

of the introduction of such a course of work as is herein described. It encourages thought, creates interest in chemistry, and furnishes the kind of knowledge most likely to prove of advantage in after years. Not only in organised science schools, but in every school where chemistry is taught, the course described in this book could be profitably introduced.

Observaciones de precision con el Sextante. Por el Conde de Cañete del Pinar, Cápitan de Fragata Retirado. Pp. 180. (Madrid: Ricardo Alvarez, 1895.)

A DESCRIPTION of the sextant and the uses to which it can be applied is here given in seven chapters, of which the first describes the instrument, and shows how it may be corrected. Following, we have four chapters on different means of the determination of latitude by means of stars, showing the methods trigonometrically, and also giving examples. The accuracy of observations taken by the sextant is graphically shown by two tables, giving the latitude obtained on several successive days. Lastly, we have a description of the means by which time is determined, and also how the longitude is obtained by means of the moon and stars. Throughout the book there are numerous examples, and no pains have been spared to make it useful.

First Stage Mechanics. By F. Rosenberg, M.A. Pp. 296. (London: W. B. Clive, 1895.)

THIS book has been made to fit the requirements of the elementary stage of theoretical mechanics of solids, as laid down in the syllabus of the Department of Science and Art. It is the first volume of a new series of Departmental text-books, and it possesses all the characteristics of the literature of the University Correspondence College Press; by which remark we mean that the text is concise, the examples numerous, and the comparative importance of the sections is indicated by the thickness of the type in which they are printed. What more does a student require, who is learning theoretical mechanics for examination purposes?

The Story of the Solar System. By George F. Chambers, F.R.A.S. Pp. 202. (London: George Newnes, Limited, 1895.)

WE are glad to be able to state that the twenty-eight illustrations in this book are better than those in the companion volume on the "Stars," by the same author. Mr. Chambers has contrived to compress an immense amount of information within a small compass, and his descriptions possess the double quality of simplicity and attractiveness. We do not know of a book in which so much is told about the solar system within such narrow limits.

British Guiana and its Resources. By the author of "Sardinia and its Resources." Pp. 104. (London: George Philip and Son, 1895.)

THE question of frontier between British Guiana and Venezuela is now so much to the front, that a large public will be interested in this description of the history, features, and resources of the region in which the debatable land lies. The book will be found valuable not only on this account, but because it is full of information useful to visitors to British Guiana. Travellers of all tastes and inclinations will find that the country offers many attractions, and is as wide a field for observation and collection as could be desired.

Mammals of Land and Sea. By Mrs. Arthur Bell (N. D'Anvers). Pp. xii + 191. (London: George Philip and Son, 1896.)

ALTHOUGH this volume will assist its readers to know the general characteristics of members of the mammalian family, it possesses no novel features, and the illustrations belong to a past age. Some readers may find the book interesting, but few will pronounce it attractive.

NO. 1368, VOL. 53]

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

A New Method of Measuring Temperature.

THE recent publication of papers dealing principally with thermometry, by Mr. Griffiths, and by the Kew Standardising Bureau, has suggested to me that the publication of a new thermometric method which I have used for some years may be of use.

Briefly, in this method two thermo-junctions are used; one is placed, protected or not, as circumstances dictate, in the substance of which the temperature is to be measured, the other in the bulb of an air or nitrogen thermometer. This junction is blackened, and may or may not be protected, but should be in the same state as the other. The bulb of the air thermometer may or may not be silvered or platinised. Within the bulb of the air thermometer is placed a coil of platinum wire, in series with this being a carbon resistance and a storage battery. The bulb of the thermometer is protected by a layer of slag-wool, or, if this cannot be obtained, of asbestos; or a sheath of polished metal may be used. In the thermo-electric circuit a low resistance galvanometer is placed. I prefer to use a d'Arsonval.

The *modus operandi* is as follows. The free thermo-junction is placed in the substance whose temperature is to be measured. The galvanometer is immediately deflected. The circuit of the platinum heating coil is then closed, and the carbon resistance screwed down till the galvanometer needle comes back to zero, or until making and breaking the thermo-electric circuit produced no movement of the needle. When this is the case the temperature of the air or nitrogen in the bulb will evidently be the same as that of the substance to be measured, and can be directly read off in any of the usual ways on the thermometer. I prefer myself to use the constant volume method.

