THURSDAY, AUGUST 6, 1903.

THE MINERAL WEALTH OF AFRICA.

Les Richesses Minérales de l'Afrique. By L. de Launay. Pp. 395; with 71 figures and maps. (Paris: Ch. Béranger, 1903.) Price 20 francs.

PROF. DE LAUNAY gives a further proof of his indefatigable industry in this new volume from his pen. It is a formidable task to deal even briefly with the mineral wealth of a huge continent, which has been only imperfectly explored; but fortunately the author is eminently qualified for the task. He is no novice in writing upon mineral deposits, and he has visited many mines in North Africa, besides the most important districts in the south. The book is arranged so as to suit two classes of readers, those who wish to learn all they can about the occurrence of some given mineral, such as gold, copper ore, phosphate of lime, &c., and those whose interest relates only to some particular country or region. This arrangement involves a certain amount of duplication, but it is certainly a convenience. Thanks are likewise due to the author for his little sketch maps. Who has not experienced the want of such maps? For when seated in an easy chair the reader is apt to be too lazy to get up and fetch his atlas, and he consequently often fails to derive full benefit from the work he is perusing.

What is the mineral wealth of South Africa? Of the future mineral resources of the Dark Continent we are ignorant; further explorations may reveal new treasures; but if by "mineral wealth" is understood the value of the present output, the question is answered by the following tables, which have been compiled from the Blue-books published annually by the Home Office. Though the information is necessarily incomplete, it will suffice for the purposes of the present article.

In a normal year, such as 1898, gold is seen to be far ahead of any other mineral as regards value; and when we consider that before the war with the Boers Africa was furnishing more than one quarter of the world's supply of the precious metal, it is evident that Prof. de Launay is fully justified in devoting his first chapter to a description of the auriferous deposits of the continent. The gold mines of the Witwatersrand naturally claim a full share of attention. Excellent figures, with full descriptions, explain the nature of the "banket" or gold-bearing conglomerate, and the question of the origin of the gold is discussed at some length. The three usual hypotheses are brought forward; they may be spoken of briefly as "previous origin," "contemporaneous origin," and "subsequent origin." In other words, it is supposed by some geologists that the gold is a detrital product, like the pebbles of quartz; others suggest that it was deposited from solutions while the pebbles were finding a resting place; whilst most mining engineers favour the idea that solutions brought it into the conglomerates long after their consolidation. The pros and cons are given in each case; however, there are difficulties in accepting any one of the three theories advanced, and Prof. de Launay honestly confesses that he is puzzled, and that he cannot make up his mind on the matter.

He is careful to point out that the Rand must be regarded as an exceptional case, and that it by no means follows from the discovery of "banket" in West Africa that the "Jungle" gold mines, as they are known on the Stock Exchange, will necessarily prove to be rich and valuable properties.

The pages relating to the occurrence of gold in Egypt contain matter of much antiquarian interest; the public are only now beginning to learn that Egypt was the California of the Old World, and that gold was being extracted from quartz veins between the Nile and the Red Sea at least 2500 years B.C. But the author makes a mistake in saying that the gold occurs under conditions similar to those under which it is found in *Cornwall*. In that county we have no auriferous deposits, for the small grains of the precious metal occasionally found in working stream tin in olden days were, practically speaking, mineralogical curiosities.

Next in importance come diamonds; for though the emeralds of Gebel Sabara and the turquoises of Sinai were known and worked by the ancients, the only gem-mining which need be taken into consideration at the present time is that of South Africa. It is a curious fact, on a continent in which both gold and gems were obtained in considerable quantities even in very remote ages, that the deposits which are now yielding so lavishly should have remained undiscovered until the latter part of the last century. The mode of occurrence of diamonds in South Africa is thoroughly well known to geologists; but the precise manner in which they were originally formed still affords room for speculation. Prof. de Launay repeats the hypothesis, already suggested in his previous work, "Les Diamants du Cap," that a bath of supercarburetted molten iron and magnesium existed beneath the granite, and that the diamonds were formed on a large scale after the fashion of the minute ones obtained artificially by Moissan.

The discovery of workable deposits of phosphate of lime is one of recent date; it now appears that they extend more or less continuously from Morocco to Egypt. Algeria already produces more than 300,000 tons a year, and Tunisia more than 200,000 tons from strata of Eocene age. The Egyptian deposits, which occur in Upper Cretaceous rocks, are extensive but poor.

There are reasons for believing that the dry Sahara and Algeria may contain deposits of nitrate of potash and nitrate of soda similar to the "caliche" of Chili; the matter is now being investigated officially.

Practically speaking, all the copper of Africa comes from Namaqualand; the advent of better means of transport may render this statement incorrect in the course of a few years, for ores of the metal are known to exist in many parts of the continent.

Coal of Permo-triassic age is worked in the Transvaal, Natal, and Cape Colony, and Rhodesia will soon become a producer.

The total value of all the minerals produced in

AFRICA.—*Output and Value of*

Mineral	Abyssinia		Algeria		Cape Colony		French Soudan		German E. Africa		Gold Coast		Madagascar	
	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £
Antimony Ore ...	—	—	136	883	—	—	—	—	—	—	—	—	—	—
Asbestos	—	—	—	—	149	2,037	—	—	—	—	—	—	—	—
Brown Coal ...	—	—	197	96	—	—	—	—	—	—	—	—	—	—
Clay	—	—	77,447	12,415	—	—	—	—	—	—	—	—	—	—
Coal	—	—	—	—	171,301	135,851	—	—	—	—	—	—	—	—
Copper Ore ...	—	—	—	—	36,822	310,636	—	—	—	—	—	—	—	—
Crocidolite ...	—	—	—	—	8	700	—	—	—	—	—	—	—	—
Diamonds (carats)...	—	—	—	—	3,270,917 [carats	4,128,321	—	—	—	—	—	—	—	—
Fireclay	—	—	—	—	1,240	not stated	—	—	—	—	—	—	—	—
Flags	—	—	6,271	2,701	—	—	—	—	—	—	—	—	—	—
Garnets	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gold (ounces) ..	—	—	—	—	127 oz.	444	2,700 oz.	11,560	—	—	17,733 oz.	63,838	—	—
Gypsum	—	—	148	15	—	—	—	—	—	—	—	—	—	—
Iron ore	—	—	466,089	140,733	—	—	—	—	—	—	—	—	—	—
Lead Ore	—	—	118	624	—	—	—	—	—	—	—	—	—	—
Limestone	—	—	25,565	21,957	—	—	—	—	—	—	—	—	—	—
Marble	—	—	969	6,001	—	—	—	—	—	—	—	—	—	—
Onyx	—	—	216	2,497	—	—	—	—	—	—	—	—	—	—
Phosphate of Lime	—	—	265,145	215,600	—	—	—	—	—	—	—	—	—	—
Plaster	—	—	29,280	22,117	—	—	—	—	—	—	—	—	—	—
Potter's Clay ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Salt	—	—	20,966	17,193	11,850[1] } 442,380 [bushels	32,598	—	—	—	—	—	—	—	—
Sand and Gravel ...	—	—	71,045	3,143		—	—	—	—	—	—	—	—	—
Silver Lead Ore ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stone, Building ...	—	—	727,349	69,766	—	—	—	—	—	—	—	—	—	—
,, Rough ...	—	—	674,663	37,843	—	—	—	—	—	—	—	—	—	—
Tin Ore	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zinc Ore	—	—	29,304	56,268	—	—	—	—	—	—	—	—	—	—
Total ...	—	—	—	612,852	—	4,610.587[3]	—	11,560	—	—		63,838	—	—

[1] Estimated at 60 lb. = 1 bushel. [3] Total incomplete.

