



Technical Report No. 36

DROGUES, DRAGS, AND SEA ANCHORS

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Multidisciplinary Research in the Great Lakes

Drogues, Drags, and Sea Anchors

by

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INTRODUCTION

This brief report graphically summarizes and categorizes the numerous drogue, drag, and sea anchor designs employed from 1500 to the present. The emphasis here is on the drogue proper and not on the surface buoy from which the drogue is suspended.

Figure 1 and Figure 1A depict or describe some 110 drogue designs. These designs have been divided into five categories. The first category includes all those drogues that are essentially planar where the plane surface is oriented parallel to the flow relative to the drogue. The drogues that fall in the second category are also planar, but in these cases the plane surface is oriented perpendicular to the flow relative to the drogue. Category three encompasses the cruciform drogues, those that project a cross-like shadow on a horizontal surface. The fourth category contains all the cylindrical and spherical drogues and all others which likewise project as circles or disks on a horizontal plane. The fifth and last category includes all those drogue designs that present a concave surface to the flow relative to the drogue. In this category are parachutes, plankton nets, and umbrellas.

The earliest drogue designs appear at the top of Figures 1 and 1A, and the most recent are depicted at the bottom.

Each design depicted or described on these figures is accompanied by an alpha-numeric symbol. (The F prefix stands for

flat, the X prefix represents cruciform, the R prefix stands for round, and the P prefix stands for parachute.) The key section relates each design, designated by its alpha-numeric symbol, to one or more of the references cited in the bibliography. In the key, only the author's last name and date of publication are given.

The bibliography lists works describing drogues and current measurements made with drogues. While the 137 references listed here include many which do not appear in the key, all distinct drogue designs encountered in these numerous references have been incorporated in Figures 1 and 1A and in the key.

In addition, several of the original figures depicting interesting and/or important early drogue designs are reproduced in this report as Figures 2 through 5.

A condensed version of Figure 1, and a discussion of certain trends in drogue design, apparent from this figure, will appear in a note in *Limnology and Oceanography* (Monahan and Monahan, 1973).

