ment with 4.1 grams of a 52 per cent. solution of hydroxylamine, 10 grams of methyl iodide (the molecular proportion), and a smaller quantity of methyl alcohol, mixed together in a flask fitted with an upright condenser, the energy of the reaction was found to be sufficiently great to heat the liquid to the point of ebullition, and crystals soon commenced to deposit. Ethyl iodide reacted in a precisely similar manner. The crystals, after draining and washing with a mixture of alcohol and ether, proved to be those of the pure hydriodides of the β -alkyl hydroxylamines. Their aqueous solutions acidulated with nitric acid do not reduce silver nitrate, so that their analysis is easily effected. In this respect they differ from nitric acid solutions of hydroxylamine, which of course at once reduce silver nitrate. They reduce Fehling's solution, however, instantly at the ordinary temperature. It would appear from this mode of preparation that the action of alkyl iodides on hydroxylamine is similar to their action upon ammonia. The salts are perfectly stable up to beyond 200° C. M. de Bruyn shows finally that it is not essential to have at command such concentrated solutions of hydroxylamine as those obtained during the preparation of the solid base. The weak aqueous or alcoholic solutions obtained in the usual manner from hydroxylamine hydrochloride, may equally well be employed; it is only necessary to decompose the solution of the hydrochloride in tepid water with potash, add an equal bulk of methyl alcohol, filter from the precipitated potassium chloride, and at once proceed to agitate with methyl iodide. The only further point of difference is that the liquid should be finally boiled in the flask fitted with upright condenser in order to complete the reaction.

THE additions to the Zoological Society's Gardens during the past week include a Black-eared Marmoset (*Hapale pentecillata*) from South-east Brazil, presented by Mr. H. M. Dodington; a Common Peafowl (*Pavo cristatus*) from India, presented by Mrs. Tannenbaum; a Monteiro's Galago (*Galago monteiroi*) from West Africa, two Pinche Monkeys (*Midas edipus*) from New Granada, deposited; a Maholi Galago (*Galago maholi*), two Japanese Deer (*Cervus sika*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

RECENT OBSERVATIONS OF JUPITER'S SATELLITES.—In the May number of *Astronomy and Astro-Physics*, Dr. E. S. Holden calls attention to some important points in connection with Prof. Barnard's observations of Jupiter's satellites, recently published in that journal and in the *Monthly Notices*. In the first place, the results announced by Prof. W. H. Pickering in 1893 (see NATURE, vol. xlvii. p. 519), with regard to the forms and rotations of these bodies, are not confirmed by Prof. Barnard's observations. Next, Prof. Barnard has found that all the Jovian satellites are spherical, whereas Profs. Schaeberle and Campbell announced in 1891 that Satellite I. was ellipsoidal, with its longest axis directed towards the centre of Jupiter. It was also concluded by these observers that the periods of rotation and revolution of the first satellite were equal; but Prof. Barnard says that his observations lead to a different result. Another point upon which Prof. Barnard's recent observations have thrown light, is the appearance of the first satellite when projected upon Jupiter. It will be remembered that the satellite was seen in transit as a double body in 1890, but Prof. Barnard has shown that the apparent duplicity was due to simple contrasts between bright regions on the planet and two extensive dusky polar caps on the satellite (see NATURE, vol. xlix. p. 300). Other strange appearances of satellites during transit can be explained in a similar manner. Prof. W. H. Pickering has criticised the statement that the assumed belt on the first satellite is a permanent one (*Astr. Nach.* 3229), and says that it certainly did not exist at the time of the opposition of 1892, during the period covered by the Arequipa observations. He points out that, upon his meteoric hypothesis, it is not unlikely that belts should form and then disappear. It is a fairly common belief among astronomers that the satellites of Jupiter can be seen

through the planet's limb during occultation. On this point, Prof. Barnard says: "In my mind this [the observation of the transparency of Jupiter's limb] has been due to poor seeing, a poor telescope, or an excited observer. For nearly fifteen years I have observed Jupiter and his satellites, and with telescopes all the way from five inches up to thirty-six inches have tried to see this phenomenon. I have often watched the satellites under first-class seeing with the 12-inch here Mount Hamilton] at occultation, but have never seen one of them through the limb of Jupiter, though that phenomenon was specially looked for." It will be seen from these points that Jupiter and his satellites still offer a wide field for investigation.

