GYROSCOPIC APPARATUS FOR STEADYING SHIPS.

IN our account of the recent meeting of the Institution of Naval Architects (NATURE, March 28, p. 522) reference was made to the paper read by Sir William White in which he gave particulars of certain experiments carried out on the estuary of the Elbe by means of a torpedo-boat, the *Seebar*, in which Dr. Otto Schlick's gyroscopic apparatus was fitted. In our report of the meeting we stated that we should return to the subject, and this we now proceed to do.

It may be remembered that three years ago Dr. Schlick read a paper at the spring meeting of the same institution on the gyroscopic effect of fly-wheels on board ship, and at the same period he illustrated, by means of models, the system of steadying vessels which he had brought forward. The models were, as Sir William White pointed out, of small inertia compared to the inertia of the gyroscopes mounted in them, and the steadying effect was, therefore, more marked than it would be under the conditions of ordinary working with ships or boats. In these circumstances it is perhaps hardly surprising that a good many persons connected with seafaring looked on Dr. Schlick's apparatus as outside the region of useful application; in fact, it would not be an exaggeration to say that the idea was largely considered to be a very pretty scientific "fad."

Dr. Schlick, though a man of science, is by no means a "faddist"; as the position he holds in the German mercantile marine, and the substantial contributions he has made to the advancement of marine engineering practice sufficiently show, and he determined to prove the soundness of his theoretical investigations by experiment on a practical scale. To this end he acquired the *Seebar*, formerly a first-class torpedo-boat, 116 feet long, 11.7 feet wide, 3.4 feet draught, and of fifty-six tons displacement. Her metacentric height was 1.643 feet, and her period of oscillation (double roll) 4.136 seconds. Into this vessel was fitted the gyroscopic apparatus, of which we give a sectional elevation in Fig. 1. The following are the main particulars:—the outside diameter of the fly-wheel was 1 metre, the weight, without the spindle, 1106 lb., and the peripheral velocity at which it was run 274.8 feet per second, the number of revolutions being 1600 per minute. The fly revolved on a vertical spindle, and was of forged steel; it was enclosed in a cast-iron case, the latter being supported by two hollow trunnions, the common axis of which was in a 'thwartships direction, as shown in Fig. 1. It would have been preferred to have used electric power to revolve the fly-wheel, but as generating machinery was not fitted it was determined to use steam direct, and for this purpose blades were fitted to the periphery so as to work the fly-wheel as if it were a turbine, steam being admitted through the hollow trunnions. For this reason the peripheral speed was less than it would have been had electricity been the motive power, and the weight was consequently greater for the production of an equal gyroscopic effect.

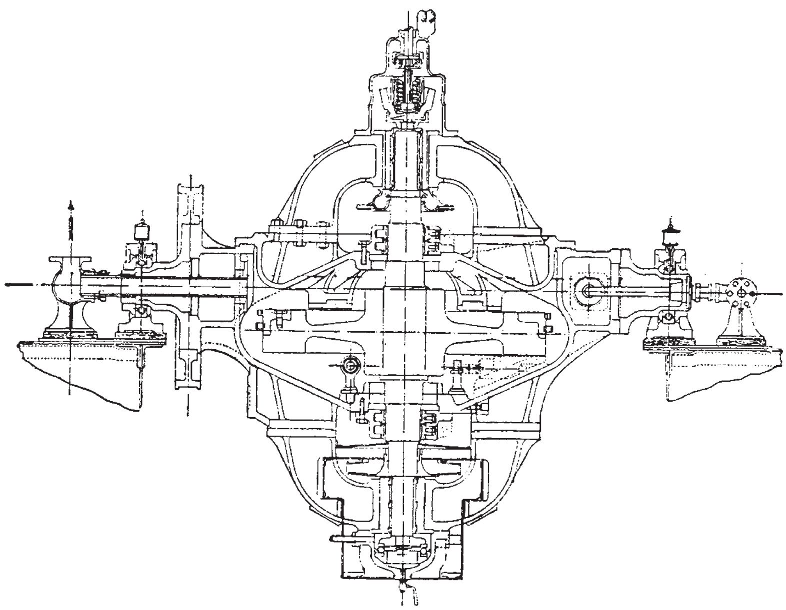


FIG. 1.—Details of steadying apparatus on s.s. *Seebar*. Scale about 1/25th full size.

