small craft, the 45-ton steamer *Husseni*—owner, Mr. Allidina Vishran, of Entebbe, Uganda—for two months, in lieu of the intended *Heinrich Otto*, of Muanza, which, though otherwise likely to answer our purposes, unfortunately had broken down just when on the way to meet us. This delay, of some four days, was the reason that, contrary to our decided intentions, we only were capable of a very insufficient collaboration during the international series of ascents of July 27 to August 1.

After having got through the starting difficulties usual with African work we managed to execute in the time from the end of July until the middle of September twenty-three ascents of self-registering balloons, of which fifteen were retrieved with their apparatus, and registered curves of pressure, temperature, &c., whereas eight instruments were lost; but even the lost balloons furnished highly valuable data for the direction and velocity of wind in the alternate vertical strata, since nearly all the balloon flights were studied by means of theodolites from a fixed point on the shore.

A large number of smaller or larger pilot balloons carrying no apparatus, and some of them ascending to enormous heights, were inserted between the ascents of the self-registering tandem systems to complete the exploration of the wind, so important in these latitudes. A dozen or more kite ascents served the purpose of furnishing details about the lower parts of the atmosphere, particularly during the sea breeze, not exceeding in elevation 3000 feet to 4000 feet above the level of the lake, where the breeze disappeared altogether, thus rendering higher kite ascents impossible.

There can be no question as yet, having only just returned home from Africa, of giving a summary of the meteorological results; this must be reserved for some months later. We can only mention here crudely a few of the most striking points.

The highest self-registering balloon recovered rose to an elevation of 65,000 feet (19,800 metres), where a temperature of $-84°$ C., $=-119°$ F., was encountered, a lower temperature than ever registered at equal or even greater heights over Europe! Two other ascents reached 55,000 feet to 56,000 feet, with variable, although also comparatively low temperatures.

These very low temperatures confirmed the similar results obtained by MM. Teisserenc de Bort and Rotch on the *Otaria* in the equatorial regions of the Atlantic; but over continental East Africa we found also, occasionally, the "upper inversion of temperature" not encountered in the high strata of the atmosphere above the corresponding latitudes of the ocean west of this continent—certainly a feature of great importance.

While omitting the enumeration of many other interesting results, we at present only desire to point out the surprising fact that several times there was found an uppermost current of air blowing nearly from due west, and flowing above the regular easterly current of the equatorial region. The lower strata, underlying the regular east trade, were dominated by diurnal (at the very bottom) and seasonal winds.

After the middle of September we made a cruise on the lake, crossing it for the first time from east to west (from Shirati to Bukoba). The interior of the lake proved to be devoid of islands and uniformly deep.

The end of September and beginning of October were devoted to simultaneous ascents on the coast—at Mombasa—where experiments with kites and pilot balloons were carried out, and on the borders of the Nyanza, where Dr. Elias remained for a couple of weeks and made a series of pilot-balloon ascents, no kite work being possible there, since the little steamer had to be given up.

From October 9 until December 5, when the expedition definitely started on its homeward voyage, Dr. Elias preceding the other members by three weeks, the headquarters of our work was transferred to Daressalam. In this whole space of time there was hardly a day without a kite ascent, and besides these quite a series of pilot-balloon experiments was carried out. Part of the kite work was executed on the ocean south of Zanzibar from the little Government steamer *Rovuma*, in order to reach greater elevations; several of those higher ascents—a few exceeding 10,000 feet—were made at the end of October in the time between the two monsoons, the others in the first days of December, the north-east monsoon blowing then steadily.

We had at first the intention of making in the month of November simultaneous researches on the coast of the continent and on the Seychelles Islands, situated in mid-ocean, some 1000 miles to the eastward. This plan had to be given up for meteorological and practical reasons; we succeeded, though, in replacing it, at least to a certain extent, by two of us going on board the small German cruiser *Bussard* to the south as far as Delagoa Bay, and making a couple of *ballons-sondes* and several kite ascents from this ship, on the ocean as well as in the bay of Inhambane, 24° S. lat. Dr. Elias, who had remained at Daressalam, made in the meantime simultaneous kite and pilot-balloon ascents there and on the sea.

