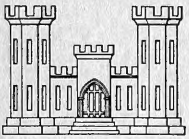
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS



THE

BULLETIN

OF THE

BEACH EROSION BOARD

OFFICE, CHIEF OF ENGINEERS
WASHINGTON, D.C.

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DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

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Dr. Martin A. Mason, Chief Technical Assistant on the Staff of the Beach Erosion Board, resigned 1 September 1951 to accept appointment as Dean of the School of Engineering at George Washington University.

During the twelve years of his employment with the Board, Dr. Mason did much to increase the general knowledge of shore processes and beach erosion control. While his departure will be felt keenly, members of the Board and Staff join in expressing congratulations upon this important and well deserved advancement in his professional career.

A METHOD FOR DRAWING ORTHOGONALS SEAWARD FROM SHORE

by

Thorndike Saville, Jr.

As a wave moves shoreward from deep water and approaches a shore line obliquely, that portion of the wave in shallower water moves more slowly than the offshore portion, and the wave crest bends to conform more nearly to the bottom contours. In analogy with the refraction of light, this change in direction of a wave as it moves through shallow water is termed refraction, and the magnitude of this change, together with the change in wave height associated with it, is most conveniently represented by a refraction diagram, which generally shows a set of orthogonals, or lines which are everywhere perpendicular to the wave crests.

The use of refraction diagrams to show the effect of hydrography in the offshore area on wave heights and direction has by now become practically mandatory in many coastal and harbor engineering problems. In general, refraction conditions over a sizeable reach of shore front must be considered, but in some cases it may be enough to consider the refraction effect only at a point, or over a very small stretch of shore. This is particularly true in dealing with the design of structures where the location of the structure is determined by other conditions (such as a jetty at an inlet). In such cases it would be much more expedient and time saving if the orthogonals could be drawn seaward from the shore rather than landward from deep water, as is usually done. Then only those orthogonals bracketing the point of interest would have to be drawn, instead of having to draw a large group of orthogonals to obtain by successive approximation the few orthogonals actually needed. Such a method would also have application in determining the deep water direction of wave trains whose breaker angle or direction in shallow water can be measured.

Dunham has previously done some work along these lines, particularly in the development of fan diagrams for jetty design (1). Apparently the drawing of orthogonals seaward from the shore line was accomplished by using the scale developed by Johnson, O'Brien and Isaacs (2) for the crestless method of drawing refraction diagrams, merely reversing the procedure used for bringing the orthogonal into shore from deep water. However this scale gives correct results only for very small changes in direction of the orthogonal and low values of $\Delta L/L_{av.}$ since the angle measured between the wave crest and the contour on the way out from shore is less than that (α) measured on the way into shore by the amount of turning, (i.e. $\Delta\alpha$) (Figure 1). Use of this scale in drawing orthogonals seaward from shore is therefore limited to cases where $\Delta\alpha$ is less than about one degree, and $\Delta L/L_{av.}$ is less than about 0.1. In general a smaller change in orthogonal direction than actually occurs is obtained from this scale.

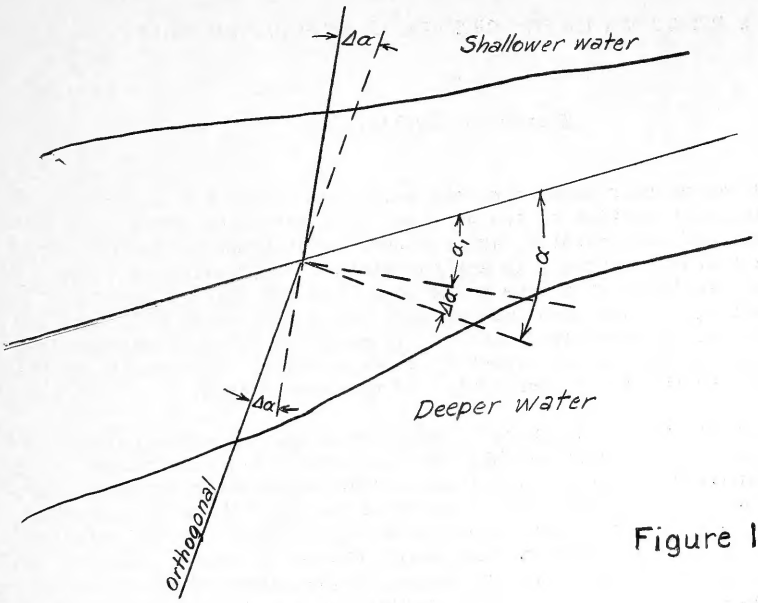


Figure 1.