THE MASS OF THE ASTEROIDS.—Mr. B. M. Roszel contributes to the Johns Hopkins *University Circular* for April a preliminary note on the probable mass of the asteroids. He has investigated the secular perturbations to which a ring of matter, such as the asteroids form round the sun, would give rise. The problem divides itself naturally into two parts—(1) to determine the combined mass of the asteroid belt; and (2) knowing the mass, to derive the secular perturbations of the elements of the orbits of certain of the major planets caused by this elliptic ring of matter. If the total number of the asteroids were known, it would only be necessary to determine the most probable mass of one member of the group to derive the combined mass of the whole group. But this is not the case, so Mr. Roszel has contented himself with determining the mass from a study of two hundred and sixteen of the minor planets at present known. The magnitudes of these bodies vary from magnitudes 6 to 15.5, the greater number lying between magnitudes 11 and 12. From photometric observations, Prof. Pickering derived for Vesta a diameter of 319 ± 10 miles. (Prof. Barnard's recent observations only assign the planet a diameter of 237 ± 15 miles). Now the ratio of the total quantities of light reflected by two planets at the same distance from the observer is equal to the ratio of the squares of their diameters. Utilising this fact, Mr. Roszel has been able to determine the volumes of the two hundred and sixteen asteroids referred to in terms of the volume of Vesta. Assuming Pickering's dimensions of Vesta to be correct, it appears that it would take roughly three hundred and ten asteroids of the sixth magnitude, or twelve hundred of the seventh, to equal our moon in volume. And in round numbers the combined volume of a ring of two hundred and sixteen would be only one two-hundredth part of that of our satellite. Assuming a mean density equal to that of Mars, the mass of the zone of asteroids comes out as about one one-hundred and seventieth part of the mass of the moon. From these considerations Mr. Roszel thinks that the probable mass of the entire asteroid belt is somewhere between one-fiftieth and one one-hundredth part of that of our moon.

EPHEMERIS OF GALE'S COMET.—The following ephemeris (for Berlin midnight) is abstracted from one given by Prof. Kreutz in *Astronomische Nachrichten*, Nos. 3227 and 3229:—

		R.A.		Decl.	Bright- ness.
		h. m. s.			
May 26	...	10 44 37	...	N. 36 11'3	0.80
30	...	10 57 40	...	38 10'9	0.60
June 3	...	11 9 14	...	39 39'3	0.40
7	...	11 19 38	...	40 45'6	0.33
11	...	11 29 12	...	41 35'6	0.26
15	...	11 38 7	...	42 13'1	0.21
19	...	11 46 31	...	42 41'0	0.17
23	...	11 54 53	...	43 1'4	0.14

The brightness on April 3 has been taken as unity.

The comet was photographed by the Brothers Henry, at Paris Observatory, on May 5. The photograph was obtained with an exposure of forty minutes, and showed a tail, about four degrees in length, divided, at a short distance from the head, into two branches separated by an angle of about three degrees. The mean direction of the two parts of the tail was very nearly perpendicular to the direction of the comet's motion.

SOME LONDON POLYTECHNIC INSTITUTES.

IT is only in recent years that any attempt has been made to supply the demand for technical education in London. Not so very long ago the question as to whether such education was desirable for the working classes was gravely

discussed; now the necessity is recognised by everyone, and the subject under consideration is the best method of carrying on the work. The commercial world has begun to realise the importance of training workmen on scientific lines; it has been led to see that the encouragement of science means the advance of industry and increase of trade. These lessons were difficult to learn, and, even at the present time, the connection between science and manufactures is not properly understood. But a beginning has been made. London, the city that prides itself upon being the largest and richest in the world, but which until recently ignored the need for technical instruction, has begun to foster the child it had done its best to kill by neglect. A comparison with the educational work carried on in Polytechnics on the continent has served to accentuate the deficiencies of London, and to create a desire to follow the lead there indicated. The awakening was rather abrupt, and it was thought by some that the time lost could be rapidly made up again. But this mistaken idea has now been given up, and it is seen that the only way to improve our arts and industries is by slowly educating the mind and training the hand of the mechanic.

