feet above sea-level. The second is at La Joya, in the desert, altitude 4140 feet. The third is at the Observatory itself, altitude 8060 feet. The fourth is upon the side of the Misti, at an altitude of about 16,000 feet, and the fifth is upon the summit of the Misti, altitude 19,200 feet. The discoveries made at the Observatory are enumerated by Prof. Pickering. They include double stars, the "lakes" on Mars and the rapid changes in some of the canals and dark markings on the planet at the time of the melting of the southern snow-cap, the observations of changes of shape of Jupiter's satellites, which led to the conclusion that the outer satellites are not solid bodies, but dense swarms of meteorites, and pointed to a modification of Laplace's nebular hypothesis, to explain some of the difficulties inherent in it. Peculiar lunar formations have also been observed, and an explanation has been given of the bright streaks seen at the time of full moon. A new class of lunar rills has been found, winding and tapering like a terrestrial river-bed, and various facts have been determined with regard to what are called "variable spots" on the moon, which darken as the sun rises upon them, and fade out as it sets. Finally, the remarkable photograph of the spectrum of Nova Normæ, showing the star's constitution to be the same as that of Nova Aurigæ, was obtained at Arequipa. But only a small portion of the work of the Observatory is devoted to original research, the greater part of the time being taken up by routine work. Few observatories, however, can show a better record than that made at Arequipa during the three years of the Observatory's existence.

THE DIAMETERS OF SOME MINOR PLANETS.—Various attempts have been made to measure micrometrically the diameters of some of the larger asteroids, and also to determine them by photometric means, but the values obtained have never been very trustworthy. Prof. E. E. Barnard has now taken up the work, using the 36-inch of the Lick Observatory, and has already obtained some new results (*Astronomy and Astro-Physics*, May). So far, he has succeeded in directly measuring Ceres, Pallas, and Vesta, to which he assigns the following diameters:—

Ceres	...	599 ± 29 miles.
Pallas	...	273 ± 12 ,,
Vesta	...	237 ± 15 ,,

It will be seen from this that, contrary to the general belief, Ceres is the largest of the minor planets, and not Vesta. The values obtained by Argelander from a consideration of the relative light of the three foregoing asteroids and Juno, and those determined by Mr. E. J. Stone in 1867 from measures made by Herschel and Lamont, are as follows:—

		Argelander.		Stone.
Ceres	...	230 miles	...	196 miles.
Pallas	...	162 ,,	..	171 ,,
Juno	...	108 ,,	...	124 ,,
Vesta	...	275 ,,	...	214 ,,

Juno will soon be in a favourable position for observation, and Prof. Barnard will then apply the filar micrometer to its disc.

RETURN OF TEMPEL'S COMET.—A telegram from the Cape Town Observatory to Prof. Krueger (*Astr. Nach.* 3228) announces that Tempel's periodical comet (1873 II), the return of which was expected this year, was observed by Mr. Finlay on May 8. Its position was then R.A. $=356^\circ\ 20'\ 16''\cdot5$. P.D. $=94^\circ\ 51'\ 11''$. The object was circular, with a diameter of about one minute of arc and some central condensation, but no tail. Its brightness was about the eleventh magnitude, or fainter.

THE NEW ENGINEERING LABORATORY AT CAMBRIDGE.

THE new Engineering Laboratory was opened on Tuesday by Lord Kelvin, in the presence of a brilliant assemblage of University dignitaries. The building occupies the site of the old Perse Grammar School, and has been erected from the designs of Messrs. Marshall, Vicars, and Co. The exterior is of plain but not unattractive red brick, in the French *château* style. The main building is of three stories. The three chief rooms, one above the other, are on the left of the handsome entrance doorway, and overlook the grounds of Corpus Christi College. To the right of the doorway are offices, small class-rooms, and rooms for special researches. The electrical laboratory is on the ground-floor; above it is the drawing school, excellently lighted by large western windows; and at the top is the mechanical museum, lighted by dormer windows and a cupola. Behind, the fine old schoolroom has been altered by raising its floor, but the beautiful oaken-roof of sixteenth-century work has been preserved, and the room gains rather than loses by the slight change in its proportions. Here is the chief mechanical laboratory, and it is furnished with all needful apparatus for work on the strength of materials, mechanism, and applied mechanics. Beyond, in the old schoolyard an admirable steam and dynamo laboratory has been erected from Prof. Ewing's designs. Here are several types of experimental steam-engines, dynamos, and motors, and in another compartment the boilers and other heavy appliances. The laboratories are on one side contiguous to the Chemical Laboratory, and when some day the necessary extension of the Cavendish Laboratory takes place, they will also abut on the Physical department. The cost of the whole has been some £6000, of which about £5000 was contributed by friends of the University who desired to see engineering science properly established and equipped in Cambridge.