AFRICA.—*Output and Value of*

Mineral	Abyssinia		Algeria		Cape Colony		French Soudan		German E. Africa		Gold Coast		Madagascar	
	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £
Antimony Ore ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Asbestos	—	—	—	—	88	1,433	—	—	—	—	—	—	—	—
Brown Coal ...	—	—	210	102	—	—	—	—	—	—	—	—	—	—
Clay	—	—	117,312	17,040	—	—	—	—	—	—	—	—	—	—
Coal	—	—	—	—	205,810	180,413	—	—	—	—	—	—	—	—
Copper Ore... ...	—	—	7,152	5,035	45,356	613,739	—	—	—	—	—	—	—	—
Crocidolite ...	—	—	—	—	3	150	—	—	—	—	—	—	—	—
Diamonds (carats)...	—	—	—	—	2,781,385 [carats	5,387,955	—	—	—	—	—	—	—	—
Fireclay	—	—	—	—	900	not stated	—	—	—	—	—	—	—	—
Flags	—	—	8,218	3,424	—	—	—	—	—	—	—	—	—	—
Garnets	—	—	—	—	—	—	—	—	not stated	2,750	—	—	—	—
Gold (ounces) ...	31,161 oz.[1]	139,600	—	—	78 oz.	302	—	—	—	—	6,162 oz.	22,187	33,600 oz.	112,860
Gypsum	—	—	591	60	—	—	—	—	—	—	—	—	—	—
Iron Ore	—	—	506,347	198,679	—	—	—	—	—	—	—	—	—	—
Lead Ore	—	—	1,588	4,383	—	—	—	—	—	—	—	—	—	—
Limestone	—	—	26,574	25,500	—	—	—	—	—	—	—	—	—	—
Marble	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onyx	—	—	289	3,352	—	—	—	—	—	—	—	—	—	—
Phosphate of Lime	—	—	260,815	212,000	—	—	—	—	—	—	—	—	—	—
Plaster	—	—	34,191	26,397	—	—	—	—	—	—	—	—	—	—
Potter's Clay ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Salt	—	—	18,226	15,995	not stated	not stated	—	—	—	—	—	—	—	—
Sand and Gravel ...	—	—	85,357	3,774	—	—	—	—	—	—	—	—	—	—
Silver Lead Ore ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stone, Building ...	—	—	785,948	73,744	—	—	—	—	—	—	—	—	—	—
,, Rough ...	—	—	1,413,566	56,550	—	—	—	—	—	—	—	—	—	—
Tin Ore	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zinc Ore	—	—	26,488	52,704	—	—	—	—	—	—	—	—	—	—
Total ...	—	139,600	—	698,739	—	6,183,992[5]	—	—	—	2,750	—	22,187	—	112,860

[1] 2,710 ounces of fine silver are contained in the gold.
[5] Total incomplete.

Minerals in the year 1898.

Natal		Orange River Coly.		Portug. E. Africa		Rhodesia		Senegal		Transvaal		Tunis		Total	
Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £
—	—	—	—	—	—	—	—	—	—	—	—	—	—	136	833
—	—	—	—	—	—	—	—	—	—	—	—	—	—	149	2,037
—	—	—	—	—	—	—	—	—	—	—	—	—	—	197	96
—	—	—	—	—	—	—	—	—	—	—	—	—	—	77,447	12,415
387,811	75,015	—	—	—	—	—	—	—	—	1,907,809	668,346	—	—	2,466,921	879 212
—	—	—	—	—	—	—	—	—	—	—	—	—	—	36,822	310,636
—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	700
—	—	288,937 [carats	498,797	—	—	—	—	—	—	22,843 [carats	43,730	—	—	3,582,697 [carats	4,670,848
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,240	not stated
—	—	—	—	—	—	—	—	—	—	—	—	—	—	6,271	2,701
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17 oz.	60	—	—	—	—	22,911 oz.	83,053 [2]	4,147 oz.	15,464	3,830,337 [oz.	16,240,630	—	—	3,877,972 oz	16,415,049
—	—	—	—	—	—	—	—	—	—	—	—	10,629	not stated	10,777	15
—	—	—	—	—	—	—	—	—	—	—	—	—	—	466,089	140,733
—	—	—	—	—	—	—	—	—	—	—	—	2,337	7,536	2,455	8,160
—	—	—	—	—	—	—	—	—	—	—	—	—	—	25,565	24,957
—	—	—	—	—	—	—	—	—	—	—	—	591	not stated	1,560	6,001
—	—	—	—	—	—	—	—	—	—	—	—	—	—	216	2,497
—	—	—	—	—	—	—	—	—	—	—	—	—	—	265,145	215,600
—	—	—	—	—	—	—	—	—	—	—	—	—	—	29,280	22,117
—	—	—	—	—	—	—	—	—	—	—	—	5,708	not stated	5,708	not stated
—	—	—	—	—	—	—	—	—	—	—	—	7,185	6,424	40,001	56,215
—	—	—	—	—	—	—	—	—	—	—	—	—	—	71,045	3,143
—	—	—	—	—	—	—	—	—	—	80	500	—	—	80	500
—	—	—	—	—	—	—	—	—	—	—	—	290,341	not stated	1,017,690	69,766
—	—	—	—	—	—	—	—	—	—	—	—	65,942	not stated	740,605	37,843
—	—	—	—	—	—	—	—	—	—	23	1,800	—	—	23	1,800
—	—	—	—	—	—	—	—	—	—	—	—	21,419	43,268	50,723	99,536
—	75,075	—	498,797	—	—	—	83,053	—	15,464	—	16,955,006	—	57,228 [3]	—	22,983,460

[2] This total is made up of gold declared to August 31, 1898, viz., 6,533 oz., and gold produced from September to December, 1898, 16,378 oz.

Minerals in the year 1901.

Natal		Orange River Coly.		Portug. E. Africa		Rhodesia		Senegal		Transvaal		Tunis		Total	
Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £	Quantity Stat. Tons	Value £
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	88	1,433
—	—	—	—	—	—	—	—	—	—	—	—	—	—	210	102
—	—	—	—	—	—	—	—	—	—	—	—	—	—	117,312	17,040
569 200	549,439	—	—	—	—	—	—	—	—	468,162 [2]	201,634	—	—	1,243,179	931,486
—	—	—	—	—	—	—	—	—	—	—	—	—	—	52,508	618,774
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	150
—	—	—[4]	—	—	—	—	—	—	—	—	—	—	—	2,781,385 [carats	5,387,955
—	—	—	—	—	—	—	—	—	—	—	—	—	—	900	not stated
—	—	—	—	—	—	—	—	—	—	—	—	—	—	8,218	3,424
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2,750
135 oz.	531	—	—	13,632 oz.	52,577	172,035 oz.	623,627	—	—	230,801 [3]	980,381	—	—	487,604 oz.	1,932,065
—	—	—	—	—	—	—	—	—	—	— [oz.	—	—	—	591	60
—	—	—	—	—	—	—	—	—	—	—	—	—	—	506,347	198,679
—	—	—	—	—	—	—	—	—	—	—	—	8,070	26,760	9 658	31,143
—	—	—	—	—	—	—	—	—	—	—	—	34,250	29,635	60,824	55,135
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	289	3,352
—	—	—	—	—	—	—	—	—	—	—	—	169,653	105,700	430,468	317,700
—	—	—	—	—	—	—	—	—	—	—	—	12,779	24,078	46,970	50,475
—	—	—	—	—	—	—	—	—	—	—	—	6,274	300	6,274	300
—	—	—	—	—	—	—	—	—	—	—	—	16,633	14,880	34,859	30,875
—	—	—	—	—	—	—	—	—	—	—	—	—	—	85,357	3,774
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	860,004	61,251	1,645,952	134,995
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,413,566	56,550
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	17,617	43,240	44,105	95,944
	549,970	—	—	—	52,577	—	623,627	—	—	—	1,182,015	—	305,844	—	9,874,161

[2] Output for the last four months of the year only. [3] Output for the last six months of the year only.

[4] No work was done at the Jagersfontein Mine during the financial year ended March 31, 1902. The output for the financial year ended March 31, 1901, was 18,002 carats, valued at 37,079*l*.

Africa in 1898 was about 23 millions sterling. This amount seems small for the huge continent, when we reflect that in 1901 the coal output of Wales alone was worth 19½ millions, and that of Northumberland and Durham about the same amount. But after reading Prof. de Launay's book, it needs no prophet to predict that Africa's mineral deposits will soon be more largely utilised.

ROWLAND'S WORK.

The Physical Papers of Henry Augustus Rowland. Collected for publication by a Committee of the University. Pp. xi + 704. (Baltimore: Johns Hopkins University Press; London: Wesley and Son, 1902.) Price 30*s*. 6*d*. net.

PROF. ROWLAND'S friends have been well-advised in issuing as a memorial to their late colleague this volume of his collected papers. It enables us to realise more fully all we owe to him and to grasp the value and importance of his work.

Commencing with an early note sent to the *Scientific American* when the author was seventeen, the list of scientific papers concludes with an article on diffraction gratings, published in the new edition of the "Encyclopædia Britannica" after Rowland's death. Then there follow some six addresses on scientific subjects, a bibliography, and an account of the dividing engines he designed.

Dr. Mendenhall's commemorative address, delivered shortly after Rowland's death, fitly forms an introduction to the whole, and gives us a glimpse of his life and methods of work.