The basic theory of Johnson et al applies equally well however, regardless of the direction of drawing the orthogonal, but it must be remembered that the measured angles are different in the two cases. As may be seen from Figure 1, $\alpha_1 = \alpha - \Delta\alpha$ where α_1 is the measured angle between the wave crest and the contour on the way out from shore, $\Delta\alpha$ is the change in angle of the direction of the wave crest, and α is the angle between the contour and the wave crest beyond the point of turning. α would be the angle measured if the orthogonal were being drawn into shore from deep water, and is the angle applicable to the equations of Johnson et al. This angle may be written in terms of α_1, however, and substituted in these equations to obtain

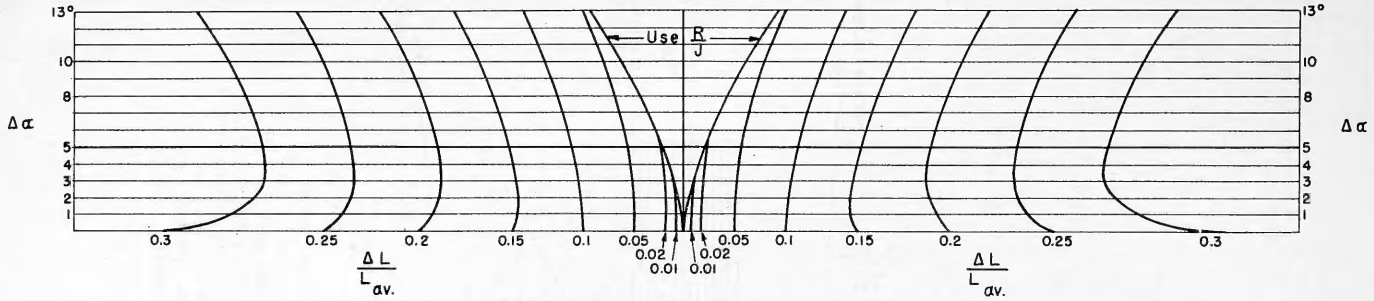
$$\Delta\alpha = \frac{R}{J}\frac{\Delta L}{L_{av.}} \sin\alpha = \frac{R}{J}\frac{\Delta L}{L_{av.}} \sin(\alpha_1 + \Delta\alpha) \qquad (1)$$

or for the general case, where R/J = sec α

$$\Delta\alpha = \frac{\Delta L}{L_{av.}} \tan\alpha = \frac{\Delta L}{L_{av.}} \tan(\alpha_1 + \Delta\alpha) \qquad (2)$$

where $L_{av.}$ is the average wave length between two adjacent contours and ΔL is the change in wave length between these two contours.

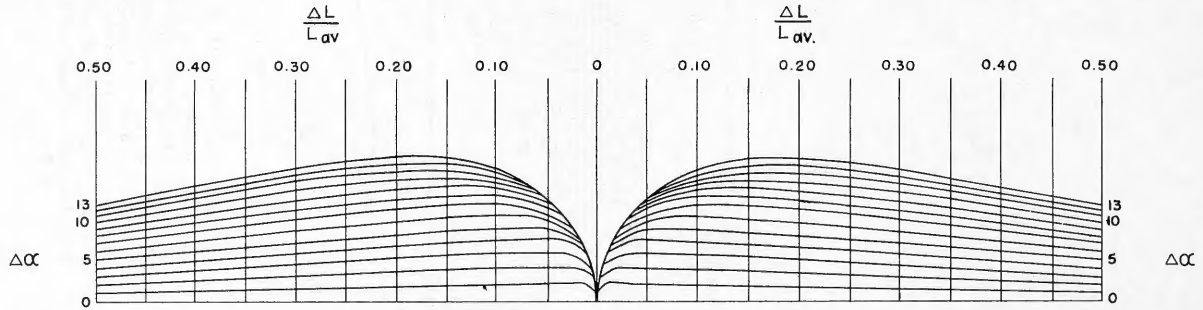
A protractor may then be drawn on the basis of equation (2) to determine $\Delta\alpha$ in terms of α_1 and $\Delta L/L_{av.}$ for drawing orthogonals directly out from shore. Two such protractors are reproduced here. That shown in Figure 2 is for use at low values of $\Delta L/L_{av.}$ and that in Figure 3 for



Refraction Protractor-Orthogonals Seaward from Shore.

