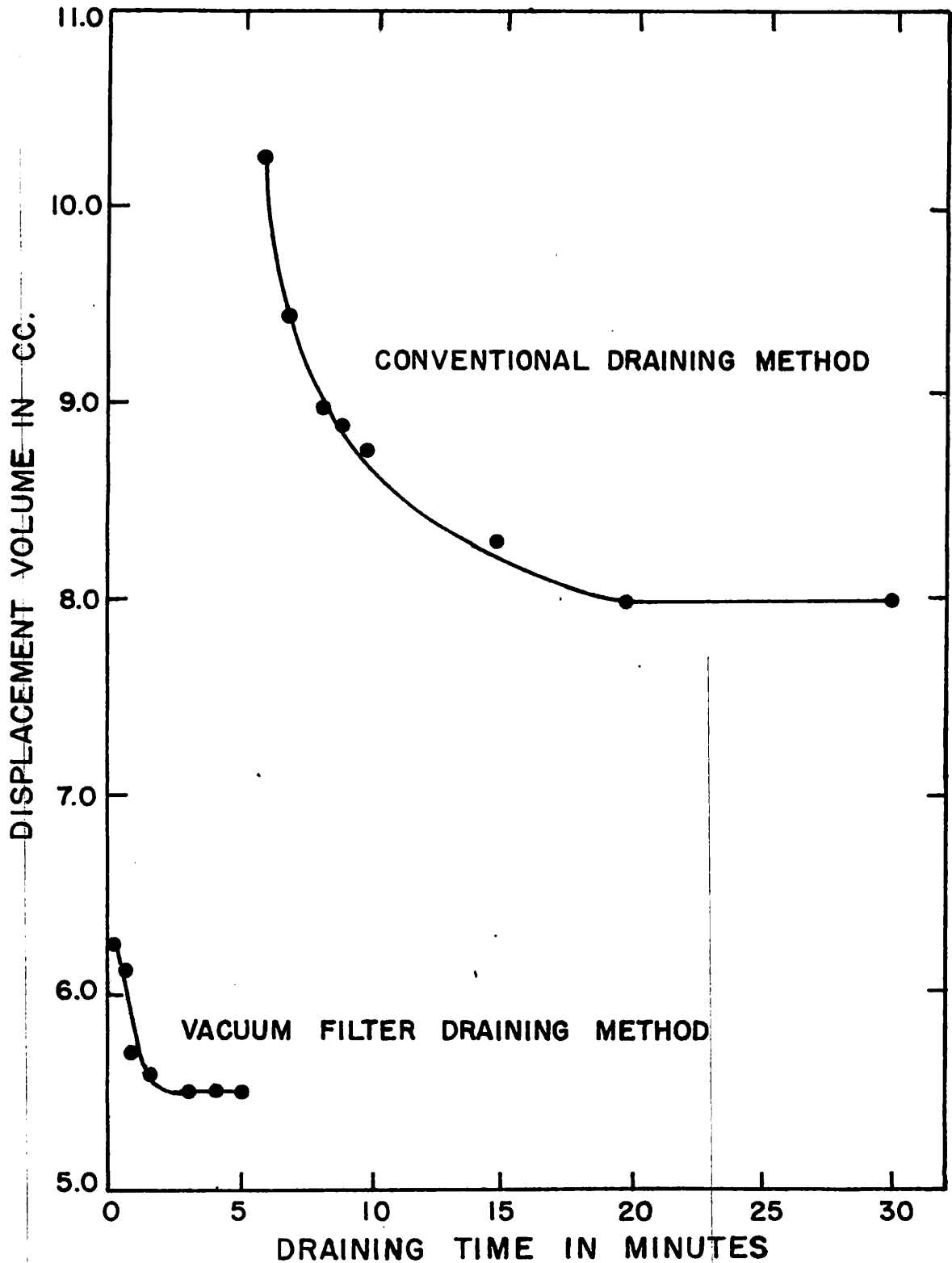


FIGURE 3. Comparison of plankton volumes determined by conventional draining method and vacuum filtering method. Values are for analysis of plankton collected at Station B on 3 January 1951 with a Clarke-Bumpus plankton sampler fitted with a No. 6 net. The values shown are typical of other analyses.

