OUR ASTRONOMICAL COLUMN.

ROMER'S DISCOVERY OF THE VELOCITY OF LIGHT ("Om Ole Rømers Opdagelse of Lysets Tøven": Høst & Søn, København).—When Römer in 1676 announced to the Paris Academy his discovery of the gradual propagation of light from observations of the first satellite of Jupiter in the course of eight years, he gave no details as to these observations. He merely stated that the period of revolution of the satellite deduced from immersions in the shadow of Jupiter (when the earth is approaching Jupiter) was always shorter than the period found from emersions observed when the earth was receding from the planet. The result was that light took about twenty-two minutes to travel over the diameter of the earth's orbit. (It appears from a letter to Huygens that this was found from observations made in 1671–73.) The only observation quoted in the short paper was one of an emersion on November 9, 1676, at 5h. 35m. 45s. p.m., ten minutes later than was calculated from observations in the previous August, as predicted by Römer in the beginning of September. Three years ago a sheet was found in the University Library at Copenhagen on which was written in Römer's hand a list of eclipses of the satellites observed in the years 1668–77. In a paper published in the Transactions of the Danish Academy of Sciences Mrs. Kirstine Meyer discusses these observations in order to find whether they represent a part of the material on which Römer's discovery was based, and shows that this is really the case. It is shown by several examples that the observations of 1671–73 give, in fact, the approximate result announced by Römer, but that the single results differ a good deal. It is interesting to see from some figures jotted down by Römer in the MS. in question that among the values found by him for the time light takes to pass from the sun to the earth is also the correct one of about eight minutes, but he probably rejected this result as founded on rather short intervals of time. The author calculates the amount resulting from the published observation of November, 1676, and finds that it is eight and a half minutes. Curiously enough, Newton, in his "Optics," gives eight minutes, though the only result published by Römer was about eleven minutes.

PARALLAXES OF TWO STARS WITH COMMON MOTION.—Some time ago it was found by Adams that the two stars, A.Oe. 14318 and 14320, though separated by 5′ in declination, had remarkably similar proper motions and radial velocities. The parallaxes and proper motions in R.A. of these interesting objects have since been determined by O. J. Lee from plates taken with the 40-in. refractor of the Yerkes Observatory (*Astronomical Journal,* No. 697). The resulting parallaxes are $0{\cdot}025'' \pm 0{\cdot}008''$ and $0{\cdot}061'' \pm 0{\cdot}012''$, and the proper motions in R.A. $-0{\cdot}0699$s. and $-0{\cdot}0692$s. respectively. More trustworthy determinations of proper motion by Prof. J. G. Porter give the total motions as $3{\cdot}693''$ in the direction $195{\cdot}7^\circ$ and $3{\cdot}675''$ in the direction $195{\cdot}6^\circ$. The difference of parallax, amounting to $0{\cdot}036''$, agrees well with the value $0{\cdot}031''$ previously given by Russell, and the evidence that the two stars are very widely separated in space, while having practically identical motions both in and across the line of sight, is now fairly conclusive. It may be recalled that the two stars are of magnitudes 9·6 and 9·2, and of types G4 and G5 respectively. The radial velocities are exceptionally great, being +307 km./sec. and +295 km./sec., according to the observations of Adams, and the difference is probably not greater than the errors of observation in the case of such faint stars. The two stars have the same R.A., 15h. 5·5m., while the declinations are $-16^\circ\ 2{\cdot}5$ and $-15^\circ\ 57{\cdot}5'$.

THE DIRECT JOINING OF GLASS AT MODERATE TEMPERATURES.

IN a paper presented to the Faraday Society on December 18, Messrs. Parker and Dalladay described some interesting experiments on the direct joining of glass at relatively low temperatures which they have carried out in the research laboratories of Messrs. Adam Hilger, Ltd. The results described are not only of very considerable direct scientific interest, but afford great practical advantages in the construction of glass apparatus out of what is actually a single solid piece instead of using more or less unsatisfactory cements. The advantage of such solid construction is particularly evident in polarimeter tubes and absorption cells—the latter can now be constructed with truly parallel faces and with inside faces optically worked. The process of joining which the authors have worked out consists in placing the surfaces of glass to be united in good optical contact under pressure, and then raising the temperature to a carefully determined degree. The glass surfaces thus treated become perfectly united, so that the two pieces of glass will not separate along their former interface, and the composite piece acts as if it were a single solid mass; even a crack or a diamond-cut will pass through the junction without hindrance or deflection. The temperature employed is chosen as high as possible in order to lessen the time required for union of the surfaces, but if distortion of the optically worked surfaces is to be avoided, then the temperature must not be taken too near the limit, which the authors describe as the "annealing point." This point they determine by observing the strains set up in a piece of glass while being heated at a definite rate in an electric-tube furnace; for each kind of glass they find that these internal stresses—which are readily observed by means of polarised light—disappear quite suddenly. At this point, also, the glass becomes appreciably soft, and can be indented by a sharp tool. When similar kinds of glass are used, having similar "annealing points," then the welding of surfaces in optical contact takes place well below this annealing point. Very dissimilar glasses, however, cannot well be joined, since the softer becomes distorted before the harder is hot enough to weld freely.