It will be assumed for the purpose of this description that the principle of gyroscopic action is known so far as it is generally understood, but those who wish to refresh their memories on this matter would do well to refer to Dr. Schlick's paper in the Transactions of the Institution of Naval Architects for 1904. The common centre of gravity of the whole apparatus was, in the *Seebar*, below the axes of the trunnions with the vessel at rest, and the spindle therefore vertical. On rolling motion being set up the spindle would be free to become inclined from the vertical in a fore and aft direction, and, as rolling proceeded, the gyroscopic effect of the fly-wheel would produce longitudinal oscillations of the apparatus having a period depending upon the distance of the centre of gravity below the axes of the trunnions and upon the moment of inertia of the apparatus

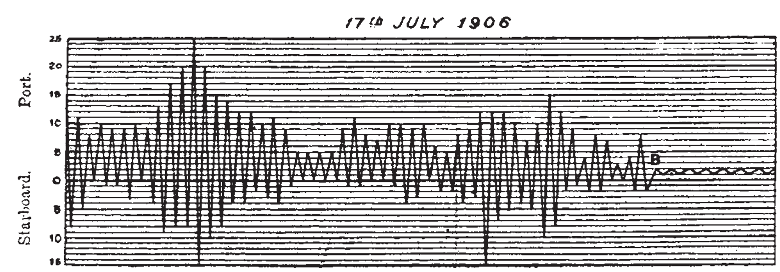


FIG. 2.—Diagram of Oscillations of s.s. *Seebar*.

about the axis. The amplitude of oscillation of the gyroscope, as Sir William White proceeded to point out, depends upon many conditions, among which the period of oscillation and its ratio to the period of rolling of the vessel are important.

In order to utilise the gyroscopic effect in checking rolling it is necessary to have a means of braking the apparatus so as to check movement on its trunnions and the rotary motion of the fly-wheel. To control the swinging motion a simple band-brake was fitted, the drum for which is shown on the left of Fig. 1. In addition to this a socket was fitted on each side of the gyroscope casing below the fly-wheel, the braking effect being supplied by hydraulic power and regulated by a valve. With the casing held by the brake the gyroscope would have no effect on the rolling motion, but on the friction band being loosened the casing would oscillate on its athwartship trunnions, and the gyroscopic action would come into play. Sir William White says that, when standing upon the deck, which maintained a practically horizontal position, the vessel heaving vertically, it was curious to notice that though the gyroscope might be oscillating longitudinally the impression was conveyed that the vessel herself was pitching.

Still-water rolling experiments were made with the *Seebar*, rolling being set up by the crew running from side to side. With the gyroscope fixed, the period of a complete double roll was found to be 4·136 seconds. When the fly-wheel was running at 1600 revolutions per minute, the period was six seconds. The boat was next hove down by a crane to an inclination of 10° to 15° from the vertical, and when let go the successive extreme inclinations were noted until they fell to about ½°.

The still-water rolling experiments strikingly illustrated the enormous extinctive effect of the gyroscope, as shown by a diagram given by the author of the paper. Selecting two experiments for illustration, it was found that with "an initial angle of inclination of 10° with the gyroscope at rest 20 single oscillations took place before the extreme inclination to the vertical was reduced to half a degree; whereas the same amount of extinction was obtained with little more than two single oscillations when the gyroscope was free to oscillate and the fly-wheel was rotating at 1600 revolutions per minute."

