THE *SCOTTISH MAID* AS 'THE WORLD'S FIRST CLIPPER'

By John Lyman

I

THE late Mr Boyd Cable's paper with the above title in *The Mariner's Mirror* for April 1943 is an interesting and valuable account of the early activities of the Hall shipyard of Aberdeen. In so far as the paper is concerned with the subject of its title, facts are presented in support of a line of reasoning that may be summarized thus: (*a*) a 'clipper' is any sailing vessel with hollow entrance water-lines; (*b*) the American *Rainbow* of 1845 is usually accepted as the first such clipper; (*c*) the Halls' *Scottish Maid* of 1839 had hollow bow-lines; (*d*) it therefore follows that the *Scottish Maid* was the world's first clipper.

A secondary thesis is also developed as follows: (*a*) a 'clipper ship' is a ship-rigged clipper; (*b*) the Halls, builders of clipper schooners, built the ship *Glentanar* in 1842; (*c*) therefore the *Glentanar* must have been the first clipper ship.

Properly to discuss this subject would require a study of the development of ship design in Great Britain from, say, 1700 to 1870. The materials for such a work are probably available in the Admiralty collection of drafts, in the records of existing shipyards, in museum collections, and in the published treatises on shipbuilding and naval architecture. The corresponding survey of American vessels has already been made,[1] but it is evident that its British counterpart will not appear for at least a few years. Nevertheless, writing with only such secondary printed sources as are readily available under present conditions, one can throw more light on the background of the *Scottish Maid*. Isolated from her contemporaries, as Mr Cable presented her, she may appear as something unique, but when taken in her proper place in the development of naval architecture her design presents little novelty.

Consider first the hollow water-lines of the *Scottish Maid*, on which so much emphasis is placed. Assuming that the plan reproduced opposite p. 80 of the April 1943 *M.M.* is actually that of the *Scottish Maid*,[2] one finds a maximum hollow in her bow level lines of about 2 in, with no concavity whatever at the load water-line. It is possible with no difficulty whatever to cite plans of yachts, warships and merchant vessels built years before the

1 H. I. Chapelle, *The History of American Sailing Ships*, New York, 1935.

2 According to the *North of Scotland Gazette* story in 1848, quoted by Mr Cable (p. 75), the *Scottish Maid* was altered on the stocks from the model originally made for her. There seems therefore to be reasonable doubt whether her exact lines were preserved.

Scottish Maid which equal or exceed her in the matter of hollow forward. The bow plan of the British sloop *Ferrett*, of about 1711, for example, shows a maximum of about 10 in. of hollow, with an inch or so in the load water-line.[1] The schooner *Marble Head*,[2] built in New York in 1767, is about as sharp as the *Scottish Maid*. A French frigate of 1780 whose lines are given in Charnock's *History of Marine Architecture*,[3] is sharper than the *Ferrett*; so is the yacht *Leopard*, built at Cowes in 1807;[4] and the list could be extended indefinitely. Even the *Ann McKim* of 1833 should be included, as an examination of the plan reproduced by Howe and Matthews[5] indicates that their description of her entrance and clearance lines as 'slightly convex' applies only to the load water-line. And if the angle that the water-lines make with the keel, on the plan, is taken as the criterion instead of the concavity of the lines, the result is not materially different.

II

What then was the novel feature in the *Scottish Maid* to which contemporary accounts referred? For a full understanding of the subject it is first necessary to go rather deeply into the topic of tonnage measurement laws. It must not be overlooked that the British tonnage law was radically changed in 1835, only four years before the *Scottish Maid* was launched. For many years previously the legal tonnage T of a British vessel had been found from the formula $T = \frac{(L - \frac{3}{5}B)(B)(\frac{1}{2}B)}{94}$, where L was the length measured along the rabbet of the keel from the sternpost to a perpendicular dropped from the fore-part of the stem under the bowsprit, and B was the maximum outside breadth of beam, neglecting doubling strakes.