It is necessary, of course, that the thermo-junctions be both in the same physical state. This is generally secured with sufficient accuracy by cutting the wire from the middle of a much larger piece which has been well annealed. In connection with other work I have found that two samples of metal, chemically identical but having different rigidities and thermo-electric powers, may always be brought to identical states by heating for a time at white heat in vacuo, first introducing, if necessary, oxygen or hydrogen to decompose any hydride or oxide combined with the metal. I have never found it necessary to do this in making thermo-junctions, but its use is recommended to experimenters who are studying the physical properties of metals.

The advantages of this method are as follows:

(1) No assumption is made in regard to any law of variation of thermo-electric effect with temperature.

(2) No assumption is made with respect to variation of voltage of standard cell in relation to temperature. The error due to the fact that the saturation of the sulphate solution of the standard cell always lags behind the temperature, and that due to the fact that the temperature is never known exactly, are thus done away with.

(3) No assumption in regard to temperature or temperature coefficient of wires is made.

(4) Both junctions being maintained at the same temperature for approximately the same length of time, and under the same conditions, the likelihood of changes in physical state, produced by one wire being annealed more than the other, is reduced to a minimum.

(5) The temperature is read directly by a nitrogen thermometer, and no intermediate standards need be used.

(6) No complicated apparatus is needed, the only instrument used being the galvanometer, and that only as an indicator. The only standard used is the kathetometer for measuring the height of the mercury column.

The only assumption made is that the air in the bulb is at a uniform temperature throughout. This assumption is justified, however, by experiment. In 1890 Mr. A. E. Kennelly and the writer made a number of experiments to determine the temperature coefficient of the electrical resistance of copper wire. In these experiments the wire was wound in two coaxial coils in the bulb of an air thermometer, the idea being that there would

probably be a difference of temperature between the coils, and the mean would be taken. On testing the matter, however, no such difference was found, even up to the highest temperature used, 250° C. If any difference existed it was less than one-tenth of 1° C., as that amount could have been measured. This being the case in a narrow tube where the air circulation was hindered by a number of mica discs (see *Physical Review*, February 1893, for description of apparatus), it is improbable that there is any appreciable difference when there is no hindrance to the air currents except the heating coil of platinum.

I have never used the apparatus for very high temperatures, but see no reason why it should not be so used; and it would apparently present a number of advantages for such work, chief among which is the fact that the temperature would be obtained by direct comparison with an air or nitrogen thermometer, and no assumptions made as to the law of variation of thermo-electric force with temperature.

It can, of course, be made self-recording by placing a recording pressure gauge in place of the mercury column, the observer simply keeping the galvanometer at zero by manipulation of the carbon resistance.

It is obvious that platinum resistance coils can be used instead of the thermo-junctions, the platinum resistance coils forming two arms of a Wheatstone bridge, and the galvanometer placed across them.

A method of measuring the heat conductivity and temperature coefficient of metals devised by me, and at present being used by one of my students, may be of interest. A metal bar, well annealed, polished, and with special precautions taken to preserve homogeneity of physical state, has its ends placed in two mercury baths, A and B. The bar is protected from radiation by concentric polished metal tubes. A is heated electrically, and B cooled by a water tube. In the regular laboratory exercise, I have been in the habit of letting the students use thermometers. But in this case, where accurate results are required, capillary tubes are led off from A and B, filled with mercury, thus forming a thermo-junction. Another thermocircuit has its junctions placed at the entrance and exit of the cooling water. It would, of course, be possible to measure the thermo-voltage directly by standard cell; but instead of this, in the present method, the two thermo-circuits are balanced against one another, the elements which are immersed in the water being chosen so as to have a much higher thermo-voltage than the copper-mercury couple. It is seen, without much difficulty, that by this means the conductivity of the copper may be measured without knowing more than one temperature, and that only approximately, to a considerable degree of accuracy. As the experiments are not concluded, I am unable to state definitely what the value of the method is, but the indications are that it will prove successful. REGINALD A. FESSENDEN.

Western University of Pennsylvania.

On Crookes' Spectrum of Helium.