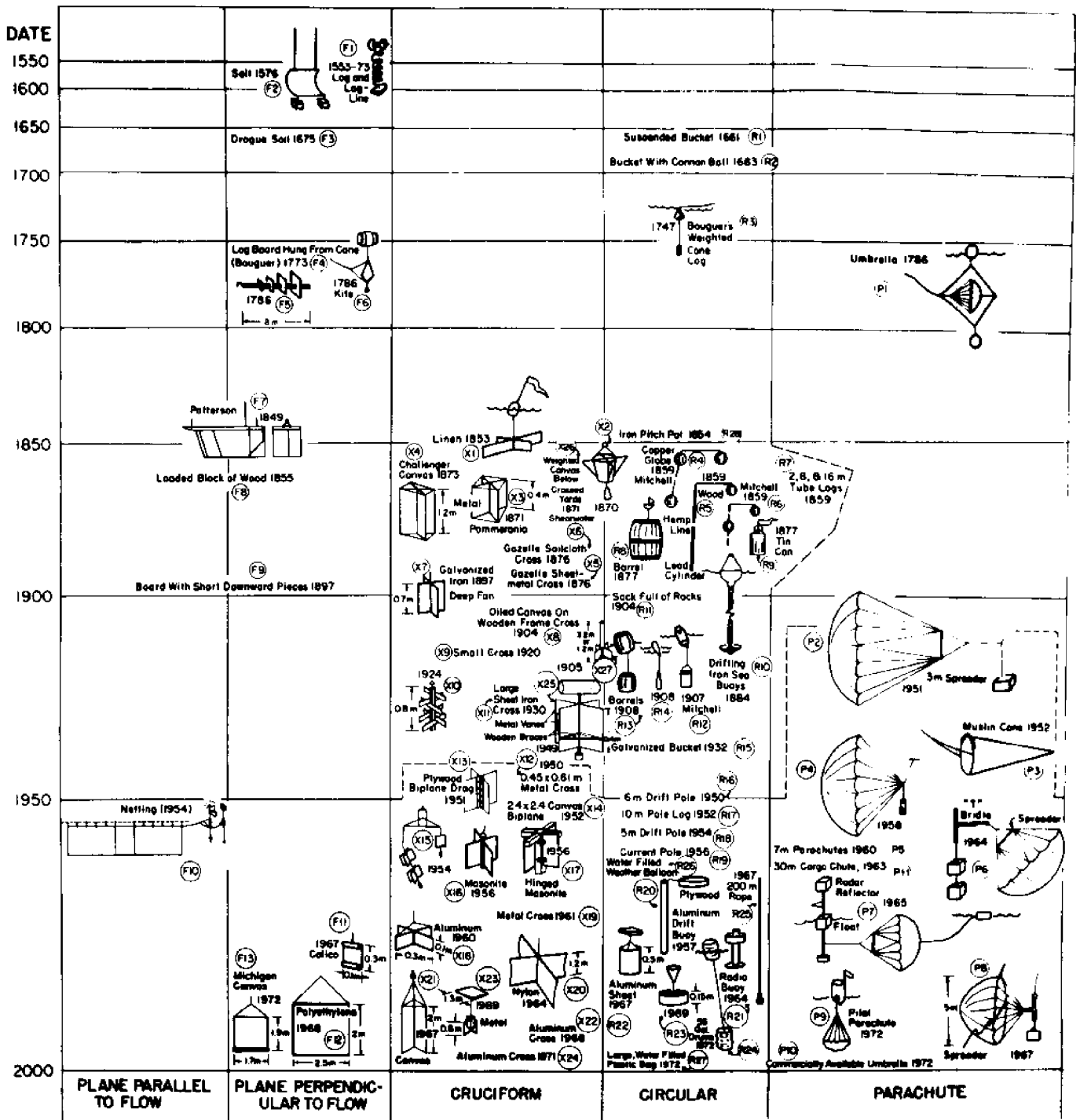


Figure 1. Categorization of various drogue types. Dates given indicate when design first used, when known; otherwise represent date of publication. Alpha-numerical symbols refer to key.

