— Prof. William Ferrel, recently connected with the signal service, has resigned his position, and removed to Kansas City, Mo.

— It is proposed to hold a meeting of the various scientific societies in Australia and New Zealand in 1888 (the one hundredth anniversary of the foundation of those colonies) upon the lines of the British association meetings, and to form an Australian association for the advancement of science with similar aims and objects. There are some twenty scientific societies in the Australasian colonies, and the number of members is between twenty-five hundred and three thousand. The sections proposed are, A, astronomy, mathematics, physics, and mechanics; B, chemistry and mineralogy; C, geology and paleontology; D, biology; E, geography; F, economic and social science and statistics; G, anthropology; H, medical and sanitary science; I, literature and the fine arts; J, architecture and engineering. In addition to the general and sectional meetings for reading and discussing papers, etc., it is proposed that excursions should be organized to various places of interest, such as the various mining districts, the Jenolan, Wambeyan, and other caves, the Blue Mountains, and similar places of interest to geologists and others. A preliminary circular signed by A. Liversidge of the University of Sydney has been issued.

— The September number of the *Political science quarterly* is largely devoted to economics. Prof. Henry C. Adams of Cornell has a learned article on 'American war financiering,' in which he criticises, from a theoretical stand-point, Secretaries Gallatin, Dallas, and Chase. Hon. Alfred E. Lee writes very clearly and strongly concerning 'Bimetallism in the United States,' showing in a way that even 'cheap money' advocates should be able to understand the real status and effect of our silver coinage. Prof. Richmond M. Smith of Columbia, who described the state bureaus of labor statistics in an earlier number of the *Quarterly*, now reviews favorably the first annual report of the national commissioner of labor. Dr. Bowen continues his interesting account of the conflict in Egypt, and Dr. C. B. Spahr discusses the 'Taxation of labor.' The department of book reviews is unusually full; and the notices of Gneist's 'Das Englische parlament' by Mr. Goodnow, of von Treitscke's 'Deutsche geschichte im neunzehnten jahrhundert' by Prof. Munroe Smith, and of a group of books on constitutional law by Professor Burgess, are of more than passing value.

— Dr. Shakespeare of Philadelphia has just returned from Europe, where for a year he has been investigating cholera. He has studied the disease in Spain, France, and Italy. During his absence, he also visited India to observe the disease in its home. As Dr. Shakespeare was sent out by the President, his report will be made to him, and forwarded to congress at its next session. From the little that we have been able to learn of Dr. Shakespeare's opinions, we infer that he agrees in the main with Koch and his German collaborators, and that he regards the comma bacillus as a diagnostic sign of the existence of cholera.

— The next meeting of the National academy of sciences will be held in Boston at the Institute of technology, to begin Tuesday, Nov. 9, at noon.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Education and the cost of living.

I AM glad that your timely comment on education and the cost of living (*Science*, viii. 313) seconds the proposed abolition of tuition-fees at Columbia college, in the case of graduate students, as 'a step in the right direction,' — one which 'we trust . . . will be taken, . . . and followed by other institutions.' It is but just to add, that Cornell, possibly first and alone among our great universities, has the honor of having already taken this step, 'lo, these many years;' that even in her days of poverty, as now in her prosperity, her library, laboratories, and lecture-rooms have been open to all college graduates who would make good use of them; and there has been no charge except for breakage and for supplies consumed.

But the Cornell experience apparently confirms your thought, that "more efficient and advantageous . . . is the foundation of numerous graduate scholarships and fellowships." We have had here such fellowships for more than two years; and, though there are only eight, their effect in raising the standard of both graduate and undergraduate work is, I think, quite marked.

If the proper business of a university be to improve the community's intellectual and educational ideals by developing in young people that have already some general culture the power of independent, well-directed investigation, of course the presence of earnest graduate students can hardly be too much encouraged. J. E. OLIVER.

Cornell university, Oct. 11.

