do not appear to have been attended with similar improvements in the quality of the material as indicated by its chemical composition, for the highest quality of sheet gutta-percha which Prof. Abel himself had been able to find contained 12·7 per cent. of resinous matter and 5 per cent. of water. Much greater pains are no doubt taken to consolidate the material and express the water from the gutta-percha coatings of wire than in the manufacture of sheet gutta-percha. Nevertheless, that a considerable amount of inclosed water still remains is evidenced by the fact that in two samples of covered wire, submitted by the same manufacturers as lately as September and November last, the one contained 1·86 per cent., and the latter 3·97 per cent. of water. Little doubt now remains that the processes of "mastication" (to which gutta-percha is subjected for the removal of certain impurities and the production of a mechanically homogeneous material) favours oxidation, so that the destruction of some of the most valuable qualities of gutta-percha as an insulator depend upon the degree of completeness to which the mechanical impurities have been removed. An examination of *old* gutta-percha seems to show that, provided the material has been reduced to a compact condition, oxidation due to exposure to the air and light proceeds but slowly.

Dr. Miller also points out that mastication promoted the oxidation of *india-rubber*, and further experience has established the similarity of the two gums in this respect. The application of vulcanising to india-rubber was hailed as a most important step in submarine telegraphy; but although many chemists have made this same process of vulcanising a subject for study and investigation, it remains imperfectly understood even to the present day. The wire manufacturer had no difficulty in meeting the most important objection urged against the application of the vulcanising process (viz., the injury done to the conductor by the chemical action of the sulphur in the dielectric upon it) by availing himself of the fact that tin would not be equally affected, and so protecting the copper by the simple process of tinning. Still the tendency to an alteration, either in the chemical or mechanical structure of vulcanised india-rubber, exhibited by it when kept submerged in water, has developed serious elements of uncertainty in cables prepared by the vulcanising processes. Prof. Abel then proceeded to give some interesting illustrations drawn from his own personal experience of the uncertainty of our existing knowledge regarding the chemical and other conditions to be fulfilled in the application of vulcanising processes to the preparation of telegraph cables.

A number of half-mile lengths, for instance, of vulcanised telegraph cable—some for field service, others for firing broadsides on board ship—were found, after a period varying from eighteen months to three years, to have undergone considerable deterioration; the dielectric in some instances had become so porous that even the variations in the hygroscopic condition of the atmosphere on board ship, where the wires were placed between decks, caused decided differences in the results obtained with a particular battery power; and this alteration was not distributed uniformly over a length, the porosity in some instances extending along a few feet only, the adjacent portions being in very good condition; an inspection of a large quantity of the same sort of cable which had remained untouched in store showed precisely similar results.

The uncertainty attaching to this is still further illustrated by the fact that in armoured cables with multiple cores of this description some of the cores remain comparatively good, whilst the insulation of others had fallen off to a very great extent.

Scarcely less conflicting is the experience gained with cables prepared according to Hooper's system. This system consists in maintaining the inner portion of the india-rubber surrounding the conductor in an unvulcanised condition by means of a "separator," which contains a preparation of a metal possessing the power of arresting the passage of the sulphur beyond it during and subsequent to the application of the vulcanising process.

The deterioration due to the alteration of the india-rubber being caused by oxidation, the question naturally arises as to how the oxygen finds access to it? It must evidently find access to the interior of the dielectric *through the substance of the cable*—a view which is more than confirmed by the researches of Graham. That eminent chemist showed that solid india-rubber absorbed oxygen to an extent which showed the gas to be twice as soluble in it as in water at the ordinary temperature, and the comparatively greater priority of vulcanised india-rubber would favour this absorption. The oxidation of unvulcanised india-rubber being once established, the tendency to the absorption of oxygen by the external vulcanised india-rubber, and to its passage through the latter, must be promoted by the increased tendency to chemical change of and continual assimilation of oxygen by the inner portion, which thus acts like the vacuum by which Graham caused air very rich in oxygen to filter through a stout vulcanised india-rubber tube.

The efforts made from time to time to improve the insulation of cables, served until lately to clear the ground for future experiments, but of late important success seems to have been achieved in a direction where different experimenters (including Prof. Abel himself) had failed—that direction is towards paraffin, "a substance which during the last thirty years had passed from the obscure position of a chemical curiosity to the foremost rank amongst important chemical products." In 1875 Mr. Field, F.R.S., working in conjunction with Mr. Talling, the mineralogist, produced by means of a solvent, or by masticating the substances together, a black ozokerit-product with india-rubber, which appeared quite free from the brittleness which Matthiessen, who also had been at work here, failed to get rid of. This preparation in point of insulation and inductive capacity compares very favourably with india-rubber and gutta-percha, and would seem likely to prove very valuable for telegraphic purposes in the future.