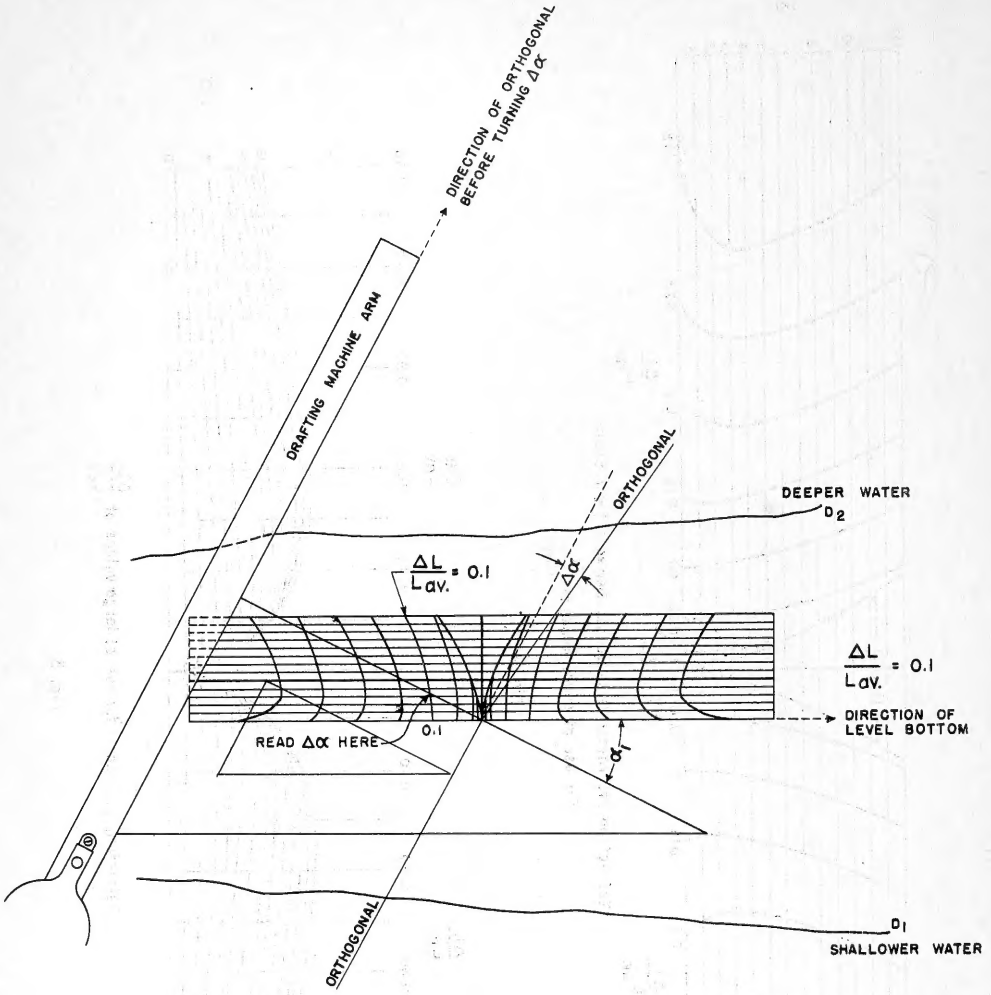
For use at small values of $\frac{\Delta L}{L_{av.}}$

Fig. 2.



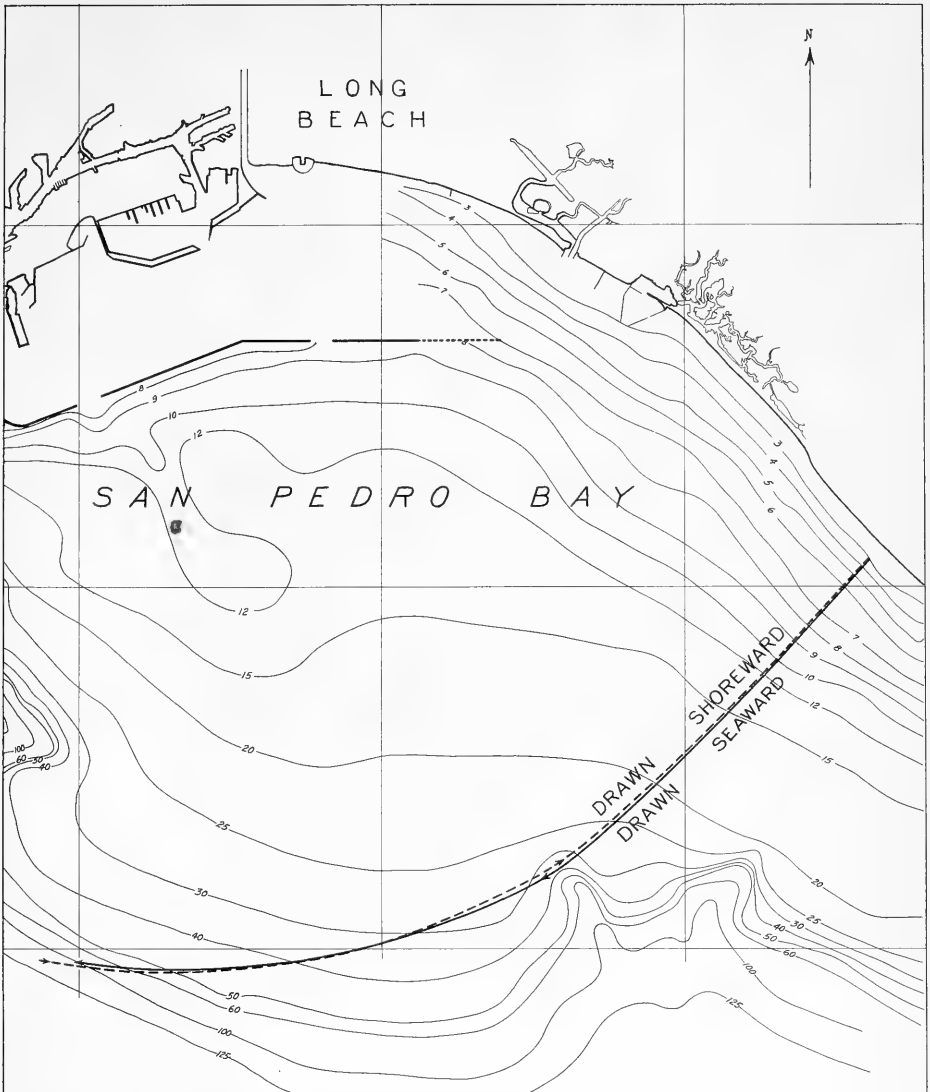
Refraction protractor for use at large values of $\frac{\Delta L}{L_{av.}}$

