

SCIENCE.

FRIDAY, MARCH 28, 1884.

COMMENT AND CRITICISM.

THE University of Edinburgh is making arrangements to celebrate, on the seventeenth day of April next, the three hundredth anniversary of its foundation, by an academic assembly, to which the chief institutions of learning throughout the world are invited. Several American colleges are to be represented. With reference to this tercentenary, Sir Alexander Grant, the principal, has just published two stout octavo volumes, in which 'The story of the University of Edinburgh' is elaborately told. The volumes are rich in illustrations of all the concurrent influences which have given renown to the youngest and strongest of the Scotch institutions. The rise of each important department of instruction is told, and the lives of all the more distinguished professors are briefly given.

Among the natural sciences, medicine has been the one most encouraged in Edinburgh, although it must be remembered that much of the medical reputation of the city is due to the peculiar arrangements by which medical men not connected with the university give instruction, and prepare young men for medical graduation. 'Extra-mural' instruction is the term employed. Nevertheless, the roll of university professors includes the name of Charles Bell, of whom the story is told, that, when he visited the class-room of Roux in Paris, Roux dismissed the class, saying, 'Sufficient, gentlemen: you have seen Charles Bell.' Another university professor was Sir James Y. Simpson, whose bold introduction of chloroform as an anaesthetic is world-renowned. When a Scotchman was presented at the court of Denmark, the king said, 'You come from Edinburgh? Ah! Sir Simpson was of Edinburgh.' Simpson himself said he was more interested

in having delivered a woman without pain than in having been made physician to the queen. At an earlier date the fame of William Cullen was wide-spread. Among the teachers of non-medical sciences, the names of Black, John Playfair, Robert Jameson, David Brewster, Edward Forbes, James D. Forbes, and Wyville Thomson are those which come first to mind; while in mental and moral science the Scotch philosophers, Dugald Stewart, Thomas Brown, and Sir William Hamilton, are not likely to be forgotten. It sounds strange enough in these days to read that Thomas Carlyle thought himself ill-used because he could not get the appointment of practical astronomy and astronomer royal in 1834. Instead came Thomas Henderson, who won renown as 'the first discoverer of our distance from a fixed star.' We do not name any of the living professors, and we pass without mention many famous men who are gone; but what we have said suggests the doctrine, which cannot too often be repeated in this country, that the standing of a university depends upon illustrious teachers. The world of scholars, no longer united under the sovereignty of the pope, but loyal to the higher sovereignty of truth, will with one accord extend its congratulations to the great modern foundation of Scotch learning, and will rejoice that in its three-hundredth year it has reached its greatest numerical expansion, with increasing devotion to all that is noble in science and education.

THE reports of the U. S. signal-office show that there were at Cincinnati, during last February, four clear days, three fair days, one cloudy, and *twenty-one* on which rain or snow fell; and that the total precipitation was 8.87 inches. The following figures give the precipitation in inches during February of each year since 1870: 1871, 2.27; 1872, 1.67; 1873, 3.76; 1874, 5.91; 1875, 1.83; 1876, 2.92:

1877, .67; 1878, 2.33; 1879, 2.22; 1880, 4.50; 1881, 4.95; 1882, 7.04; 1883, 8.22; 1884, 8.87. We hazard nothing in asserting, that it does not lie within human ability to arrest such mighty storms as occurred in 1883 and 1884: and it may fairly be questioned whether the ingenuity of man can devise means to prevent the wide-spread and destructive floods which must follow such a volume of water as then fell; whether any extension of forests, or system of catch-basins or reservoirs, could possibly retain or mitigate to any considerable extent such general and overwhelming floods. A system of artificial lakes might indeed be at such times a serious element of danger; for, if one of them should break its restraining banks, its accumulated waters would be likely to carry away others, and then the waters, suddenly let loose, would do damage of which we have had a few frightful examples on a small scale.

THE demands of progressive agriculture for a more substantial scientific basis are just now beginning to find definite expression in the Dominion of Canada. From the known attitude of certain members of the government, from the recent examination of experts before a special House committee at Ottawa, and from the general expressions of those who have a direct interest in the question, it is apparent that a keen sense of the utility of experiment-stations is now developing a movement, which, it is to be hoped, will secure for the Dominion one or more much-needed stations, founded upon the European idea of their utility from a scientific stand-point, and from that of the practical application of acquired results.

THIS season promises to be one of unusual activity in the observation and study of tornadoes. In response to an invitation from the signal-service, a considerable number of tornado reporters is secured; and the first fruit of their labors has just appeared with most praiseworthy promptness in the form of a set of four preliminary charts illustrating the recent numerous and destructive tornadoes in the southern states on Feb. 19. Further investigation is

needed before a final account of these terrible storms is prepared; but it is shown by these charts, that over fifty tracks of tornado-action have been reported for Feb. 19, between seven in the morning and midnight, all occurring within a cyclonic area, and from three to seven hundred miles south-south-east of the centre of low pressure. As the broad cyclone moved forward, its centre passing from Illinois to Lake Huron, the tornado district on its southern edge had a similar advance across the southern states. The cyclone was peculiar in showing a long, trough-like barometric depression, and in presenting notably strong contrasts of temperature between its south-eastern and north-western sides. The tornadoes were all developed within the district occupied by warm southerly winds, somewhat in advance of the cold north-westerly winds; but they moved, without exception, in a north-easterly direction. Their destructive action was most severe in eastern Alabama, northern Georgia, and centrally across the Carolinas. Rough estimates place the value of property destroyed at between three and four million dollars; the loss of life, at about one thousand; the wounded, at more than double that number; while the homeless and destitute people are reported to count from fifteen to twenty thousand, many of whom are in a starving condition. About ten thousand buildings are said to be destroyed, and domestic animals were killed in great numbers. It hardly need be urged, that the possibility of giving some warning of immediate danger before such storms warrants the fullest and most careful investigation of all their attendant conditions.

