

The Distribution of Modern Benthonic Foraminifera in the
Northwest Gulf of St. Lawrence*

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The benthonic foraminifera of bottom sediment samples from 63 stations in the northwest Gulf of St. Lawrence were studied using factor-vector analysis in the QQ-mode (Manson & Imbrie, 1964). The sampling localities are shown in Figures 1 and 2. Results obtained by the use of the mathematical method suggest that the modern dead benthonic foraminiferal fauna comprises five depth and watermass-related assemblages with depth-zone ranges as follows: 12-73 m, 18-90 m, 73-183 m, 155-324 m and 274-400+m. Furthermore, the method indicates that 4 samples may be of sediment displaced downslope (Figure 6).

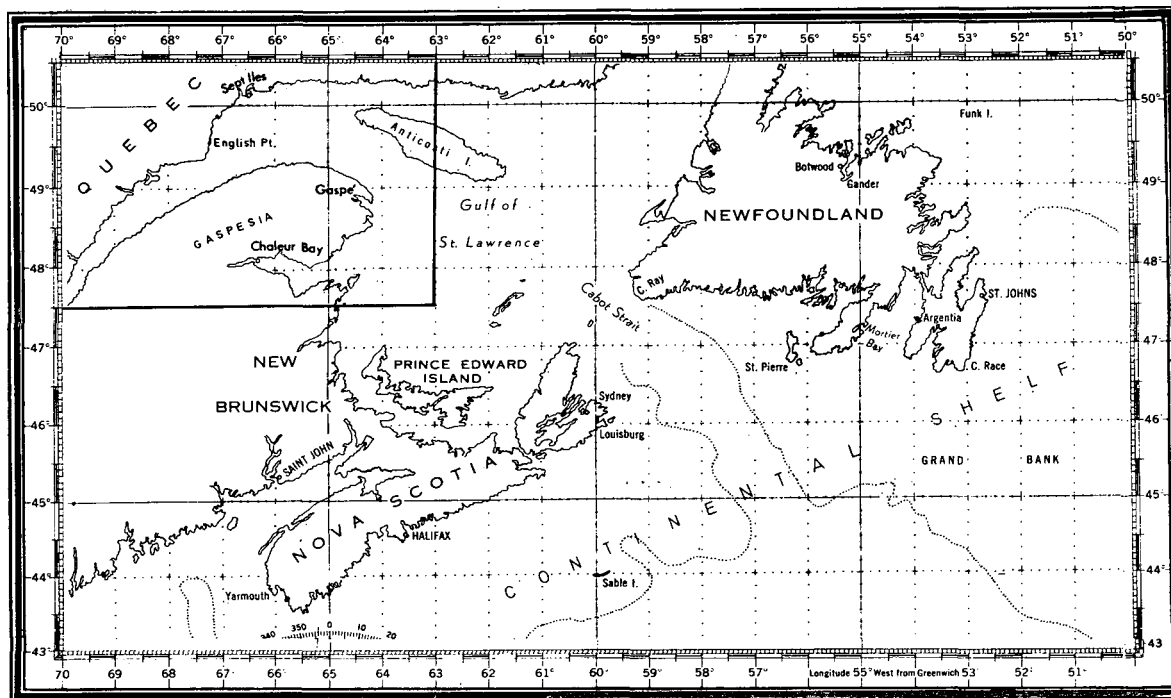


Figure 1 - Eastern Canada on the Western Atlantic Continental Shelf. Study area shown in block in northwest corner of map area.

For the living benthonic foraminiferal fauna, factor-vector analysis also suggests five depth and watermass-related assemblages. The depth-zone ranges are 11-73 m, 18-155 m, 73-199 m, 166-250 m and 230-400+m. Thus, although there is an approximate agreement of depth-zone ranges between the dead and the living assemblages, there are some differences. Particularly notable is the replacement of the dead assemblage of range 18-90 m with an assemblage ranging from 18-155 m in the living fauna. The results for the living fauna are based upon a comparatively small number of specimens collected in late spring, 1965.