THE EXPLOITATION OF INSHORE FISHERIES.[1]

MANY advisory and other committees, some in connection with the great Government departments and others among the leading scientific societies, are at present engaged in deliberations in regard not only to immediate and pressing war problems, but also to the later, and possibly equally important, after-war questions, which are bound to arise, affecting the prosperity of the country and the maintenance of the Empire. A large number of these matters turn upon the application of scientific knowledge and scientific methods to various industries, and amongst these not the least important are those concerned with the allied subjects of agriculture and aquiculture, or the scientific regulation and cultivation of our land crops and our sea-fisheries.

It is recognised that, with the view of making a rapid recovery from the effects of the war, amongst other things, agriculture and allied industries must be promoted, and it must be seen to that no suitable land is wasted, that none is applied to the wrong purpose, and that the most favourable treatment to ensure the best results is given to each area. In fact, a more

[1] Introductory address (abridged) given by Prof. W. A. Herdman, F.R.S., in opening the discussion on Inshore Fisheries in the section of Zoology of the British Association at Newcastle-upon-Tyne on September 7.

systematic study and more intensive cultivation of the land must be made. In quite a similar way, and for no less important reasons, the harvest of the sea must be promoted, the fisheries must be continuously investigated, and such cultivation as is possible must be applied to our barren shores. All such fisheries cultivation is one of the natural applications of biological science, and ought therefore to be supported and directed by the members of this section and other marine biologists.

Now that considerable areas of the British fishing grounds are either closed to trawlers or impracticable for the usual fishing operations, any increase of employment on the seashore and in shallow waters round the coast may be of direct and immediate advantage both to the men and to the country. Such industries as shell-fish cultivation, shrimping and prawning, whitebait and sprat fishing, and herring fishing and curing, if extended and exploited judiciously, will add to employment, will increase the food supply of the country, and may lead to the establishment of permanent industries of a profitable nature. On the west coast the Lancashire and Western Sea-Fisheries Committee has been alive to such possibilities for some time past, and much of its scientific fisheries work has been directed towards showing the improvements that might be introduced in connection with the local shell-fish industries. It has been shown in its annual reports how mussels and cockles can be fattened and greatly increased in value by transplanting to better feeding grounds, and how, if reared in sewage-polluted waters, they can then be cleansed and purified before being sent to market. The Lancashire Committee, realising the present opportunity of helping such deserving industries, has worked out several concrete cases where a moderate expenditure, either in transplanting or in purifying the shell-fish, or both, would be likely to give immediate beneficial results, and so far as opportunity offers it is endeavouring to promote such useful work.

This is not a time when it is easy to induce public bodies to undertake any fresh expense, but it will be unfortunate for the country if such directly productive expenditure, which may reasonably be expected to lead to the establishment of permanent shell-fish industries, be prevented or delayed for want of the comparatively small sums which are necessary to start the work.

As an example of what can be done at a small cost to improve the value of shell-fish by judicious transplanting, the work of the Lancashire and Western Sea-Fisheries Committee in 1903–5 may be cited.[2] It was carried out on the mussel beds at Heysham, in Morecambe Bay, probably the most extensive mussel-producing grounds on the west coast of England.

In 1903 the committee gave a grant of 50*l.* to be expended on labour in transplanting overcrowded and stunted mussels, which were not showing any growth, to neighbouring areas which were not so thickly populated. The result was most striking. Mussels, which in their original condition could never have been of any use as food, had been turned into a valuable commodity at comparatively little trouble and expense. The money value to the fishermen of these mussels that had been transplanted for 50*l.* was estimated a few months later to have been at least 500*l.* In 1904, again, a grant of 50*l.* resulted in the transplanting of under-sized mussels, which were later on sold at a profit of more than 500*l.* In the following year (1905) a grant of 75*l.* resulted in the sale of the transplanted mussels some months later for 579*l.* On that occasion more than 240 tons of the under-sized mussels had been transplanted in six days' work. It was found that on the average the transplanting increased the bulk of the mussels about two and a half times, and the increase in length to the original shell was in some cases well above an inch.