IN his investigation on the spectrum of helium,¹ Crookes has examined the spectrum of five different samples of gas, two being developed from cleveite (No. 1 and No. 5), another from uraninite (No. 2), and two from bröggerite (No. 3 and No. 4). Sample No. 5 has been prepared with special care, and is designated "helium purissimum." The five spectra are by no means identical, and it has been concluded that besides helium there are other gases present. E. A. Hill² has even gone so far as to infer the existence of at least fifteen new elements from the comparison of these five spectra. Thirty of the seventy-nine wave-lengths measured by Crookes coincide (within the limits of error) with wave-lengths that we have measured in the spectrum of cleveite gas.³ But the remaining forty-nine lines, many of which are strong, do not coincide with any of ours. As far as we know, it has not been noticed that thirty-three of these forty-nine lines almost certainly belong to argon, among them nearly all the stronger lines. Six more may also be argon lines, but the identification is rather doubtful. Two lines in all probability are mercury lines, which naturally are likely to appear in a vacuum-tube made by means of a mercury pump. One line may be due to carbon. The table on p. 246 contains a list of the forty-nine wave-lengths that do not coincide with wave-

lengths that we ascribe to helium, and gives their probable origin. The wave-lengths of argon lines are taken from Kayser (*Chemical News*, August 30, 1895), Eder and Valenta (*Ber. der Wiener Akad.*, October 24, 1895), and from Crookes' own measurements.

3890.5 and 3885.9 are strong lines that have been seen in the spectra of all five samples. Crookes considers them as satellites or components of the strong line between them, the wave-length of which is 3888.785 according to our measurements. But as our photographs show that this line is single, or if not single has a weak component 0.05 lower, which can only be observed with much greater dispersion than Crookes has used, we are inclined to believe that 3890.5 and 3885.9 are spurious lines due to some error of apparatus having made their appearance on account of the enormous energy of 3888.8.

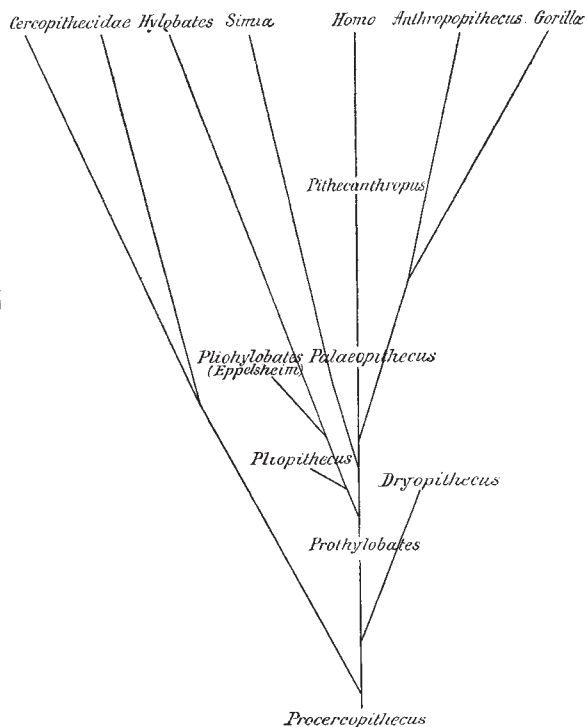
Of the five remaining lines, three are only of intensity 2. The two stronger ones have only appeared in the gas from uraninite, and may possibly belong to a substance hitherto unknown. But it is far from being established.

C. RUNGE AND F. PASCHEN.

Hannover, Technische Hochschule.

The Place of "Pithecanthropus" in the Genealogical Tree.

IN the report on the scientific meeting of the Royal Dublin Society on November 20, in *NATURE* of December 5, 1895, it is stated that I placed *Pithecanthropus* in the genealogical tree, drawn by Prof. Cunningham, below the point of divarication of the Anthropoid apes from the human line. This indeed I did. But this statement could be misleading as to my real views on the genealogy of *Pithecanthropus*, such as I stated them already on p. 38 of my original memoir ("Pithecanthropus erectus, Eine menschenähnliche Uebergangsform aus Java,"⁵ Batavia, 1894), and more fully at the last meeting of the Anthropological Institute of Great Britain and Ireland, on November 25.



It may not be superfluous to explain my views here by means of the accompanying diagram, representing the evolution of the Old World apes from a hypothetical common ancestor, whom I call *Proceropithecus*.

In Prof. Cunningham's tree, figured in *NATURE* of December 5, p. 116, he regards the left branch as all human, the right one as entirely simian, and he placed *Pithecanthropus* midway between recent Man and the point of divarication.

¹ *Chemical News*, August 23, 1895. reprinted in *NATURE*, August 29, 1895.

² *American Journal of Science*, November 1895.

³ *Berichte der Berl. Akad.*, July 1895. See also *NATURE*, September 26, 1895.