The Vice-Chancellor presided at the ceremony, and in a happy speech alluded to the doubts at first entertained by many worthy Cambridge men as to the wisdom of admitting purely professional studies among those fostered by the University. In medicine, however, in law, and lately in agriculture, the claims of applied and practical knowledge had been recognised, and the recognition had been amply vindicated. It was due to the enterprise and ability of Prof. Ewing that engineering had now overcome all opposition to its admission to rank as a scientific profession, the preliminary training for which might fitly be carried on within the academic precincts. Lord Kelvin, in declaring the Laboratory open, spoke of the direct evolutional connection between the theoretical mechanics and pure mathematics of his day at Cambridge, and the establishment of a department in which their principles found application and verification. The Laboratory was excellently furnished so far as it went, but £20,000 might well be spent, in the interest of the University as well as of engineering science, in extending and completing it. Prof. Kennedy spoke of the place of such laboratories in the training of the engineer. Engineering was taking its due rank as a liberal profession, and from Cambridge, the centre of mathematical and physical inquiry, future engineers would go out fitted for acquiring with sureness and rapidity the practical details of their work. Sir Frederick Bramwell told stories of his early experiences. Prof. Jebb, M.P., and Prof. Ewing, who was very warmly received, gave thanks to all who had wrought with the Engineering Laboratory Syndicate to bring about the result they were celebrating. The donors, past and future, the architect, builders, demonstrators and workmen received their meed of acknowledgment. After the ceremony a reception was held by Prof. and Mrs. Ewing, and nearly 800 of the members of the University and ladies inspected the rooms. The students acted as guides and demonstrators, and at the close it was on all hands acknowledged that the occasion had been one of the most successful of University functions in recent years.

SCIENCE IN THE MAGAZINES.

THOUGH articles on scientific subjects are sprinkled through this month's magazines, they contain little that is new or suggestive. In the *Quarterly Review* (No. 356) two interesting articles appear, one on "Shakespeare's Birds and Insects," and another on "Ocean Meadows." Much has been written concerning Shakespeare's natural history, but the conclusion to which an examination of the poet's writings inevitably leads is that he was not an observant student of animal and plant life. The *Quarterly* reviewer criticises Shakespeare's knowledge of these matters, pointing out that Chaucer wrote of what he saw and heard in the animal life about him with a sense of personal delight that convinces the reader of his familiarity with animate nature. So too with Spenser, and with Ben Jonson. But, says the reviewer, Shakespeare resembles neither of these. "He borrows from Gower and Chaucer and Spenser; from Drayton and Du Bartas and Lyle and William Browne; from Pliny, Ovid, Virgil, and the Bible; borrows, in fact, everywhere he can, but with a symmetry that makes his natural history harmonious as a whole, and a judgment that keeps it always moderate and passable." This indictment is supported by

uncontrovertible evidence, and concludes with the remark that Shakespeare's natural history "is commonplace when it is correct, and 'Elizabethan' when it is wrong." His method of handling animated nature has had a momentous effect on all succeeding poetry, so that poetry has sung of nature on Shakespeare's lines with an extraordinary fidelity. Groups of creatures which he misrepresented have been held up to reproach by poets since his time, and many others deserving of notice have been neglected. It is remarked, however, that "there is no necessity for a poet to be a naturalist in order to be true to nature; but there is the most urgent necessity that he should be in sympathy with nature and ready to acknowledge the good and beautiful, even if it should reach him in such questionable shapes as 'the deadly owle' or 'a full-blown toad that venom spits.'" In fact, owing to the great influence of Shakespeare's writings, the peculiarities of his sympathies and antipathies have been followed by almost all succeeding poets. His natural history was largely at fault; indeed, the reviewer asserts that he was sadly unsympathetic and unobservant. We conclude with a quotation which will come as a revelation to many people: "But taking men all round, ordinarily intelligent men of a country life (a town life was in Shakespeare's day what we should now call country life), was Shakespeare, as compared with these average individuals, an observer of nature?' The question is one liable to shock whose who have followed blind guides so long. The answer to it is liable to shock them more severely. No. Shakespeare was curiously unobservant of animated nature. He seems to have seen very little. Our authority for this is his own works, which, while they abound with beauties of fancy and imagination, are most disappointing to lovers of nature by (their errors apart) their extraordinary omissions."

Four important works on marine fauna and flora form the basis of an article in the *Quarterly Review* on "Ocean Meadows." In the course of the article, the reviewer refers to the necessity for making scientific investigations in the sea round our coasts, and shows the improbability of such work being furthered when those who hold high offices cannot appreciate its importance. In his words:—

"The minute animal life in turn furnishes food for shoals of fishes, and the importance of an inquiry into the whole life-history and seasonal occurrences of such organisms—the basis of the nutrition of marine life, as green plants are of terrestrial life—can scarcely be overrated. No such inquiry has ever been conducted in a serious scientific spirit in our seas by other than private investigators, unequipped with adequate resources for the proper study of the subject in its economic aspect. Our Fishery Boards concern themselves as little with this vital matter as they possibly can, Nor is this apathy surprising, when it is remembered that the present Government have appointed to the chairmanship of the Scottish Fishery Board an estimable gentleman, who possibly understands the 'branding' of herrings, but whose chief qualification for the post was a safe constituency. Yet, at the moment when this appointment was made, they had the opportunity, pressed upon them by a large body of scientific men, of choosing an eminent naturalist, whose claims as a student of the ocean are admitted by men of all nations to be unrivalled."