When the depth-zone ranges are compared with those of the benthonic foraminiferal depth-assemblages of the eastern Canadian Continental Shelf obtained by the author in a previous study (Hooper, 1969), a high degree of agreement of zone boundaries is noted. This is shown in Table 1 where assemblages based upon dead populations are compared with those of the earlier study which were undifferentiated as to whether the foraminifera were living or dead at the time of collection. It is noted that: (1) The Sept-Iles assemblage is extended to 73 m from 36 m; (2) the slope-assemblage of the Laurentian Channel has its upper boundary raised by 10 m to 155 m, the lower boundary at about 320 m is confirmed; (3) the deep-assemblage of the Laurentian Channel has its upper boundary defined at 275 m; (4) the shallow-water assemblage is extended to a range of approximately 18-90 m, some such extension was anticipated in the previous study; (5) the intermediate assemblage has its range extended from 106-191 m to 73-183 m.

The interpretation based on the present study is preferred because it is based upon four times as many samples.

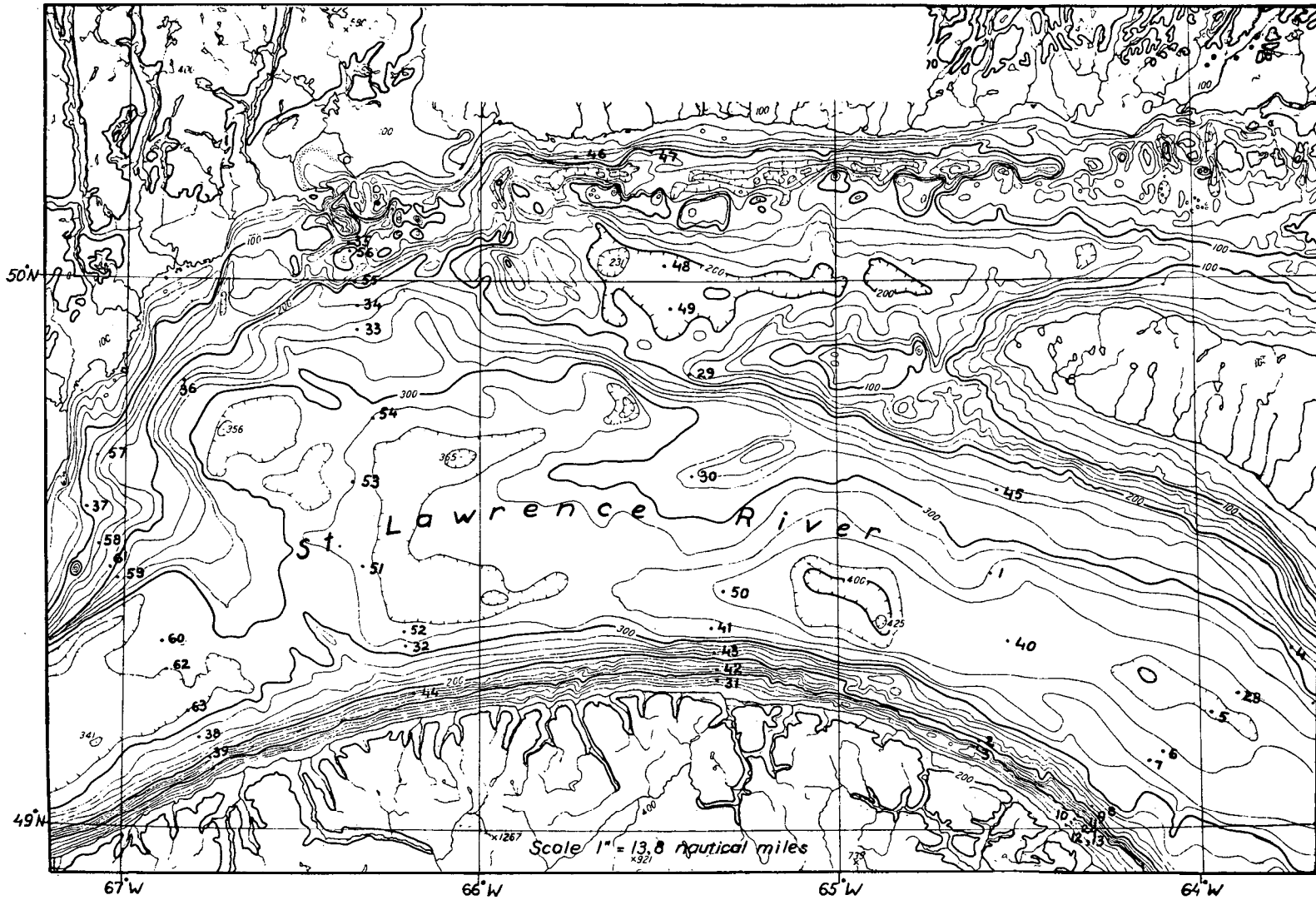


Figure 2 - Northwest Gulf of St. Lawrence showing stations and bathymetry.

Table 1 - Comparison of Depth-zone Ranges of Assemblages

Watermass	Live	Dead	Previous Study (Hooper, 1969)	Name of Assemblage
