tage is obviously one that is deferred to the later stages of the work, the only instances in the part of the work hitherto published being that the calculations of sections (v.) and (viii.) of chapter iv. are to some extent facilitated by the previous calculation of section (ii.) of the same chapter.

The ordinary method of approximation in the simultaneous equations proceeds by determining approximate values of the unknown quantities in order of magnitude, at first neglecting the smaller of these quantities in the equations of principal importance for determining the larger ones. It happens, from a well-known cause, that sometimes the coefficients of certain unknowns are small even in the equations of principal importance in determining them. Prof. Brown has, in these cases, found it best to defer their determination until he has found all the other quantities in terms of them.

After considerable experience of both sets of differential equations, Prof. Brown has come to the conclusion that the first set on the whole is the best adapted to the numerical work. An important exception, however, arises. The two coefficients of a term of long period are principally determined by two equations very nearly deducible, the one from the other, the determinant of the coefficient varying inversely as the square of the period. The difficulty is considerably lessened by using one equation derived from the homogeneous set.

The following table will give some idea of the extent of the calculations already performed. The terms have been calculated

Reference Number.	Characteristic.	Argument.	Number of Terms.	Approximate value in arc of the largest coefficient (1) including (2) excluding purely elliptic terms.		Value of unity in the last figure given in millionths of a second of arc.
				(1)	(2)	
1*	1	0	13	206265″	1800″	0·0002
2	e	$\pm l$	18	17000	3000	2
3	e'	$\pm l'$	21	350	350	0·4
4	α	D	9	80	80	0·05
5	k	F	11	9000	300	0·01
6	e^2	$\pm 2l$	21	240	170	3
7	e^2	0	11	340	100	3
8	ee'	$\pm (l + l')$	21	140	140	4
9	ee'	$\pm (l - l')$	22	100	100	4
10	e'^2	$\pm 2l'$	18	6	6	0·6
11	e'^2	0	10	2	2	0·6
12	k^2	± 2F	20	400	40	0·4
13	k^2	0	11	400	40	0·4
14	$e.\alpha$	D $\pm l$	19	12	12	0·6
15	$e'.\alpha$	D $\pm l'$	20	14	14	0·1
16	α^2	0	9	0·01	0·01	0·1
17	ke	F + l	10	15	15	0·06
18	ke	F − l	11	45	45	0·06
19	ke'	F + l'	10	1	1	0·01
20	ke'	F − l'	11	0·4	0·4	0·01
21	$k\alpha$	D + F	10	4	4	0·02

* Calculated by Dr. Hill.

in twenty-one groups, the order of calculation being indicated by the number in the first column. The second column gives the multiple of the eccentricities, inclination, and ratio of parallaxes that is common to each coefficient of the group. The third column gives the fundamental argument from which all the other arguments are derived by the addition or subtraction of multiples of twice the elongation, Delaunay's notation being used, The fourth column gives the number of terms calculated. The fifth column gives the approximate value in arc of the largest coefficient, and the sixth column the value of the largest coefficient indicating a disturbance from elliptic motion. The last column gives the value in arc of the last significant figure, and where, as often happens, the coefficients of a group have been calculated to a different number of decimal places, then the number given in this column corresponds to the coefficient calculated with least accuracy.

Dr. Brown gives as the approximate values of the constants in the third column of the above table

$$e = 0{\cdot}11 \qquad e' = 0{\cdot}017 \qquad k = 0{\cdot}045 \qquad \alpha = 0{\cdot}0026$$

It will be seen that the terms calculated include all that ar algebraically of the second order. The ratio of the parallaxe is here considered as being of the first order. The terms depending on the square of this ratio, it will be noticed, are insensible to observation. This is fortunate, as the terms cannot be corrected for the neglected mass of the moon.

We think that the results selected for publication are a little too meagre. They consist of the actual solution itself, and one other set of terms whose calculation divides the labour of each section into two fairly equal halves. We hope that an appendix will be finally published in which the value of every auxiliary quantity will be given. Such an appendix might be of great use in other investigations. It would also be of immense value should there ever be a suspicion of error in Dr. Brown's own calculations, for it would then be far easier to establish the fact of such an error, should one ever creep in, and it would entail less labour to carry through the correction.

MARINE BIOLOGY AT THE BERMUDAS.

