MEMO TO DEPLOYMENT WORKSHOP.

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The deployment workshop is asked to consider procedures for deploying two different DUMAND arrays, with quite different properties and aims. Each exists in three slightly different versions, which differ somewhat in performance. However, the difference in performance is not great; and the three versions are mentioned with some trepidation, since they appear to complicate matters more than may be warranted. The only reason for mentioning them is to discover whether there may be significant differences in the procedures, cost, or difficulty of deployment. For the sake of definiteness, the version called the Hexagonal should be taken as the standard, and the other two as variations.

The two arrays are being called the MINI and the MIDI. They are geometrically similar, differing only in scale. The MINI is a small array: the cubical version is 150m on a side. Its sensor elements are an 18" glass sphere containing a single 13" hemispherical PMT. Such sensors are rugged, familiar and readily packed into canisters. The various versions of MINI are described in Table 1.

The MIDI is a much larger array. It is geometrically like MINI, except that the spacing is 50m, the side 500m, and the volume therefore 1/8 km^3. Should the water transparency permit, the spacing may be increased to 60m. MIDI requires higher-sensitivity sensors than MINI; their sensitivity must be 6 stengers rather than 1, for MINI. (A sensor has a sensitivity of 1 stenger when a flux of 100 quanta/m^2 produces one photoelectron at the first PMT dynode.) The required sensitivity can almost certainly be reached with Sea Urchin, as demonstrated by laboratory measurements. It may also be possible to reach it with a special direct-view cylindrical-cathode PMT, now under development at EMI; but that tube is some distance off.

Sensor Packaging.

We expect that Sea Urchin will be packaged in a cylinder about 1m in diameter, and about 4 meters high. The canister for a string must then contain 11 such units. If the EMI tube should come along, it will go into a glass cylinder with hemispherical ends; the overall length will be about 2m and the diameter about 2/3 of a meter.

Following is a table of possible MINI-DUMAND arrays, for study at the deployment workshop. The arrays are nominally 150m on a side, with 15m spacing. They are illustrated in Figs. 1 - 3.

Table 1. MINI-DUMAND Arrays.

PROPERTY	CUBE	RHOMBUS	HEXAGON	MIDI(CUBE)
No. of strings on a side	11	11	7	11
Spacing between strings,m.	15	16.12	16.12	50
Spacing along strings, m.	15	15	15	50
Total No. of Strings	121	121	127	121
Sensors per string	11	11	11	11
Total No. of sensors	1331	1331	1397	1331
Length of bottom edge,m.	150	161.2	96.72	500
Array height, m.	150	150	150	500
Area of bottom,m^2	22500	22500	24304	.25 km^2
Volume of Array, m^3	3.37×10^6	3.37×10^6	3.65×10^6	.125 km^3
Typical Diagonal, m	212	241	230	800
Av No of sensors/track	12	12	11	8
Maximum Distance of an Interior Point from nearest sensor, m.	16.77	15.14	15.14	53.5

It should be noted that while the cubic array is slightly inferior in performance to the rhombic or hexagonal arrays, all three would in fact be satisfactory in performance. Thus the choice among them would be influenced if there is a significant difference in ease or cost of deployment.

Possible Deployment Procedures.

To date three deployment techniques have been suggested for the build-up of the first DUMAND array on the ocean floor. One is that proposed for the 1978 Workshop (1). Another has recently been proposed by Howard Talkington (2), and a third, originally proposed by Wilkins in 1978 and withdrawn, has recently been revived (3) in a modified form.

All three schemes envisage each string packaged into an individual canister. The sensors proposed for the 1980 MINI array are glass spheres 18" in diameter, and there are 11 per string; the canister might thus be a meter in diameter and two to three meters long. In the 1978 Workshop scheme, these canisters are connected together into rows. Of the three forms of the MINI array, the row in the case of the cubic array is 150m long; in the rhombus it is 162m long; and depending on the procedure used for the hexagonal array, it would vary from 96m to 192m long.