Upper	11- 73 m	12- 73 m	7- 36 m	Sept-Iles Bay
80 m ----->	18-155 m	18- 90 m	56- 74 m	Shallow-water
Intermediate	73-191 m	73-183 m	106-191 m	Intermediate
185 m----->	166-250 m	155-324 m	166-317 m	Laurentian Channel, slope
Deep	230-400 +m	274-400 +m	218-457 m	Laurentian Channel, deep

Assemblages are related to watermasses as indicated in Table 1. The area of the northwest Gulf of St. Lawrence is characterized by three main watermasses (Lauzier 1957, 1958). This is confirmed by data supplied to the writer by the Canadian Oceanographic Data Centre. The data for temperature and salinity are generalized and presented in Figures 3 and 4. Figure 3 shows the variation of temperature with depth, and Figure 4 shows variation of salinity with depth. Water-mass boundaries are drawn at approximately 80 and 185 m in both cases. These boundaries are very close to those between the shallow-water assemblage and the intermediate assemblage, and between the latter and the assemblage of the Laurentian Channel slope at 155 or 166 m. Thus, it seems reasonable to regard the benthonic foraminiferal assemblage as depth and watermass-related, in a general way, with two assemblages present in the upper watermass, one in the intermediate water-mass and two in the deep watermass.

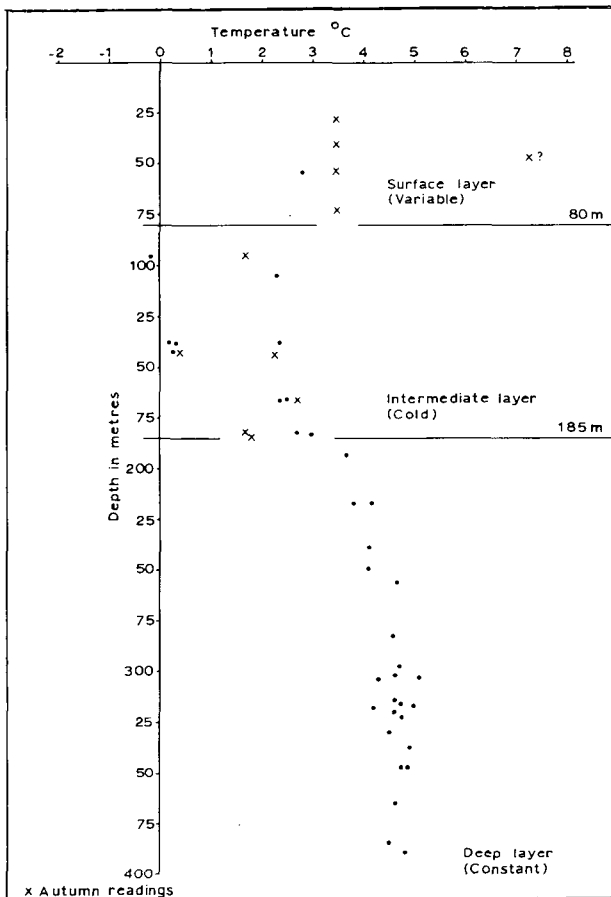


Figure 3 - Variation of Temperature with depth of water.