AN expedition of the biological department of New York University went to the Bermudas a few months ago to study the marine fauna, and to investigate the conditions offered for the establishment of a permanent biological station there. The party has now returned, and an account of the observations made is contributed by Prof. C. L. Bristol to *Science*, from which source the following particulars have been derived :—

The most attention was given to a search for the various forms and a careful survey of the general conditions subtending their abundance and collection, so that, taken as a whole, the work might prove a reconnaissance and furnish knowledge for future investigations. In this the expedition was fairly successful and would have been much more so but for a long spell of south-west wind which prevented off-shore work, excepting for a few days. Our work was confined mainly to the lee shores, and here we were greatly rewarded. Of corals the genera *Diploria*, *Meandrina*, *Astrea*, *Siderastrea*, *Porites*, *Isophyllia*, *Oculina* and *Mycedium* were found ; of Gorgonians, *Rhipidogorgia* and *Gorgonia*. The Actinaria are very abundant and our collections are numerous. We found but few hydroids and a millespore coral. The Medusæ and Hydro-Medusæ are very abundant in the still waters of Harrington Sound. The Echinoderms are exceedingly interesting and abundant. The Holothuria are represented by the genera *Holothuria*, *Semperia*, *Stichopus*, the last being very abundant. The Asteroidea are few, and are represented by one species of *Asterias* and one of a new genus not yet determined ; the Ophiuroidea by several genera. The Echinoidea are represented by *Cidaris*, *Diadema*, *Hipponæ*, *Echinometra*, *Toxopneustes*, *Mellita* and one new genus. The Crustacea are numerous and exceedingly interesting. Our collections will be studied by Dr. Rankin, who will report on them later.

The Mollusca of the archipelago number, according to Heilprin, about 170 marine forms and thirty terrestrial. Among the cephalopoda are *Octopus* and *Argonauta*. The naked *Aplysia* is fairly abundant, and numerous other naked molluscs are found in Harrington Sound.

The Annelids are not as numerous in the places we searched as we expected, but those we found are new to us and the genera are not yet determined. The sponges are very numerous in genera and plenty in individuals. The Tunicates are exceedingly numerous and offer a rich field for investigations. *Amphioxus* is reported, but we had no opportunity to search for it. The abundance and beauty of the Bermuda fishes is notorious. Dr. Bean is making a study of them, carrying on the work started by his colleague the late Dr. G. Brown Goode. Incidental to the main work of the expedition we undertook to furnish the Aquarium in New York with live specimens of some of these fishes, and thousands of visitors to that institution testify to their beauty and gracefulness. This part of the work was by no means the least interesting. We installed four large tanks and a pumping engine on White's Island, in the harbour of Hamilton, and acclimatised the fish before transferring them to the steamship On board the boat the fish were supplied with running water, thanks to the kindness of the Quebec Steamship Company, and no small part of our success was due to the generous and skilful aid given us by the Chief Engineer, Mr. Ritchie. Under these favourable conditions our loss was slight, and another season will be much less. It is interesting to note that our efforts to bring invertebrates alive failed in every

case but one, though we could keep them in prime condition until we struck the polluted waters of the coast, when they died quickly. Our failures, however, have suggested remedies, and next year we hope to show *Octopus*, *Palinurus*, *Ibacus*, *Aplysia* and the sea-anemones, as well as the fishes. The fishes thrive in the Aquarium, although the water is several degrees cooler than they are accustomed to, and the salinity much less. There would be little difficulty apparently in carrying them from New York across the Atlantic, if that were desirable, under the same conditions that we carried them from Bermuda.

Our hasty survey strengthens the idea of establishing a station, and we are planning to have one in working condition by the summer of 1899, if not before. It will have two stories, the lower given up to aquaria, as at Naples, and open to the public during the winter at a small fee; the upper story will be fitted up for a laboratory, and while under the charge of the University will be open to any one competent to carry on an investigation in botany or zoology. It is not intended to rival any of the stations on the Atlantic coast, but to supplement them, and to afford opportunity to investigators of America and Europe to study the flora and fauna of a tropical horizon with ease and comfort. The healthfulness of the place is testified by the yearly visitation of over two thousand guests who spend the winter months there. Malaria is unknown, as is also prostration by heat. The climate during June and July is not disagreeable, the thermometer rarely going up beyond 82° F.

Another project in hand with the station at the Bermudas is the exploration of the West Indies with the Bermudas as a base. Two lines of steamers connect the islands with the West Indies, and the investigator starting on them equipped from the appliances of the station may make a rapid collecting trip to a desired place, and return to work over his material under the more favourable conditions at the station.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The examination for University Mathematical Scholarship and Exhibition will begin on January 20, 1898.

At the Junior Scientific Club on Friday last, November 19, Mr. A. C. Le Rossignol (Exeter) read a paper on "Nitro-explosives." Mr. H. Balfour (Trinity), exhibited a series showing the ancient and modern use of bones of animals as skates. Mr. N. V. Sedgwick (Ch. Ch.) was in the chair.