Fig. 3.



Use of scale. The arm of a drafting machine is set parallel to the orthogonal direction. The protractor is placed in the direction of level bottom, with its midpoint at the point of turning. The intersection of the perpendicular from this point to the drafting machine arm with the appropriate $\Delta L / L_{av.}$ line gives the correct $\Delta\alpha$ This angle is then turned on the drafting machine, and the orthogonal continued in its new direction.

FIGURE 4



WAVE PERIOD – 15 SEC.
BEARING OF ORTHOGONAL AT 3 FATHOM LINE – 225° TRUE.
DEPTH CONTOURS ARE IN FATHOMS.

COMPARISON OF ORTHOGONALS DRAWN SHOREWARD AND SEAWARD

FIG. 5

higher values of $\Delta L / L_{av.}$. The method for their use is the same as that for the scale devised by Johnson et al for drawing orthogonals shoreward from deep water, except that the direction of turning is reversed. Figure 4 demonstrates the method of use.

The use of equation (2) is limited to values of α_1 less than about 70-75°, since, as $\alpha_1 + \Delta\alpha$ approaches 90°, $\tan(\alpha_1 + \Delta\alpha)$ becomes infinite, resulting in very rapid changes in $\Delta\alpha$. This necessitates the crossing of a contour interval in a series of short steps, and it is therefore desirable to employ equation (1) whenever α_1 exceeds about 75°. For values of α_1 greater than 75°, $\sin(\alpha_1 + \Delta\alpha)$ may be given the value of 1, and the equation becomes

$$\Delta\alpha = \frac{R}{J} \frac{\Delta L}{L_{av.}} \qquad (3)$$

or the same as used in bringing orthogonals into shore from deep water at high values of α . Hence, at large values of α_1 , when it is necessary to use the R/J method, the protractor developed by Johnson, O'Brien and Isaacs should be used. The method is again the same, merely reversing the direction of curvature of the orthogonals.

Figure 5 shows a comparison of an orthogonal drawn from shore out with one drawn from deep water into shore.

Acknowledgment

Much of the computing necessary for the development of these protractors was done by F. R. Lewis, now with the U. S. Navy.

* * * * * * *

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(1) Dunham, J. W. - Refraction and diffraction diagrams. Unpublished paper given at Institute of Coastal Engineering, 12 October 1950.

(2) Johnson, J. W., M. P. O'Brien, and J. D. Isaacs. - Graphical construction of wave refraction diagrams., U. S. Hydrographic Office Technical Report No. 2, H. O. Pub. No. 605, January 1948.

BEACH EROSION STUDIES

The principal types of beach erosion control studies of specific localities are the following:

a. Cooperative studies (authorization by the Chief of Engineers in accordance with Section 2, River and Harbor Act approved 3 July 1930).

b. Preliminary examination and surveys (Congressional authorization by reference to locality by name).

c. Reports on shore line changes which may result from improvements of the entrances at the mouths of rivers and inlets (Section 5, Public Law No. 409, 74th Congress).

d. Reports on shore protection of Federal property (authorization by the Chief of Engineers).

Of these types of studies, cooperative beach erosion studies are the type most frequently made when a community desires investigation of its particular problem. As these studies have greater general interest, information concerning studies of specific localities contained in these quarterly bulletins will be confined to cooperative studies. Information about other types of studies can be obtained upon inquiry to this office.

Cooperative studies of beach erosion are studies made by the Corps of Engineers in cooperation with appropriate agencies of the various States by authority of Section 2, of the River and Harbor Act approved 3 July 1930. By executive ruling the cost of these studies is divided equally between the United States and the cooperating agency. Information concerning the initiation of a cooperative study may be obtained from any District Engineer of the Corps of Engineers. After a report on a cooperative study has been transmitted to Congress, a summary thereof is included in the next issue of this bulletin. A list of cooperative studies now in progress follows:

COOPERATIVE BEACH EROSION STUDIES IN PROGRESS

NEW HAMPSHIRE

HAMPTON BEACH. Cooperative Agency: New Hampshire Shore and Beach Preservation and Development Commission.