Deducting $\frac{3}{5}B$ supposedly converted the measured length to the length of the keel, while the term $\frac{1}{2}B$ represented the assumed depth of hold. Since the actual keel length and depth of hold were not considered in the formula, shipowners found it expedient to increase these quantities and hence the actual capacity to the practical maximum. The inevitable result in many cases was relatively short, narrow and deep hulls, with full ends, raking sternposts and straight vertical stemposts. Although structurally very strong, they had indifferent sailing qualities, and 'tonnage reform' was included among the liberal movements of the eighteenth century, culminating in the enactment of 5 and 6 Wm. IV, cap. 56. The new law was still 'tonnage by formula', but the formula was a fairly elaborate one, and probably represented reasonably well the relative hold capacity of the existing vessel types.

1 Chapelle, p. 21. 2 Chapelle, p. 223.

3 Available to me only through the reproduction in Höver, *Von der Galiot zum Fünfmaster*, Bremen, 1934, p. 216.

4 G. L. Watson, 'The Evolution of the Modern Racing Yacht' in vol. 1 of *Yachting*, Badminton Library, 1894, p. 72.

5 *American Clipper Ships*, Salem, 1926, pp. 12 and 16.

The Act, which came into effect in January 1836, provided for setting off six equal divisions of the upper deck length between the after-part of the stem and the fore-part of the sternpost. At the foremost, midmost, and aftermost of the five points so found, depths were measured, and each depth was divided into five equal parts. Next the inside breadth was taken at six of these intermediate depths, as follows: at two-fifths and four-fifths from the upper deck at the midship depth, and at one-fifth and four-fifths at the foremost and aftermost stations. Sums were then made; the fore depth plus the after depth plus twice the midship depth; the upper fore breadth plus the lower, plus three times the upper midship breadth, plus the lower, plus the upper aft breadth plus twice the lower. These two sums were multiplied together, and by the length at half the midship depth, and the product (cubic feet) divided by 3500 to give the register tonnage.

On comparing the new formula with the old, several features stand out. Depth was now taxed, in addition to length and breadth; but any addition to capacity obtained by increasing the length above half the midship depth was free, and likewise a substantial reduction in register tonnage could be obtained by arranging for the fore and after breadths to be minimized.

Such a consideration appears to underlie the construction of the *Scottish Maid's* bow. By raking the stempost and introducing a concavity into its profile, the builders increased the untaxed length on deck, while the first tonnage station, at one-sixth of this length abaft the stem, was brought forward into a relatively narrow part of the hull. So it was in the case of the *Bonnie Dundee*, the steamer given as an example by Mr Cable on p. 76, which had the 'Aberdeen bow' built on her, adding 22 ft. to her length but diminishing her register by 7 tons.[1]

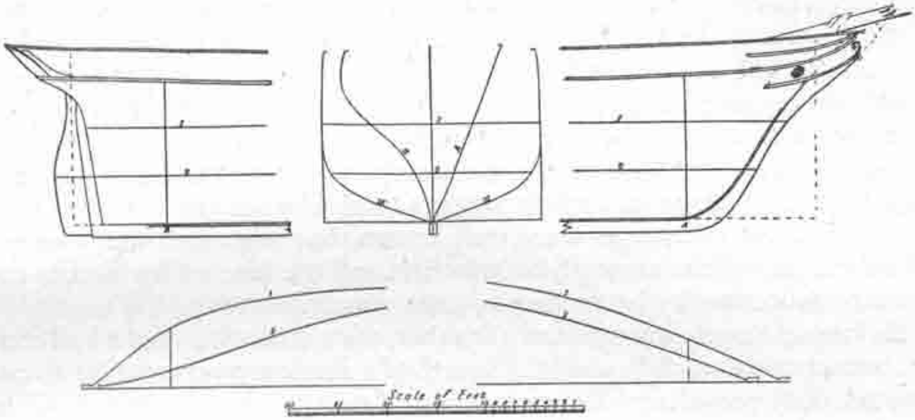
The 'invention' of the Halls may thus be attributed chiefly to the influence of the 1835 Registry Act and the desire to keep tonnage under it at a minimum; a particularly desirable feature in a fast vessel on a short run, which would have to pay dock and port charges (based on registered tonnage) many times a year. The Halls proposed a theory that 'the perpendicular longitudinal lines of the forebody ought to be as acute as the horizontal lines' and made model tank tests in support of their theory; but it seems plain that theory and tests are to be dated several years after the *Scottish Maid* appeared and were to help explain the observed performance of that vessel rather than to provide the elements worked into her design.[2]