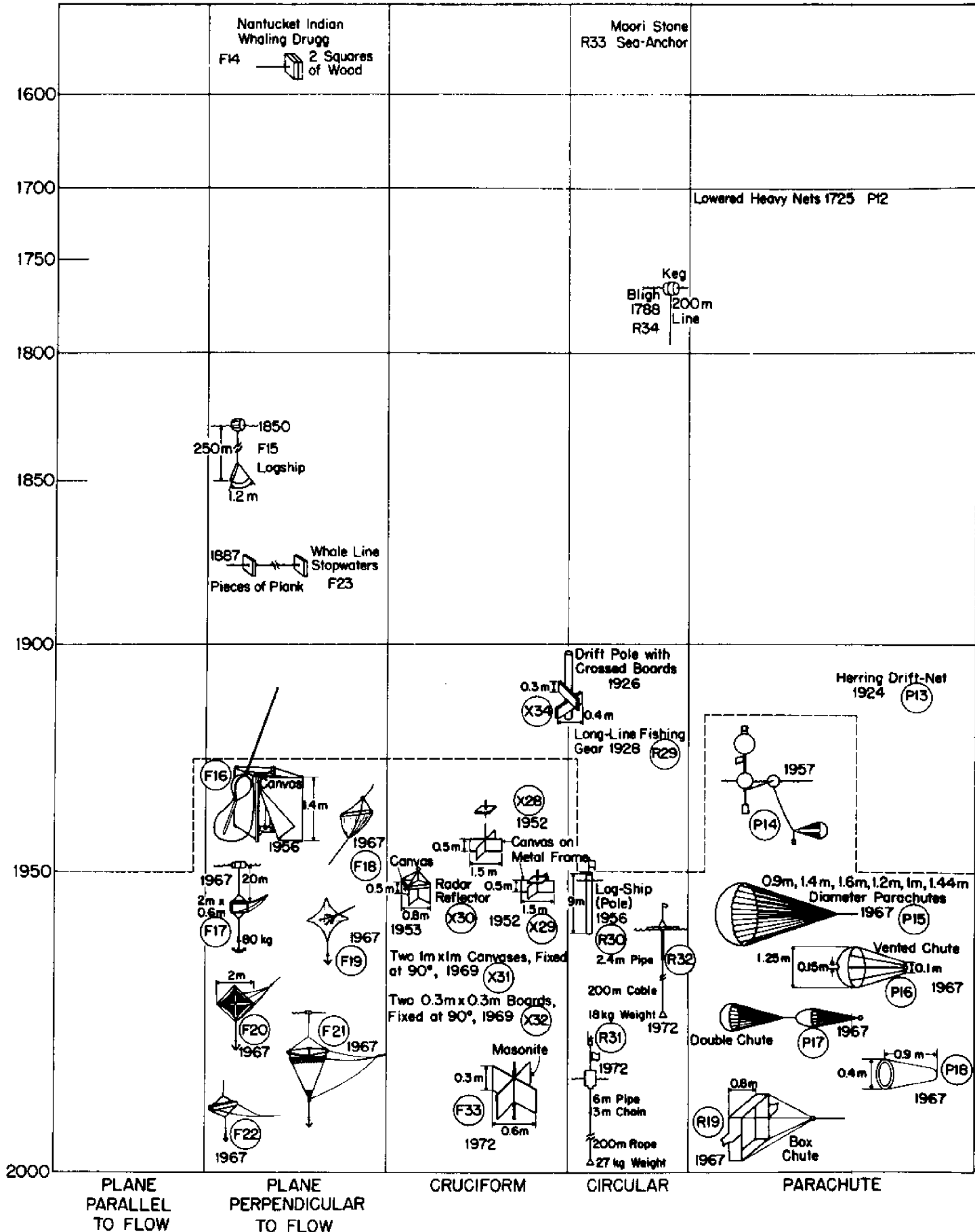


Figure 1A. Additional drogue designs encountered since Figure 1 prepared in summer of 1972.

KEY

F

- | | |
|--------------------------|------------------------------|
| 1. Waters 1956 | 8. Thoulet 1904 |
| 2. Gilbert 1598 | 9. Granqvist 1921 |
| 3. Deacon 1968 | 10. Carruthers 1932 |
| 4. Taylor 1968 | 11. Witting 1930 |
| 5. Franklin 1785 | 12. Doe 1952 |
| 6. Franklin 1785 | 13. Pritchard and Burt 1951 |
| 7. Bache 1849 | 14. Reid 1958 |
| 8. Maury 1858, Lee 1854 | 15. Stommel 1954 |
| 9. Dawson 1897 | 16. Gaul and Stewart 1960 |
| 10. Cromwell et al. 1954 | 17. Gaul and Stewart 1960 |
| 11. Welsh 1967 | 18. Shulman and Bryson 1961 |
| 12. Terhune 1968 | 19. Anderson et al. 1962 |
| 13. Monahan et al. 1973 | 20. Farlow 1965 |
| 14. Melville 1851 | 21. Hamblin and Rodgers 1967 |
| 15. Findlay 1853 | 22. Ragotzkie et al. 1969 |
| 16. Evans 1957 | 23. Gunwaldsen et al. 1970 |
| 17. Nomura et al. 1967 | 24. Miller et al. 1972 |
| 18. Nomura et al. 1967 | 25. Putnam et al. 1949 |
| 19. Nomura et al. 1967 | 26. Montgomery & Stroup 1962 |
| 20. Nomura et al. 1967 | 27. Chevallier 1917 |
| 21. Nomura et al. 1967 | 28. Romanovsky 1952 |
| 22. Nomura et al. 1967 | 29. Romanovsky 1952 |
| 23. Bullen 1898 | 30. Broc 1953 |