Rowland's fame came to him early, though not without some severe struggles and disappointments on his part, and it is a satisfaction to us Englishmen to know that it was Maxwell who first recognised his genius. Prof. Mendenhall tells again the story of his first serious paper, "On Magnetic Permeability and the Maximum of Magnetism of Iron, Steel, and Nickel," *Phil. Mag.*, 1873. The paper was more than once rejected in America because it was not understood, and finally it was sent to Maxwell, who wrote immediately that since the temporary suspension of their meetings made it impossible to communicate the paper to the Royal Society, he would send it to the *Philosophical Magazine*, where it appeared in August, 1873, Maxwell having himself, to save time, corrected the proofs. In this paper Rowland introduced the idea of the magnetic circuit as the analogue of Ohm's law, and developed the now well-known ring method of measuring permeability. In 1875, on his appointment as first professor of physics at the Johns Hopkins University, he came to Europe and worked for a time in Helmholtz's laboratory at Berlin, and by his researches answered Tait's question, put to Maxwell in these words—

> Will mounted ebonite disc
>   On smooth unyielding bearing,
> When turned about with motion brisk
>   Nor excitation sparing,
> Affect the primitive repose
>   Of + and − in a wire?

To which Maxwell replies—

> The mounted disc of ebonite
>   Has whirled before nor whirled in vain,
> Rowland of Troy that doughty knight
>   Convection currents did obtain
> In such a disc of power to wheedle
>   From its loved North the subtle needle.

And Maxwell goes on to explain that such convection currents will not produce electromotive force in a neighbouring wire unless the speed of the disc were variable.

The paper on the "Magnetic Effect of Electric Convection," No. 12, in the volume before us, was presented in the *American Journal of Science* for 1878; von Helmholtz had already announced the result to the Berlin Academy in 1876. Rowland returned to the problem with the same result in 1889, in a paper presented in the *Philosophical Magazine*, No. 43 of his collected works. As is well known, the results were challenged by Crémieu shortly before Rowland's death. Many readers of NATURE will remember the interesting occasion in Section A of the British Association at Glasgow, when Crémieu described how he had failed to obtain the effect. Those present felt that in view of the confirmation of Rowland's results obtained at Baltimore by Pender, Crémieu must have been misled, but no one could put his fingers definitely on the error. It is satisfactory to know, from the recently published joint work of Crémieu and Pender, that Rowland was right, and that a convection current of electricity does produce a magnetic field.

The research into the value of the British Association unit of resistance, No. 15, and a determination of the value of "*v*," No. 44, complete the series of fundamental electrical researches, though his collected papers contain many other memoirs of real importance.

In his experiments on the absolute unit of resistance, Rowland shows his usual acumen as a critic and skill as a mechanic and observer. Various lines of argument had shown that the B.A. unit, supposed to represent 10^9 C.G.S. units of resistance, was in error. Rowland sums up effectively his criticisms on the method of the B.A. committee and points out the sources of error in Weber's method by damping adopted by Kohlrausch. He then describes his own method, a modification of that originally proposed by Kirchhoff, and, after a careful account of his apparatus and measurements, arrives at the result 1 B.A. unit$=0{\cdot}9911\times 10^9$ C.G.S. units. A repetition of his experiments in 1884 gave 0.98627, while about the same time his pupil, Kimball, using Lorenz's method, arrived at the result 0·9864. The value obtained at the Cavendish Laboratory was 0·9867.

Part iii. of the collected papers deals with the work on Heat, and foremost among these is the great memoir on the "Mechanical Equivalent of Heat," a work which, if it stood alone, would have made Rowland's name as the foremost physicist of his nation.

The refinements of modern thermometry have enabled us to introduce some small corrections into certain of the results, but the work remains unrivalled.

Rowland was an engineer, and this stood him in good stead in all his researches, and nowhere more so than in the paper under consideration.

In arranging his laboratory, Prof. Mendenhall tells us, many of his friends thought he was giving undue prominence to the workshop, its machinery and tools, and to the men to be employed in it, but he planned wisely, for in original work "a well-manned and equipped workshop is worth more than a storehouse of apparatus already designed and used by others."

So, too, it was in the optical work described in part iv.; the concave grating is the child of the perfect screw, and he who would make a perfect screw must follow Rowland as he described his method in the article, "Screw," "Encyclopædia Britannica," ninth edition, No. 33 of the Collected Papers.

The secret is to correct the screw by grinding it in a long adjustable nut longer than the screw itself; thus, if the finished screw is to be 9 inches long, the nut should be 11 inches; as the grinding progresses the nut is closed in, and the grinding continues for two weeks, the nut being turned end for end every ten minutes and the screw kept in water constant in temperature to within 1° C. all the time.

It is not strange that machines which can rule gratings are rare.

The original paper on "Concave Gratings," No. 29, is a short one, but valuable details are given in No. 49, "Gratings in Theory and Practice," and in the "Encyclopædia" article already referred to.

The addresses which fill the last hundred pages of the book are full of interest. To many who have followed the accounts recently given in the pages of NATURE of the wealth and endowments of American universities, "A Plea for Pure Science" will appeal forcibly. Rowland was not satisfied that even America was doing all that was needed.

"The whole universe is before us to study. The greatest labour of the greatest minds has only given us a few pearls, and yet the limitless ocean, with its hidden depths filled with diamonds and precious stones, is before us. The problem of the universe is yet unsolved, and the mystery involved in one single atom yet eludes us. The field of research only opens wider and wider as we advance, and our minds are lost in wonder and astonishment at the grandeur and beauty unfolded before us. Shall we help in this grand work or shall we not? Shall our country do its share or shall it still live in the almshouse of the world?"

Or, again, in his last address, "On the Highest Aim of the Physicist," note his words, after speaking of the work of the Physician :—

"The aims of the physicist, however, are in part purely intellectual; he strives to understand the universe on account of the intellectual pleasure derived from the pursuit, but he is upheld in it by the knowledge that the study of nature's secrets is the ordained method by which the greatest good and happiness shall finally come to the human race."

Rowland unlocked some of the hidden chambers himself; he did more than this, he put into our hands the machine by which we may hope to forge the key which will open the door leading to some of the innermost recesses. R. T. G.

A VINE DISEASE.

Annales de l'Institut Central Ampélologique Royal Hongrois. Tome ii. Pp. vii+288+plates. (Budapest: Société d'Imprimerie et d'Editions Pallas, 1902.)

THIS admirably printed volume is devoted entirely to an exhaustive study of the *Rot livide* of the vine, a destructive disease due to the ravages of a minute fungus known to botanists as *Coniothyrium Diplodiella.* The memoir reflects credit on the author, Dr. Istvánffi, not only on account of the thoroughness and clearness of the 288 pp. of text, but also from the beauty and completeness of the numerous (215) excellent figures set forth on the 24 plates.

Of the fifteen chapters into which the work is divided, the first deals with the somewhat extensive history of this now almost ubiquitous malady, the place of origin of which is not known with certainty, but which appears to have been more probably south-eastern Europe than the America to which we owe so many pests.

Chapters ii.–iv. are concerned with the description of the rot as manifested on the shoots and leaves of both native and American vines grown in Europe, and the pathological alterations induced in the tissues by the parasite.

The principal signs when the disease is advanced are brown spots and patches on the leaves, in the dead tissues of which the minute black pycnidia appear; the cortex shrivels, turns brown, and peels in fibrous masses as it dries. The dead twigs also show that the pith is destroyed, and similar pycnidia—frequently accompanied by other fungi such as Botrytis, Pestalozzia, Colletotrichum, &c.—appear on the surface. The dead twigs easily disarticulate at the nodes, and the leaves above, even if not directly attacked, shrivel and die because the diseased internodes cannot supply them with water. A characteristic chambering of the dying pith often precedes its total destruction, and may remain visible at the nodes long after the pith of the internodes has dried up.

Microscopic examination shows that the hyphæ of the fungus causing these destructive effects permeate all the softer tissues, and rapidly destroy the cortical parenchyma with the formation of large gaps filled with mycelium, and an interesting struggle for the mastery between fungus and host is evinced as the medullary rays, parenchyma and cambium attempt to heal up the wounds already made; in vain, however, and the hyphæ pass from cortex to pith *viâ* these medullary rays.

It is, of course, impossible to enter here into the numerous microscopic details, which, as might be expected from so able a histologist as Dr. Istvánffi, are very thoroughly done, and embrace many discoveries of interest, such as the sugar sphærocrystals in certain cells of the diseased cortex, the curious, cambium-like callogene layer, &c. Every botanist will find the careful microchemical reactions valuable, and the coloured diagrams of the behaviour of the diseased tissues are particularly instructive.

But it is not only the stems and leaves that are invaded by this fungus; it also attacks the grapes themselves, either *viâ* the pedicels or from outside, and the author gives an instructive set of figures illustrating the development of the flower and young fruit in connection with chapter v.

Chapter vi. is concerned with the development of the fungus in the different organs of the vine, and with descriptions and figures of its numerous reproductive phases, comprising two forms of conidia, two forms of pycnidia, the perithecia, and certain sclerotium-like stages.