In this whole series of experiments on or near the ocean, forming the second part of our work, the kite and "pilot" experiments prevailed, whereas ascents of self-registering balloons, forming the chief feature of the investigations on Lake Victoria, could only be carried out in two cases in the months of October and November. The higher reached 13,300 metres, =nearly 44,000 feet, the kite ascents, as mentioned, reaching some 10,000 feet, =3200 metres; but the highest pilot balloon soared up to an elevation of about 21,000 metres, =nearly 70,000 feet, before it burst, yielding most interesting data about the superposition of the wind systems and the westerly air-drift in the highest strata of the atmosphere in those regions.

A. BERSON.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual meetings of the Institution of Naval Architects opened on Wednesday, March 31, and were continued on Thursday and Friday, the rooms of the Royal Society of Arts being used, as on previous occasions. Owing to a family bereavement, Lord Cawdor, the president, was unable to be present, and the chair was taken by Sir Wm. White, K.C.B. The institution, having been founded in 1860, will complete its fiftieth year in 1910, when it proposes to commemorate the occasion by an international congress to be held in London.

The programme comprised eighteen papers, together with an additional paper by Sir Philip Watts on trials of torpedo-boat destroyers in waters of various depths. Limitations of space will permit of only a few of these to be noticed here.

Lord Brassey contributed the opening paper, on types of warships omitted in recent programmes of naval construction. Every maritime Power is now building Dreadnoughts; the needs of different countries may differ, but almost identical types are being produced, unanimity having been attained by imitation of British design. Types other than the Dreadnought, however, are of great value for the line of battle. Armoured cruisers have disappeared from the latest programmes, being too vulnerable to be reckoned as fighting ships. It is a waste of public money to keep such ships as the *Powerful* and the *Terrible* in commission. The naval experience and professional skill which we have available should now be directed to the creation of a type specially designed for the inshore squadron. The Dreadnoughts are essentially ships for the open sea, beyond the range of torpedoes and free from the danger of floating mines.

In closing the discussion on this paper, Sir Wm. White pointed out that the responsible naval architect had to produce designs to fulfil conditions laid down by the Admiralty. The *Powerful* and the *Terrible* had been designed to deal with some large Russian cruisers which had been built for the purpose of harrying our commerce, and would certainly have done so satisfactorily had occasion arisen. Although ships should be put out of service when twenty years old, it did not follow that such ships then disappeared for all practical purposes. In 1884 the speaker had designed two cruisers for the Japanese, and these ships destroyed Russian cruisers in 1905, when, of course, they ought to have been non-existent. Two matters had to be specially considered in modern policy—power of concentration and power of distribution.

An interesting paper was contributed by Prof. J. B. Henderson on the elasticity of ships as deduced from experiments on the vibration of dynamical models. A dynamical model of the ship is constructed out of a bar of steel of uniform thickness and varying breadth, and is loaded with lead weights soldered on. The conditions are that the model must have a load curve similar to the load curve of the ship, and also a curve of moments of inertia of cross-sections about the neutral axis similar to the corresponding curves for the ship. The scale for the load curve need not be the same as that for the moment-of-inertia curve. The model has its frequency measured stroboscopically when supported at two nodes, the vibrations being maintained electromagnetically. Experiments have been made at the Royal Naval College, Greenwich, on models representing H.M.S. *Pathfinder* and the *Lusitania*, giving results for Young's modulus of 21,000,000 lb. and 23,000,000 lb. per square inch respectively for these ships. The method seems likely to be useful in dealing with other forms of riveted structures, such as bridges. Prof. Henderson also showed in his paper how the causes of vibration in a ship may be located from an analysis of the pallograph record, and applied the method to the records of the *Lusitania* and *Mauritania*. It must, of course, be understood that no criticism is being directed at special vibration in either of the last-mentioned vessels.