X

- | | |
|------------------------------|------------------------|
| 1. Scoresby 1853 | 31. Chang 1969 |
| 2. Carpenter & Jeffreys 1871 | 32. Chang 1969 |
| 3. Karsten 1873 | 33. Soule & Oguri 1972 |
| 4. Tizard et al. 1885 | 34. Ogura 1926 |

- | |
|----------------|
| 5. Rottok 1888 |
| 6. Rottok 1888 |
| 7. Dawson 1897 |

R

- | |
|----------------|
| 1. Deacon 1968 |
| 2. Smith 1684 |
| 3. Waters 1956 |

P

- | | |
|--|----------------------------------|
| 4. Mitchell 1859 | 1. Franklin 1785 |
| 5. Mitchell 1859 | 2. Volkmann et al. 1956 |
| 6. Mitchell 1859 | 3. Cromwell et al. 1954 |
| 7. Mitchell 1859 | 4. Jennings and Schwarzlose 1960 |
| 8. Marindin 1877 | 5. Wooster and Gilmartin 1961 |
| 9. Marindin 1877 | 6. Gerard and Salkind 1965 |
| 10. Johnson 1884 | 7. Gerard 1965 |
| 11. Thoulet 1904 | 8. Hamblin and Rodgers 1967 |
| 12. Richard 1907 | 9. Miller et al. 1972 |
| 13. Thoulet 1908 | 10. Palmer 1972 |
| 14. Thoulet 1908 | 11. Parker 1973 |
| 15. Carruthers 1932 | 12. Carruthers 1963 |
| 16. Doe 1952 | 13. Uda 1934 |
| 17. Sharpey-Schafer 1952 | 14. Kawamoto 1958 |
| 18. Mackay 1954 | 15. Nomura et al. 1967 |
| Herlinveaux 1954 | 16. Nomura et al. 1967 |
| 19. Pickard 1956 | 17. Nomura et al. 1967 |
| 20. Bumpus et al. 1957 | 18. Nomura et al. 1967 |
| 21. Favorite et al. 1965 | 19. Nomura et al. 1967 |
| 22. Scott and Landsberg 1969 | |
| 23. Gannon and Brubaker 1969 | |
| 24. American Geophysical
Union 1972 | |
| 25. Stalcup 1972 | |
| 26. Parker 1973 | |
| 27. Green 1972 | |
| 28. Lee 1854 | |
| 29. Ulda 1934 | |
| 30. Gilmour 1960 | |
| 31. Parker 1972 | |
| 32. Parker 1972 | |
| 33. Best 1918 | |
| 34. Bligh 1792 | |

Figure 2. A reproduction of a figure that accompanied an early annual report of the U.S. Coast and Geodetic Survey (Mitchell, 1859) showing several devices used in a current study of New York Harbor.

U.S. COAST SURVEY

AD. BACHE Supdt.