An alternative scheme, as described by Talkington (2) at the 1980 Summer Workshop, dispenses with the concept of rows. It introduces instead a "master buoy", containing up to perhaps 30 canisters, each enclosed in a specially shaped "glider" capable of being steered as it glides downward in the ocean, via an umbilical cord connected to the master buoy. The latter is lowered to a suitable height above the sea floor and stopped. It then releases these gliders one at a time and guides each to its target position. When all the canisters have been released, the cable is raised, and the process repeated at another location. The umbilical cables may then be severed, or, alternatively, perhaps remain connected to a central junction point, perhaps to be utilized later in making array interconnections. The original proposal is not explicit on this point.

A related technique suggested by Wilkins in 1978 (3) should also be reconsidered. In this scheme the canisters are also individually packaged in "gliders". However, the master buoy, instead of being controlled from shipboard at the end of a long cable, is allowed to fall freely, attached to an anchor. The entire system is provided with movable control vanes, and guides itself to a pre-programmed position with respect to a network of acoustic transponders on the bottom. The master buoy is thus analogous to a guided or "smart" bomb.

Both these "master buoy" concepts envisage deploying many strings at a time, but in roughly circular or hexagonal clusters rather than rows. They should be adaptable to all three array ground plans of Table 1. Fig. 3 shows how these deployment schemes might be used with the hexagonal array.

In both Talkington's and Wilkins' schemes the accuracy of placement is estimated at about 5m. This would be perfectly satisfactory for MIDI; but for MINI I estimate that the error should not exceed half that much.

Needless to say, additional new ideas will be welcome.

REFERENCES.

1. Deployment and Emplantment of the DUMAND Array, DUMAND Deployment Task Group, A. J. Schlosser, Chmn; Proc. 1978 DUMAND Summer Workshop at La-Jolla, CA. Vol. 3, p. 121. G. Wilkins, ed. HDC 1979.

2. Proposed 1980 DUMAND Master Buoy Array, H. R. Talkington, Proc. 1980 DUMAND Summer Workshop/Symposium, V. Stenger, ed. HDC, to be published.