Almost every great advance in the study of the ocean has been made by this country, and though other countries are now competing with us, an opportunity will soon arise for us again to forge ahead.

"The proposed Antarctic expedition, for which a convincing case has been made out, can add to its usefulness by taking such an investigation in hand, not only in the Southern Seas but on its way to them. There is probably no region so fertile in the forms of pelagic life as the Southern Ocean, and an expedition which should not make the study of its vegetation one of its main objects had better stay at home. There is little fear of the subject being neglected in its widest aspects, since it is one of the professed 'aims which the promoters have in view,' to use the language of a prospectus. Botanists will have themselves to blame, and the public will have them to blame, if through their supine indifference this great and rich harvest of the ocean be not gathered in. In another respect the times are favourable. For many years this country lost its once eminent position in the study of the coast vegetation of the sea; but during the last six or seven years so much good and honest work has been done by a young and energetic band of observers that this position has been in a great measure retrieved. There are not lacking among our younger botanists men of skill in the use of the most recent methods of research, capable of meeting the Germans on their own field. It will be their fault if the naturalists of another nation forestall them in taking possession of not the least honourable part of our empire over the sea."

In the *Fortnightly*, Mr. Grant Allen, in an article entitled "The Origin of Cultivation," attempts to answer the question as to how early savages found out that plants would grow from seeds. His views are as follows:—"Cultivation began with the accidental sowing of grains upon the tumuli of the dead. Gradually it was found that by extending the dug or tilled area and sowing it all over, a crop would grow upon it all, provided always a corpse was buried in the centre. In process of time corpses were annually provided for the purpose, and buried with great ceremony in each field. By-and-by it was found sufficient to offer up a single victim for a whole tribe or village, and to divide his body piecemeal among the fields of the community. But the crops that grew in such fields were still regarded as the direct gifts of the dead and deified victims, whose soul was supposed to animate and fertilise them. As cultivation spread, men became familiarised at last with the conception of the seed and the ploughing as the really essential elements in the process; but they still continued to attach to the victim a religious importance, and to believe in the necessity of his presence for good luck in the harvest. With the gradual mitigation of savagery an animal sacrifice was often substituted for a human one; but the fragments of the animal were still distributed through the fields with a mimic or symbolical burial, just as the fragments of the man-god had formerly been distributed. Finally, under the influence of Christianity and other civilised religions, an effigy was substituted for a human victim, though an animal sacrifice was often retained side by side with it, and a real human being was playfully killed in pantomime."

Another origin about which Mr. Grant Allen makes suggestions is that of language. His remarks on this subject appear in *Longman's Magazine*, under the title "The Beginnings of Speech." The *Sunday Magazine* contains an article on "The Stuff we are Made of," by Dr. J. M. Hobson, in which some facts concerning amœbæ are stated, and also a sketch of the life and environment of Richard Jefferies, by the Rev. B. G. Johns. "Moon-Man or Moon-Maid" is the title of a short article by Mr. William Canton in *Good Words*. One of Cassini's drawings of the Gulf of Rainbows on the moon shows the form of a girl's head emerging from the rocks of the promontory of Heraclides on one side of the Gulf. M. Flammarion reproduced this drawing in *L'Astronomie* some time ago, and lamented that he had been unable to find the figure in any other drawing, or observe it himself. A few months later, however, M. Quénesset made out the form of a man's face at the spot to which attention had been drawn, and two hours later on the same evening M. Mabire, observing at the Juvisy Observatory, depicted "without a single stroke of imagination" the head of a woman in the same place. Mr. Canton's remarks refer to these two drawings, reproductions of which are given. The illustrations are curious, but not very instructive; they appeal more to the poetical than the scientific mind.

Mr. Henniker Heaton writes on "Telephones: Past, Present, and Future," in the *New Review*, his point of view being chiefly commercial. Sir Herbert Maxwell espouses the cause of tree-planting in London, and enumerates some of the trees suitable for town adornment. "The Imitative Functions, and their Place in Human Nature," is the theme of Mr. J. Royce in the *Century*. *Chambers's Journal* has several quasi-scientific contributions, among them being articles on amber, breath-figures and dust-photographs, and trees of the genus *Adamsonia*—Cream-of-Tartar trees. In addition to the magazines named in the foregoing, we have received *Scribner's*, the *Contemporary*, and the *Humanitarian*; but none of these contain articles calling for comment here.

THE SCIENCE OF VULCANOLOGY.[1]

VULCANOLOGY, or the science which deals with volcanoes and related phenomena, is a very important branch of geology—the science which treats of the earth's crust in general. Geology is yet hardly a century old; for before that time it consisted of little else than a collection of romantic hypotheses

[1] Introductory Address to a Course of Lectures on Vulcanology, delivered in the R. Univ. of Naples, by Dr. H. J. Johnston-Lavis.