IMPROVED FORM OF SUB CURRENT APPARATUS

Devised for use of the Coast Survey

by

H. MITCHELL Asst.

1859

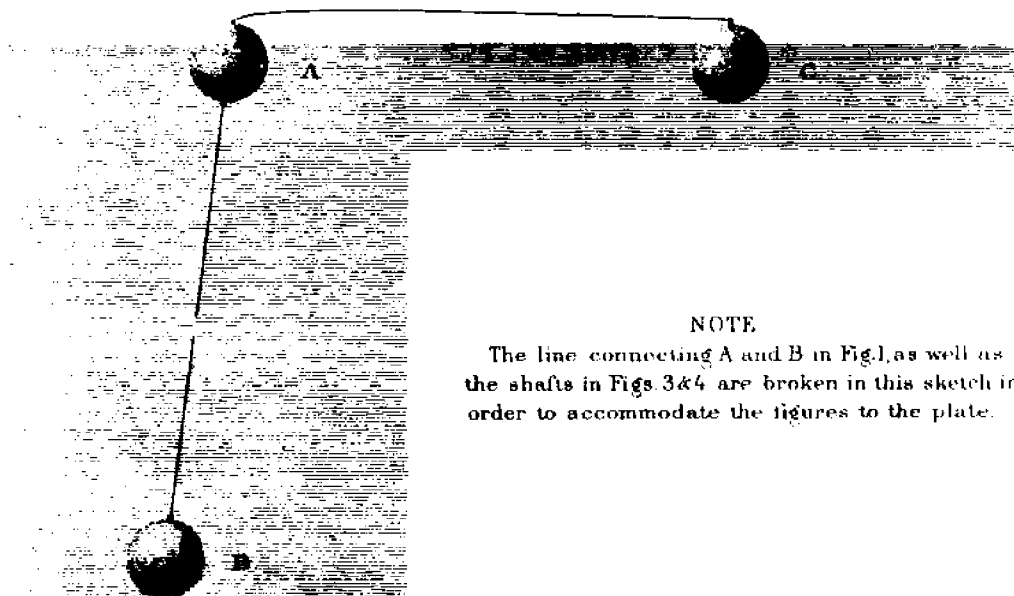
Fig. 2

NOTE

This Fig. represents, on an enlarged scale the globe A of Fig. 1 opened so as to show the reel upon which the log-line is wound.



Fig. 1



NOTE

The line connecting A and B in Fig. 1, as well as the shafts in Figs. 3 & 4 are broken in this sketch in order to accommodate the figures to the plate.