3. G. Wilkins, private communication.

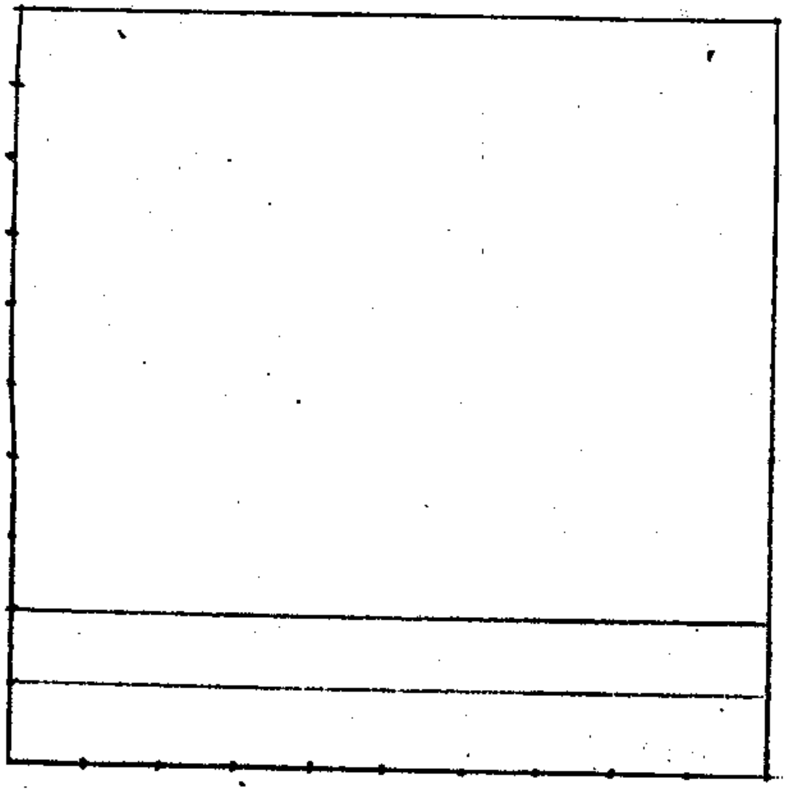
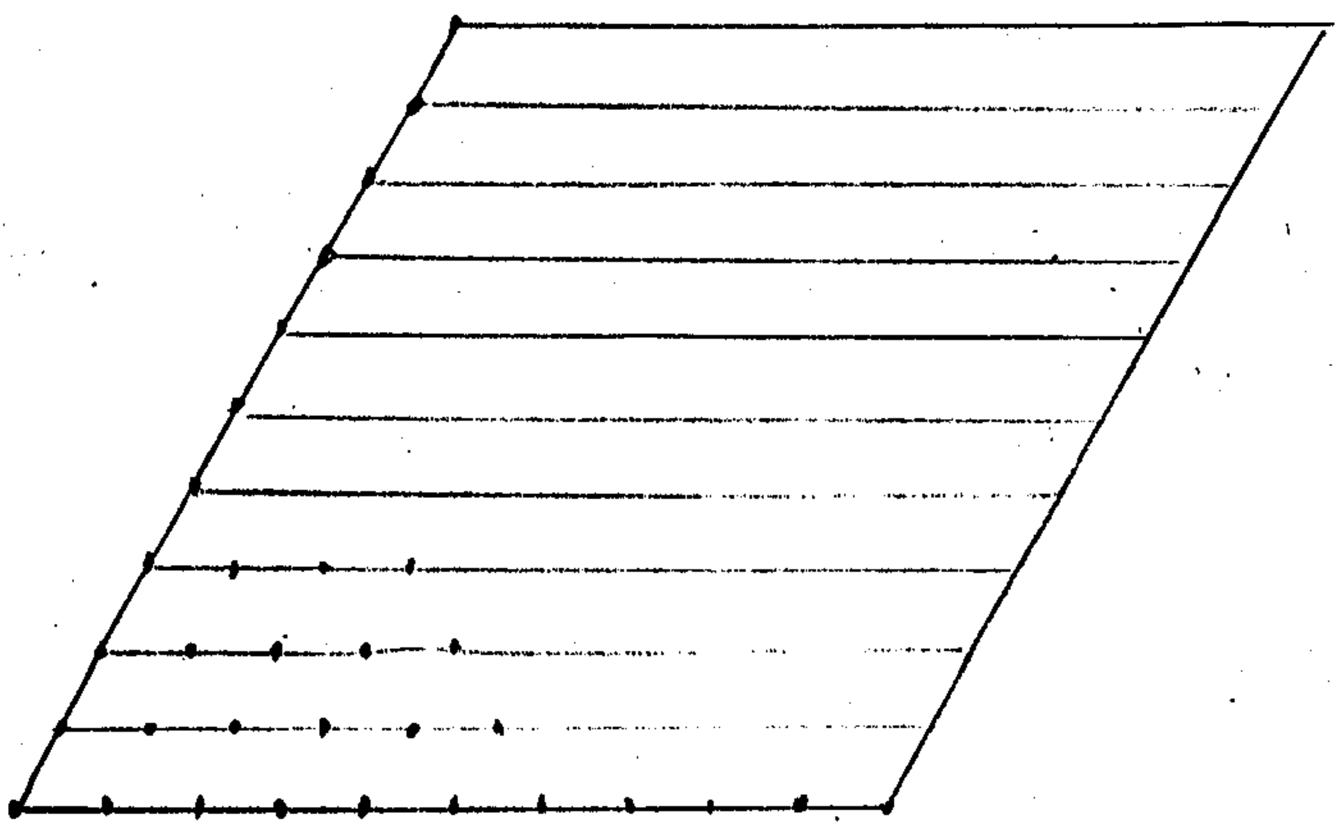


Fig. 1. Ground plan of cubic array, 150m on a side,15m spacing between rows, strings.