In chapter vii. the results of pure cultures are described, and the conclusion established that the spores may germinate in rain-water, and the young mycelium suffer desiccation, and again revive if wetted; further, that spores germinating on the surface of the plant may remain alive and active for as much as six days in damp weather, awaiting a moment favourable for infection, as it were. Dry spores may be kept twenty-three months, and still germinate on placing in water. The numerous morphological details must be passed over here.

In chapter viii. the various modes of infection are dealt with, and the results are that the fungus may enter by the pedicel, by the peduncle or one of its branches, or at the articulation of the fruit to its stalk, or it may enter the fruit directly. A valuable series of coloured figures shows the various tints assumed by the diseased grapes, and we are reminded of one form of the disease termed "shanking" in this country.

Chapter ix. is devoted to the experimental infections. Many points of interest are given here, *e.g.*, the tips of the germ-tubes directly dissolve the cuticle; a cellulose dissolving enzyme also occurs; liquefied walls resist attack, &c.

Chapters x. to xii. deal very thoroughly with treatment, and the numerous experiments show that calcium bisulphite and free sulphurous acid are practically the only efficacious remedies, Bordeaux mixture and other copper compounds, or mixtures, as well as several other media being found useless.

In chapter xiii. an account is given of the various other fungi which may accompany the Coniothyrium.

Chapter xiv. is devoted to a discussion of the systematic position of the fungus, while chapter xv., and last, again returns to the question of treatment, this time dealing with it in the form of advice as to methods, quantities, periods, &c.

There can be no question that Istvánffi's memoir has a three-fold importance, (1) to the vegetable pathologist, owing to the clear and exhaustive account of the parasite and its relations to the host; (2) to the histologist and morphologist, because it contains so many interesting anatomical details concerning the host and its parasite, and (3) to the practical vine-grower, who will get from it one of the best accounts of symptoms and treatment we have ever met with.

The scientific value of Istvánffi's book is undoubtedly dependent on his clear recognition of the fact that, to deal properly with any parasitic disease, it is essential to take into account not only the peculiarities of the fungus, but also the reactions of the host-plant.

The one great fault we have to find with it is the want of summaries to the several chapters and to the whole work.

OUR BOOK SHELF.

Kinematics of Machines. By R. J. Durley, B.Sc., Ma.E. Pp. viii + 379. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 17*s.* net.

THIS is a carefully written elementary text-book dealing with the subject from the Reuleaux standpoint. In the first chapter the author introduces the notions of kinematic links and chains and the pairing of elements, and gives some fundamental propositions relating to degrees of freedom and constraint, and to instantaneous centres and centrodes in plane motion.

The next chapter treats pretty fully of motion in a straight line and about a fixed axis. Position, velocity and acceleration, linear and angular, in regard to both time and displacement, are exhibited by means of rectangular and polar diagrams, and problems are worked by graphical processes, the scales for measuring the results being always most carefully determined. The alternative, and often more desirable method of tabulation and the numerical calculation of differences seems to have been overlooked; it might well have been introduced and illustrated in an example like that of the electric car found on p. 47. Several problems on simple harmonic motion are given; but the author is scarcely alive to the great and growing importance of this branch of the subject. The fruitful idea of a rotating vector is not fully taken advantage of. A few additional pages are all that would be required in order to show how, in many cases of periodic motion, being given or having plotted a number of suitable positions in the cycle, the motion could be quite easily analysed and expressed approximately in the first three or four terms of the Fourier series, and thus readily comprehended and dealt with.

In the next two chapters the various mechanisms contained in the quadric and slider crank chains are well described and excellently illustrated. In all the more important cases the relations between the linear and angular velocities and accelerators are obtained both graphically and analytically, the principles established in the first two chapters being now applied.

Chapter v. is interesting, being an investigation of the motion in plane mechanisms in general. The author establishes and uses the velocity and acceleration images of Prof. R. H. Smith. As an example it is shown how to find the velocity of any point in a Stephenson link. The direct and powerful method of working from point paths is also illustrated, but is deprecated on account of its supposed inaccuracy. We, however, have found that, by the use of suitable appliances, large scale plotting can be carried out expeditiously, and with a degree of precision which render it possible to obtain not only velocities, but accelerations (or second differences), with quite surprising accuracy, and sufficient for most purposes.

Subsequent chapters relate to mechanisms containing higher pairing and non-rigid links, illustrated by spur gearing, cams, ratchets, escapements, belt and chain gearing, springs, chamber trains, &c. And there are chapters on screw and spheric motions, the latter containing an instructive investigation of the rolling and spinning velocities in various types of ball-bearings. The book concludes with a short historical account of the attempts which have been made to classify mechanisms.

The rigid exclusion of kinetics and of all dynamical considerations from a book like the present seems artificial, and to restrict its value; but those who do not take this view, and who follow Reuleaux, will welcome the volume. The descriptions are clear, the illustrations well selected, and the diagrams beautifully executed. Graphical and analytical calculations are judiciously mixed without an undue use of either.

Determination of Radicles in Carbon Compounds. By Dr. H. Meyer. Translated by J. Bishop Tingle, Ph.D. Pp. xii + 162. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 4*s.* 6*d.* net.

Dr. Meyer has brought out a book of considerable value to chemists engaged in research work; it is hardly a book for students, unless working along research lines. Such a work as this is very difficult to criticise, because it is really a small dictionary of methods; such dictionaries are naturally very useful, provided they are carefully drawn up, which we consider to be the case in the book before us. Take, for example, the first chapter, which consists of 37 pp., and includes practically all the methods which may be used for determining the hydroxy-groups. One might be inclined to think this rather an unnecessary amount of space to devote to such an apparently simple matter as the determination of the –OH radicle, but as there is very little padding, it really points out that in organic chemistry conditions govern everything; that a method which, under certain conditions, may be applied with success is quite useless when these conditions are altered or modified.

In the next chapter we have the determination of the methoxy- and ethoxy-groups by means of Zeisel's method. Three diagrams of complicated pieces of apparatus are given for the carrying out of this important determination. It is a pity, considering both the author and translator have evidently taken considerable trouble to bring the book up to date, and the importance of the method, that they missed Hewitt's simple modification described in the *Journal* of the Chemical Society for 1902; this is probably an oversight, because at another place they give a reference from the same journal.

Under the determination of the carboxyl groups, the method by means of the electrolytic conductivity of the sodium salts is described. It is doubtful, however, whether the description will be of much value to anyone who has not previously carried out such a determination. Not that this matters very much, because in a foot-note a reference to Ostwald's work is given, where a description of the parts of the apparatus may be found.

Dr. Meyer has evidently taken great pains in preparing this book, and has considerably added to its value by the copious references to original literature which he has added. For the rest the translator and publisher have carried out their part of the work with discretion and care. F. M. P.

A Laboratory Guide for Beginners in Zoology. By Clarence Moores Weed, D.Sc., and Ralph Wallace Crossman, B.A., M.Sc. Pp. xxiv + 105. (London: D. C. Heath and Co., 1903.) Price 2*s.* 6*d.*

This handy and very moderately priced laboratory guide will be useful in those courses of elementary instruction in zoology which aim at a fairly wide survey of the types of animal life without going into great detail in regard to any. Thus there are instructions in regard to six Protozoa, two sponges, three Hydrozoa, a rotifer, three Echinoderms, the earthworm and Nereis, Cyclops, the wood-louse, the lobster, the crab, the centipede, three insects and a spider, three molluscs and three vertebrates, altogether thirty-two types. The directions for study are for the most part really directions, and not little paragraphs of condensed information; many of them take the form of questions. The student is not supplied with ready-made diagrams; he is asked precisely to draw certain things. There is a directness and business-like clearness about the whole book that we like, and its partiality is frankly admitted, supplementary text-books being indicated. It would have been well if the authors had always stated what particular species they had in view, *e.g.* what Tubularian and Campanularian hydroid or hydroids. In some cases the headings do not read very happily, if the book is to be used in Britain, *e.g.* "The simple Marine Sponge (Grantia sp.). This sponge is a marine animal, found commonly along the Atlantic coast of the United States." But we can recommend the little book as a terse, unpretentious, and clear guide to introductory studies of the structure of animals.

A Manual of Drawing. By C. E. Coolidge. Pp. iv + 200 (alternate pages blank). (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1902.) Price 1 dollar.

The drawings and designs made by the professional draughtsman in a good manufacturing workshop are characterised by a style and completeness which easily distinguishes them from the amateur productions commonly met with in the technical school and college. The object of the author in this book is to give to students precise and minute instructions relating to the numerous small details of manipulation and drafting that must be followed if drawings are to be such as would command respect in a commercial establishment.

Thus we find information about drawing and tracing papers, black and coloured inks, printing processes, drawing boards and squares, compasses, scales and protractors, indiarubber, drawing pens and pencils, and, in fact, about drawing tools and implements in general. Instruction is given as to the proper way of arranging the several views in a drawing, of inserting the dimensions, printing the titles, &c. Various types of drawing are described, including detail sheets fully dimensioned, with the machining and materials specified; general views, with only leading features exhibited; patent office drawings made in conformity with the United States' regulations, and suitable for photographic reproduction, &c.