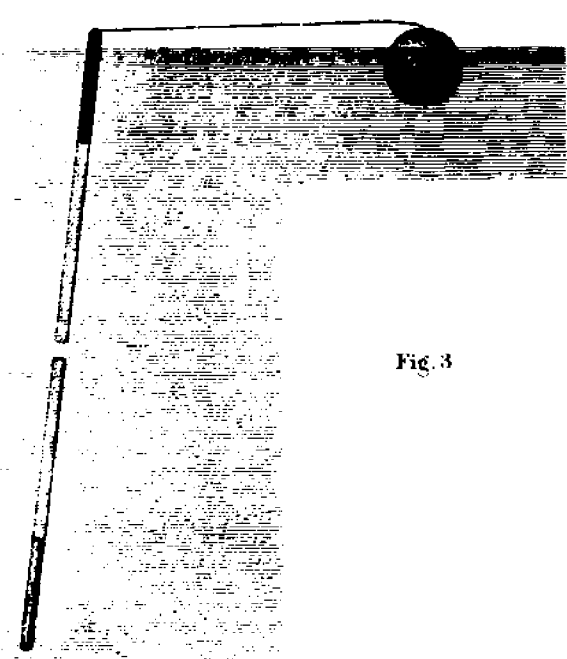


Fig. 3

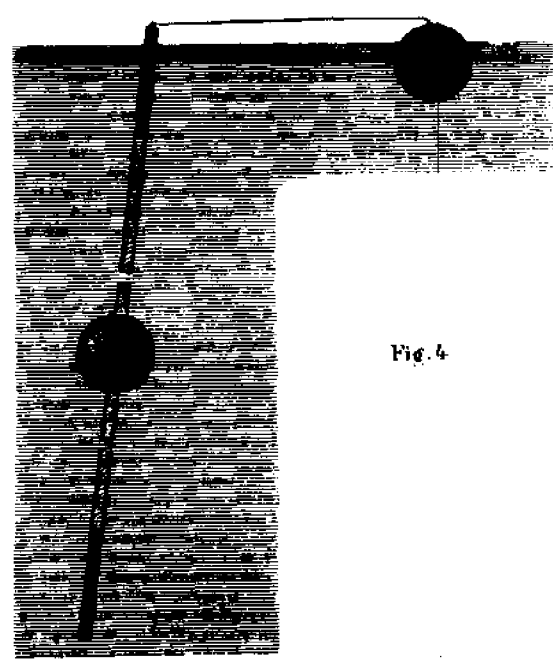


Fig. 4

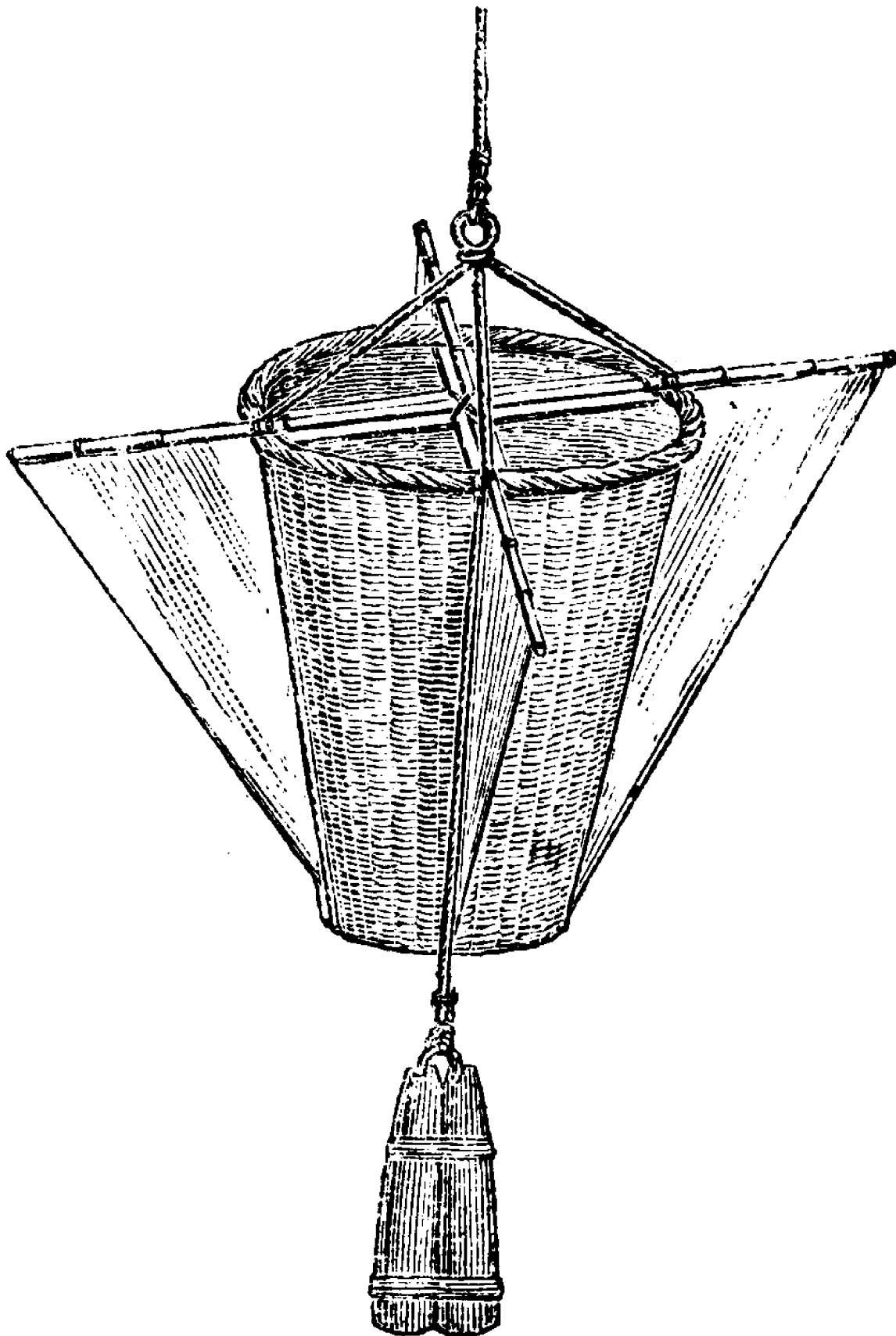


Figure 3. A reproduction of a figure that originally appeared in the Proceedings of the Royal Society (Carpenter and Jeffreys, 1871) showing a drogue used aboard H.M. Surveying Ship PORCUPINE.