Fig. 2 (below.) Ground plan of rhombic array, 162m on a side, 16.2m spacing between rows, strings. Area is same as Fig. 1, above.



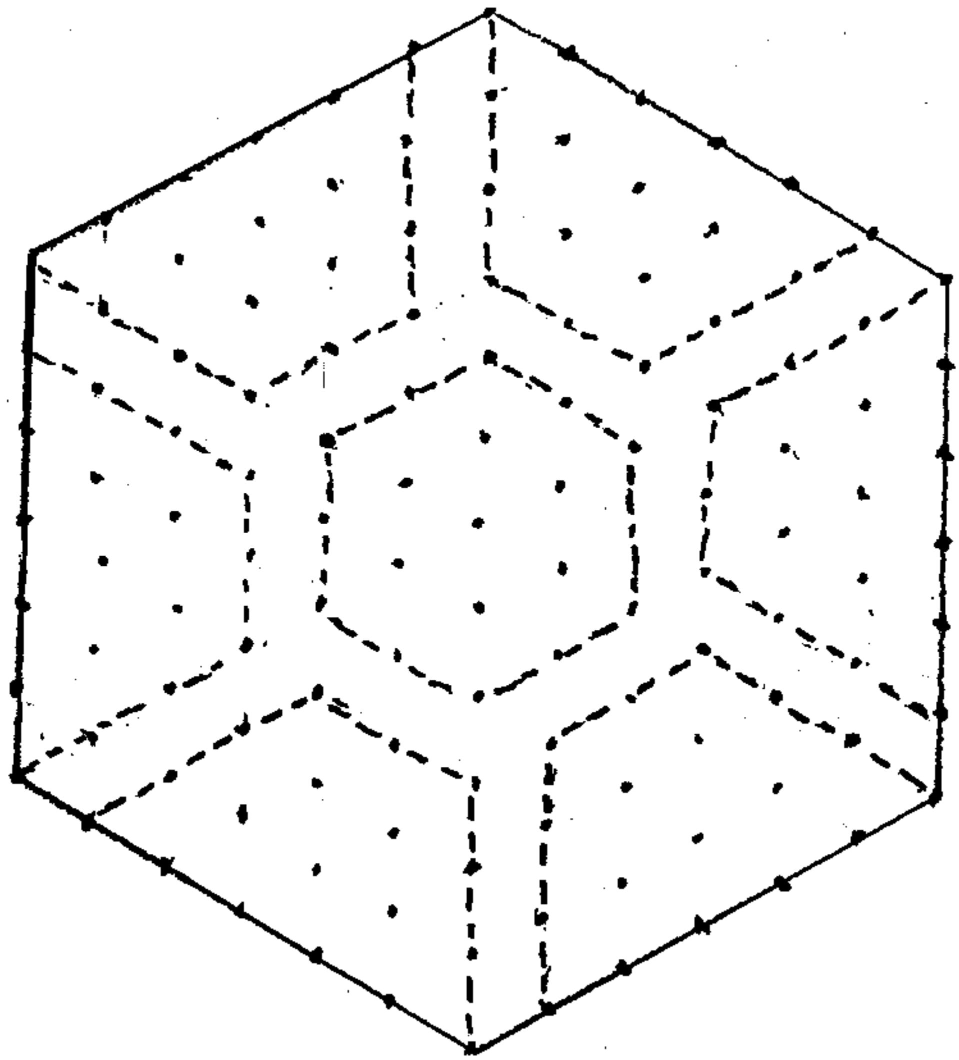


Fig. 3. Ground plan of a hexagonal array. There are 127 strings, 16.1m apart. The array could be deployed in several ways:

a). in rows along 3 legs, like the 1978 Standard Array;

b). in parallel rows of varying length,

c). in 7 separate clusters, as e.g. those indicated by the dotted lines, each from a single Master Buoy,

or d). some other rearrangement of clusters.