PROBLEMS IN FATHOGRAM INTERPRETATION

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Although the 808 fathometer has been used over 10 years in hydrographic surveying, the correct interpretation of fathograms still remains a major problem on many surveys. Recordings of strays caused by the mechanical or the electrical systems of the fathometer, and of grass, kelp, side echoes, fish, and floating debris confuse the reading of the bottom profile or of obstructions on the bottom over which the least depth must be obtained. The correct depth must be scanned, in some cases, from several possible traces and the proper interpretation of the recordings is, therefore, of paramount importance. Faulty interpretation may frequently result in the plotting of erroneous soundings.

A rescanning of early fathograms of kelp and grass areas would undoubtedly reveal a change in fathogram interpretation since the early days of recording fathometer operation. In present-day interpretation, many more fathogram traces are regarded as kelp, grass, or strays, than in the past. In fact, where the recorded traces cannot be attributed with considerable certainty to reflections from the bottom or from obstructions, they should not be recorded as soundings. However, even present-day interpretation is variously agreed upon. Constant study of the subject is necessary in order that uniform concepts may be developed to effectively accomplish the scanning of fathograms.

Questionable recordings on the fathogram or at least a representative number of them should be investigated with the handlead in order to verify the correct interpretation of returns for a particular fathometer. It is not suggested that this procedure will provide infallible interpretation for an entire survey, but it will provide a tangible basis for interpretation. Not only will the scanner have greater confidence in reading soundings but a more accurate interpretation can be made after the characteristic recordings of the fathometer have been confirmed by this means.

In many areas, the fathometer is only an imperfect means of obtaining soundings and it should not be relied on as the sole depth-measuring device. Supplementary handlead or pole soundings are required for clarification of certain traces, substantiation of doubtful least depths, and, in areas of very dense grass, even for the basic development.

As it is thought that information regarding fathogram interpretation can best be presented by actual illustrations from fathograms, this article will present examples of various fathogram recordings, some of which may illustrate problems in interpretation not found in the Hydrographic Manual or in prior issues of the Journal.

Kelp

Kelp recordings probably cause the greatest difficulty in interpretation. Usually occurring on irregular bottom inshore or on shoals or pinnacles, kelp traces may be similar to side-echo traces. Heavy kelp traces may also blend in with the bottom profile and create a problem in determining the point of separation. The bottom profile can usually be traced through the kelp traces by holding the fathogram at a slant to accentuate the differences in shading. If the similarity between the kelp and bottom traces is so strong that there is need to assume that certain traces are bottom traces, then there is a need for confirmation of the depth by other means, such as the handlead. In Figure 1, the heavier shading of the bottom can be distinguished at *A*. At *B*, the dark beginnings of the kelp traces should not be interpreted as bottom returns, although they are sharp and may lead one to so interpret them.

There are numerous variations in the appearance of kelp on fathograms. Above pinnacles, such as in Figure 2, a few streamers of kelp will appear as a faint thread as at *A*, or as a denser ribbon beginning at *B*. In Figure 3, the kelp has a soft feathery appearance, and in Figure 4 a denser mass has a speckled effect, especially when viewed with the fathogram held at a slant. On the foot scale, the kelp may appear as a heavy mass above the bottom, as in Figure 5, or as more open streamers, as in Figure 6. The separation from the bottom can be distinguished by the darker contrasting with the lighter shading or the uneven coloring of the kelp traces.

Boulders and kelp

In areas characterized by boulders and kelp, such as off parts of the New England coast, a few strands of kelp may grow in the immediate vicinity of isolated boulders lying on an even bottom. If the sounding vessel passes almost directly over a boulder, the recording will appear as in Figure 7 at *A*. The boulder can be detected by the heavy traces rising about 1 foot off the bottom. The fainter traces above are from kelp. When the sounding vessel passes slightly to one side of the boulder, only traces of the covering kelp or kelp growing directly off the even bottom, as at *B*, may register, and no indication of the boulder can be detected. Care should be taken not to interpret arbitrarily such traces as being from boulders. However, it is also realized that side echoes from boulders could appear almost identical to traces from small patches of kelp. As a result of this similarity, uncertainty in interpretation may exist in the minds of even the most skillful scanners. No positive and trustworthy method has been found to distinguish between kelp or grass and side-echo traces on the fathograms, and verification by other methods of depth measurement is often needed for proper interpretation.

