JOINT JUNIOR BRANCH I.N.A. AND I.MAR.E.

SOUTHERN AREA

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Chairman: MR. R. W. L. GAWN, O.B.E., R.C.N.C.
(Vice-President Joint Junior Branch)

Lecture

THE LIMITATIONS OF MODEL EXPERIMENTS AND POSSIBLE FUTURE RESEARCH

by

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The following is a summary of the Lecture, which was attended by some 106 members and visitors.

The Ship Division of the National Physical Laboratory is employed mostly on work for the merchant navy, and the primary object of the model experiments carried out there is to ensure a low resistance hull and a high efficiency hull-propeller combination.

The lecturer dealt first with the difficulties experienced in applying model results to full-sized ships, and expressed the opinion that such correlation should occupy a high place on the list of future researches. This would involve research into all the many forms of resistance experienced by a ship and the fundamental laws which govern them, the exploration of the pressure distribution and the velocity pattern around model hulls, and the extension of the measurements made on models to the much larger Reynolds' numbers experienced on ships. Model experiments are essential in this work, but are limited by the present lengths of towing tanks and speeds of carriages.

In order to measure the frictional resistances of surfaces at high Reynolds' numbers (among many other problems) the high speed tank at the Taylor Model Basin in U.S.A. has recently been extended to 3,000 ft. and is being equipped with a carriage capable of a top speed of 100 ft. per sec. Pressure plotting around a model hull in the ordinary towing tank is also a most time-consuming process, because of the time spent in waiting for the water to settle between runs and the very short time available at steady speed during any given experiment. Such work could be done much more expeditiously in a circulating water channel in which the model is held at rest and the water moves past it, giving the opportunity of almost continuous readings.

The performance of model propellers is also subject to scale effects, and in the present tanks at Teddington the models cannot always be made large enough, and the future calls for experiments both on larger model propellers and on full-sized ships. The conduct of careful ship trials is, indeed, an essential part of the research, not only to investigate the scale effect on propellers but also the effect of the change in surface roughness of the hull in going from model to ship.

The ordinary model test also suffers from a further serious limitation—the lack of correct pressure similarity. This is usually overcome by running the model propeller for a high-speed ship in a cavitation tunnel, where the air pressure above the water can be reduced to the correct scale figure, but even then the inflow conditions are not the same as behind the ship hull and bossings. Such a tunnel is also of use for investigating the behaviour of typical propeller blade sections under cavitation conditions in order to obtain basic data for the design of screws for high-speed ships.

Other problems calling for urgent research are the effect of rough water and wind on ship performance, the dynamic effects of heaving and pitching, the steering of ships, involving the provision of a steering pond, a facility not available in this country to-day, the effect of shallow and restricted water upon resistance, propulsion, and steering, interaction between passing ships, planning forms, vibration, and many others.

We live to-day in a world where startling advances in the development of power are likely in the near future—and who can say what speeds may be obtained both by surface craft and under-water missiles? Our research should therefore not stop at covering the problems with us to-day, but should push beyond them, as far, in fact, as available facilities will allow. Much time, energy, and money will be saved in the development stages of such ships and weapons if fundamental research has previously been pushed to the farthest possible limits. Any such research must be carried out systematically, and theory and experiment must walk hand in hand if the utmost value is to be obtained from it, and this is vitally necessary when so much remains to be done and our facilities are so restricted.