The student is assumed to have obtained elsewhere a practical knowledge of workshop processes, of machine construction, and of the forms and proportions of machine parts. The author gives that kind of information which would be gradually acquired, almost unconsciously, by any one working alongside an expert in a commercial drawing office. The book contains a useful index and a number of plates in illustration of the text. Alternate pages are left blank in order to induce and enable the student to collect and record additional notes and observations of his own, or which his instructor may impart.

Zoologische Wandtafeln. Gezeichnet und herausgegeben von Prof. Dr. Paul Pfurtscheller, Wien. (Wien und Leipzig: A. Pichler's Witwe und Sohn.)

This is a new series of large wall diagrams for lecture-rooms, similar to those which we owe to Leuckart and Nitsche. The two samples we have seen—of the sea-urchin and the snail—command our admiration, especially the former. They are boldly and clearly drawn, with more shading than colour, and they stand out admirably from a distance. Two of those on the sea-urchin sheet are even beautiful. Our only criticism is that it seems a mistake to mix up *mere* diagrams, *e.g.* two simple figures on the snail sheet, with the chief picture, which shows things more or less as they are. The mere diagram can be drawn on the blackboard in a minute, and should not be put on the same plane as the elaborate drawing of the half-opened sea-urchin, which the teacher requires as a permanent part of his illustration equipment.

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.*]

Radium and Cancer.

IT has occurred to me that perhaps you would care to publish the enclosed letters, and thus start some one experimenting with the radium rays in the manner suggested.

Dr. Sowers is a distinguished physician of Washington, D.C., now spending a portion of his summer vacation in Baddeck, Nova Scotia.

ALEXANDER GRAHAM BELL.

Baddeck, N.S., July 21.

Dr. Z. T. Sowers,
1707 Massachusetts Avenue,
Washington, D.C.

Dear Dr. Sowers,

I understand from you that the Röntgen X-rays, and the rays emitted by radium, have been found to have a marked curative effect upon external cancers, but that the effects upon deep seated cancers have not thus far proved satisfactory.

It has occurred to me that one reason for the unsatisfactory nature of these latter experiments arises from the fact that the rays have been applied externally, thus having to pass through healthy tissues of various depths in order to reach the cancerous matter.

The Crookes's tube from which the Röntgen rays are emitted is, of course, too bulky to be admitted into the middle of a mass of cancer, but there is no reason why a tiny fragment of radium sealed up in a fine glass tube should not be inserted into the very heart of the cancer, thus acting directly upon the diseased material. Would it not be worth while making experiments along this line?

Yours sincerely,
(Signed) ALEXANDER GRAHAM BELL.

Baddeck, N.S., July 21.

Dr. A. Graham Bell,
Baddeck, N.S.

Dear Dr. Bell,

The suggestion which you make in regard to the application of the radium rays to the substance of deep seated cancer I regard as very valuable. If such experiments should be made, I have no doubt they would prove successful in many cases where we now have failures.

Yours sincerely,
(Signed) Z. T. SOWERS, M.D.

Baddeck, N.S., July 21.

The American Tariff and the St. Louis Exhibition.

As a member of the Royal Commission appointed to make a success of the British Section of the St. Louis Exhibition, I have, in common with some of my colleagues, been met by the difficulty, which for a time seemed an insuperable one, that our manufacturers could not be prevailed upon to send their goods to this exhibition, even though they would be admitted duty free, because the tariff had practically killed their trade with the country.

Even in the subject in which I am interested, instruments of precision, I have been met with this answer to such an extent that for a time I feared that the formation of a representative collective exhibit would be impossible.

I wish, if you will afford me the space, to point out to our manufacturers that in our class the incidence of the duty need not be so disastrous to trade as it must be in many others. Not only will instruments and other goods sold from the exhibition to public institutions in the United States be allowed to be sold free of duty, but instruments and other goods sold to public institutions in the United States from this country are also admitted free of duty. (See extract from Tariff Law below.)

As in the case of instruments of the highest class the requirements of public institutions are necessarily large in comparison with the demands of the public, more especially, I believe, in a country like the United States, where institutions of this kind are so liberally supported, and as this disparity is probably greater in the case of goods in this class than in any other, I hope you will enable me through your columns to urge our makers to reconsider any refusal to assist the Royal Commission in the formation of an adequate collective exhibit that may have been made on these grounds, and to avail themselves of such advantages as we are able to offer.

Section 638 of the Tariff Law of 1897 provides as follows:—

"638. Philosophical and scientific apparatus, utensils, instruments and preparations, including bottles and boxes containing the same, specially imported in good faith for the use and by order of any society or institution incorporated or established, solely for religious, philosophical, educational, scientific or literary purposes, or for the encouragement of the fine arts, or for the use or by order of any college, academy, school, or seminary of learning in the United States, or any State or public library, and not for sale, subject to such regulations as the Secretary of the Treasury shall prescribe."

It should be noted, however, that surgical instruments are not classified as philosophical or scientific.

C. V. BOYS.

The Eucalypts.

YOUR reviewer of two recent works on Eucalypts (April 2, p. 524) seems to require correction on certain points. *Eucalyptus globulus* cannot be considered as the first in economic importance amongst the Eucalypts. In almost every shade of extra-tropical climate there is to be found a Eucalypt which will grow as well, or better, than *E. globulus*, and yield a far superior timber. It is generally held now that Eucalypt planting has suffered by the indiscriminate praise showered on *E. globulus* by the early Eucalypt enthusiasts.

Your reviewer says, further, that Eucalypt plantations now exist in Italy, France, Algeria, California, and other countries. He does not appear to be aware that there is probably more Eucalypt plantation in South Africa than in any other country, and that at the present rate of progress there will, in a few years, be more Eucalypt plantations in South Africa than in all the other countries combined. There is no group of trees in the warm temperate regions of the world that can produce hardwoods of good quality so rapidly and so cheaply as Eucalypts, and their cultivation bids fair to become the central factor in the forestry of these regions. At this moment train-loads of Eucalypt timber are pouring into South Africa, Eucalypt sleepers displacing metal and creosoted-pine sleepers. South Africa will soon be paying out something like a *quarter of a million pounds yearly* for Eucalypt timber imported for railway sleepers and mining timber (little or none of this, by the way, *E. globulus*), so that any delay in the prosecution of Eucalypt planting in South Africa would be a most expensive proceeding. It is noteworthy that, so long as the Eucalypt is properly fitted to its climate, it seems to grow better in South Africa than in Australia, the explanation being probably that all the Eucalypts in South Africa have been raised from seed, and are thus growing in South Africa free from their Australian pests, both fungoid and insect. With the view of preserving this happy immunity from disease, the importation of Eucalypt plants into Cape Colony is placed under stringent restrictions.

The meritorious work of Messrs. R. T. Baker and H. G. Smith, if carried to a conclusion, should be the classic for many years on Eucalyptus oil. Your reviewer is mistaken in saying that practically all the Eucalypt species indigenous to Australia are included in their work. Practically, all the Eucalypts are indigenous to Australia, but they are not included in Messrs. Baker and Smith's work, which embraces 111 out of 120 described species of New South Wales and a few others from the neighbouring colonies of East Australia, but none of the well-known timber Eucalypts of Western Australia, Jarrah, Kari, Touart, red gum, York gum, &c.

It is a little disappointing that the authors were unable to obtain leaves of such a prominent Eucalypt as *Eucalyptus regnans*, the tree which shares with *E. diversicolor* the honour of being the tallest tree in the world. It is common enough in the Government plantations near Cape Town, as is also *E. alpina*, which figures also in the list of unprocurables. It is particularly unfortunate that they have not tested *Eucalyptus calophylla*, the type of the parallel veined Eucalypts. This is a West Australian species.

Messrs. Baker and Smith state that forty tons of Eucalypt leaves were used and 500 distillations made. Their work is a model of painstaking investigation, and to the chemist and those interested in the oil industry will no doubt prove extremely useful.

But the authors have not confined themselves to the chemistry of Eucalyptus oil. They propose a number of new Eucalypt species and a new classification of Eucalypts. How far the numerous new species will stand the test of critical investigation in the field remains to be seen. Many of their new species have already been contested.