Department of Oceanography
University of Washington
Technical Report Distribution List

- | | | |
|---|---|--|
| 2 Geophysics Branch, (Code 416)
Office of Naval Research
Washington 25, D.C. | 1 Chief of Naval Research
Navy Department
Washington 25, D.C.
Attention: (Code 466) | 1 Director, Chesapeake Bay Institute
Box 4264, RFD #2
Annapolis, Maryland |
| 6 Director, Naval Research Laboratory
Attention: Technical Information
Officer
Washington 25, D.C. | 8 U.S. Navy Hydrographic Office
Washington 25, D.C.
Attention: Division of Oceanography | 1 Director, Narragansett Marine
Laboratory
Kingston, R. I. |
| 2 Officer-in-Charge
Office of Naval Research
London Branch Office
Navy #100, Fleet Post Office
New York, New York | 2 Director, U.S. Navy Electronics
Laboratory
San Diego 52, California
Attention: (Codes 550, 552) | 1 Head, Department of Oceanography
University of Washington
Seattle, Washington |
| 1 Office of Naval Research Branch
Office
346 Broadway
New York 13, New York | 1 Chief, Bureau of Yards and Docks
Navy Department
Washington 25, D.C. | 1 Bingham Oceanographic Foundation
Yale University
New Haven, Connecticut |
| 1 Office of Naval Research Branch
Office
Tenth Floor, The John Crerar Library
Building
86 East Randolph Street
Chicago, Illinois | 1 Commanding General, Research and
Development Division
Department of the Army
Washington 25, D.C. | 1 Department of Conservation
Cornell University
Ithaca, New York
Attention: Dr. J. Ayers |
| 1 Office of Naval Research Branch
Office
1030 East Green Street
Pasadena 1, California | 1 Commanding Officer, Cambridge Field
Station
230 Albany Street
Cambridge 39, Massachusetts
Attention: CRHSL | 1 Director, Lamont Geological
Observatory
Torrey Cliff
Palisades, New York |
| 1 Office of Naval Research Branch
Office
1000 Geary Street
San Francisco, California | 1 National Research Council
2101 Constitution Avenue
Washington 25, D.C.
Attention: Committee on Undersea
Warfare | 2 Director, U.S. Fish & Wildlife
Service
Department of the Interior
Washington 25, D.C.
Attention: Dr. L. A. Walford |
| 1 Office of Technical Services
Department of Commerce
Washington 25, D.C. | 1 Project Arowa
U.S. Naval Air Station
Building R-48
Norfolk, Virginia | 1 U.S. Army Beach Erosion Board
5201 Little Falls Road N. W.
Washington 16, D.C. |
| 5 Armed Services Technical Information
Center
Documents Service Center
Knott Building
Dayton 2, Ohio | 1 Department of Aerology
U.S. Naval Post Graduate School
Monterey, California | 1 Allen Hancock Foundation
University of Southern California
Los Angeles 7, California |
| 1 Assistant Secretary of Defense for
Research & Development
Attention: Committee on Geophysics
and Geography
Pentagon Building
Washington 25, D.C. | 1 Chief of Naval Operations
Navy Department
Washington 25, D.C.
Attention: Op-533D | 1 U.S. Fish & Wildlife Service
Fort Crockett
Galveston, Texas |
| 1 Office of Naval Research Resident
Representative
University of Washington
Seattle 5, Washington | 1 Commandant (OAO), U.S. Coast Guard
Washington 25, D.C. | 1 U.S. Fish & Wildlife Service
450 B Jordan Hall
Stanford University
Stanford, California |
| 2 Assistant Naval Attache for Research
American Embassy
Navy #100, Fleet Post Office
New York, New York | 1 Director, U.S. Coast & Geodetic
Survey
Department of Commerce
Washington 25, D.C. | 2 Director, Scripps Institution of
Oceanography
La Jolla, California |
| 2 Chief, Bureau of Ships
Navy Department
Washington 25, D.C.
Attention: (Code 847) | 1 Department of Engineering
University of California
Berkeley, California | 1 Director, Hawaii Marine Laboratory
University of Hawaii
Honolulu, T. H. |
| 1 Commander, Naval Ordnance Laboratory
White Oak
Silver Spring 19, Maryland | 1 The Oceanographic Institute
Florida State University
Tallahassee, Florida | 1 Director, Marine Laboratory
University of Miami
Coral Gables, Florida |
| 1 Commanding General, Research and
Development Division
Department of the Air Force
Washington 25, D.C. | 1 U.S. Fish & Wildlife Service
P.O. Box 3830
Honolulu, T. H. | 1 Head, Department of Oceanography
Texas A & M College
College Station, Texas |
| | 1 U.S. Fish & Wildlife Service
Woods Hole, Massachusetts | 1 Head, Department of Oceanography
Brown University
Providence, Rhode Island |
| | 2 Director, Woods Hole Oceanographic
Institution
Woods Hole, Massachusetts | 1 Department of Zoology
Rutgers University
New Brunswick, New Jersey
Attention: Dr. H. K. Haskins |
| | | 1 Dr. Willard J. Pierson
New York University
New York, New York |

1 LIBRN - CALIF. FISH. LAB.
 TERMINAL ISLAND STAT
 SAN PEDRO. CALIFORNIA