The history of naval architecture since 1840 does not give support to the

1 Before leaving the subject of tonnage it might be useful to point out that the present British system of accurately measuring *internal volume* and taking 100 cu. ft. to the ton was adopted in 1854. In the United States a formula very similar to that used in Britain before 1835 was in effect from 1789 to 1864, when the internal volume rule was adopted.

2 One has here to choose between the 1848 *North of Scotland Gazette* and 1910 *Engineering* accounts and that of James Cochar Hall—of events which took place 15 or 20 years before the latter was born.

Hall theory that the stempost should meet the water at as acute an angle as the fore-planking; nevertheless, it is obvious from the contemporary accounts quoted by Mr Cable that the raking stempost design found favour for a few years among the Aberdeen schooner builders and operators. In a small sharp vessel the greatly increased area of waterplane at each additional increment of immersion provided buoyancy when running into a head sea—hence the ability of the London-Leith packets to keep their figureheads. But this very same feature involved a serious source of strain in larger vessels. The weight of bowsprit and head rigging, anchors, cables and windlass, and of the vessel's structure itself, plus any cargo or stores that might be stowed above the water-line forward, acting on the long lever arm of the stem, gave rise to a substantial hogging moment on the ship's backbone, which, owing to the fineness of the immersed bow, was not counteracted by an opposite hydro-



static moment. The Halls were careful to step the *Scottish Maid's* foremast farther aft than was then usual. It is therefore extremely doubtful whether the *Glentanar* or any other wooden ship-rigged vessel combined the raking stempost of the *Maid* with anything approaching clipper lines.

The accompanying figure[1] illustrates the state of evolution of the Aberdeen clipper design 12 years or so after the *Scottish Maid*, and indicates that the rake of the stem had by this time been modified from the 45° of the *Maid* to nearer 35°. With the incorporation of the Moorsom tonnage system in the 1854 Merchant Shipping Act, the tonnage advantage of the raking stem vanished. Such later British clippers as the *Thermopylae* and *Cutty Sark*[2] returned to a stem of straight rabbet, raking 18° or 20° from the vertical; although the strength of their iron frames would have permitted as acute an angle as that of the *Scottish Maid* design had their designers preferred.

1 From Fincham, *Outline of Shipbuilding*, 1852, Pl. 20. I am indebted to Mr E. de Kerchove of New York City for the reference and copy of the plan.

2 Built in 1868 and 1869. Lubbock, *The China Clippers*, p. 276; *The Log of the* Cutty Sark, p. 31.

III

If an analysis of the circumstances surrounding the building of the *Scottish Maid* indicates that there was no invention involved in the design of her under-water lines, we are left with the question of whether any other vessel can be properly described as the 'first clipper'. The answer to this has already been supplied by Carl Cutler in a thorough discussion in *Greyhounds of the Sea*[1] as an unqualified negative. Legends have attached themselves to such vessels as the *Ann McKim* and *Rainbow* simply because no sharp vessels so large had been built within the experience of the observers. Their names have been handed down to us partly because of a natural desire to simplify history; partly in recognition of the application of properties of design already well understood in smaller vessels to a slightly larger scale than heretofore attempted in the vicinity. Likewise the important feature about the voyage of the American *Oriental* from China to London in 97 days in 1850 was not the fact that she had beaten British vessels by a few days, but that a 1003-ton vessel had outsailed competitors of half her tonnage. At that time size and speed were still held to be mutually exclusive qualities in a sailing vessel: a frigate was expected to outsail a battleship, a brig-of-war a frigate, and a pilot-boat schooner or smuggling lugger a brig. The features that gave speed to the schooner and lugger were well known, but it was felt that owing to considerations of the strength of materials and the laws of hydraulics they could not successfully be applied to large vessels.