A clue to the possible existence of grass or kelp can sometimes be obtained in the field by decreasing the gain, as illustrated in Figure 8. Here the kelp has been eliminated entirely from the fathogram by the decrease in gain. However, in very heavy grass or kelp, even this procedure probably would not eliminate all the grass or kelp traces without eliminating the bottom profile as well.

Grass

In areas of heavy grass, the fathometer signal is at times reflected entirely from the grass and no portion of the recorded trace represents the bottom. Pseudo-peaks resembling bottom irregularities and boulders are actually variations in the

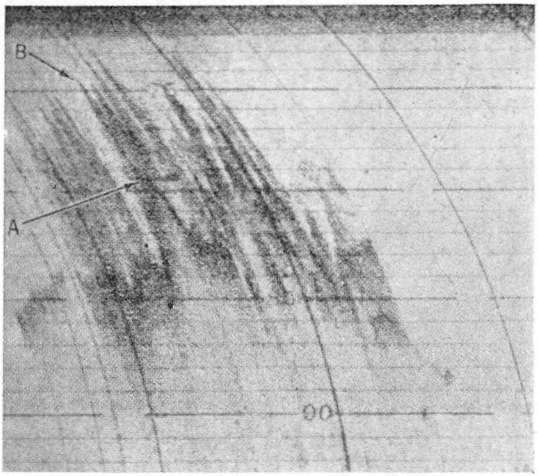


Fig. 1.

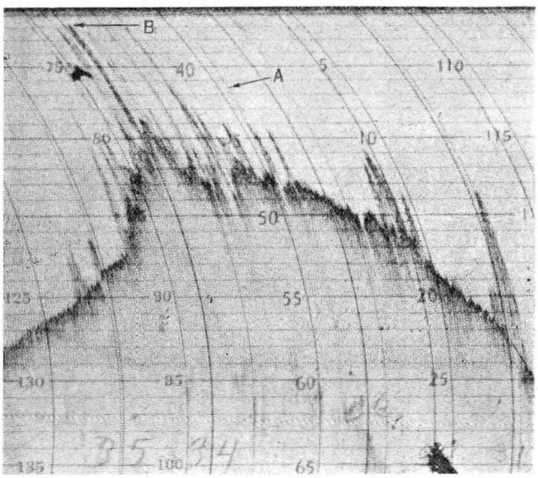


Fig. 2.

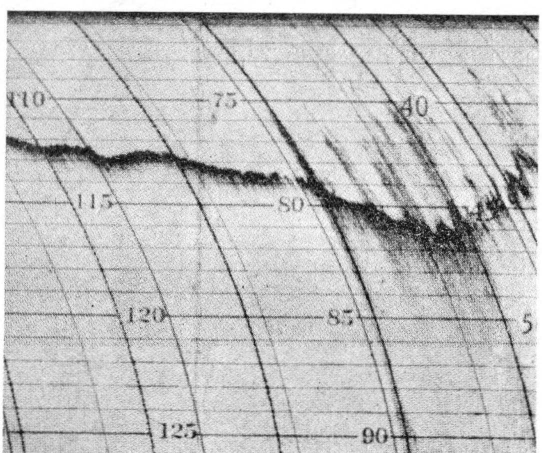


Fig. 3.

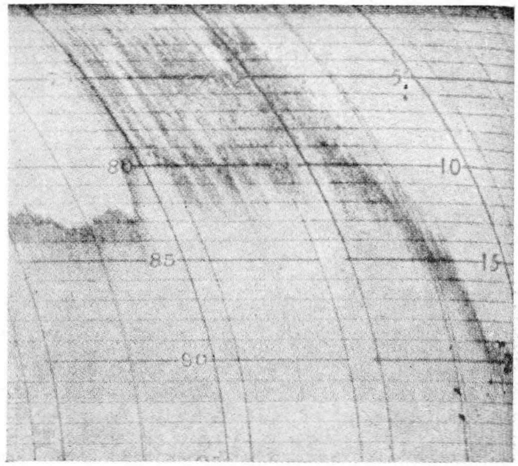


Fig. 4.