Problem: To determine the best method of preventing further erosion and of stabilizing and restoring the beaches, also to determine the extent of Federal aid in any proposed plans of protection and improvement.

MASSACHUSETTS

PEMBERTON POINT TO GURNET POINT. Cooperating Agency: Department of Public Works, Commonwealth of Massachusetts.

Problem: To determine the best methods of shore protection prevention of further erosion and improvement of beaches, and specifically to develop plans for protection of Crescent Beach, The Gladds, North Scituate Beach and Brant Rock.

CONNECTICUT

STATE OF CONNECTICUT. Cooperating Agency: State of Connecticut (Acting through the Flood Control and Water Policy Commission).

Problem: To determine the most suitable methods of stabilizing and improving the shore line. Sections of the coast will be studied in order of priority as requested by the cooperating agency until the entire coast is included.

NEW YORK

JONES BEACH. Cooperating Agency: Long Island State Parks Commission

Problem: To determine behavior of the shore during a 12-month cycle, including study of littoral drift, wave refraction and movement of artificial sand supply between Fire Island and Jones Inlets.

NEW JERSEY

OCEAN CITY. Cooperating Agency: City of Ocean City

Problem: To determine the causes of erosion or accretion and the effect of previously constructed groins and structures, and to recommend remedial measures to prevent further erosion and to restore the beaches.

STATE OF NEW JERSEY. Cooperating Agency: Department of Conservation and Economic Development.

Problem: To determine the best method of preventing further erosion and stabilizing and restoring the beaches, to recommend remedial measures, and to formulate a comprehensive plan for beach preservation of or coastal protection.

VIRGINIA

VIRGINIA BEACH. Cooperating Agency: Town of Virginia Beach.

Problem: To determine the methods for the improvement and protection of the beach and existing concrete sea wall.

FLORIDA

PINELLAS COUNTY. Cooperating Agency: Board of County Commissioners.

Problem: To determine the best methods of preventing further recession of the gulf shore line, stabilizing the gulf shores of certain passes, and widening certain beaches within the study area.

LOUISIANA

LAKE PONTCHARTRAIN. Cooperating Agency: Board of Levee Commissioners, Orleans Levee District.

Problem: To determine the best method of effecting necessary repairs to the existing sea wall and the desirability of building an artificial beach to provide protection to the wall and also to provide additional recreational beach area.

TEXAS

GALVESTON COUNTY. Cooperating Agency: County Commissioners Court of Galveston County.

Problem: To determine the best method of providing a permanent beach and the necessity for further protection or extending the sea wall within the area bounded by the Galveston South Jetty and Eight Mile Road.

To determine the most practicable and economical method of preventing or retarding bank recession on the shore of Galveston Bay between April Fool Point and Kemah.

CALIFORNIA

STATE OF CALIFORNIA. Cooperating Agency. Division of Beaches and Parks, State of California.

Problem: To conduct a study of the problems of beach erosion and shore protection along the entire coast of California. The current study covers the Santa Cruz area.

WISCONSIN

RACINE COUNTY. Cooperating Agency: Racine County.

Problem: To prevent erosion by waves and currents, and to determine the most suitable methods for protection, restoration and development of beaches.

KENOSHA. Cooperating Agency: City of Kenosha.

Problem: To determine the best method of shore protection and beach erosion control.

OHIO

STATE OF OHIO. Cooperating Agency: State of Ohio (Acting through the Superintendent of Public Works).

Problem: To determine the best method of preventing further erosion of and stabilizing existing beaches, of restoring and creating new beaches, and appropriate locations for the development of recreational facilities by the State along the Lake Erie shore line.

TERRITORY OF HAWAII

WAIKIKI BEACH
WAIMEA & HANAPEPE, KAUAI. Cooperating Agency: Board of Harbor Commissioners, Territory of Hawaii.

Problem: To determine the most suitable method of preventing erosion, and of increasing the usable recreational beach area, and to determine the extent of Federal aid in effecting the desired improvement.

BEACH EROSION DEVELOPMENT STUDIES

The Staff of the Beach Erosion Board is continuously engaged in development studies designed to improve the general knowledge of shore processes and to enable the Board to render better service to the public. To carry out its civil functions, the technical staff is organized in three divisions; Reports and Publications, Engineering and Research. An Administrative Services Division relieves the technical staff from administrative tasks to the maximum extent practicable. While each division has specific functional and coordination responsibility, close liaison is maintained to insure integration and application of knowledge gained in each field of effort.

