

rectly fastened to the ring at the end of the arms, but is made fast to one of the end-bars of the dredge-frame, and is stopped to the ring by a single strand of bolt-rope. If the dredge get caught on a rock—a rare occurrence fortunately in deep water—the stop carries away, the direction of the strain on the dredge is altered, and it probably relieves itself and comes up end upward. In deep water, a 28-lb. deep-sea lead is usually hung from the centre of the tangle-bar, with four tangles on each side.

It is altogether a new experiment to dredge and to take deep-sea observations from so large a ship, and it seems to present some special difficulties, or, at all events, to require great management. The weight of the ship is so great that there can be no “give and take” between her and the dredge, such as we have in smaller vessels. If there be any way on, the impulse to the dredge is irresistible, and it seems to tend to jerk it off the ground. The roll of the ship, her height above the water, her want of flexibility of movement compared with the vessels which had been previously employed for the purpose, raised new questions as to the method of working.

Dredging and sounding are carried on in the *Challenger* from the main yard-arm. A strong pendant is attached by a hook to the cap of the mainmast, and by a tackle to the yard-arm (Fig. 17). A compound arrangement of fifty-five to seventy of Hodge's patent accumulators is hung to the pendant, and beneath it a block, through which the dredge-rope passes.

The donkey-engines for hoisting the dredging and sounding gear are placed at the foot of the mainmast on the port side. They consist of a pair of direct-acting, high-pressure, horizontal engines, collectively of eighteen horse-power nominal. Instead of a connecting-rod to each, a guide is fixed to the end of the piston-rod, with a brass block working up and down the slot of the guide. The crank-axles run through the centre of the blocks, and the movable block, obtaining a backward and forward motion from the piston-rod, acts on the crank as a con-