Some useful information on the applications of the internal-combustion engine to marine propulsion was given in two papers, one by Mr. H. C. Anstey and the other by Mr. F. R. S. Bircham, the latter having special reference to submarines. Mr. Anstey deals with questions of economy of fuel, weight, and space, and, using certain data, estimates that with powers of, say, 500 horse-power on one shaft, it seems reasonable to expect 12 horse-power to 15 horse-power per ton of machinery weight for a complete installation of oil engines without auxiliaries. The weights would be greater with gas engines on account of the necessity for installing gas producers. The author also deals with a method of splitting the power into a number of convenient units, and transmitting the energy to the propeller electrically. This method has not commercial advantages sufficient to warrant its use for mercantile work, and for naval work could not compete with existing machinery in the considerations of weight and space. Mr. Anstey considers that the installing of internal-combustion engines would, in general, save space, but no great saving in weight would result. The difficulties of producing very large gas engines of a type trustworthy enough for marine purposes were pointed out by Prof. B. Hopkinson, who referred especially to the difficulty of efficiently keeping large cylinders cool. The Marquis of Graham gave an interesting illustration of a vessel in which he had the reciprocating engines taken out and gas engines and producers substituted. He was satisfied with the trustworthiness of the new plant, and found that the radius of action of the vessel was doubled, on account of the lower fuel consumption per horse-power. The total horse-power in this instance was about 500. Sir Wm. White thought that progress in this matter must be gradual, and deprecated the popular exaggeration of the size of engine which could be installed.

Mr. Bircham discussed the advantages and disadvantages of the system of propulsion for submarines in which internal-combustion engines are used when on the surface and electric power when submerged. In Del Proposto's alternative method, one cylinder of a four-cycle four-cylinder Diesel engine is used as an air compressor when running on the surface in order to charge storage bottles to a high pressure, the remaining cylinders propelling the boat and driving the compressor. When submerged, this cylinder is used as an air engine, exhausting into the boat and keeping the air therein fresh. In Mr. Bircham's modification of this plan the internal-combustion engine is coupled to a multi-stage compressor, which is run as an air engine of the multi-expansion type when the boat is submerged; the exhaust is used by the internal-combustion engine, a part being turned into the boat to renew the air therein when required. Efficient cooling of every part of the internal-combustion engine is necessary, the cylinders being entirely jacketed and the exhaust pipes water-cooled to the boat's skin. This paper is illustrated with several working sections of engines suitable for submarine propulsion.

Lieut.-Colonel G. Rota, R.I.N., described some trials which he has made on a steamer in the Royal Dockyard at Castellammare di Stabia, first with a single screw and afterwards with two contrary turning screws of different diameters on a common axis and having a constant pitch, and also with another pair having increasing pitch in accordance with Prof. Greenhill's rules given in 1888. One of the propeller shafts was tubular, the other rotating inside the first, both driven in opposite directions from an ordinary reciprocating engine. The author of the paper found that a reduction of power required to maintain the same speed was obtained of from 30·5 per cent. to 26·8 per cent. for speeds of from 5 to 7 knots respectively, the comparison being between double propellers of constant pitch and a single-screw propeller. The gain with double propellers of increasing pitch at the same speeds amounted to 23·8 per cent. and 17·3 per cent. as compared with that required with a single propeller in use. The experimental vessel had a length of 46 feet, a breadth of 11 feet 9 inches, and a displacement of 25 tons. The gain is evidently due to the better guiding of the stream of water reaching the propellers, which are of smaller diameter when double than that required for a single propeller; the gain in wake is considerable. In this respect the effect of the fore propeller, acting as a guide to the water on its way to the after propeller, may be compared with that of the fixed guide-blades of a steam or hydraulic turbine. The author also points out the adaptability of turbines for driving the shafts, and thus dispensing with gearing; a special turbine for reversing would also not be required.

A note on a mechanical method for determining the thrust of propellers was contributed by Mr. J. H. Heck. In this method one of the tunnel shafts is utilised to form the ram of a hydraulic press, and a slight separation is allowed between two of the tunnel-shaft flanges, these being enclosed within a hollow cylindrical casing in which the shafting can revolve. The casing is fixed in the tunnel, and is made water-tight by means of stuffing-boxes. Water is supplied to the casing by means of a small force pump, and its pressure is indicated by a pressure gauge or recorder. On pressure being applied by means of the pump, the propeller shaft will be slightly forced out of the casing, and, on releasing the pressure, the thrust of the propeller will push it in again. The mean of the gauge readings during both movements of the shaft is taken in order to eliminate frictional effects. This mean pressure, when multiplied by the cross-sectional area of the shaft at the place where it is revolving in the stuffing-box, will give the total thrust of the propeller. The author describes some experiments made with this apparatus.