Messrs. Baker and Smith have discovered that there is a relation between the venation of Eucalypt leaves and the chemical constitution of the oils of those leaves. Parallel veins and pinene go together. Many of the parallel veined leaves smell of turpentine like a pine leaf. Then come the peppermint Eucalypts, containing piperitone, with a more complex venation; and then a still more complex venation yielding oils rich in eucalyptol or cineol, which is the valuable constituent in the best Eucalypt oils. This is a very interesting and important correlation, especially if further investigation shows that it holds good through the whole Eucalypt genus. As chemists, one can pardon the authors their enthusiasm over it. But whether it is sufficient to found a new classification of Eucalypts on may be doubted. We have numerous Eucalypt classifications in the field. There is that which is generally accepted in default of a better, the anthereal system of Bentham, somewhat modified and simplified, but not improved in Mueller's subsequent works. There is a (perhaps more practical) bark system, and there are various obsolete systems founded on the shape of the cones and the flower buds. As Messrs. Baker and Smith most justly remark, a natural classification founded on a combination of all these, including the quality and structure of the timber, has yet to be made. It is not likely that their oil-and-vein classification will be sufficient in itself. It seems unlikely that anyone, except a scientifically trained forester, who has spent a large portion of his life among the Eucalypts in their natural forests, will be able to construct a sound natural grouping of the species of this difficult genus. The work will require a Mathieu, a Brandis, or a Gamble, that is to say, a practical forester with special scientific qualifications. It is not to be done with botanical specimens as Bentham and Mueller attempted it, nor with practical knowledge alone as Wools attempted it, nor in a chemical laboratory where Messrs. Baker and Smith have done most of their work! It is true that Mr. Maiden is now bringing out a "Critical Revision of the Genus Eucalyptus," and from this, with his great reputation as a practical botanist, much is expected. The first number, on that very important species *Eucalyptus pilularis* and its allies, has already appeared, also part ii. on *E. obliqua* and the gum-top stringy barks.

In view of the differences in the quality of the oil yielded by various Eucalypts, the authors advocate plantations in certain circumstances of good oil-yielding species. The lopping they suggest a forester would replace by coppicing. It is believed that all Eucalypts coppice well. Most of them will stand a considerable amount of lopping, but it eventually kills them. It is only in a few instances that species of Eucalyptus are found predominating over an area of country to any great extent, so that a particular species being worked for its oil may soon be cut out in close proximity to a permanent plant. But some Eucalypts are very tenacious of life, and "suckers" soon spring from the stumps of the trees cut down; it is thus only a matter of a few years when fresh material is again obtainable. This may be seen from the photograph of *E. Smithii*, where most of the dense growth is from "suckers" of this nature. We have been able to show, in several instances, that the oil obtainable from this young growth is of the same character as that obtained from the mature leaves, so that no great differences in the quality of the oil need be expected. But we think it to be a pity that the trees should, in many instances, be felled for their leaves alone. By judicious lopping a fresh supply of leaves could more quickly be obtained, so that a permanent supply might be assured. There are a few species of Eucalyptus, however, which form the prevailing vegetation in certain localities, and are found growing gregariously in their native habitat; this is particularly the case with some of the "Mallees." In New South Wales there are several species of this nature, as, for instance, the "Blue Mallee," *E. polybractea*; the "Red" or "Water Mallee," *E. oleosa*; the "Grey Mallee," *E. Morrisii*; and the "Argyle apple," *E. cinerea*; all these species give good eucalyptol oils, and all are more or less gregarious in their habits, so that natural plantations of these species are practically ready to hand; but besides these naturally covered areas the question of the cultivation of certain Eucalyptus species is of importance in this connection.

It may possibly be accepted as conclusive that some Eucalyptus species are not inexhaustible under certain conditions, and it is worthy of consideration whether plantations of young trees of *Eucalyptus Macarthuri*, for instance, might not be profitably cultivated for the preparation of its valuable geranyl-acetate oil. So with the eucalyptol oils, it is probable that the cultivation of some species, *E. Smithii*, for instance, could be profitably undertaken, and from which young growth an oil could be distilled that would compete satisfactorily, both in price and eucalyptol content, with any European oil of this class.

A minor fault running all through their book is their use of the word "sucker." By "sucker" is properly understood shoots from the roots, such as one sees in poplars, elms and willows. Eucalypts do not sucker (except rarely and accidentally), and the authors use the word in the sense of "coppice shoot." No doubt "sucker" is an Australian colloquialism, but naturally the use of slang expressions is to be avoided in a scientific work. To be accurate the authors should use the term early or first foliage, or its equivalent, since this important diagnostic feature is seen in the first foliage of Eucalypt seedlings equally with coppice-shoots.

As yet no one of the Australian colonies has taken the first step in scientific forestry. Though Mr. Maiden in his various writings has let in a flood of light on the subject, and the student of Eucalypts stands deeply in his debt, there is not a line by a scientifically trained forester descriptive of the forests of Australia. There is no want of liberality on the part of Australia in endowing the researches of scientific men living in cities, but there is a woeful neglect of forestry in the field. Scientific forestry as understood on the Continent of Europe is unknown in Australia, and unless the Commonwealth can bring its attention to bear on the terrible waste of its natural forest resources now going forward, its future history will be a black one, comparable only in modern times to that of the Spaniards in Mexico.

In the older settlements of East Australia the forests, pillaged of their best species, or burnt and ruined, have greatly declined in value. Gone are the valuable reserves of iron-bark, tallow-wood, and forest mahogany among the Eucalypts, and the splendid cedars (*Cedrela toona*) which should have been the country's pride. South Africa is getting most of its timber from the comparatively newly settled West Australia. The Australian has yet to learn to take the honey without destroying the bees!

When your reviewer takes us to America, we get amongst a people awakening to the fact that there is such a thing as scientific forestry. As he remarks, the American volume on Eucalypts is excellently got up. It is a pleasure to turn over the pages with their life-like pictures of Eucalypts. It is not likely, however, that there will ever be any great production of Eucalypt timber in North America. It is only South California that quite repeats any Australian climate, namely, South-West Australia. It is doubtful if Eucalypts will ever do much in the eastern States. The Gulf States, which are alone suited to Eucalypts, have their cold snaps and freezes, together with an all-the-year-round rainfall which we do not find in Australia, while there is an abundance of good hardwood already in the country, and the four pitch-pines, rivalling hardwoods in strength and durability. Eucalypt culture in America is still in its infancy; they have not yet discriminated the valuable from the many worthless species, nor fitted, as far as may be, the species to its climate.

D. E. HUTCHINS.
E. HUTCHINS.

Cape Town, June 23.

A Simple Form of Tide Predictor.

FOR the past four years a very simple form of tide-predicting machine, the invention of Captain A. Inglis, the harbour-master, has been in use at Port Adelaide for the construction of the yearly published tide tables. The tides at Port Adelaide are rather peculiar in their behaviour, this being due principally to the fact that the solar and lunar semi-diurnal components are almost exactly equal. At and near the neaps these neutralise one another, and the diurnal components, which are relatively large, are then the main sources of the tidal movement. Before these tides were harmonically analysed, their prediction by ordinary methods was quite impossible, except near the springs. By means of this machine, however, they are now predicted yearly with considerable accuracy. The essential principles of the machine are as follows:—A number of thin wooden templets are cut, each in the form of a sine curve, representing the various tidal components (Fig. 1). These waves are of different lengths, the length of each component wave bearing

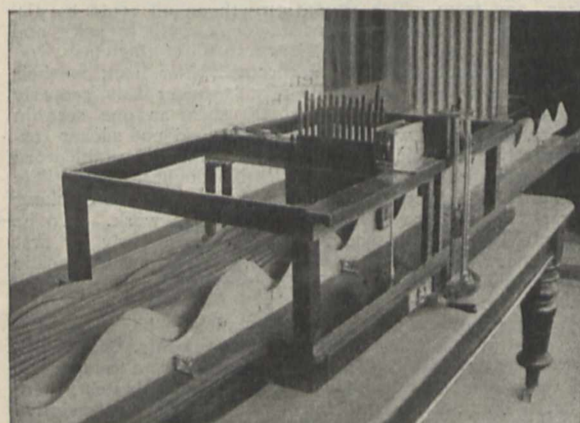


FIG. 1.

the same ratio to the solar semi-diurnal as its angular speed does to 15°. The templets are all fixed side by side, with their planes vertical and parallel, being supported on a carrier, which can be moved forward in the direction of the waves by means of a rack and pinion underneath. A number of vertical plungers rest in a transverse line with their lower ends resting on the tops of these templets, and are moved up and down as the curves progress forward. The motions of the plungers are then compounded by means of a fine wire passing over pulleys at the top of each one, and under fixed pulleys between adjacent ones. This wire is connected to an indicator, which moves up and down alongside a vertical scale, thus marking the height of the compound wave at any instant.

The wire passing over the plungers is an endless wire, going round a pulley on the indicator and round a larger pulley at the other end of the line of plungers. This larger pulley is attached to a plate which is movable backwards and forwards by means of a fine screw. This gives a means of adjusting the height of the indicator, and also of allowing for the effect of the annual and semi-annual tides. The rise or fall due to these long period tides is treated as constant for fourteen days, and the screw adjusted so as to alter the height of the indicator by the proper amount at the end of each such interval. In front of the frame of the machine, between it and the indicator, is a vertical slide, which is moved forward at the same rate as the carrier, and carries a sheet of paper on which the tidal curve may be traced if required (Fig. 2).