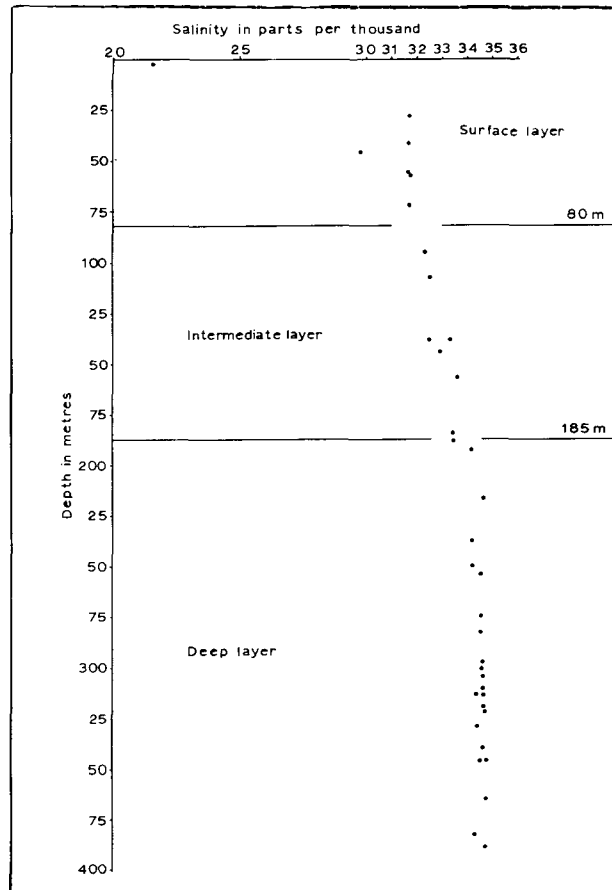


Figure 4 - Variation of salinity with depth of water.