Experiments have also been made on the Lancashire coast in the transplantation of cockles from overcrowded to less crowded sands with equally favourable results.[3]

It is obvious that when, on the conclusion of war, many men return to work along our coasts any increase of employment in connection with such local fishing industries will be of direct and immediate advantage to the country. It is to be hoped that nothing will be allowed to interfere with this transplantation and purification work, and that whenever possible further funds will be devoted towards the promotion of schemes which seem desirable, if not, indeed, essential, from the point of view of the industry and of public health alike. In connection with the public health aspect of the matter, much of Dr. Johnstone's work on the Lancashire coast for some years past has dealt with the condition of the shell-fish beds in relation to sewage contamination, by means both of topographical inspections on the shore and of subsequent bacteriological investigations of samples in the laboratory.[4]

As an example of a local fishery which has been started as the result of a little ingenuity and enterprise, we may take the Morecambe winter sprat fishery which has developed during the last couple of years. The fish are being caught in great quantities by a new method, which is the "stow"-net modified to suit the conditions prevailing in the strong tidal currents of the Morecambe Bay channels. The sprats appear in September, then become very abundant off Morecambe in November, and remain in quantity until the end of January, after which the sprats become smaller and the fishery diminishes in value. During the height of the fishery fully 70 tons of fish were landed per day, and the money value of this catch to the fishermen was more than 300*l.* A ton of sprats contains on an average 130,000 fish. In a day's fishing, therefore, nine millions of sprats may be captured, and this goes on day after day without making any appreciable difference to the abundance of the fish. A full account of this recent fishery and the method of using the "stow"-net is given by Mr. Andrew Scott in the Lancashire Sea-Fisheries Report for 1915

Another interesting and very profitable local fishery, which has arisen or been resuscitated quite recently in the Irish Sea, is the summer herring fishery off the south end of the Isle of Man. In former days there seems to have been a regular summer herring fishery, but for the last thirty years or so it has failed—the fishermen say because of the absence of herrings, but more probably it is because these men have found more profitable employment on shore. A few years ago a firm of Scottish herring curers was induced to establish a branch at Port St. Mary, and this so stimulated the local fishermen that a fleet was equipped and sent to sea, and a profitable fishery ensued. That was in the summer of 1910, and the same conditions have held good more or less since. But the prices obtained by the men for their catch have fluctuated, notably in accordance with the market facilities and the amount of competition between rival buyers and curers. In 1910–12, with one buyer, the price was 18*s.* the cran; in 1913, with four buyers, the price rose to 40*s.*; in 1914, with two buyers, the price was 30*s.*; in 1915, with four buyers, the maximum price was 91*s.*; while in the present summer (1916), with five rival buyers, the record price of 97*s.* a cran was reached.

From this record of recent years, and from what one

[2] See Lancashire Sea-Fisheries Laboratory Report for 1905.

[3] For further details reference must be made to the successive Annual Reports of the Committee.

[4] All this work has been recorded in detail in recent Annual Reports of the Lancashire Committee.

can ascertain of conditions in the past, it is clear that—in addition to the presence of the fish, which can probably be relied upon in most years—it is necessary for a prosperous herring fishery in the Isle of Man either that a local market should be constituted by competing buyers and curers from Scotland or elsewhere, or that arrangements should be made to transport the daily catch by steam-carriers to a market on the mainland, such as Liverpool, Fleetwood, or Holyhead. As a result of the lack of market facilities, it may be noted that during the greater part of this summer herrings have been sold retail at Port Erin at twenty for a shilling, while in Liverpool they cost from three-halfpence to twopence halfpenny each.

After the war it will for some time probably be just as important as it is now to prevent money from leaving the country, and with a view to this, as well as for other reasons—in brief, the production of food and the employment of men—it is obviously desirable that all home productivity should be organised and stimulated. The exploitation of minor fishing industries along our shores naturally occurs as one step in this direction, and the economic need for developing these deserving industries seems obvious and urgent.