In preparation for this work, the 'tornado circulars,' issued by the signal-service to promote the accumulation of record and statistics of these destructive storms, have now reached the number of twenty. The most considerable of the later ones is No. 16, which contains, in all, two hundred and three questions or directions designed to aid in the precise description of tornadoes and the conditions of their formation: these are arranged under several head-

ings, addressed to observers on the immediate track, or more than ten miles from it; and, if carefully read, they will serve as good training for those who desire to take part in the investigation of these most disastrous upsets of the atmosphere. Circular 18 relates to observations to be made 'concerning the presence of electricity in tornadoes,' and asks thirty-two questions to this end. It is to be hoped that all persons living in the tornado districts of the country, and desiring to take part in the work as volunteer observers, will apply to the chief signal-officer for circulars of instructions.

It is worth mentioning, that the single waterspout recorded in the supplement to the pilot-chart of the North Atlantic for March occurred on Feb. 19, eighty miles east of Charleston, where it struck the schooner *Three sisters*, "carrying away main gaff, mainsail and foresail, and flattening in the after-hatches." This is evidently connected with the group of tornadoes above described.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible.*

Law connecting physical constants.

It may be of interest to some of your readers to know how the two formulæ published in the advertising columns of *Science*, No. 54, can be derived from the magnetic theory of molecular cohesion.

The work necessary to separate completely the particles of a body occupying the unit of volume can easily be calculated if we know the original attraction between every two particles, and its rate of change during expansion. For small magnetized spheres, this work is equal to the resultant attraction across the unit of surface. The latter, moreover, is necessarily equal to the pressure which the particles keep up by their incessant motion; which, again, is shown, by a well-known dynamical theorem, to be equal to the continued product of the coefficients of expansion and of resilience and the absolute temperature. This product is therefore finally the mechanical equivalent of the internal latent heat of the unit of volume of a liquid.

The theory does not apply to such liquids as water, in which, at low temperatures, a molecular re-arrangement is evidently going on; but in general, the higher the temperature, the more closely is the law fulfilled. The grouping of the atoms, and their vibration within the molecule, recently treated by Professor Eddy of Cincinnati, produce in the most unfavorable cases a variation of about thirty per cent from the theory: nevertheless, the general agreement is too great to attribute to chance, and becomes almost perfect when the causes alluded to are considered. The average value of the latent heat for ordinary liquids may be

shown to be about 1.2 times greater than for simple substances.

The molecules of all liquids appear to be very close together, notwithstanding the common prejudice that they are far apart; and, taking into account the comparative shortness of their free path, the coefficients alluded to may be obtained approximately by processes of ordinary differentiation, while their rate of change as the temperature increases can be determined as accurately as by actual observation.

The latent heat is found to vary inversely, the coefficient of expansion almost directly, as the free path of the molecule; and their continued product with the molecular weight is therefore nearly, but not quite, constant. The average value is about eight and a half; and any slight variations from this average are accounted for by the complete formula.

With these hints, and remembering that the inductive attraction between two small magnets varies as the seventh power of the distance inversely, while their normal attraction is inversely as the fourth, any mathematician familiar with the principles of physics may verify the laws already enunciated, and deduce others of equal importance in the same way.

The difference, for instance, between the specific heats in the state of liquid and vapor, is evidently the derivative of any true expression for the latent heat; and the critical temperature is found by supposing the latent heat equal to zero. The relations between all these quantities are represented with a remarkable degree of approximation.

The magnetic theory of cohesion promises to be, in molecular physics, what the law of universal gravitation has proved to be in astronomy. While carrying on the development as rapidly as possible myself, I would urge others, independently, to do the same, in the belief that this theory affords a most magnificent field, both for work and for discovery.

HAROLD WHITING.

Cambridge, March 17.

Relics in Ventura county, Cal.

Rincon Creek, fourteen miles west of San Buenaventura, is the dividing-line between Ventura and Santa Barbara counties. Where this creek flows into the ocean, at least a hundred acres are covered with shells, bones, fish-scales, and other kitchen debris of the Indians, who have lived here from time immemorial. The creek, which is fed by mountain springs, afforded good water; the ocean yielded fish and mollusks; while the foot-hills and mountains furnished wild game. A large variety of mollusks are still found at this point, and the shell-heaps indicate their great abundance in past time. Edible clams especially abounded; as *Pachydesma crassatelloides*, *Tapes staminea*, *T. diversa*, also *Mytilus californianus*.

Rincon Point was doubtless long a favorite resort for the early race that inhabited this coast. In one spot I found human bones, a few years since, which were in a semi-fossil state. They had been buried on the brow of a high bluff overlooking the sea, and were about four feet below the surface. One skull, that of an aged person, was perforated at the apex. The perforation seems to have been made by a sharp instrument, and some time before death, but for what purpose it is difficult to say. In another spot on the mesa, and three hundred yards from the ocean, occurred a burial-place in which the skeletons were reduced to an impalpable dust. In this dry soil and climate it must have required centuries for them to decay. In this place I found many 'sinkers' from three to twelve inches long, carved from sandstone, limestone, etc. They were from three-fourths of an