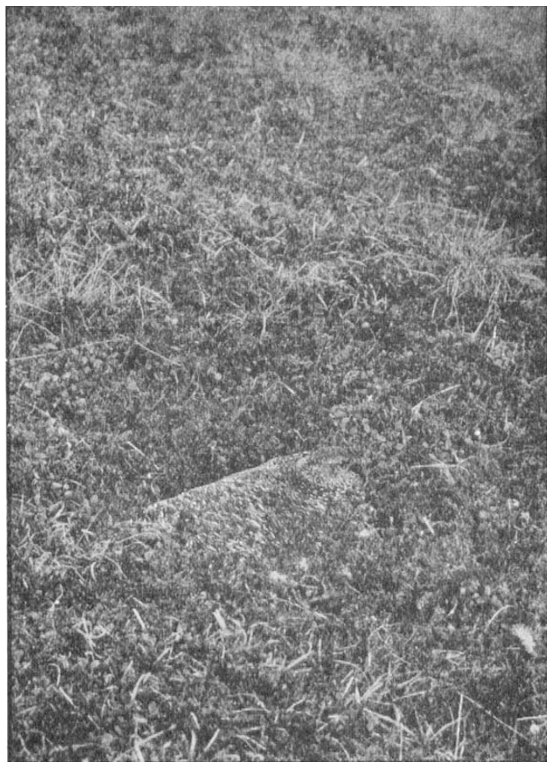
In Fig. 2 we reproduce from Sir William White's paper a graphic record of rolling experiments made with the *Seebar* off Cuxhaven. The point marked B denotes the time when the brake band was released, the gyroscopic wheel becoming free to swing on its trunnions, and the extinctive forces coming into action. The revolutions were 1600 per minute, and, as will be gathered, the practical result was to extinguish the rolling motion almost immediately, although the vessel was naturally still subject to heaving motion. The inclinations were insignificant, varying from about ½° to 1°.

Sir William White in his paper discussed the further application of the apparatus to war vessels, and though he did not commit himself to any definite opinion, it may be said that the impression given was decidedly of a hopeful nature. In connection with this subject the experiments of Sir John Thornycroft with his steam yacht, the *Cecile*, and those of the late Mr. Beauchamp Tower with his hydraulic steady gun platform controlled gyroscopically, will doubtless be remembered. Particulars of both series of investigations are to be found in the Transactions of the Institution of Naval Architects.

G. R. DUNELL.

BRITISH NESTS AND EGGS.[1]

THIS handsome and exquisitely illustrated volume (which is practically a new work, so greatly does it exceed its predecessor in bulk and in wealth of illustration) makes its appearance, no doubt purposely, at an opportune time, and if it induces but half-a-dozen collectors in the coming season to devote their attention to photographing the nests of our native birds in place of robbing their eggs, it will have done a great service to British ornithology. According to the letter of an admirer quoted in the preface, such a conversion has already taken place in several instances as the result of the Messrs. Kearton's previous works, and an extension of the new practice may therefore be confidently awaited. Mr. Kearton observes that "it is a curious kind of morality that will scorn to steal from the individual



Ptarmigan on Nest. From "British Birds' Nests."

and yet rob the community without compunction. Wild birds are national property, and no individual has a right to harm one of them without the sanction of the law to do so." Although this is, no doubt, to a great extent true, it must be remembered that by nature we are all essentially hunters and spoilers, and as many of us, at any rate, have not yet fully imbibed the socialistic spirit, it would not do for the present to be too hard on the egg-collector if he conducts his operations with moderation. *Festina lente* is an admirable motto in this and many other matters.

As regards the book itself, a critic is frequently embarrassed as to what he should write from the intrinsic badness of the work set before him; in the present instance the reverse of this is the case, and

[1] "British Birds' Nests, How, Where and When to Find and Identify Them." By R. Kearton. New edition, revised and enlarged. Pp. xii+520; illustrated. (London: Cassell and Co., Ltd., 1907.) Price 21s. net