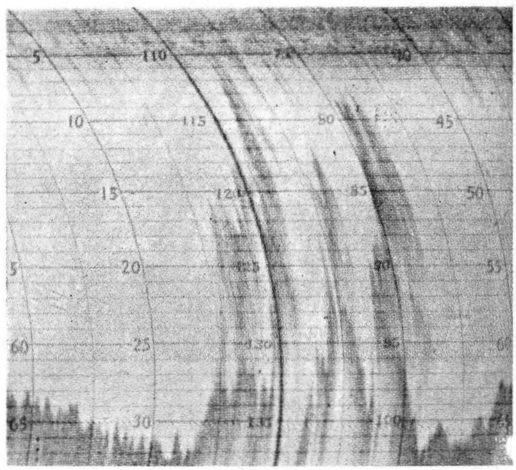


Fig. 5.

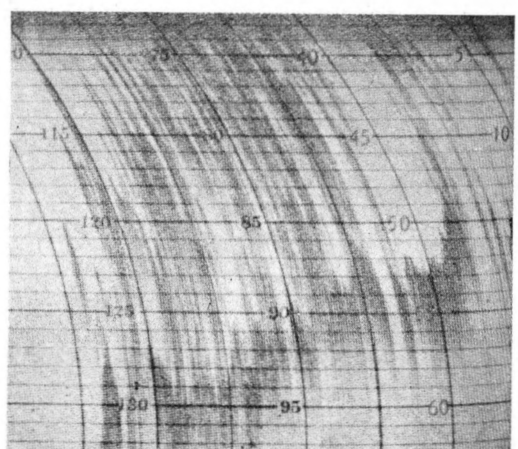


Fig. 6.

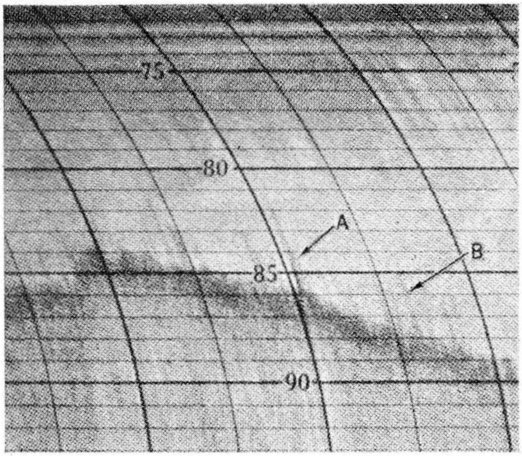
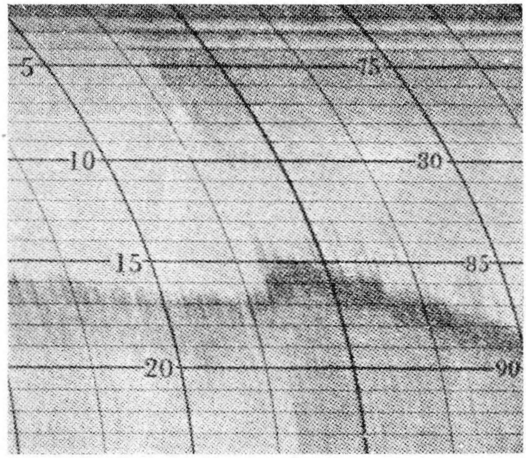


Fig. 7.



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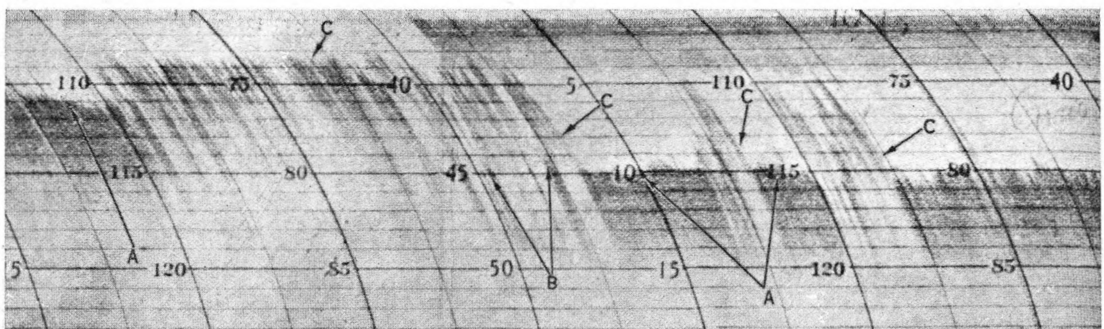

Fig. 9.