As long as vessels were framed of timber, the assumption was, a hull could not be increased much beyond the length of a single tree without (as already pointed out) providing adequate buoyant support for the ends.[2] What 'invention' there was in the design of the great wooden clippers, therefore, lay in the discovery of their builders of ways and means to circumvent the limitations of their materials and model large hulls to have as sharp lines as small ones.

Most accounts of American clipper ships begin with a discussion of the Western Ocean packets, but nowhere do I remember having read an explicit appreciation of how the North Atlantic served as a proving ground of wooden shipbuilding. When the Black Ball Line was founded in 1817[3] it was dedicated to a new principle of vessel operation: to sail on the advertised date 'full or not full'. Their masters (part owners) saw to it that the ships were driven to the utmost limit of their capabilities, in order to maintain schedule; and the builders (also part owners) kept them in repair. Thus, four times a year, the packet constructors had an opportunity to examine how each of

1 New York, 1930, pp. 89–92.

2 For example, the *Ann McKim* was badly hogged when only a few years old. See Howe and Matthews, p. 12.

3 R. G. Albion, *Square Riggers on Schedule*, Princeton, 1938, especially pp. 93 and 313–16.

their products stood up against the hardest kind of treatment on some of the roughest waters on the face of the earth; while the steady growth of the packet lines, both in size and number of vessels, gave the builders ample opportunity to install in new vessels the lessons learned in older ones.

It was therefore no coincidence that Smith and Dimon, who built the *Rainbow*, had already turned out nine packets; and William H. Webb and Donald McKay met the demand from shipowners for large sharp vessels with confidence in their strength. From their packet-building experience they and their apprentices had learned where to provide knees and straps, where to thicken keelsons and ceiling, to replace the buoyant forces lost when waterlines were hollowed out.

It happens that British shipowners and shipwrights had practically no participation in the North Atlantic packet lines at this period. Running costs were about equal under either British or American registry, so that building costs were the ruling consideration. Owing to the relative prices of timber on the two sides of the Atlantic, no London or Liverpool shipyard could compete with New York or Boston in building wooden sailing vessels. With iron steamers the story was different.

IV

To return now to the propositions of Mr Cable, as summarized in my first paragraph, it appears that (*a*) the definition of a clipper is a matter of opinion, and that (*b*) the precedence of the *Rainbow* is true only if size is selected as the criterion of a clipper. The hollow bow-lines of the *Scottish Maid* (*c*) were no more extreme than those of vessels of equivalent size a century earlier, so that it hardly follows (*d*) that the *Maid* was the world's first clipper. The claim that the *Glentanar* was the first clipper ship is supported by even more diaphanous evidence.

In this discussion I have attempted to show that the design of the *Scottish Maid* was brought about as a consequence of the Tonnage Registry Act of 1835, that her fineness of form was comparable to that of many other small vessels built years previously in Europe and America, and that her outstanding characteristic—the extreme rake to her stem—was unsuitable for larger vessels and was not retained in designs made after the tonnage standard was changed in 1854. Evidence has been adduced to indicate that the first large sailing vessels of sharp model were produced in the United States, chiefly because of the greater experience that leading American shipbuilders had acquired in dealing with the strains encountered in wooden hulls and the structural measures required to compensate for them, owing to their close association with the North Atlantic packets.