Prof. Abel could only allude to the importance of chemical science in the proper management of batteries, a subject which, after the valuable paper read before the Society by Mr. Sivewright, "On Batteries and their Employment in Telegraphy," and the instructive discussions which it elicited, needed only to be named. Amongst other matters of importance where the telegraph engineer might derive great benefit from the fruits of applied chemistry, were the decay and preservation of telegraph poles, the preservation of fibrous materials used in constructing submarine cables, the production of points and the protection of cables against the deposition of vegetable or animal growth.

Prof. Abel then concluded his address by a final illustration of the manner in which the practical electrician may unexpectedly be brought face to face with problems which can be solved by a knowledge of chemistry and by that alone. Lieut.-Col. Stotherd, R.E., having pointed out certain defects in the permanency and difficulties connected with the testing of Abel's "phosphide" fuse, he (Prof. Abel) constructed another form of high tension fuse specially designed for submarine mining. The poles of this new fuse were 0·05 of an inch apart, in an insulating column consisting of Portland cement with sufficient sulphur to allow of its being melted and cast in a mould. Fuses manufactured in this way were supplied to different military stations, and after a time it was found that the average resistance of the fuses being 15,000 ohms, that of many of them had fallen as low as 300 or 400 ohms, and one or two had gone down even below 50 ohms. The cause of this at first sight inexplicable change in the stability of the fuse was traced by Mr. E. O. Brown to the existence in many of the cement pillars of very minute hair-line cracks or fissures extending sometimes right across the space between the inclosed small copper wires. The sulphur in the cement and the copper wire in presence of the air which had penetrated with the ever-concomitant moisture had set up a galvanic action which had formed one or more complete bridges, thereby short-circuiting the copper poles. Chemical knowledge, which unravelled this mystery at once, provided the remedy; platinum, upon which sulphur and air were powerless, replaced the copper, and the permanence of the fuse was secured.

A hearty vote of thanks to Prof. Abel was carried by acclamation, and it was decided that the address should be printed and circulated amongst the members.

SCHOLARSHIPS AND EXHIBITIONS FOR NATURAL SCIENCE AT CAMBRIDGE, 1877

THE following is a list of the Scholarships and Exhibitions for proficiency in Natural Science to be offered at the several Colleges and for Non-Collegiate Students in Cambridge during the present year:—

Trinity College.—One or more Foundation Scholarships of 100*l.*, and one Exhibition of 50*l.* The examination for these will commence in the first week of April.

St. John's College.—One of the value of 50*l.* per annum. There is a separate examination in Natural Science at the time of the annual College examination at the end of the academical year, in May; and Exhibitions and Foundation Scholarships ranging in value up to 100*l.* will be awarded to students who show an amount of knowledge equivalent to that which in Classics or Mathematics usually gains an Exhibition or Scholarship in the College.

King's College.—On Wednesday, April 4, 1877, and following days an Exhibition in Natural Science will be offered for competition. The Exhibition is worth about 90*l.* a year, and is tenable for three years, but not with any other Exhibition or Scholarship of the College.

Christ's College.—One or more in value from 30*l.* to 70*l.*, according to the number and merits of the candidates, tenable for three-and-a-half years, and for three years longer by those who reside during that period at the College.

Gonville and Caius College.—One of the value of 60*l.* per annum. The examination begins on the last Tuesday in the Lent term. College examinations are held annually in the Easter term for Medical and Natural Science Students who have passed the University previous examination, in Anatomy, Physiology, Physics, Chemistry, &c., at which prizes and Scholarships of the value of from 60*l.* to 20*l.* are awarded to members of the College of the first, second, and third year, on precisely the same conditions as those for other branches of learning. Examinations are also held, as vacancies occur, in Botany and Comparative Anatomy in its most general sense (including Zootomy and Comparative Physiology), for two Shuttleworth Scholarships, each of the value of 60*l.* per annum, and tenable for three years. The successful candidates for the Tancred Medical Studentships are required to enter at this College; these studentships are five in number, and the annual value of each is 100*l.* Information respecting these may be obtained from B. J. L. Frere, Esq., 28, Lincoln's Inn Fields, London.

Clare College.—One of the value of 60*l.* per annum, tenable for two years at least. The examination will be held on March 20.

Downing College.—One or more of the value of 60*l.* per annum. The examination will be on or about April 9.

Sidney College.—One of the value of 60*l.* The examination will be on March 20.

Emmanuel College.—One Foundation Scholarship of 70*l.*, tenable till the holder is of standing for the degree of B.A., and four Minor Scholarships (two of 70*l.*, and two of 50*l.*), tenable for two years, will be awarded. The examination will take place on March 20.

