mention only incidentally as the present conference does not deal with education in the ordinary sense of the word.

It will not be suspected that I wish to make physiologists of all the world. It would be as reasonable to accuse an advocate of the "three R's" of a desire to make an orator, an author, and a mathematician of everybody. A stumbling reader, a pot-hook writer, and an arithmetician who has not got beyond the rule of three, is not a person of brilliant acquirements; but the difference between such a member of society and one who cannot either read, write, or cipher is almost inexpressible; and no one nowadays doubts the value of instruction, even if it goes no further.

The saying that a little knowledge is a dangerous thing is, to my mind, a very dangerous adage. If knowledge is real and genuine, I do not believe that it is other than a very valuable possession, however infinitesimal its quantity may be. Indeed, if a little knowledge is dangerous, where is the man who has so much as to be out of danger?

If William Harvey's life-long labours had revealed to him a tenth part of what may be made sound and real knowledge to our boys and girls—he would not only have been what he was, the greatest physiologist of his age, but he would have loomed upon the seventeenth century as a sort of intellectual portent. Our little knowledge would have been to him a great, astounding, unlooked-for vision of scientific truth.

I really see no harm which can come of giving our children a little knowledge of physiology. But then, as I have said, the instruction must be real, based upon observation, eked out by good explanatory diagrams and models, and conveyed by a teacher whose knowledge has been acquired by study of the facts, and not the mere catechismal parrot-work which too often usurps the place of elementary teaching.

It is, I hope, unnecessary for me to give a formal contradiction to the silly fiction, which is assiduously circulated by fanatics who not only ought to know, but do know, that their assertions are untrue, that I have advocated the introduction of that experimental discipline which is absolutely indispensable to the professed physiologist, into elementary teaching.

But while I should object to any experimentation which can justly be called painful, for the purpose of elementary instruction, and while, as a member of a late Royal Commission, I gladly did my best to prevent the infliction of needless pain for any purpose, I think it is my duty to take this opportunity of expressing my regret at a condition of the law which permits a boy to troll for pike, or set lines, with live frog bait, for idle amusement; and, at the same time, lays the teacher of that boy open to the penalty of fine and imprisonment if he uses the same animal for the purpose of exhibiting one of the most beautiful and instructive of physiological spectacles, the circulation in the web of the foot. No one could undertake to affirm that a frog is not inconvenienced by being wrapped up in a wet rag, and having his toes tied out; and it cannot be denied that inconvenience is a sort of pain. But you must not inflict the least pain on a vertebrated animal for scientific purposes (though you may do a good deal in that way for gain or for sport) without due licence of the Secretary of State for the Home Department, granted under the authority of the Vivisection Act.

So it comes about, that in this present year of grace 1877, two persons may be charged with cruelty to animals. One has impaled a frog, and suffered the creature to writhe about in that condition for hours; the other has pained the animal no more than one of us would be pained by tying strings round his fingers, and keeping him in the position of a hydropathic patient. The first offender says, "I did it because I find fishing very amusing," and the magistrate bids him depart in peace; nay, probably wishes him good sport. The second pleads, "I wanted to impress a scientific truth, with a distinctness attainable in no other way, on the minds of my scholars," and the magistrate fines him five pounds.

I cannot but think that this is an anomalous and not wholly creditable state of things.

## OUR ASTRONOMICAL COLUMN

D'ARREST'S COMET.—M. Leverrier notifies the discovery of the periodical comet of D'Arrest by M. Coggia at Marseilles, on the 8th inst., nearly in the position assigned by M. Leveau's calculations. It was also detected at Florence by M. Tempel, on the 10th.