The offer made by Mr. A. F. Yarrow a year ago to defray the cost, up to 20,000*l*., of establishing an experimental tank at the National Physical Laboratory will be remembered, and the report of the experimental tank committee is of interest. A building subcommittee has been at work, the members being Sir Wm. White, Mr. R. E. Froude, Dr. Glazebrook, and Mr. W. J. Luke. At present 1240*l*. out of the guarantee fund of 2000*l*. per annum required for maintenance under the terms of Mr. Yarrow's offer has been secured, and it is hoped that the total amount will be shortly made up. Meanwhile, in order to avoid delay, the executive committee of the National Physical Laboratory has guaranteed 800*l*. per annum, and has entrusted Messrs. Mott and Hay with the preparation of plans. The committee has considered the question of the management of the tank, and proposes an advisory committee, appointed by the governing body of the National Physical Laboratory, consisting mainly of representatives of the Institution of Naval Architects. Steps will be taken to preserve the confidential character of all work done at the tank for private firms, as well as the arrangements for problems of general interest to be taken up, and the publication of the results of these Dr. Glazebrook has visited the most recent establishments of the kind in this country, and also in France and Germany, and the results of his visits of inspection are included in the report. The suggested dimensions of the

Bushy tank are:—effective length, 500 feet; depth of water, 12·5 feet; breadth of water, 30 feet; area of cross-section, 40 square yards; breadth of building, 42 feet; breadth of carriage, 31 feet; weight of carriage, 10 tons; velocity of carriage, 25 feet per second; horse-power on carriage, 50. The opinions expressed by the members at the meeting indicate that they are satisfied that these dimensions will amply provide for, not only ordinary commercial problems, but also for any special problems that may arise. One of the first systematic researches after the tank has settled down to its work will be the investigation of the many propeller problems regarding which little or no knowledge exists.

RURAL EDUCATION IN ITS VARIOUS GRADES.

THIS subject was discussed at a conference of the County Councils' Association held at Caxton Hall, Westminster, on March 31, under the presidency of Mr. Henry Hobhouse. The conference had been convened at the request of the Central Land Association, the Central Chamber of Agriculture, and the Farmers' Club, and was in every sense thoroughly representative.

A resolution was moved by Sir J. Cockburn to the effect that local education authorities should aim at securing better instruction in rural subjects, and that the teaching should be adapted to the circumstances of country life; school gardens and equipment for manual instruction should be provided, and elementary-school teachers should be specially trained for their work. The resolution was referred to a special committee.

To those unacquainted with country schools it must come as a surprise that such a resolution should be necessary nearly forty years after elementary education became the business of a Government department. Yet, as a matter of fact, it is only within quite recent years that the education of the country child has begun to have any sort of relation to his environment; he has been taught the same subjects as the town child, and in the same way, but often not quite as well. The teaching has been didactic, and has not necessarily involved any observation by the child of the things happening outside the school doors. For this the teacher has not been to blame, for country teachers, as a class, have as keen a professional spirit as town teachers, but the system has been at fault. Country children are sometimes said to be less intelligent than town children of the same class. This is emphatically not the case; on the contrary, the country child has often a larger stock of experience than the town child, and a proper system of education, based on his experience and dealing with the things about him, ought to give admirable results. It is much to be hoped that Sir J. Cockburn's resolution will be acted upon by those in authority.

After-education was also dealt with. The more promising children, it was urged, should be sent to secondary schools, where nature-study and elementary science teaching were given in close connection with practical work in the workshop and garden. The idea is admirable, but there would be considerable difficulty in getting to the school, especially in winter; while, if the children had to board at the school, the numbers would necessarily be very limited. Both elementary and secondary schools would remain under the Board of Education, but the more special agricultural education, the conference considered, should be dealt with by the Board of Agriculture. It was proposed that each group of counties should be connected with some agricultural college, which should be responsible for educating the students sent there, and for giving lectures and other instruction to farmers who cannot attend college. This system is already at work in some places, and was discussed in NATURE for March 25.