The genesis of the diamond.

I send you the following abstract of a paper read by me at the Birmingham meeting of the British association for the advancement of science, September, 1886, in the hope that it may interest your readers.

The discovery of diamonds at Kimberley, South Africa, has proved to be a matter, not only of commercial, but of much geological interest. The conditions under which diamonds here occur are unlike those of any other known locality, and are worthy of special attention.

The first diamond found in South Africa was in 1867, when a large diamond was picked out of a lot of rolled pebbles gathered in the Orange River. This led to the 'river-diggings' on the Orange and Vaal rivers, which continue to the present time.

In 1870, at which time some ten thousand persons had gathered along the banks of the Vaal, the news came of the discovery of diamonds at a point some fifteen miles away from the river, where the town of Kimberley now stands. These were the so-called 'dry diggings,' at first thought to be alluvial deposits, but now proved to be volcanic pipes of a highly interesting character. Four of these pipes or necks, all rich in diamonds, and of similar geological structure, were found close together. They have been proved to go down vertically to an unknown depth, penetrating the surrounding strata.

The diamond-bearing material at first excavated was a crumbling yellowish earth, which, at a depth of about fifty feet, became harder and darker, finally acquiring a slaty blue or dark green color and a greasy feel, resembling certain varieties of serpentine. This is the well-known 'blue ground' of the diamond miners.

It is exposed to the sun for a short time, when it readily disintegrates, and is then washed for its diamonds. This blue ground has now been penetrated to a depth of six hundred feet, and is found to become harder and more rock-like as the depth increases.

Quite recently, both in the Kimberley and DeBeers mines, the remarkable rock has been reached which forms the subject of the present paper. The geological structure of the district, and the mode of occurrence of the diamond, have been well described by several observers.

As Griesbach, Stow, Shaw, Rupert Jones, and others have shown, the diamond-bearing pipes penetrate strata of carboniferous and triassic age, the latter being known as the Karoo formation.

The Karoo beds contain numerous interstratified sheets of dolerite and melaphyr, also of triassic age, the whole reposing upon ancient mica schists and granites. The careful investigations of Mr. E. J. Dunn demonstrate that the diamond-bearing pipes enclose fragments of all these rocks, which fragments show signs of alteration by heat. Where the pipes adjoin the Karoo shales, the latter are bent sharply upwards, and the evidence is complete that the diamond-bearing rock is of volcanic origin and of post-triassic age.

The diamonds in each of the four pipes have distinctive characters of their own, and are remarkable for the sharpness of their crystalline form (octahedrons and dodecahedrons), and for the absence of any signs of attrition. These facts, taken in connection with the character of the blue ground, indicate, as Mr. Dunn has pointed out, that the latter is the original matrix of the diamond.

Maskelyne and Flight have studied the microscopical and chemical characters of the blue ground, and have shown that it is a serpentinic substance containing bronzite, ilmenite, garnet, diallage, and vaalite (an altered mica), and is probably an altered igneous rock, the decomposed character of the material examined preventing exact determination of its nature. They showed that the diamonds were marked by etch figures analogous to those which Prof. Gustav Rose had produced by the incipient combustion of diamonds, and that the blue ground was essentially a silicate of magnesium impregnated with carbonates.

The blue ground often contains such numerous fragments of carbonaceous shale as to resemble a breccia. Recent excavations have shown that large quantities of this shale surround the mines, and that they are so highly carbonaceous as to be combustible, smouldering for long periods when accidentally fired. Mr. Paterson states that it is at the outer portions of the pipes where the blue ground is most heavily charged with carbonaceous shale that there is the richest yield of diamonds.

Mr. Dunn regards the blue ground as a decomposed gabbro, while Mr. Hudleston, Mr. Rupert Jones, and Mr. Davies regard it as a sort of volcanic mud. Mr. Hudleston considers that the action was hydrothermal rather than igneous, the diamonds being the result of the contact of steam and magnesian mud under pressure upon the carbonaceous shales, and likens the rock to a 'boiled plum-pudding.'