The comet was discovered by the late Prof. D'Arrest at Leipsic on June 27, 1851, and observed till October 6. The elliptical character of the orbit was pointed out by the discoverer early in August, and his conclusions were verified by the calculations of Vogel and Villarceau shortly afterwards, the latter astronomer commencing, while the comet was yet under observation, a series of elaborate computations of the effect of planetary perturbations upon its motion, which were continued by him until taken up by Leveau. With the aid of Villarceau's ephemerides the comet was detected on its ensuing return to perihelion at the Royal Observatory, Cape of Good Hope, and observed from December 5, 1857, to January 18, 1858. Oudemans, in a memoir published by the Royal Academy of Sciences at Amsterdam in 1854, had also carried forward the elements to this appearance, his results indicating that while the normal positions of 1851 were best represented by a mean motion which would bring the comet to perihelion again on December 5, 1857, there yet remained an uncertainty to the extent of eighty-five days in the length of the revolution. Villarceau, in the *Comptes Rendus de l'Académie des Sciences*, 1852, December 6, considered the period fixed within narrower limits, one of his sets of elements assigning November 28, 1857, for the next perihelion passage, on which day the Cape observations show that it actually occurred. At the second return in the spring of 1864 the comet was not observed, and a very heavy work was involved in the preparation of an ephemeris for 1870, owing to the large perturbations due to the action of Jupiter in 1861, the comet having in April of that year approached the planet within 0·36 of the mean distance of the earth from the sun, and the two bodies remaining in proximity for a considerable time; it was therefore necessary to determine the effect of this near approach to the most powerful of the planets with every possible precision, a long work successfully accomplished by Leveau, who found on continuing the calculation of the perturbations of Jupiter, Saturn, and Mars, to June, 1870, the following material changes in the elements at the perihelion passage in November, 1857.

| | ° ′ | | ° ′ |
|---|---|---|---|
| Long. of Perihelion | − 4 32 | Angle of Eccentricity | − 1 52 |
| ,, Ascend. Node | − 2 12 | Mean anomaly ... | + 10 10 |
| Inclination ... ... | + 1 43 | Mean motion ... | − 15″·82 |

So that the period of revolution was lengthened sixty-eight days, the comet arriving at perihelion on September 22, 1870. The effect of these perturbations was to alter the geocentric place at this time, no less than 14°·6 in right ascension, and 7°·6 in declination. At all three returns the comet has been a faint object, and it was particularly so in 1870, when it was, nevertheless, sufficiently observed, Prof. Julius Schmidt, profiting by his favourable position at Athens, to follow it until nearly the end of the year.

The following are the dimensions of the orbit of D'Arrest's comet in the present year, according to the elements of Leveau.

| | | | |
|---|---|---|---|
| Semi-axis major ... | 3·54139 | Perihelion distance | 1·31809 |
| ,, minor ... | 2·75651 | Aphelion ,, ... | 5·76469 |
| Semi-parameter ... | 2·14559 | Eccentricity ... | 0·6278048 |

The period of revolution is 2434·2 days, or 6·664 years, therefore nearly identical with that of Biela's comet up to 1852. The comet passed its perihelion on May 10. It will not arrive at its least distance from the earth until October 20, but the theoretical intensity of light diminishes from the present time, indeed has been on the decrease since the middle of May; the comet may be a test object on the borders of the constellations Eridanus and Orion in September and October.

It is probable that this comet had been revolving in its present restricted orbit for many years previous to its discovery in June, 1851. It certainly does not furnish a parallel case to that of Brorsen's comet, which was detected at its first perihelion passage after the attraction of the planet Jupiter had impressed upon it the actual form of orbit in May 1842. The nearest approach of D'Arrest's comet to Jupiter during the revolution immediately preceding discovery, took place at the end of September 1849, when the distance was 1·136.

THE BINARY STAR *a* CENTAURI.—Mr. Ellery communicates to the Royal Astronomical Society recent measures of this, the finest and most interesting of all the revolving double-stars. Taking means the following epochs result from the Melbourne measures:—

| | | | | |
|---|---|---|---|---|
| 1876·72 | Position | 51°·1 | Distance | 4″·3 |
| 1877·25 | ,, | 69°·1 | ,, | 3″·13 |

Mr. Maxwell Hall (NATURE, vol. xv. p. 510) supplies the following:—

| | | | | |
|---|---|---|---|---|
| 1877·14 | Position | 64°·4 | Distance | 3″·3 |

Mr. Ellery states that the distance in 1862 was 10″, but this must be an over-estimate with the meridian instrument; a mean of seventy micrometrical measures by Mr. Eyre B. Powell at Madras, gives for 1862·2, a distance of only 6″·79, a result no doubt entitled to great confidence. The first *minimum* of distance appears to have occurred in 1856. Capt. Jacob's measures for 1856·27 giving 3″·89, and a maximum of about 10″ followed in 1868-70. It is to be hoped that the star will now be frequently measured micrometrically with all possible precision, though the brilliancy and closeness of the components may render such measures difficult. A practised computer should be able to throw some light on the real nature of the orbit from the data already in our possession, but the continued regular measurement of the star at this critical period cannot fail to be of great importance in extending our knowledge of the motion in this system. The reliable estimate of its distance resulting from the observations of Henderson, Maclear, and Moesta, vastly increases the interest attaching to it.