It will be observed that the resolutions were very comprehensive in their scope, and adequately covered the various problems of rural education. Whether the Boards of Education and of Agriculture could carry through so bold a scheme remains to be seen; it is undoubtedly to the interests of rural districts that they should.

To those wishing to learn the present position of higher agricultural education in England, a White Paper (Cd. 4569) issued by the Board of Education, giving certain tables of expenditure, will be useful. It was not possible to ascertain the exact amount spent on higher agricultural education, because in many cases agriculture only forms part of the work, and a fine estimate of what it receives is impossible. The Board of Agriculture grants are, of course, entirely *ad hoc*, but the Board of Education grants are for the whole institution. We find that the former Board gives 8800*l*. a year to colleges of university standing in England and 3350*l*. to smaller colleges and schools. The Board of Education gives 72,856*l*. and 25,496*l*. respectively. In one way and another the County Council grants must be considerable, but as a whole institution is often involved it is impossible to work out the exact share that agriculture gets. Four counties, viz. Bucks, Cumberland, Herefordshire, and Wiltshire, all active in providing rural education, spend between them about 10,000*l*. annually. The paper goes on to point out that the Board of Education is prepared to give still higher grants when a properly coordinated scheme is submitted to it, and we should imagine that considerable advantage will be taken of the offer.

SOME MARINE AND FRESH-WATER ORGANISMS.

IN the first part of vol. xcii. of *Zeitschrift für wissenschaftliche Zoologie*, Mr. L. Luders gives a full description of the wonderful ostracod crustacean described by Müller in 1895 under the name of *Gigantocypris agassizi*, together with a brief reference to the second species of the same genus. The first evidence of the typical species was a specimen dredged in deep water off Prince Edward's Island during the cruise of the *Challenger*, which indicated a veritable giant in the group, the shell measuring no less than 25 mm. in length and 16 mm. in width. Of the soft parts only the head was preserved, but this and the shell were sufficient to indicate the distinctness of the species from all shallow-water forms, and it was suggested at the time that it might prove to represent a new family group. In 1891 other examples were dredged by the *Albatross* off the Pacific coast at depths of as much as 1700 fathoms, and these were duly described and named by G. W. Müller. Another specimen was obtained by the Prince of Monaco off the Azores, while later still several others were dredged in deep water by the *Valdivia*. It is these last which form the subject of Mr. Luders's paper, where full details of the external form and anatomy of the species are given. One of the specimens collected by the *Valdivia* was dredged in the Gulf of Guinea, while the others were obtained in widely separated localities. This, together with the structure of the shell, suggests that it is a deep-sea pelagic organism, which does not, like other ostracods, live in sand.

In connection with the foregoing may be conveniently noticed a paper by Dr. Esther Byrnes on the fresh-water species of Cyclops of Long Island, published in No. vii. of Cold Spring Harbour Monographs. The observations in this monograph, which are based on several years' work, have special reference to the variability displayed by the fresh-water species of these crustaceans. Those from Long Island agree generally with the forms from the western lakes, and indicate their wide distribution. Variation of a varietal type is strongly developed, but much more so in some species than in others; it attains its maximum in the forms inhabiting stagnant waters, which can only exist at all by the power of readily adapting themselves to environment. Size is largely dependent upon habitat.

The American snapping shrimps of the genus Synalpheus form the subject of a memoir by Mr. Henri Coutière, published as No. 1659 (vol. xxxvi., pp. 1–93) of the Proceedings of the U.S. National Museum. Previous to the appearance of this paper six American species of the group were nominally recognised, under the generic title of Alpheus, but the author is unable to retain more than three of these names. On the other hand, he names a considerable number of new species, not only from American waters, but from other parts of the world. In No. 1663 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 173–7) Miss H. Richardson describes a specimen, from Wood's Holl,