The earlier theories as to the origin of the diamond have, in the light of new facts, quite given way to the theory that the diamonds were formed in the matrix in which they lie, and that the matrix is in some way of volcanic origin, either in the form of mud, ashes, or lava.

The exact nature of this matrix becomes, therefore, a matter of great interest. The rocks now to be described are from the deeper portions of the DeBeers mine, and were obtained through the courtesy of Mr. Hedley. They are quite fresh, and less decomposed than any previously examined. Two varieties occur, — the one a diamantiferous, the other free from diamonds, — and the lithological distinction between them is suggestive. The diamantiferous variety is crowded with included fragments of carbonaceous shale, while the non-diamantiferous variety is apparently free from all inclusions, and is a typical volcanic rock.

Both are dark, heavy, basic rocks, composed essentially of olivine, and belong to the group of peridotites. Both are of similar structure and composition, differing only in the presence or absence of inclusions. The rock consists mainly of olivine crystals lying porphyritically in a serpentinic ground-mass.

The olivine is remarkably fresh, and occurs in crystals which are generally rounded by subsequent corrosion. The principal accessory minerals are biotite and enstatite. The biotite is in crystals, often more or less rounded, and sometimes surrounded by a thin black rim, due to corrosion. Similar black rims surround biotite in many basalts. The biotite crystals are usually twinned according to the base. The enstatite is clear and non-pleochroic. Garnet and ilmenite also occur, the latter often partly altered to leucoxene. All these minerals lie in the serpentinic base, originally olivine. This rock appears to differ from any heretofore known, and may be described as a saxonite porphyry.

The diamond-bearing portions often contain so many inclusions of shale as to resemble a breccia, and thus the lava passes by degrees into tuff or volcanic ash, which is also rich in diamonds, and is more readily decomposable than the denser lava.

It seems evident that the diamond-bearing pipes are true volcanic necks, composed of a very basic lava associated with a volcanic breccia and with tuff, and that the diamonds are secondary minerals produced by the reaction of this lava, with heat and pressure, on the carbonaceous shales in contact with and enveloped by it.

The researches of Zirkel, Bonney, Judd, and others, have brought to light many eruptive peridotites, and

Baubree has produced artificially one variety (lherzolite) by dry fusion, but this appears to be the first clear case of a peridotite volcano with peridotite ash.

Perhaps an analogous case is in Elliot county, Kentucky, where Mr. J. S. Diller has recently described an eruptive peridotite which contains the same accessory minerals as the peridotite of Kimberley, and also penetrates and encloses fragments of carboniferous shale, thus suggesting interesting possibilities.

H. CARVILL LEWIS.

The eccentricity theory of the glacial period.

I desire to add a supplementary note to my letter of Aug. 16, published in the issue of *Science* for Aug. 27.

In that letter I called attention to the contrast between the northern and the southern hemisphere in respect of glaciation, as tending to show, that, other things being equal, a climate of means (mild winters and cool summers) is more favorable to the accumulation of snow and ice than a climate of extremes (cold winters and hot summers). The bearing of this proposition upon the eccentricity theory is pointed out in my letter.