The program for development studies provides for concurrent activity in three fields of effort, the immediate operational objectives of which are summarized below:

a. General Investigations. To compile existing data in such form that it be of maximum aid in the solution of specific shore problems.

b. Research. To pursue systematically a broad program of laboratory and field investigations designed to solve the mysteries of shore processes, and to limit the scope of individual research projects so that a steady flow of reports will enable early use of knowledge gained.

c. Engineering Studies. To produce a manual for design of shore structures which will serve as a guide in determining functional structural and economic criteria applicable to any type shore structure.

A detailed description of the current program in each of the above categories follows:

General Investigations Program

Experience in the conduct of beach erosion control studies has demonstrated a need for investigations which are regional rather than local in scope, and which will serve to improve, simplify and speed investigations of local problem areas. General investigations are to be conducted with a view to compiling all existing data for selected shore regions pertinent to shore processes in those regions, analyzing and interpreting the data to the extent justified, and publishing the data and conclusions in the form of technical reports.

The ultimate program contemplates twenty-three such reports covering the continental shores of the United States and three additional for the territorial possessions. The initial program will be limited to eight regions considered to be among the most important. Assuming that the services of competent personnel can be obtained, one report will be completed in the first year and seven in the second year of the program.

The eight regions selected are not necessarily those of highest priority with respect to economic importance because selection has been governed to some extent by availability of data. For example, it has been necessary to exclude the entire South Atlantic Coast in the initial program because of the uncertainty of obtaining statistical wave data for that area. Knowledge gained through the research program is expected to enable future coverage of coastal areas omitted at this time. The initial program provides for reports on the following regions:

1. The South Shore of Long Island
2. The New Jersey Shore from Sandy Hook to Cape May Point
3. The Peninsular Gulf Coast of Florida, from Cedar Keys to Cape Sable
4. The Gulf Coast of Texas
5. The Coast of Southern California from Pt. Fermin to the Mexican Border
6. The Coast of Southern California from Pt. Conception to Pt. Fermin
7. The Shores of Lake Michigan
8. The United States Shore of Lake Erie.

Each report will consist of five chapters titled as follows:

1. Geomorphology
2. Littoral Forces
3. Littoral Materials
4. Littoral Measurements
5. Summary and Conclusions

The chapter on geomorphology is intended to include all description necessary to make the report complete, and to supply the most acceptable hypothesis of the geological background of the region in non-technical language. It will include such data as are available concerning sediment supplied to the shore from upland tributaries and shore headlands. It is planned that this chapter will be written by an outstanding geomorphologist long familiar with the area concerned, following a detailed outline prepared by the Board Staff to insure that it will be concise and clear.

The chapter on littoral forces will consist principally of wave statistics determined by hindcasting at selected stations, and will include comparisons of observed and hindcast waves within the region to provide a measure of the limits of accuracy. Typical examples of refraction analysis will be given, and existing refraction analysis for all localities within the region will be identified in tabular form with references to the offices in which the drawings are filed. Tide and current data will be extracted from existing publications or covered by reference to appropriate publications. The compilation of wave statistics will be a joint effort, accomplished in part by the Board Staff and in part by

cooperative arrangement with other agencies. The mission of producing this chapter is assigned to the Research Division.

The chapter on littoral materials will include all information available on mechanical composition, sorting, and disposition of beach and offshore sediments. In areas where data are completely lacking, a limited amount of sampling and analysis will be undertaken. Preparation of this chapter is assigned to the Engineering Division. The staff will be augmented for this purpose by temporary employment of selected specialists. Action has been initiated to secure consulting service from Dr. W. C. Krumbein of Northwestern University for this task.

The chapter on littoral measurements will involve compilation of all applicable data from prior surveys such as shore line changes, offshore changes, computation of volumes of accretion or erosion rates where possible or compilation of such data previously computed. Production of this chapter is assigned to the Reports and Publications Division, which also has editing and processing responsibility for all chapters of the report.

The summary and conclusions will be a joint effort of the staff and will be subjected to critical review by all participating authors of other chapters. Publication of each complete report will be subject to approval by the Board. Individual chapters other than the summary and conclusions may be published as technical memoranda without Board approval in cases where completion of all chapters would be delayed for an appreciable time. The reports when completed will permit much broader consideration of the long range effect of erosion problems in local areas and of remedial measures proposed to correct them. They will fill an acute need for authoritative data which can be supplied in response to the numerous requests for such data. They will form a foundation of shore information of broad scope which can be built upon as information is gained.

The Research Program

The research program of the Beach Erosion Board is directed toward obtaining a more correct and thorough understanding of beach processes and the effect on these processes of various types of protective works, leading to the design of more effective and more economical plans of shore protection and improvement.