Each templet is fixed in the carrier in proper relative position according to its phase at the start, as determined by previous harmonic analysis. When the handle of the machine is turned, the carrier, vertical slide and clock are set in motion, and the indicator shows the height of the

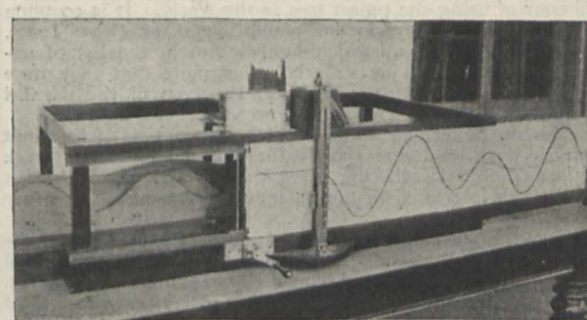


FIG. 2.

tide at the time shown by the clock, and the curve may at the same time be traced on the vertical slide.

There are three carriers and three or four templets to each component. When one of the carriers has been worked forward far enough, it can be disconnected from the others and connected up again at the other end. The curves are again placed in their respective grooves, and, by means of a suitable attachment, butted close up to the preceding ones. In this way the process is made continuous.

The setting of the curves can easily be checked at every month, to see that there has been no slipping.

The machine involves no expensive construction, and enables a year's tides to be predicted expeditiously, and, as experience has proved, with quite sufficient accuracy.

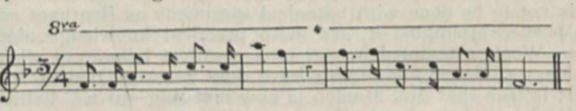
The University, Adelaide. R. W. CHAPMAN.

[In a subsequent letter, Mr. Chapman informs us that he made the following errors in the list of values of the tidal components at Port Darwin, printed in last week's NATURE (p. 295). "The amplitude of N should be 1·04, of ν 0·48, and of T 1·53. The phase of ν should be 141°, and that of T 70°."—ED. NATURE.]

Sympathetic Song in Birds.

IN your issue of April 30 (vol. lxvii. p. 609) Mr. George Henschel describes an interesting vocal duet between a bullfinch and a canary, and invites contributions to the subject.

In 1893 I obtained a nestling Australian magpie (*Gymnorhina tibicen*, Latham), and taught it on the flute to pipe the following:—



Some years later I acquired another bird of the same species; this learned the tune from the original magpie. I do not know how the birds agreed upon the duet (or fugue) rendering, but it was performed in the following way:—When the first bird commenced its song, the second one immediately came to attention, and with half-open beak awaited the point marked *, whence it finished the strain alone. The birds were kept in a large outdoor aviary in company with many others, and no matter where or how engaged, the second bird would, on hearing its mate, assume an attentive attitude, and await the conclusion of the first portion of the theme.

The second bird died, and the original one, which I still have, now pipes the whole strain alone, as was its original custom.

I may also mention that this bird has the faculty of absolute pitch, and pipes the theme in F as originally taught.

EDGAR R. WAITE.

Australian Museum, Sydney, June 18.

THIRTY YEARS OF UNIVERSITY EDUCATION IN FRANCE.

THE modern conception of a University in France dates from the Revolution. In place of the old Sorbonne, veritable Bastille of scholasticism, the new University was conceived as a kind of laboratory and clearing-house in which every form of knowledge was to be pursued or dispensed. Yet in spite of the multiplicity of the subjects, unity was to be secured by the natural connection between the different branches and the common aims and ideals of the teachers themselves. Unfortunately the Revolution failed to realise the grandiose ideas of Talleyrand and Condorcet. With the exception of the Institute, the only establishments it created were the so-called "special schools" limited to the study of a single science or group of subjects, such as, for instance, the school of mathematics, the school of medicine, the school of Oriental languages, &c. To these the Consulate added the schools of law and altered the title of many of these schools into that of "faculties." It further increased the number of faculties by adding those of letters and of science. The research side of university work was ignored, the faculties were mere examination machines for turning out professional men. The only university was the University of France, which, though made a corporate body by Napoleon, was above all things an institution for the propagation of an official education most favourable to Imperialism. To this university all the different faculties in the different towns were subordinated. But here all connection ended. Although often existing three and four together in the same town, they were completely strangers to one another, having no unity or even relationship with one another, almost entirely devoid of the necessary resources, not merely for original investigation, but also for their ordinary work.

The evils arising from such an excessive centralisation combined with the practical isolation of the local faculties were certain to make themselves felt in the long run. "Paris," wrote Guizot in his "Memoires," "morally attracts and absorbs France." For this, in his eyes, the only remedy was the creation of a few large provincial universities. Recognising the impossibility of creating seventeen complete and fully equipped universities, he proposed to limit their number to four. Unhappily he was in advance of his time. The second Republic reduced the status of the university itself from that of a corporation to a mere branch of the central Government. The most enlightened Education Minister of the Empire, Victor Duruy, seeing the impossibility of reforming the faculties, determined to establish alongside of them a scientific institution called the École des hautes Études, which reminds one, though its scope was wider, of the Royal College of Science, inasmuch as the savants who formed the "personnel" were chosen on their merits alone, and no question was made as to whether they were members or not of the university. The school had no fixed quarters, but any professor of ability in the Sorbonne, the Collège de France, the Museum of Natural History, or in any laboratory, was pressed into the service of this new corps of learned and scientific teachers. The effect of the opening of this "opposition shop" was most beneficial on higher education throughout the whole of the country.

Nevertheless the general condition of higher education was, in the words of M. Liard, "very lamentable, and what was most lamentable of all was not the insufficiency of the buildings, the poverty-stricken state of the laboratories, collections and libraries, or the dearth of resources, but the almost absolute misconception of their real functions by the professors of those faculties which ought to have been above all the instruments of scientific progress and of the propagation of scientific methods. With a few exceptions, in the faculty of letters the teaching was above all rhetorical and fashionable, in that of science it was nearly everywhere limited to the mere popularisation of discoveries. The highest work of university education, the training and formation of the man of science, was almost unknown. The admirable savants of the time were self-taught persons without a university degree."

Such was the state of things when the disaster of 1870 occurred. With the conclusion of peace, savants and patriots joined forces in favour of a radical reform of the university system. It was felt that inefficiency in higher education had been one of the causes of national defeat.

The most competent judges were agreed that the essential defect in university education was the multiplicity and isolation of the faculties. The remedy in their eyes was the concentration of the faculties of the different orders into a limited number of "powerful centres of study, science and intellectual progress." Jules Simon affirmed the necessity of "having a certain number of intellectual capitals in which are to be found united all the necessary resources for the complete development of the young." Again, according to M. Laboulaye, universities were the one thing needful. "Let them cease to scatter over the surface of France faculties the isolation of which condemned them to sterility."

Some of the strongest arguments in favour of reform came from the men of science of the day. It was pointed out that the duty of the Universities was not merely to distribute the existing stores of knowledge, but also to lead in the van of discovery. "Close the laboratories and libraries," said Bertholet, "stop original investigation and we shall return to scholasticism." Insistence was also laid on the extreme value of scientific discovery as a factor in the industrial struggle between the different nations, while at the same time the importance of introducing the scientific spirit into the mental life of a people only too often swayed by sudden emotions was strongly emphasised.

But the advocates of university reform had a very serious difficulty to encounter at the outset. Alongside of the faculties there already existed the big scientific establishments like the Collège de France, the Museum of Natural History, and the professional schools, such as the École Polytechnique and the École Normale, in which the flower of military engineers and university professors were being trained. All these bodies were bitterly hostile to incorporation. Fortunately they were all situated in Paris, where in reality there was room both for themselves and the University. The main problem after all was the creation of provincial universities.