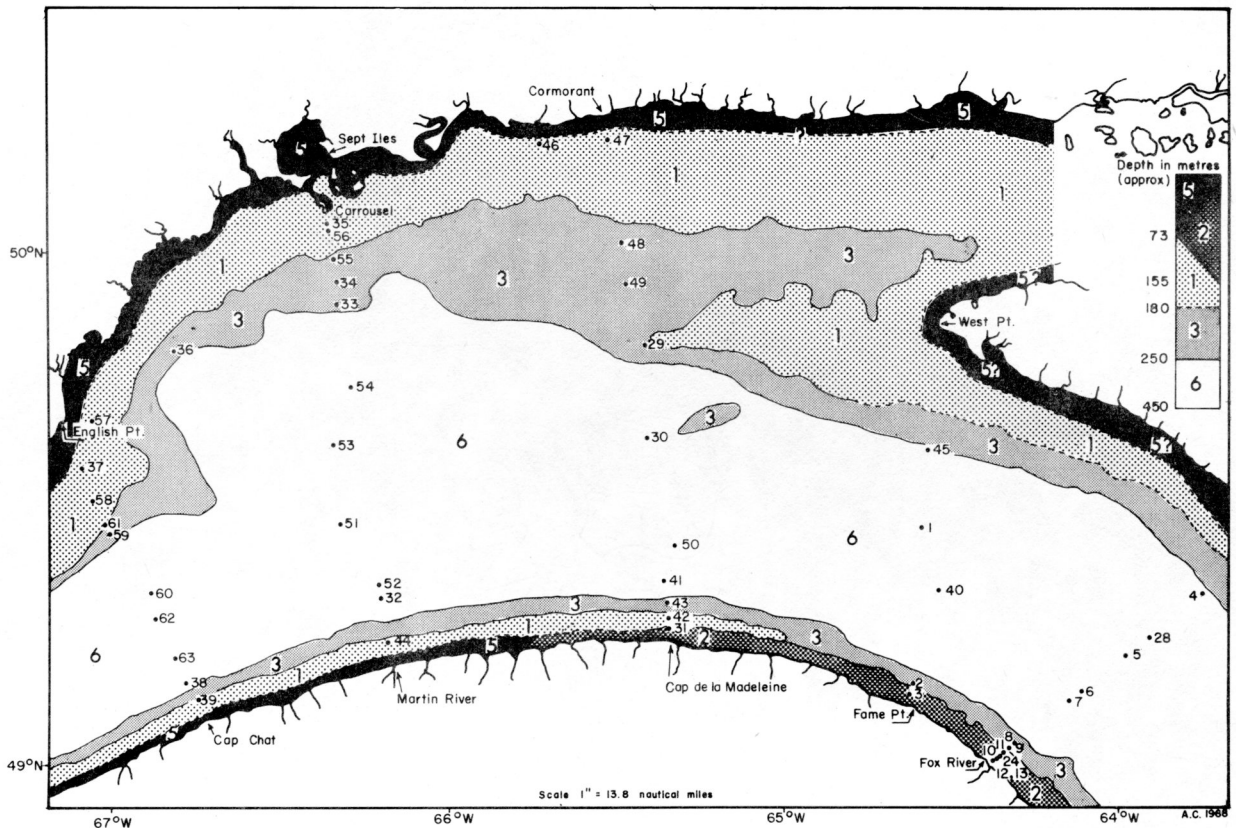


Figure 5 - Living foraminiferal depth-assemblages.

