

Steel-wire rope was first used for deep-sea dredging by Alexander Agassiz, in the winter of 1877-78, and since then he has continued to use it with great success. His rope¹ "was one and one-eighth inches in circumference, and was composed of six strands laid around a tarred hemp heart. Each of the six strands was composed of seven galvanized steel wires of No. 19 American gauge (No. 20 Birmingham gauge). The ultimate strength of the rope was 8750 pounds, weight per fathom 1.14 pounds in air, and approximately one pound in sea water; price, eight cents per foot." Captain Sigsbee sets down the following as safe work when dredging with wire rope—"Time per one hundred fathoms paying out and hauling back, three to five minutes, according to circumstances; time for dragging, ten to thirty minutes, according to depth and the character of the bottom. The rate of dragging may be from one and a half to three miles per hour, according to the character of the bottom and the state of the sea."² In the summer of 1878,³ Mr Buchanan fitted the steam yacht "Mallard" with a steel-wire rope for work in depths up to 200 fathoms. It consisted of five strands arranged round a centre of cotton, and each strand consisted of seven steel wires (No. 24 B.W.G.) 0.023 inch in diameter. The diameter of the rope was only 0.19 inch, its weight per fathom 0.33 lb., and its breaking strain 30 cwt. This rope was unfortunately not galvanized, and in the course of four seasons gradually perished with rust. It was replaced by a slightly stouter rope made of *phosphor-bronze*, which seems to have many advantages; especially it does not rust, nor does it fly into kinks whenever it gets loose on the deck, while its tensile strength is very little inferior to that of steel, and when worn out it has a value as old metal. In the "Mallard" the dredge rope was laid through a block suspended by a stout iron davit in the bow, and in-board it passed through a dynamometer. This arrangement was also adopted by Captain Magnaghi in the "Washington."

For dredging in very deep water it might be of importance to have a *tapered* wire rope. For, taking Agassiz's rope, with a breaking strain of 8750 lbs., and weighing in water 1 lb. per fathom, it would be working at half its breaking strain in 4000 fathoms of water, even without any dredge or dragging. This points to a definite limit of depth, beyond which dredging with wire rope becomes practically impossible. A similar limit to the use of hemp line exists also, but owing to its great buoyancy this is unlikely to be approached in any existing sea. It is conceivable that a sea might be so deep that it would be impossible to reach its bottom with a line of any known material.

Dredging and Trawling.—For dredging and trawling purposes the Challenger was supplied with three different sizes of rope—2, 2½, and 3 inches in circumference. This cordage was made of the best Italian hemp, tarred, well hackled and rubbed down, and laid up softly. The 2-inch rope weighed 95 lbs. per 100 fathoms, and

¹ Sigsbee, *Deep-sea Sounding and Dredging*, Washington, 1880, p. 155.

² *Loc. cit.*, p. 146.

³ *Journ. Soc. Arts*, vol. xxix. p. 326, 1881, London.