## GEOLOGICAL NOTES

GEOLOGICAL SURVEY OF THE UNITED KINGDOM.—The gradual progress of the English and Scottish Geological Surveys has brought the members of the two corps almost within sight of each other. The line of demarcation between the two kingdoms being nearer the base of operations from Scotland, has been sooner reached from that side. From Berwick-on-Tweed southwestwards the work has been carried up from the north to the English border through the range of the Cheviot Hills, and down the valley of Liddesdale to the Solway. To prevent any subsequent risk of the lines from either side not fitting accurately, the officers on the Scottish border are at present engaged in running their boundaries into Cumberland and Northumberland for such a short distance as may be required to leave them in a position where they can be easily taken up by the advanced guard of the English Survey. When this and some few isolated areas are completed, the whole of the south of Scotland between the Tay and Clyde and the English border will have been geologically surveyed, and the Scottish staff will then be engaged on both sides of the flanks of the Highlands. Already ground has been broken, and some progress has been made on the north side of the Grampian chain. On the English side the mountainous lake district is all surveyed, while the work is so well advanced in Cumberland that it may probably be completed up to the Scottish border by the end of this year. Considerable progress has likewise recently been made on the eastern side in pushing the survey northwards in Northumberland, though a considerable tract of that country still remains unmapped towards the Cheviots and Tweed. Among the south-eastern counties the survey is advancing through Norfolk, Suffolk, and Cambridgeshire, while in the south-west some of the maps which were made in the early days of the Geological Survey are being re-surveyed and brought up to date in West Somerset and Devon.

GEOLOGICAL SURVEY OF CANADA.—The Report of this Survey for 1875-76 has just arrived. In size, general interest, and geological value, it fully equals its well-known predecessors, while in regard to maps, sections, and other illustrations, it even surpasses them. Briefly told, its story is this—The Philadelphia Exhibition absorbed much of the time and thought which would otherwise have been expended on the field-work, laboratory, and museum duties of the officers. But the director need not regret this temporary suspension of the usual operations of his staff, for there can be no doubt that the display of rocks, minerals, and fossils, made by Canada at the Centennial Exhibition, so universally admired brought the mineral resources of the dominion and the skill of its geological survey before the world with such prominence as could hardly have been attained even with the ablest maps and memoirs. Mr. Selwyn's own labours from April to November, 1875, embraced an exploration of parts of British Columbia where likewise Mr. George M. Dawson, who has lately been appointed to the Canadian Survey, has been actively employed. Prof. Macour, besides his geological work, made a careful botanical survey of the region traversed, and his detailed narrative appears in this Report. Mr. Ellis was sent into the North-west Territory to make a series of borings. Mr. Bell explored the country between James Bay and Lakes Superior and Huron; while in the eastern parts of the Dominion detailed surveys were made in the coal-fields of Nova Scotia, in New Brunswick, and in Cape Breton. Besides these explorations others were continued by Mr. Vennor in Ontario. Of these Mr. Selwyn remarks that they prove the existence in Western Quebec and Eastern Ontario of a massive red orthoclase gneiss without visible stratification, lying probably unconformably under the vast crystalline masses containing *Eozoon*. He suggests that what is called Lower Laurentian may have to be termed Middle, the fundamental red gneiss becoming the Lower.

EXCREMENTITIOUS DEPOSITS IN THE ROCKY MOUNTAINS.—A recent paper to the Philadelphia Academy by Mr. Henshaw, on the excrementitious deposits in the Rocky Mountain region, sustains Prof. Cope's view that they were made by big-eared rats, a species of *Neotoma*, probably *N. cinerea*. They consist of vegetable matter, sometimes with a bitumen-like look, and varying from this appearance to that of pill-like excrements. In a crevice of the rocks one deposit had a depth of two feet, and contained also some small twigs and "birds'" feathers. "The mass was evidently the accumulation of years, and had served as a nest. Throughout was a large amount of hard droppings from which the urine had passed, and whose nature was unmistakable. The urine, charged with a certain amount of excrementitious matters, had filtered through to form the singular deposits." Water or the urine has carried the portions it could dissolve down the faces of walls, and deposited it on shelves where no animals without wings could reach, and sometimes on the roofs of cavities. All the regions where these deposits occur are inhabited by the *Neotoma*, which is essentially a vegetarian.