Goldsmiths' Institute is specially fortunate in having a very strong Governing Body, containing as it does the names of Sir Frederick Abel, Sir Frederick Bramwell, Sir Richard Webster, Sir Walter Prideaux, Dr. Anderson, and Mr. G. Matthey. It will be seen from Fig. 1, which shows a view of the Institute from the back, that the building covers a considerable area. The structure is the old Royal Naval School building adapted and extended to the requirements of the Institute. Some people considered it a disadvantage to take an institute like that of the Goldsmiths' Company into an old building, but, on the whole, there are many advantages in so doing. In a new building, the architect provides everything he is told to provide, but he does not leave room for future exigencies. In an old building, however, there are usually facilities for extensions in the direction which experience shows to be necessary.

The buildings of the Goldsmiths' Institute are considerably larger than those of any of the other London Polytechnics. A technical museum is now being added, which will be a special feature of this Institute.

The Institute differs from most other Polytechnics in the conditions of membership. The Battersea Polytechnic and the

FIG. 1.—The Goldsmiths' Institute (from the back)

It is proposed in this article to give an account of three institutes in London which provide evening education and recreation for persons engaged in various trades and industries during the day. The institutes referred to are the Goldsmiths' Institute, the People's Palace, and the Battersea Polytechnic Institute. Other institutes, however, are referred to incidentally.

To begin with the technical and recreative Institute at New Cross, established and endowed by the Goldsmiths' Company. The expenditure of this Company upon their Institute has amounted to something like £80,000, and they have assigned it an endowment of £5000 per annum. Work was commenced in the Institute in October, 1891, Mr. J. S. Redmayne, of Merton College, Oxford, the Secretary, having been appointed about eighteen months previously in order to draw up a scheme of work and get together a strong and efficient staff. His duties are generally to supervise the staff and work, under the direction of the Governors, and generally act as resident representative of the Governors. It is hardly necessary to remark that the success of Polytechnic Institutes from an educational point of view depends very largely upon the Governors. The

People's Palace exclude from membership of the institute, that is, from the social and recreative side, all except students. At the Regent Street Polytechnic, we believe, the rules are exactly the opposite way; those who care to pay for enjoying the social side can also, in virtue of so doing, get their education cheaper, that is to say, the class fees are reduced to members. We have no hesitation in saying that this plan is very bad. The first object of a Polytechnic should be the advancement of technical education. When this purpose is kept more or less in the background, the social and recreative side of the work tends to run rampant. In such cases the "House of Commons," where persons play at Parliament, is one of the most flourishing of the societies, and the "dreary drip of dilatory declamation" constitutes the pabulum of a large proportion of the members. The Governors of the Borough Institute have apparently found that too much attention to clubs and concerts is detrimental to educational work, for they have recently required that all new members should belong to one or more of the classes, and even now there seems to be room for improvement.

At the Goldsmiths' Institute there is one class fee for members.

and students alike, but a student can get his membership—that is, his social and recreative privileges—at a cheaper rate through being a student. At the same time, people are not excluded from the social side of the Institute, even if they are not students. To put the matter briefly: at the Regent Street Polytechnic studentship is of less account than membership. At Battersea, the People's Palace, and, to some extent, Borough Road, there is no membership without studentship, while at the Goldsmiths' Institute studentship is the main thing, but those who are not students are not excluded from membership—they are only made to pay a little more for their privileges because they are drones.

It must not be supposed that the social or recreative side of Polytechnic Institutes consists entirely of play, for some extremely useful societies belong to it. The mechanical

ciency than that shown by examinational honours. If the mere obtaining of certificates is inculcated into students as the end and aim of their work, the useful results expected from technical education will never arrive. The test, indeed, of the work done in Polytechnics must not be rated according to the list of examinational successes, but by the number and quality of papers published, and inventions made, by its alumni. So far as we know, no London Polytechnic Institute is yet able to produce this evidence of the development of originality, though it is impossible to say what may be done in the future. We would suggest, however, that such institutes should begin to record the additions to knowledge made by their students, and publish the lists year by year in their prospectuses. There would then be no difficulty in determining which of them all had borne the best fruits.