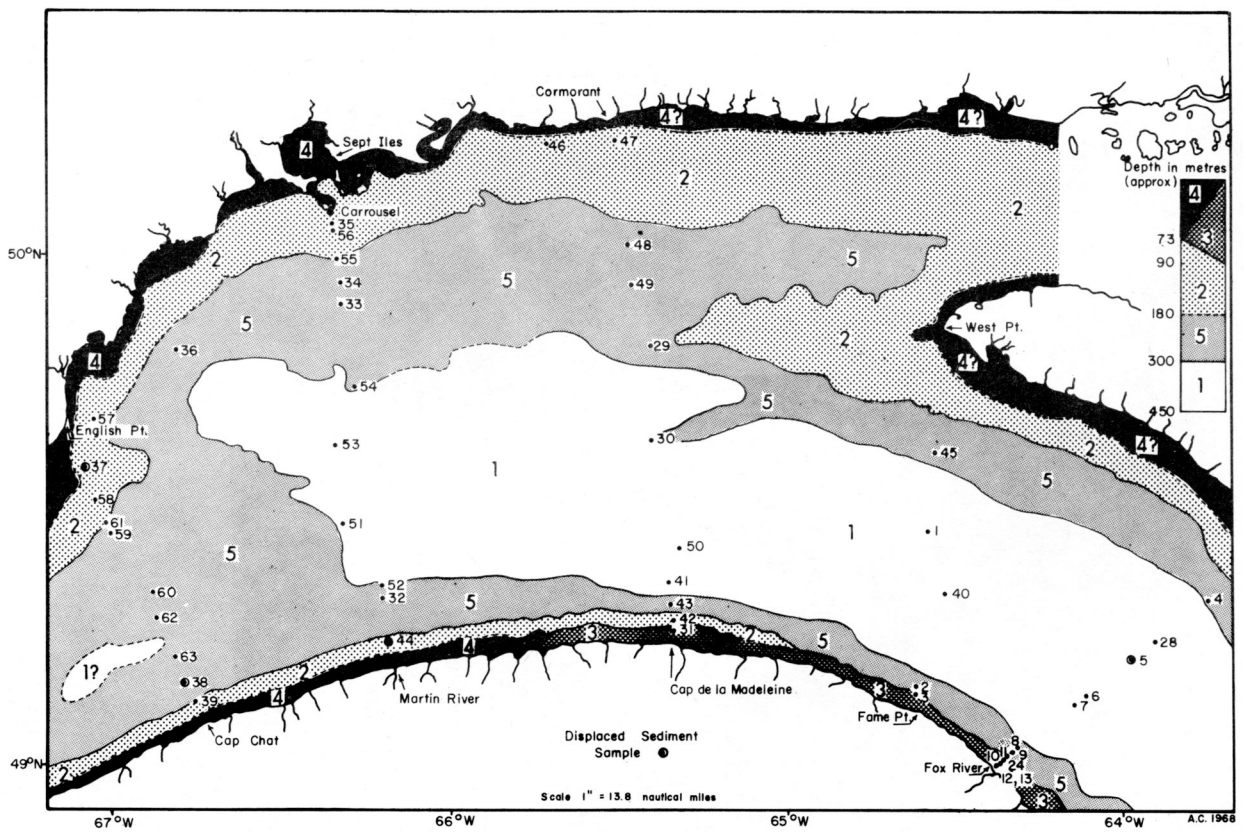


Figure 6 - Dead foraminiferal depth-assemblages.

The distribution of the assemblages in the northwest Gulf of St. Lawrence is shown in Figures 5 and 6. Overlap, in depth, of some assemblages prevents the precise demarcation of some depth-zone boundaries, therefore only approximate depths in metres are given in the figures. The method used for plotting the boundaries was to consider the bathymetrical position, geographical position and the factor-analytical assemblage designation of the sediment samples.

Comparing the distribution of the living with that of the dead populations some differences will be noted, but there is a general similarity of pattern between them. The living arenaceous assemblage 5 passes laterally into calcareous assemblage 2 between Martin River and Cap de la Madeleine. The same change occurs between dead assemblages 4 and 3. Living assemblage 1 and dead assemblage 2 both terminate laterally between Cap de la Madeleine and Fame Point. Living assemblage 3 does not occupy the bottom of the deep part of the Laurentian Channel in the western part of the area whereas dead assemblage 5 does.

Taxonomic Method. In these studies an attempt was made to distinguish potentially useful ecological varieties or subspecies. The method used was to split species into supposed subspecies and varieties where this seemed to be justified by slight morphological variations. In practice this procedure led to much subjectivity in identification, and to the erection of subjective varieties which were often difficult to re-identify. 247 species and varieties were recognized, some of which behaved as assemblage-indicator (restricted) species and varieties. Later, (1) all the varieties were merged with their species and then the factor-vector analysis program was run with the reduced number of species (210); and (2) only varieties of indicator species were merged with their species, varieties of non-indicator species were permitted to stand, and the program was then repeated with the reduced number of entities (220). In both cases the results, as shown by the reordered projection matrices, were essentially similar so far as the number of depth assemblages and the depth of their boundaries were concerned, and they were essentially similar to those assemblages and boundaries described above. Thus it was shown that the additional taxonomic refinement of splitting into varieties was unnecessary for the elucidation of these assemblages using the factor-analytical method.

Acknowledgements

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References cited

- HOOPER, K., 1969, Recent foraminifera of the Continental Shelf off Eastern Canada. A Preliminary Report, Report A.O.L. 70-3 (unpublished manuscript), Atlantic Oceanographic Lab., Bedford Institute, Dartmouth, N.S.
- LAUZIER, L., 1957, A Preliminary Report of the Winter Oceanographic Survey in the Gulf of St. Lawrence, 1956; Fish. Res. Bd. Can. Ms. no. 9.
- _____, 1958, Some aspects of oceanographic conditions in the Gulf of St. Lawrence from autumn 1956 to spring 1957; Fish. Res. Bd. Can. Ms. no. 10.
- MANSON, V. and IMBRIE, J., 1964, Fortran program for factor and vector analysis of geologic data using IBM 7090 and 7094/1401 computer system. State Geol. Surv. and Univ. Kansas Spec. Dist. Publ. 13, 46 p.