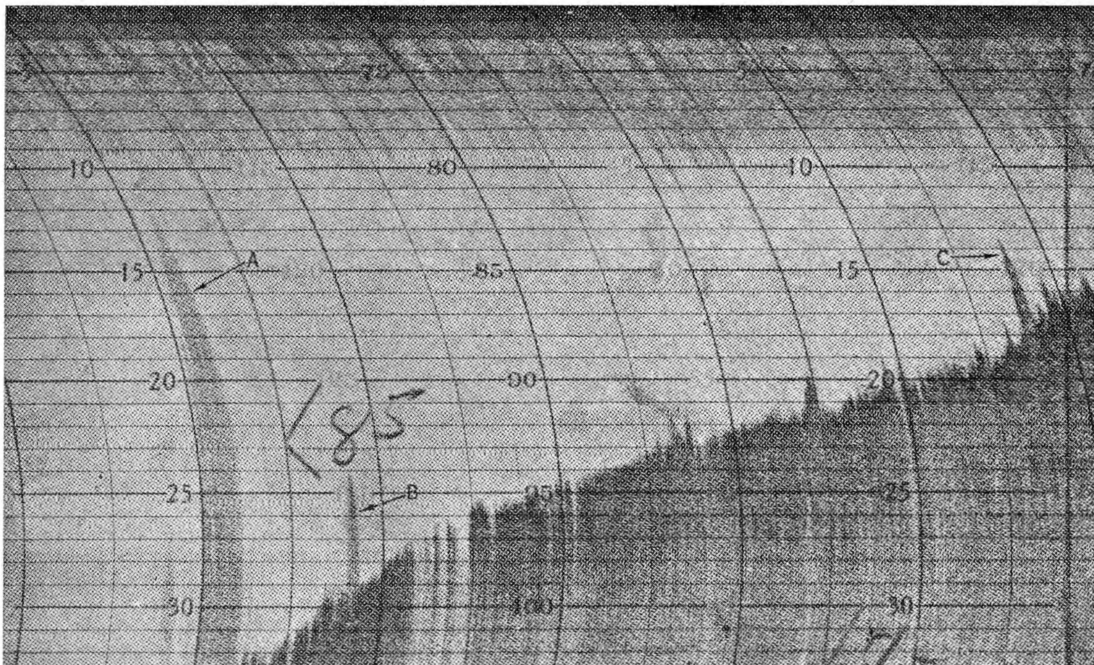

Fig. 10.

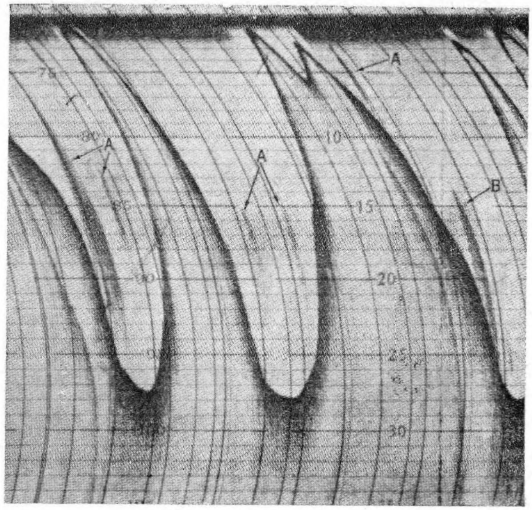

Fig. 11.

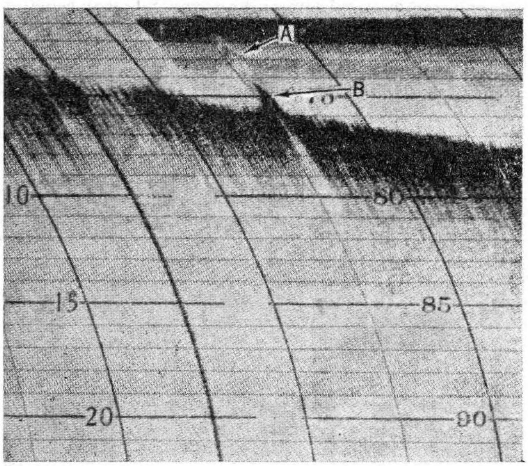

Fig. 12.