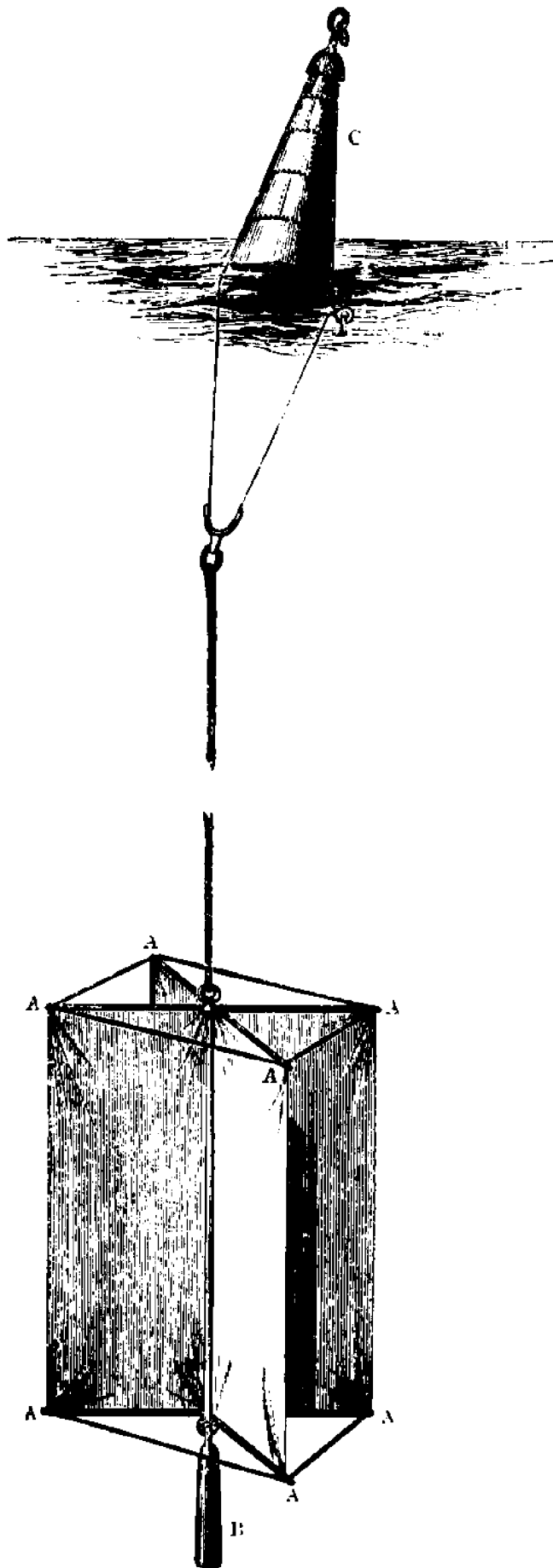


Figure 4. The current cross used during the famous voyage of H.M.S. CHALLENGER. Reproduced from the original figure that accompanied the narrative of the voyage (Tizard, Moseley, Buchanan, and Murray, 1885).