Non-Collegiate Students.—An Exhibition each year is given by the Clothworkers' Company, value 50*l.* per annum, tenable for three years. Examination about Christmas, open to Non-Collegiate Students who have commenced residence in the October term, and to any who have not commenced residence. Information to be obtained from the Rev. R. B. Somerset, Cambridge.

The subjects, it may be stated generally, are Chemistry, Physics, Geology and Mineralogy, Botany, Comparative Anatomy and Zoology, and Physiology; but for detailed information application must be made to the tutors of the respective Colleges.

Although several subjects for examination are in each instance given, this is rather to afford the option of one or more to the candidates, than to induce them to present a superficial knowledge of several. Indeed, it is expressly stated by some of the Colleges that good clear knowledge of one or two subjects will be more esteemed than a general knowledge of several. In some instances, as at Caius College, each candidate is required to furnish beforehand a list of the subjects in which he desires to be examined.

There is no restriction on the ground of religious denominations in the case of these or any of the Scholarships or Exhibitions in the Colleges or in the University.

Some of the Colleges do not restrict themselves to the number of Scholarships here mentioned, but will give additional Scholarships if candidates of superior merits present themselves; and other Colleges than those here mentioned, though they do not offer Scholarships, are in the habit of rewarding deserving students of Natural Science.

It may be added that Trinity College will give a Fellowship for Natural Science, once, at least, in three years, and that such a Fellowship will be given in the present year. The examination will take place at the end of September, and will be open to all Bachelors of Arts, Law, and Medicine of the University, of not more than three years' standing from their first degree. Application should be made to the Rev. Coutts Trotter, Tutor of Trinity. Most of the Colleges are understood to be willing to award Fellowships for merit in Natural Science equivalent to that for which they are in the habit of giving them for Classics and Mathematics.

OUR ASTRONOMICAL COLUMN

THE COMET OF 1812.—In view of the approaching return of the comet discovered by Pons on July 20, 1812, which beyond doubt, at the time of its visibility, was moving in an elliptic orbit with a period of about seventy years, it is not without interest to inquire into the particular circumstances of its track in the heavens, and distance from the earth and sun, under different assumptions, with regard to the time of the next perihelion passage. The case is a very different one to that of Halley's comet (which has a period only five or six years longer than that of the comet in question) at its last appearance in 1835, or even at the previous one in 1759. The semi-axis major of Halley's comet was already known with considerable precision, from this body having been observed at several returns to perihelion since the year 1456, and in 1835 an exceedingly close prediction of the date of the comet's arrival at its least distance from the sun was made, it is true, after most laborious calculation. Pons' comet of 1812 is not thus situated. So far, no previous appearance has been recognised, and we are, therefore, dependent entirely upon the observations made in 1812 for the determination of the length of the revolution, and hence of the epoch of its next return. Within what limits these observations admit of the period being assigned, has not perhaps as yet been fully examined, but it appears probable they will be wider than in the case of another comet of similar length of revolution, that discovered by Olbers on March 6, 1815, the perturbations of which were calculated for the present revolution by Bessel, who fixes the return to February, 1887, though the prediction may be materially in error.

From the great inclination of the orbit of Pons' comet to the plane of the earth's annual path, it is perhaps possible that with a fairly accurate prediction of its position, it might be detected with very powerful telescopes, no matter at what time of the year the perihelion passage falls, but such prediction being impracticable, it is desirable, as we have already remarked, to trace out the apparent path of the comet amongst the stars, on different hypotheses as to date of arrival at perihelion. At present we shall confine our remarks to the more favourable conditions under which it is possible for the comet to appear.

The nearest approach of the comet's orbit to that of the earth (0·185) occurs near the passage of the descending node, about $9\frac{3}{4}$ days before the arrival at perihelion, and the longitude of the descending node being in 73° 56′ for 1880, we may assume the perihelion passage to take place on December 15·0. In this case the comet would have the following track:—

	R.A.	N.P.D.	Distance from earth.
	°	°	
Nov. 5	223·8	32·9	0·787
,, 15	228·4	38·3	0·551
,, 25	236·3	52·7	0·316
Dec. 5	252·5	110·1	0·185
,, 15	283·0	157·0	0·356
,, 25	311·4	164·8	0·629

If the perihelion passage be taken eight days later, when the earth and comet would have about the same heliocentric longitude, with the latter body in perihelion, we shall have:—

	R.A.	N.P.D.	Distance from earth.
	°		
Oct. 24	231·3	29·6	1·181
Nov. 13	241·8	34·7	0·760
,, 23	251·4	40·1	0·529
Dec. 3	267·8	56·4	0·308
,, 13	293·9	110·7	0·223
,, 23	320·9	146·2	0·396
Jan. 2	336·9	155·8	0·656

Under such conditions it appears very improbable that the comet could escape observation. At its discovery in 1812 it was a diffused telescopic nebulosity, but towards the end of August it became visible to the unaided eye, and about the time of