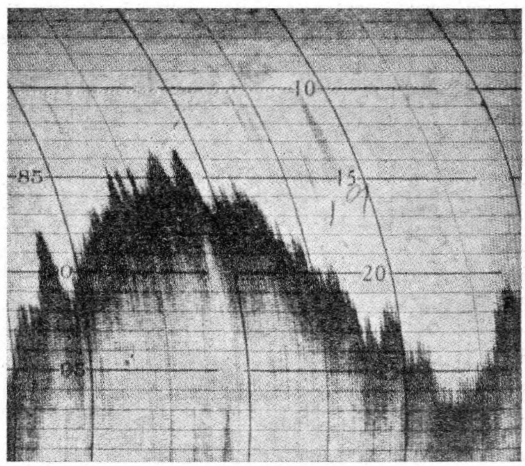

Fig. 13.

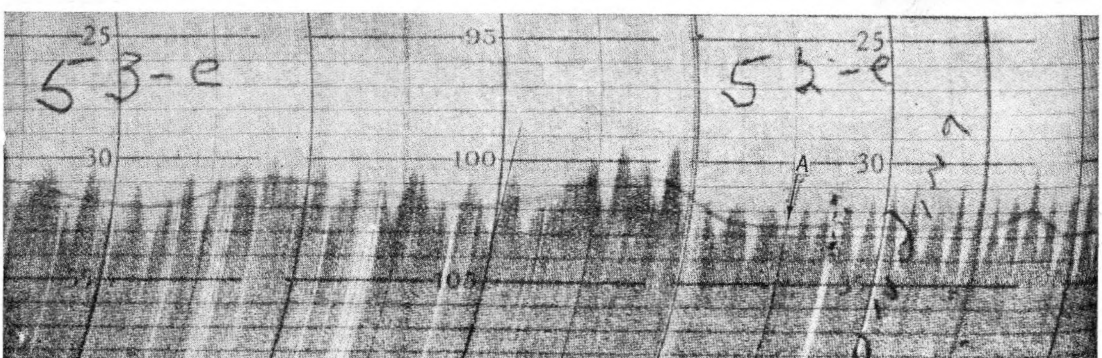

Fig. 14.

profile of the grass. Usually the top of the profile will have a rather ragged appearance, and, where only patches of grass are crossed, the change from bottom profile to top of heavy grass may be abrupt. However, in some instances the top of the grass beds will appear no more irregular than many ragged bottom profiles.

In Figure 9, the bottom can be easily identified at points *A* and at open areas in the grass at points *B*. Points *C* are patches of grass completely replacing the bottom profile. Bottom depths here cannot be determined from the profile and must be obtained by other means. Particular caution must be exercised to avoid reading « down a little » from the top of the grass profile, assuming thereby that the bottom is read.

Strays

Strays resulting from excessive gain, poor fathometer installation, or from faulty electrical or mechanical characteristics of the fathometer frequently cause uncertainty in interpretation. In areas characterized by numerous boulders, side-echo traces which may be the sole indication of the boulders are often undistinguishable from erratic strays.

In Figure 10, the traces at *A* are apparently strays. The traces at *B* could be strays occurring close to bottom depths or they could be side-echo reflections from a pinnacle or shoal similar to that shown at *C*. However, inasmuch as traces such as at *B* are very common on fathograms containing numerous strays, all such traces cannot be reasonably accepted as side echoes. In areas of boulders or pinnacles, maximum effective use can be made only of fathograms free from strays.

Too high a gain is probably the most general cause of excessive strays appearing on the fathograms. The Hydrographic Manual specifies that the fathometer should be operated at the highest gain setting possible without the introduction of excessive strays. This requirement minimizes the effect of variation in the time lag of the fathometer and results in soundings more nearly approaching true depths.

Inasmuch as many fathometers will show excessive strays at a relatively high gain, a lower gain might eliminate the strays and also a serious problem in fathogram interpretation. The minimum gain permissible would be such that no appreciable change in depth would result from an increase in gain. No error in depth for a specific range should result from using a gain not less than that minimum. This gain value would not be suitable for all depths, and bar check corrections would be needed for changes in gain necessary for other ranges in depths.