THE LONDON MATHEMATICAL SOCIETY.[1]

IN the midst of the universal cataclysm of the war, when all interests are strained towards the national defence, the London Mathematical Society has passed, without notice, its fiftieth year of activity. The first meeting was held at University College, on January 16, 1865, and heard an address by Prof. de Morgan on the aims and prospects of the society. The de Morgan medal is a reminder for us of his predominant share in the inauguration of the society, which he did not survive long to guide. In the early days the publications consisted of a series of pamphlets separately paged, containing single communications; the names of Sylvester, Cayley, Harley, Tucker occur as authors in the first year. There followed later brief reports of meetings, along with papers by de Morgan, Sylvester, Crofton, Cayley, H. J. S. Smith, Cotterill, and others. These publications now stand as vol. i. of the first series of the Proceedings. With vol. ii., which begins with the annual general meeting of November 8, 1866, the Proceedings became crystallised into a form which has persisted substantially, except as regards size of page, to the present time. The society began operations with twenty-seven original members, nearly all of them members of University College, London; at the end of the first year the number of members was sixty-nine, rising to ninety-four in November, 1866; and the society had already become representative of British mathematical science by having on its roll most of the eminent investigators in our subject belonging to Cambridge and Oxford, as well as London.

On January 15, 1866, it was resolved "That steps be taken to ascertain on behalf of the society whether and on what terms rooms can be obtained at Burlington House," and on November 8 a report was made that "by the kindness of the Chemical Society in lending their rooms, the society had been enabled to hold their meetings at Burlington House, where they now meet for the first time." By 1868 most of the British authorities on pure and applied mathematics of that time, who were resident within reach, including de Morgan, Cayley, Sylvester, Hirst, Crofton, H. J. S. Smith, Archibald Smith, Clerk Maxwell, Spottiswoode, S. Roberts, Clifford, Stirling, had been taking active share in the work of the society by attendance and service on the council, as well as by the contribution of papers for discussion at the meetings. We must not omit from this list Lord Rayleigh, whose memoirs illuminated our Proceedings for many years; who, stimulated by the increasing importance of the society, became the donor of our most substantial benefaction, which has largely increased our resources for publication ever since the early days. In November, 1870, the society migrated to rooms occupied also by the British Association, in the house of the Royal Asiatic Society, 22 Albemarle Street, where accommodation was found for the library, of which a nucleus had been formed by the books of Sir J. W. Lubbock, the physical astronomer, presented by his son, afterwards Lord Avebury; and there by successive forms of tenancy we have remained until now.

For some years past the library, rendered valuable by accumulation of scientific journals through exchange, and by donations of books, has quite outgrown the accommodation available; and weighty complaints became frequent that, by overcrowding, the books had become, notwithstanding the zeal of successive honorary librarians, almost inaccessible to members of the society. The problem, thus pressed upon them from many sides, was taken in hand resolutely by the council during the last session, and after various plans had been proposed and closely considered, a solution was reached.

It came to the knowledge of the council that the Royal Astronomical Society would probably be willing to extend hospitality to the Mathematical Society, as regards both place of meeting and general headquarters, thereby establishing, or rather renewing, an alliance between British mathematicians and astronomers, whose activities have always interpenetrated with the closest mutual benefit. Following on the confirmation of this plan, subject to the approval of the Office of Works, arrangements have also been made with great cordiality by the authorities of the Science Museum at South Kensington, whereby our library will be deposited in their scientific library under a scheme which will maintain full use of it by the members of the society, in surroundings where the cognate scientific literature, and extensive mechanical applications of mathematical. principles, will be accessible for study.

We have, therefore, the pleasure now of holding the first of our meetings under the new conditions, at Burlington House, in very congenial surroundings.

The necessities of the national emergency have mobilised with striking success the industrial resources of science, hitherto neglected too largely in our defensive organisations. A most welcome result is the increased sense that has arisen of the national value of scientific pursuits; but danger is by no means absent that, in the haste to secure the material fruit, the welfare of the tree of knowledge, the pure and fertile source from which it springs, may be neglected or even impaired, and, like others of ancient days as well as recent times, we may succumb to the temptation "propter vitam vivendi perdere causas."

It is our duty here to take into consideration how our own special energies may best be rejuvenated and renewed, so as to become more effective in the enhanced and purified national life which, as we trust, will emerge from our present ordeal. Mathematical knowledge, in all ages the ally of sustained and exact activities, is now more indispensable than ever, when our material well-being depends so much on scientific engineering in its mechanical, electrical, and chemical forms. The highest commendation of any growing department of research is to be able to say that it is approaching the quantitative, the mathematical, form; many sciences, formerly descriptive and

[1] From an address delivered at the anniversary meeting of the London Mathematical Society on November 2 by the retiring president, Sir Joseph Larmor, M.P., F.R.S.