In order to formalize the research program, the various factors (excluding economic factors) which are believed to play a significant part in the understanding and solution of beach erosion problems have been classified under nine basic headings and 36 sub-headings as follows:

Classification of Factors Involved in Solutions

of Shore Protection Problems

1. Waves in Deep Water

   A. Mechanics of Internal Movement

   B. Origin, Propagation, and Dimensions

   C. Affect of certain factors on Waves

2. Waves in Shallow Water

   A. Mechanics of Internal Movement

   B. Transformation Without Energy Loss

   C. Transformation with Energy Loss

   D. Origin, Propagation, and Dimensions

3. Currents in Shallow Water

   A. Internal Wave Currents

   B. Long-period Currents

4. Factors Affecting Supply & Movement of Beach Material to Littoral Zone

   A. Sources of Beach Material

   B. Rate of Transformation of Material to and from Littoral Zone

   C. Physical Characteristics of Beach Material Affecting Material Movement

   D. Long-period Water Level Fluctuations

5. Significance of Natural Formations

   A. Hydrographic Formations Higher than Surrounding Hydrography

   B. Hydrographic Formations Lower than Surrounding Hydrography

   C. Shore Line Formations

   D. Miscellaneous Formations

6. Beach Processes

A. Mechanics of Material Transport in the Littoral Zone

B. Rate and Result of Onshore-offshore Material Movement

C. Rate and Result of Alongshore Drift

D. Creation and Alteration of Shore Forms

E. Rate and Result of Wind Transport of Beach Material

7. Functional Design and Effects of Man-made Structures

A. Structures Perpendicular to the Shore

B. Structures Parallel to Shore

C. Navigation Channels

D. Artificial Fill

E. Sand By-passing Plants

8. Structural Design of Man-made Structures

A. Structures Perpendicular to the Shore

B. Structures Parallel to Shore

C. Sand by-passing Plants

D. Resistance of Structural Materials

E. Foundation Design including Soil Mechanics

9. Supporting Investigations and Activities

A. New Instrument Developments

B. New Test Facilities

C. New or Improved Test Methods and Procedures

D. Preparation of Bibliographies and Reference Data

Another step in drawing up the research program of the Board is a statement, in order of priority, of the ten questions or problems most frequently encountered in specific shore protection studies for which adequate, quantitative answers are not generally available based on the present knowledge of beach processes. These questions are listed below.

It is recognized that the order of priority given is subject to question and might be re-arranged in significantly different order depending upon the experience and needs of the user; however, the order as given is the one finally agreed upon by the staff of the Board.

With the classification table and the priority list at hand, a proposed Fiscal Year 1952 Research Program was prepared. In preparing this program, the research personnel available, the funds allocated, and the available test equipment were considered in addition to the priority and classification tables. The resulting program presented below is based on the needs, personnel, funds, and equipment of the Board. The relations of each project study to the classification table and the priority list are indicated in parenthesis following the study title in each case.

Problem Priority (FY 1952)

1. Rate and result of alongshore drift.

2. Functional design of shore-connected structures. (Groins and groin fields including length, height, and spacing)

3. Functional design of structures parallel to shore near the mean water line (bulkheads and seawalls) with special reference to criteria for setting crest heights.

4. Functional design of artificial fill as to elevation and width.

5. Functional design of sand by-passing plants.

6. Significance of inlets in shore processes.

7. Significance of horizontal breaks in shore line including headlands with special reference to littoral drift compartments.

8. Rate and result of wind transport of beach material.

9. Structural design of man-made structures.

10. Effect of offshore structures (particularly submerged breakwaters) on shore processes.

Results Expected in F.Y. 1952

Collection of data has been completed and preparation of reports are under way on the studies listed below. These reports will be completed during the present fiscal year.

(1) Study of quantity of sand in suspension in coastal waters (6A-1)
(2) Study of equilibrium profiles of beaches (4C-1)

(3) Study of model scale effects in movable-bed wave models (9C)

(4) Study of wave generation in inland waters (2D-1)

Studies on which the collection of field and laboratory data have been completed and on which reports will be prepared during the fiscal year are as follows:

(1) Study of pressures developed by waves breaking against vertical structures (8B-9)

(2) Correlation of waves and alongshore currents (3B-1)

(3) Effect of Mission Bay jetties on adjacent beaches (7A-2)

(4) Preparation of charts showing effect of submerged breakwaters on waves (7B-10)

(5) Preparation of reports based on Mission Bay field data (6B, C, D-6)

(6) Use of radio-active material for tracers in beach studies (9C)

The following studies, though not necessarily underway at present, are scheduled to be undertaken and completed during the present fiscal year.