Figure 11 illustrates strays from indeterminate causes at points *A*. At point *B* the traces have the appearance of considerable shape and substance and closely resemble a side echo. However, all these traces were investigated in the field and found to be spurious. Strays of this sort clearly make interpretation difficult.

Fathometer speed change

A sudden change in the speed of the fathometer, if large enough, can sometimes be detected by the appearance of the initial traces on the fathogram. The initial traces will be shortened or lengthened depending on the speed change. The bottom profile will correspondingly reflect the speed change by pseudofeatures — peaks or depressions. In Figure 12, the change in fathometer speed is detected by the shortening of the initial traces which causes an indentation to appear in the lower edge of the initial at *A*. The corresponding pseudo-feature is the peak in the bottom profile at *B*.

A similar change in the bottom profile and in the appearance of the lower portion of the initial trace will occur when the initial jumps because of slippage in the index setting devise or looseness in the phasing head. However, when this occurs, the jump will also appear at the upper edge of the initial trace, whereas in a speed change the upper edge of the initial will change only very slightly.

Lobster pots

Lobster pot lines reflect echoes which record as traces very similar in appearance to faint kelp markings. There are no distinctive identifying characteristics to the traces ; however, supplementary notes regarding the visible markers found in lobster pot areas do make possible the correct interpretation of the traces. Figure 13 shows traces from lobster pot gear.

Chop and seas

Irregular profiles reflecting the effect of chop or seas are caused by the rise and fall of the sounding vessel. Readings should be taken along a line representing the mean depth. This line should be an average position in the jagged sawtooth profile of choppy seas, or the average of the undulations caused by a following sea. In Figure 14, a line has been drawn to represent an average depth in chop to the right of *A*, and in the following seas to the left of *A*. Profiles reflecting chop on one course contrast sharply with profiles reflecting following seas on the reverse course.

In some areas, profiles of sand waves have much the same appearance as profiles from a boat in chop or following seas. However, a discrimination can sometimes be made by examining the fathograms for the position where the boat entered and left the sand ridge area. In general, chop or seas will be apparent over the entire line, whereas sand ridges will frequently be confined to a local area. Ample notes regarding the seas are always of great assistance in fathogram interpretation and in areas of sand waves they may be a requisite to correct interpretation.

Faulty stylus

Blotches of light areas in the initial or bottom traces may be caused by a faulty stylus — usually one with the points burned. Figure 15 illustrates this condition. If the stylus is not replaced or repaired, the blotches may eventually obscure so much of the bottom profile as to make the fathogram useless.

Excessive tension in the stylus spring is illustrated in Figure 16 where traces extend downward from the perforations in the fathogram.

Dirty contacts

Dirty or corroded contacts can be detected by the ragged appearance of the initial trace. Because of the dirt or corrosion, erratic discharges will occur before the time of normal signal transmission, as illustrated in Figure 17. The reflected signal traces will be correspondingly displaced and possess a similar ragged appearance. Compensation for this displacement should be made in scanning the bottom profile.

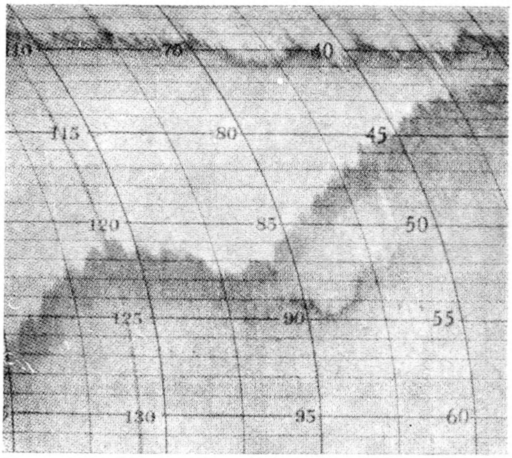

Fig. 15

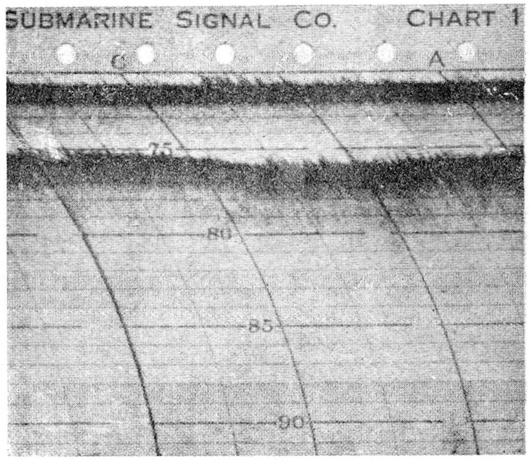

Fig. 17.