I now wish to call attention to another well-known geographical fact, which seems to confirm the conclusion that glaciation is favored by a climate of means rather than by a climate of extremes. I refer to the altitude of the snow-line in torrid, temperate, and frigid zones respectively. At the equator the snow-line falls below the annual isothermal plane of 32° F.; while, as we recede from the equator, the snow-line rises above the plane of 32°. So far does the snow-line rise above the isothermal plane of 32°, as we go polewards, that, while the latter plane reaches the sea-level not far from 60° latitude, it has been doubted whether in the northern hemisphere the snow-line anywhere reaches the level of the sea. According to J. D. Forbes, "the mean temperature at the snow-line near the equator is 34.7°; in the temperate zone it is 25.3°; in the arctic regions, about 21°" (Johnston, *Physical atlas of natural phenomena*, Edinburgh and London, 1856, p. 33). While all such numerical statements of the temperature of the snow-line in different latitudes can be considered only rough approximations, there can be no doubt of the general law that (apart from local abnormalities) the temperature of the snow-line falls as we go from the equator towards the poles. Now, it is also true that the annual range of temperature increases from the equator to the poles. At the snow-line near the equator, the extreme summer temperature is but little above the freezing-point; while at the snow-line in the arctic regions, though the mean temperature for the year falls several degrees below freezing-point, the extreme summer temperature rises far above it. The comparison of the zones of climate leads, accordingly, to the same conclusion as the comparison of the northern and southern hemispheres. The existence of perpetual snow is shown by both comparisons to depend less upon cold winters than upon cool summers.

A very simple *a priori* consideration suggests the probability of the same conclusion which we have drawn from geographical facts. It seems probable, *a priori*, that extreme winter cold cannot greatly increase the amount of snow-fall. So long as the temperature of any place keeps below 32°, the precipitation will be all in the form of snow; and this will be the case when the temperature is but little below 32°, as truly as when it falls far below zero.

Cooling a mass of air from 32° to a lower temperature can produce but little additional precipitation, since the maximum vapor tension at 32° is very little, and the change of maximum vapor tension corresponding to changes of temperature in the lower part of the thermometric scale is very slight. The influx of warm and moist air bearing supplies of vapor is not favored by extreme winter cold, since such extreme cold tends to increase barometric pressure over the area affected. On the other hand, every degree that the summer temperature rises above 32° shows an effective increment of the melting-power of the summer sun. The inference would seem to be justified, that, in any place where the annual mean temperature is below or not much above 32°, the more nearly the extreme summer and winter temperatures approach the annual mean, the greater will be the tendency (other things being equal) to the accumulation of perpetual snow. This *a priori* inference seems to be in exact accord with the geographical facts referred to in this and in my former letter.

WILLIAM NORTH RICE.

Wesleyan university, Oct. 8.

The theory of utility.

In connection with the suggestive article in *Science* of Oct. 1, on 'Launhardt's Mathematical economics,' I would like to offer a new theory of utility, or, rather, to discuss it from a new standpoint, and indicate what I consider to be the error in Jevons's main premise.

Utility, or usefulness, is the satisfying of desires. Desires are always in the present, though many, perhaps the most of them, have a prospective nature. Usefulness is not the capacity or capability of being useful: it is the state or quality of *being* useful. It involves, not a possible, but an actual satisfying of desires: e.g., on a certain day a loaf of bread would have possessed utility for Robinson Crusoe in satisfying his hunger; a second loaf would have possessed utility, not in satisfying the hunger of the morrow, but in satisfying his desire to have the possible wants of the future provided for.

If utility be defined as a capacity to serve man or to satisfy his desires, and by this is meant something quite different from the actual satisfying, it serves no purpose of distinction, for with this definition, when affirming utility to be an attribute of any thing, we must always add, 'under certain circumstances;' and there is probably not a thing in existence but what, under certain circumstances, possesses this capacity.

The confusion prevailing as to the nature of utility has arisen from the fact, that, in discussions upon the subject, the provident trait in man's character has been entirely neglected; for from this trait spring desires which are, indeed, of a prospective nature, but whose satisfaction involves utility as indubitably as does the satisfaction of his physical needs.

Utility being of the present moment, time is not one of its dimensions, as the theory of 'final degree of utility' necessarily presupposes. When Jevons ('Theory of political economy,' p. 51) declares that "utility may be treated as a *quantity of two dimensions*, — one dimension consisting in the quantity, and another in the intensity of the effect produced upon the consumer," — it is clear that the supposed dimension of quantity does not have reference to the