FIG. 2.—Engineering Workshop of the Goldsmiths Institute.

engineering and the chemical societies of the Goldsmiths' Institute are really doing splendid work. At their meetings students read papers of really scientific merit, and important problems in mechanics and chemistry are discussed. Too much praise cannot be given to societies of this kind, and we are glad to find that most institutes recognise their usefulness. They create interest and stimulate research; they help students to realise that scientific attainments must not be gauged by certificates, but by contributions to knowledge. Many institutes put forward as an advertisement of their efficiency the fact that a larger proportion of their students passed certain examinations than those of any other Polytechnic; that their students carried off such and such medals, and so on. This is all very well, but we look to Polytechnics for further evidence of effi-

The engineering department of the Goldsmiths' Institute is one of the best in London. Through the kindness of Mr. W. J. Lineham, the head of this section of work, we are able to give an illustration of the engineering workshop. It will be seen that the workshop is extremely well-fitted with useful machines—far better, indeed, than many of the shops in manufacturing factories. Students who pass through workshop courses are made familiar with almost all the tools and appliances met with in ordinary practice. As for the courses themselves, we can suggest nothing to improve them. Each student is given a rough casting, and is expected to turn out from it a finished product. The first bit of work consists in grinding a cold chisel, both flat and cross cut, and in learning how to do simple marking off. For practice in chipping, filing, and scraping a cast iron

block is worked into a paper-weight. A scribing block is then made, the castings and forgings being provided. This serves as exercise in chipping, filing, drilling, turning, and screwing. The student has afterwards to turn out a surface plate, hexagonal pattern, with handles. This work serves as exercise in planing, turning, drilling and screwing, filing and scraping. During the second year a ratchet brace is made, and a lathe; and third-year students make a shaping and a slotting machine. The course of study for engineering students is worth reprinting, for in it theory and practice are excellently combined:—

First year.	Second year.	Third year.	Fourth year.
Fitting and Machining (Shops).	Heat Engines, Advanced.	Smithing (Shops).	Smithing (Shops).
Engineering Lecture (Preliminary).	Mathematics (2nd stage).	Fitting and Erecting (Shops).	Pattern Making (Shops).
Applied Mechanics, Advanced.	Fitting and Machining (Shops).	Machine Construction (Special).	Smithing (Shops).
Machine Drawing, Elementary.	Machine Drawing, Advanced.	Engineering Lectures.	Engineering Lectures (Special).
Fitting and Machining (Shops).	Engineering Lecture.	Pattern Making (Shops).	Pattern Making (Shops).
The Steam Engine, Elementary.	Applied Mechanics, Advanced.	Finished Drawing and Design (Special).	Finished Drawing and Design (Special).
Mathematics (1st stage).	Fitting and Machining (Shops).		
Drawing Practice (Special).	Drawing Practice (Special).		

The course for building students is just as good. These courses are very popular, and they well deserve the success they have gained. Another successful class is one of carpentry for women; not merely Sloyd or woodwork, but real, practical carpentry. This is, we believe, the first class of the kind that has ever been held. The chemistry classes are specially good, and the laboratories the largest of all the Polytechnic Institutes.

Certain classes of the Goldsmiths' Institute are open to a limited number of *bonâ fide* artisans and handicraftsmen, on payment of half the ordinary fees. This is a rule well worth following in other institutes. Some of the trade classes are open to any one, irrespective of occupation. The clerk who has a taste for machine work may go through the same courses as fitters. If the clerk were allowed to waste his time in dabbling with the lathe and making pretty things, then he ought to be kept out; but when he is compelled to take up routine work, the case is different, for nothing but good can come of it. The young man who is willing to forego empty pleasures in order to obtain technical knowledge, is the one who will develop into an inventor. He works for the pure love of it, and something original may be confidently expected from him in time.

R. A. GREGORY.

(To be continued).

EXPLORATION OF THE HADRAMUT.

AT the last meeting of the Royal Geographical Society Mr. J. Theodore Bent gave an account of the archaeological tour recently made by him and Mrs. Bent in Southern Arabia. On account of the fanaticism of the people, only one European had previously been able to penetrate to the broad valley of the Hadramut, which runs for one hundred miles or more parallel to the south coast of Arabia, gathering in tributary valleys from north and south, and carrying their drainage to the sea at Saihut. Opposition to the expedition was offered, as in the case of Mr. Hirsch, by the British officials at Aden, but in spite of this the Bents, accompanied by the accomplished Indian surveyor, Imam Sharif, and by botanical and natural history collectors, travelled in safety without disguise, and, though there were some hostile appearances, without injury through a large tract of unmapped country.