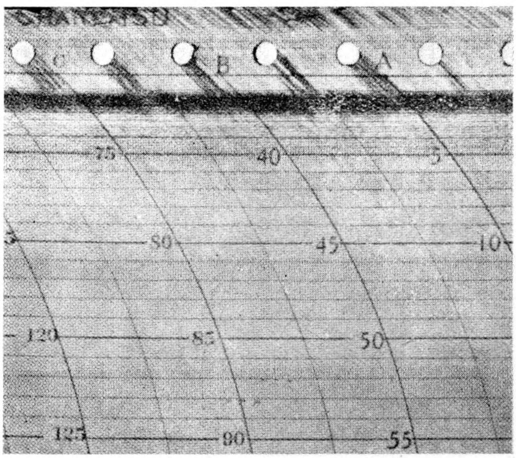

Fig. 16.

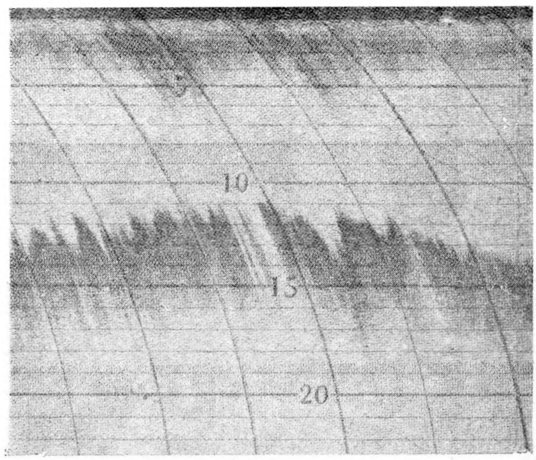

Fig. 18.

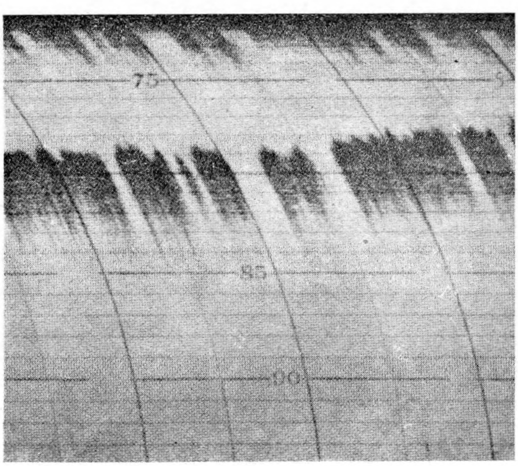

Fig. 19.

Turbulence

Turbulent waters caused by the propeller wash of the sounding vessel or a passing ship frequently contain sufficient air bubbles to completely reflect the transmitted signal and thwart the registry of the bottom profile. In Figure 18, the traces at *A* are from the wake of the sounding vessel on a turn. Air bubbles in the water caused by breakers or surf may record somewhat similarly and in shoal water the recorded traces may join and be confused with the bottom profile.

In many instances where the « fish » is exposed or where the wash of the waves carries bubbles along the hull of a vessel containing an inboard transceiver, the outgoing signal is weakly transmitted or blocked out entirely, and no return is received from the bottom. Usually the initial trace is also blocked out or registers only in part, as shown in Figure 19.

Conclusion

The preceding examples illustrate some of the difficulties inherent in fathogram interpretation. Our knowledge is still incomplete and should be augmented by additional field experimentation. On surveys made for the U.S. Navy, divers have been used to verify traces of objects revealed on the fathograms. This procedure offers a possible means of supplementing our knowledge of fathogram interpretation. Temperature inversions have been ascribed as the possible cause of «flying saucers». Similar phenomena in the water may be the cause of some fathometer strays. Additional knowledge together with the dissemination of information necessary for the establishment of common concepts in interpretation will not only result in the more efficient processing of survey records but also in more accurate surveys.