The regulations for carrying into effect the provisions of the statute relating to the training of teachers are as follows:—I. To obtain the certificate the candidate shall (1) satisfy the authority appointed by the delegates in practical work done under supervision in Oxford; (2) present a record in writing, satisfactory to the delegates, of lessons prepared and given by him, or her, during the training course in Oxford; (3) have taken a further probationary course of teaching in some school appointed by the delegacy; such course to include not less than one hundred lessons, and the report of this work to be signed by the head master or mistress; (4) pay a fee of 2*l.* 2*s.* when the diploma is awarded. II. In the case of candidates already teachers (with the exception of those who shall have passed, or taken honours at, the second public examination after Trinity Term, 1898), the delegacy will certify that a candidate has satisfied them of proficiency in the practice of teaching, provided that the candidate (1) has taught for a year in a secondary school approved by the delegacy; (2) has attended at least one holiday course held under the authority of the delegacy; (3) has satisfied the persons appointed by the delegacy of his, or her, proficiency in the practice of teaching; (4) shall pay a fee of 3*l.* 3*s.*

A HALL of physics, in connection with Syracuse University, will, it is expected, be built next year, the sum of 5000*l.* having already been subscribed for the purpose.

SIR WILLIAM MACCORMAC, the President of the Royal College of Surgeons, England, has been appointed a Governor of the Mason College, Birmingham, for five years.

THE new chemical laboratory building of the University of Berlin, which is at present in course of erection, will, it is stated, contain four large laboratories and twenty-five research rooms, and accommodate 250 students. Its cost will be about 50,000*l.*

AMONG a number of bequests by the late Sir Thomas Elder, of Glan Osmond and Adelaide, South Australia, are:—4000*l.* to Prince Alfred College, Adelaide; 2000*l.* to Way College, Adelaide; 25,000*l.* to Adelaide University; and 20,000*l.* to the Medical School of Adelaide University.

MANUFACTURERS having at heart the advancement of technical education should emulate the action of Messrs. Brunner, Mond, and Co. This firm voluntarily tax themselves to the extent of one penny in the pound on their works at Anderton, Barton, and the rural portion of Winnington, in the interests of technical education in Cheshire.

AT a meeting of the Council of the Royal College of Surgeons, England, on November 11, Felstead School and Watford Endowed Schools were added to the list of recognised places of instruction in chemistry, physics, and practical chemistry; and the South-west London Polytechnic Institute, which was already recognised for instruction in these subjects, was added to the recognised places of instruction in elementary biology.

THE Court of the Drapers' Company have approved the plans of a new building at Oxford, which will be the future home of the Ratcliffe Library if the authorities at Oxford accept them. The cost of the new structure will be 18,500*l.* The Ratcliffe Library was founded by Dr. Ratcliffe considerably over a century ago, but the space it now occupies will be absorbed by the extension of the medical school. The Drapers' Company, in the interests of education, has undertaken to erect the new building, the plans of which have been prepared for the Company by Mr. T. G. Jackson, R.A.

AMONG recent appointments abroad, we notice the following: Dr. Theodore Curtius, of Bonn, to succeed the late Prof. Victor Meyer at Heidelberg; Mr. G. S. Wilkins to be professor of civil and mining engineering at the University of Alabama, and Dr. John Y. Graham to be professor of biology at the same institution; Dr. Max von Frey, of Leipzig, to be professor of physiology at the University of Zürich; Dr. Kraus to be professor of botany at the University of Halle; Dr. Max Dessoir to be associate professor of psychology at the University of Berlin; Dr. Lothar Heffter to be associate professor of mathematics at the University of Bonn; and Dr. Brikencajer to be associate professor of mathematics at the University of Krakau.

THE extent to which County and County Borough Councils in England are working in connection with secondary schools may be seen in a tabular statement published in the current *Record of Technical and Secondary Education*. The tables go to show that during the year 1896–97, sixty-three local authorities gave direct or indirect assistance to three hundred and twenty-eight individual secondary schools to the extent of 144,871*l.*, this sum including the value of scholarships and exhibitions granted for pupils proceeding from secondary schools to higher institutions. Other ways in which the sum referred to was expended were in capitation grants, for teaching staff, maintenance, apparatus, &c., and buildings.

THE Birkbeck Science Society has just been formed in connection with the Birkbeck Institution, London, and purposes holding meetings on the first and third Saturdays of each month, for the reading and discussion of papers on scientific and philosophical subjects. It is also intended to make frequent excursions to places of scientific interest, especially chemical and physical works. It is further intended to publish a journal, containing abstracts of the papers read before the society, together with reports of the scientific excursions. The first meeting of the Society was held on Saturday, in the Chemical Lecture Theatre of the Institution, when a large number of past and present students were present. The Principal of the Institution, Mr. G. Armitage-Smith, occupied the chair, and after welcoming the Society on behalf of the governing body, made some very appropriate and interesting remarks about the value of scientific study. An interesting and instructive paper on "Cavendish and his Work" was then read by Dr. J. E. Mackenzie. The lecturer started by picturing the state of science at the beginning of Cavendish's work, and traced it down to the present day, showing that the 1 per cent. of gas which always remained after his experiments with air, was in reality the argon discovered by Lord Rayleigh and Prof. Ramsay. The Secretary's report was very encouraging, showing