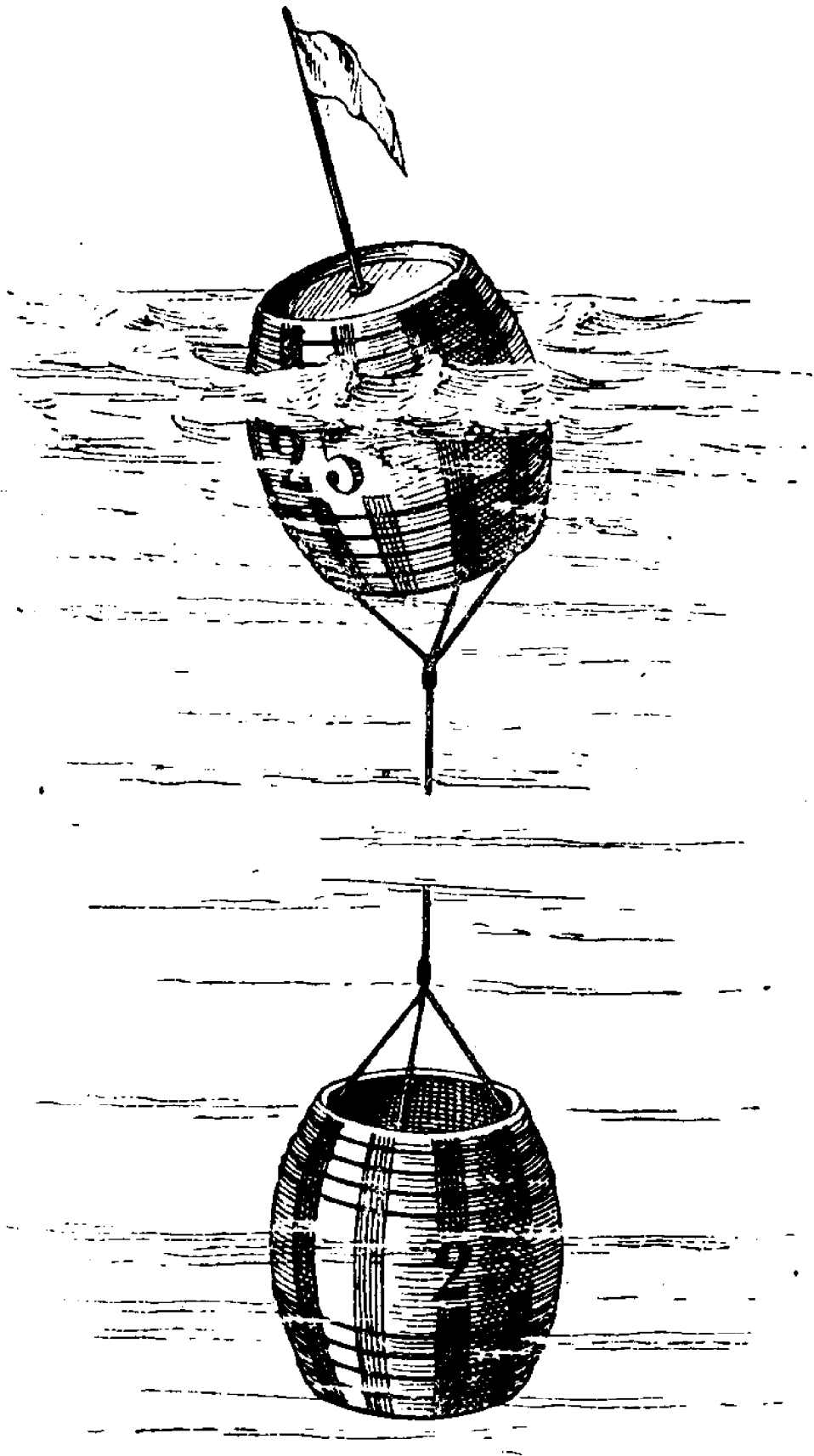


Figure 5. An early drogue design incorporating two barrels. This figure is a reproduction of one that appears in Thoulet (1908). The U.S. Coast and Geodetic Survey also used barrels in some of their early drogue designs, e.g. item R8 on Figure 1.

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