(1) Measurement of deep-water ocean waves by an airborne wave recorder (1B - 1)

(2) Measurement of deep-water ocean waves by a spar-buoy wave gage (1B-1)

(3) Wave tank study of wave energy loss by bottom friction and permeability (2C-1)

(4) Wave tank study of wave run-up on shore structures (7B-3)

(5) Wave tank study of sand sorting due to wave action on sand beds (6B-1)

(6) Study of effect on beach profiles of varying wave periods (6B-4)

(7) Preparation of selected list of references pertaining to beach erosion (9D)

Studies scheduled to be undertaken and completed insofar as possible during Fiscal Year 1952 are as follows:

(1) Study of wave refraction theory by wave tank tests (2B-1)

(2) Wave tank study of re-forming of waves after breaking (2C-1)

(3) Study of concurrent hydrographic changes in deep and shallow water (4A-1)

(4) Study of rate of littoral drift reaching South Lake Worth Inlet by-passing plant (6C-5)

(5) Study of Salina Cruz, Mexico, by-passing plant (8C-5)

(6) Summary of information on transport of sand by wind (4B-8)

(7) Review of existing knowledge of effects on internal wave currents of coalescence and interference of wave trains (2A-1)

(8) Development of magnetic induction type current recorder (9A)

Studies being made at present by outside agencies under contract to the Beach Erosion Board are as follows:

(1) Study of methods of analysis of wave records by electronic speech analyzers (1B-1)

(2) Study of methods of computing wave refraction over complex hydrography (2B-1)

(3) Development of method of computing refraction coefficients from one orthogonal (2B-1)

(4) Study to improve methods of forecasting alongshore currents (3B-1)

(5) Investigations of historic source and travel of sand found on existing beaches (4A-1)

(6) Geological study of San Nicolas Island beaches (4A-1)

(7) Study of submarine canyons as traps for littoral drift (5B-7)

(8) Development of instruments (9A)

The Engineering Studies Program

The primary task assigned to the Engineering Division is the preparation of a manual for the design of shore protection structures. Existing published data on this subject is widely scattered, and there is acute public demand for a single publication covering functional, structural and economic considerations in the selection of the type structure best suited for shore protection in a problem area.

Many types of shore protection have been constructed with varying degrees of success throughout the United States. Data concerning functional effectiveness, cost, economic life, and structural adequacy may be obtained readily by compilation of case histories. Much information concerning stresses introduced by wave action is available from experimental investigation in recent years, but little has been done to compile the results in such form as to be of maximum aid to the designing engineer.

The manual will be presented in five chapters, titled Definitions, Functional Design, Structural Design, Economic Life and Design Analysis. Structure types will include bulkheads, seawalls, groins, jetties, breakwaters, and beach fills. Materials will include steel, concrete, stone, and wood, and the varying qualities of sand and other sediments employed in fills. Data will be summarized in tabular or graphic form to simplify design computations, and examples of type problems and solutions will be included. It is planned to publish each chapter as it is completed in the form of technical memoranda, and the final volume as a technical report. Addenda or revisions will be issued thereafter as knowledge gained may warrant. It is expected that the manual will aid the research program by indicating the relative importance of the many features in which opinion must at present be substituted for fact. The initial publication will be prepared on a basis of existing knowledge, and will not be delayed for the purpose of including results of research in progress.

For this task, the Engineering Division will be augmented temporarily by obtaining the best qualified personnel available, recruited from within the Corps of Engineers and educational institutions which have specialized in the various phases of the problem. In addition to preparation of the Manual, the Engineering Division will perform normal supporting functions including the design, construction and installation of facilities for laboratory experimentation, the installation and maintenance of wave recording stations, and field studies and surveys as assigned. Studies will be made of the composition, sorting, source and disposition of littoral materials from inclusion in general investigations reports.

BEACH EROSION LITERATURE

There are listed below some recent acquisitions to the Board's library which are considered to be of general interest. Copies of these publications can be obtained on 30-day loan by interested official agencies.

"First Progress Report on Tidal Flow in Entrances, the Velocity Distribution at the Entrance," John L. French, National Bureau of Standards, June 1951

This report applies the methods of potential theory to the problem of determining the velocities in the approaches to a canal connecting an ocean with a lagoon or bay. Entrances with and without jetties extending into the ocean are considered. The streamlines are determined and the velocities along the streamline are given in a form suitable for simple application to engineering problems.

"Some Observations of the Velocity Profile Near the Sea Floor," R. M. Lesser, April 1951

Observations of the current speed at four levels near the sea floor in shallow water show that the velocity profile follows a logarithmic curve. Conditions of rough and smooth turbulence are found to exist.

"The Damping Action of Submerged Breakwater," University of California, HE-116-322, April 1951.

The results of an experimental investigation on the damping action of submerged rectangular breakwater is presented. The experimental data also are compared with published theories. A new theory is presented which compares more favorably with the experiments than the previous theories. Also given is a summary of all available published theoretical and experimental information on the damping action of tropezoidal triangular breakwaters, reefs of various configurations, and plane barriers of various orientations.

"The Generation and Decay of Wind Waves in Deep Water," University of California, C. L. Bretschneider, August 1951.

This paper presents the analysis and incorporation of data collected by the University of California on the generation and decay of wind-generated gravity waves and the original data presented in H.O. Pub. No. 601. These data are analyzed and the results presented in dimensionless graphs suitable for use in wave forecasting.