The region they traversed consisted of three parts, the narrow coast strip or Sahil, backed by the high plateau or Akaba, and the Hadramut and other valleys on the north, which lies between the southern plateau and the high desert land farther north. The whole coast strip from Mekulla to Saihut was extremely arid, only fertilised in patches by occasional hot springs. No traces of antiquities were found along the coast. The plateau of

Akaba was ascended by the Wadi Howari, one of numerous short valleys which diversify the southern slope. The plateau presented the appearance of an unbroken plain with only a few flat-topped indications of a previously greater height to break its surface. This district was waterless except for tanks preserving precarious supplies of rain water along the paths. The highest point was found to be Haibel-gabrein, near the southern edge, its elevation being 5300 feet. The plateau was wandered over by a few Bedouins, and on its northern slope considerable numbers of frankincense trees occur, their produce being gathered not by the Bedouins but by Somalis, who come across in the season for that purpose. Where the plateau was trenched by the Hadramut valley the tributary valleys were found remarkably short and steep, cut out of the edge of plateau-like slices from a cake. All these valleys have their floors nearly on the same level as the main valley, and terminate at their heads in steep cliffs 700 or 800 feet high. Their appearance did not seem to justify the theory of water erosion, and Mr. Bent is inclined to consider them as lateral fjords excavated when the Hadramut was an arm of the sea. The rocks were exposed in steep cliffs of horizontally stratified red sandstone. The valley-bottoms are richly cultivated, thronged with villages shaded by palm groves, in effective contrast with the shadeless sterility of the plateau and the desert on either side. In this valley many archaeological finds were made, principally in the shape of Himyaritic monuments and inscriptions dating back, in some instances, to B.C. 300. The people of the part of Arabia visited formed four distinct classes. The wild tribes of Bedouins, scattered irregularly, living in isolated houses or caves, rear camels and do all the carrying work. Next are the Arabs proper, who dwell in towns, cultivate the surrounding lands, and engage in extensive trade, sometimes visiting India and the Straits Settlements. Thirdly, the Sayyids and Sherifs form a sort of aristocratic hierarchy, tracing their descent from the Prophet; they are the religious fanatics who object to the admission of foreigners. The last class is that of the slaves, all of African origin, acting as labourers, personal servants, and soldiers to the Sultans of the many independent tribes into which the other classes of the population are divided.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In connection with the visit of the Royal Agricultural Society to Cambridge next month, the University will bestow honorary degrees on a number of the high officers of the Society and others who have distinguished themselves in promoting agricultural science. The Duke of Devonshire, Chancellor of the University, is President of the Society, and will probably himself confer the degrees. The list of names submitted to the Senate includes H.R.H. the Duke of York, the Duke of Richmond and Gordon, Lord Cathcart, Sir John Thorold, Sir Dighton Probyn, Sir Nigel Kingscote, Sir John B. Lawes, Sir Joseph H. Gilbert, Mr. A. Peckover, the Lord Lieutenant of Cambridgeshire, and Mr. Albert Pell. The Master and Fellows of Trinity College have issued invitations to a banquet in the College Hall for June 26, at which the Prince of Wales, the Chancellor, and the recipients of honorary degrees, will be entertained.

WE learn from the *Scotsman* that two important draft ordinances were issued on May 14 by the Scottish Universities Commission. One of these deals with the matter of the regulations for the encouragement of special study in research and for the institution of Research Fellowships. The ordinance provides that the Senatus Academicus of each university may make regulations under which graduates of Scottish universities, or of other universities recognised for the purposes of the ordinance, or other persons who have given satisfactory proof of general education and of fitness to engage in some special study or scientific investigation, may be permitted such study or research in the university. The University Court in each university may establish Research Fellowships, which shall be open to research students only, and may set aside out of the General University Fund such sums as it may think fit to provide for stipends of Research Fellowships. The Court may also provide such sums as it may think fit in aid of the expenses of special research. Research students may be admitted to the degrees of Doctor of Science or of Doctor of Letters of the university in