Here the difficulties were far more real and pressing. To begin with, many of the existing professors in the faculties were by no means in sympathy with the reformers. For them the function of the faculties was to turn out lawyers, magistrates, doctors, pharmaceutical chemists (the calling of chemist in France ranks as a liberal profession), not to conduct original research. Did not the Collège de France and the Museum of Natural History exist specially for these purposes? The answer was one which has since been given in higher technical education in England and elsewhere, that science should be the centre of professional training. Practice without science was pure empiricism, and empiricism was out of date. Claude Bernard had already converted medicine into an experimental science, and the historical method had wrought a similar transformation in the study of law. Whether the faculties remained isolated or not, they would henceforth have to adopt scientific methods. Naturally every student could not be turned into a man of science, but every one had a right to know the scientific truths on which his professional education was based, while the small élite of really talented students should have the opportunity of engaging in scientific investigation. In the case of these exceptional students the method of working in common with their masters had hitherto been largely neglected. Yet its importance in working out a discovery to its fullest extent is not only beneficial to all parties, but often of the highest importance to the country at large. Another objection urged by the opponents of reform was that a university by definition implies the concentration of subjects, whereas modern science on the contrary is fissiparous by nature, ever splitting up into new branches and specialities. To this it was easily answered that one of the chief dangers of the day was excessive specialisation, and that the university is therefore the best antidote, as its chief function is to coordinate knowledge and make it a general object of culture. Warned by the excessive specialism that is rampant in German universities, the French have taken for their motto, "Specialisation subordinated to a general culture."

In 1883 Jules Ferry brought the question within the sphere of practical politics by a circular addressed to the faculties; after speaking of the efforts he had made to develop in higher education the sentiment of responsibility and the habit of self-government, he went on to say:—

"We shall have obtained a great result if we are able to constitute one day universities uniting within themselves the most varied kinds of teaching, in order mutually to assist one another, managing their own affairs, convinced of their duties and of their merits, inspiring themselves with ideas suitable to each part of France with such variety as the unity of the country allows, rivals of adjoining universities, associating in these rivalries the interest of their own prosperity with the desire of the big towns to excel their neighbours and to acquire particular merit and distinction."

In conclusion he invited the faculties to give their opinions on his suggestion. These were, in the main, favourable. It was left, however, to his successor, M. René Goblet, to take the first official steps. It was evident to all that the new universities could not be constituted after some ideal plan, but would naturally have to be built up out of the existing faculties. To group the latter in collective wholes, effacing all distinction between them, would have proved too drastic a measure. The best way of building up a university was to begin by strengthening and not by weakening the faculties. This was done by restoring to them the "personalité civile" which had lapsed, and recognising their capability to receive and hold property. At the same time another decree, without giving them the absolute right to frame a budget, allowed them the right to expend all subventions, to which no conditions had been attached by the parties making them, whether departments, communes, or private individuals, on the creation of new courses of instruction, on laboratories and libraries, and on scholarships. To regulate this expenditure a council was created called the "Conseil général des Facultés." This council, established for purely financial reasons, was destined to become the real nucleus in the development of the universities. As M. Liard has well said, "the decree of 28th December, 1885, was truly the provisional charter of the universities before the universities." Linking together the faculties of a single town, the Council not only dealt with the functions for which it was first created; it was soon allowed, under certain conditions, to draw up the programmes of courses and lectures, to exercise certain disciplinary powers, to make financial proposals to the Minister, and to engage in a multiplicity of tasks which fall to the lot of an ordinary university to perform. In 1889 the separate faculties received the right to frame budgets of their own. At the same time those grants were directly paid to them which the Ministry previously had itself expended on buildings and equipment. So far the Government had only proceeded by way of decrees, a method which is not unknown in England, and corresponds roughly to an order in council, but in 1890 the moment seemed to have come for legal enactment, and M. Léon Bourgeois, the then Minister of Public Instruction, brought forward a Bill to settle the whole subject once for all.

Nothing gives a better idea of the enormous sacrifices made by the Republic for the sake of higher education than the preamble of the Bill, which ran as follows:—

"The Republic has understood that university education is in the highest degree necessary; that if primary education is, according to the phrase of one of our predecessors, the canalisation by which knowledge is distributed to the very lowest strata of democracy, university education is the source where it collects and whence it flows. It has understood that a particular dignity and utility are attached to this grade of education, that in it especially are formed and trained the men who are capable of conceiving general ideas, by the power and novelty of which the real influence of nations is measured to-day. Therefore it has liberally given to it the necessary millions which had been persistently refused by former administrations.

"In the last 15 years it has renewed the buildings of the faculties.

"It has supplied almost entirely their equipment, their laboratories, their libraries.

"It has enlarged and increased the scope and range of their teaching.

"It has more than doubled their budget.

"It has improved the position of the 'personnel' and endowed their teaching with the requisite resources.

"It has created two categories of student, formerly unknown in France, students in science and in letters.

"It has introduced more science into those courses in which the preoccupations of professional studies predominated, and it has imposed a professional task on those orders of faculties which were without it.

"It has restored to the faculties the 'personalité civile,' a right which a suspicious *régime* had denied they possessed.

"It has rendered relationship possible between them by giving them a common function to fulfil.

"It has given full liberty to science and theory.

"It has favoured the coming together of students as well as that of teachers.

"In conclusion it has seen the number of its students rise from 9000 to more than 16,000, foreigners returning to its schools, and frequenting them in greater numbers than in any other country in Europe."

The Bill itself proposed to create universities in the fullest sense of the word out of the existing groups of faculties in the seven largest towns. Unfortunately local influences proved too strong; the other ten towns possessing two or more faculties demanded equality of treatment. The former adversaries of the project joined forces with them, and in the end the Government was obliged to withdraw the Bill.

Beaten on the question of establishing local universities of the fully equipped type, the reformers took once more the line of least resistance, and in 1893 an Act was passed investing with the "personalité civile" the groups of faculties formed by the union of several faculties, and represented by the Conseil Général. This was followed in 1896 by an Act introduced by M. Poincaré, which converted these groups of faculties into universities. The idea of full and complete universities, which had been the underlying conception of the Bill of 1890, was abandoned, and wherever an academy existed, even if it had but two faculties, its place was taken by a university. As M. Liard well says, "it was a choice between having too many universities or of having none." To provide funds, the tuition fees, which had hitherto gone to the Treasury, were handed over to the new bodies. The examination fees, however, were still retained by the Treasury. The law contained but four clauses. The first decided that the groups of faculties should take the name of universities. The second decided that the Conseil Général should receive the title of university council. The third enlarged the disciplinary powers of the new council. The fourth dealt with the financial arrangement mentioned above, the new funds provided being "earmarked" for certain definite purposes, such as expenditure on laboratories, &c. Certain other financial rearrangements were made, with the result that the extra cost to the State came to about 15,000*l.* a year. The existing "personnel" was paid, as before, by the State, and the regular grant, variable year by year, for buildings and equipment was likewise continued. By the law of 1899 the universities were allowed to establish "degrees of a purely scientific kind." This was largely done to encourage the attendance of foreigners, while the proviso that they conferred no rights or privileges safeguarded the State from incurring any responsibilities *vis à vis* their recipients.

The preamble of the Bill of 1890, quoted above, gives an adequate summary of the progress made from 1870 up to the university year 1888-1889. More detailed information of the progress since that date is to be found in the "Statistique de l'Enseignement Supérieur," which brings up the record to the university year 1897-98 (the last year available). The following are some of the principal items of interest. Though the French universities have not, with very rare exceptions, found any benefactors on the scale of the Rockefellers and Carnegies, the list of benefactions published in full shows that the power of the new universities revived in 1875 to receive donations and legacies has not remained unappreciated. The University of Paris has received such lump sums as 210,000*l.*, Montpellier such as 60,000*l.*, while several have received donations of 4,000*l.* or less. In 1889 the annual grant from the State amounted to about 456,284*l.* In 1898 it was more than 523,640*l.*, showing an increase of 67,000*l.* odd over the grant of ten years before, which itself was more than double the grant under the Empire. Though the universities received the above sums in hard cash, the actual cost to the State was less, as one must deduct from it the fees for degrees, which, as has been already stated, go into the coffers of the State. These amounted to 5,135,162 francs in 1898, or, roughly, 205,406*l.* The net expenditure, therefore, of the State was about 318,000*l.*

The departments and municipalities make contributions to nearly all the universities, their contributions being "earmarked," as a rule, for specific purposes. They practically support all the medical schools, whether situate at the seat of the university itself or within its area of control, the only exceptions being Paris and Bordeaux, which also receive a State subvention. The contributions of the departments and municipalities to the budgets of the university and faculties amount to about 68,000 francs and 132,000 francs respectively; their contributions to the medical schools unsupported by the Government, and to the so-called preparatory classes in letters and science amount to about 135,500 francs and 882,000 francs respectively. The total income of the universities, including these medical schools, but excluding the Collège de France, the Museum, and the various special schools, amounts to about 14,142,000 francs for the universities, and 1,582,858 for the medical and preparatory schools, in all a grand total of about 15,725,000 francs. Towards this total the State contributes 13,096,664 francs, the departments about 203,000 francs, and the municipalities about 1,014,000 francs; the rest is made up of students' fees, legacies, and contributions by societies and private persons. As, however, the towns receive from university sources the sum of 421,837 francs, their net contribution is only about 593,000 francs, or roughly about 23,720*l.*

Since 1888-89 the number of students has risen in a remarkable fashion, though no doubt this increase is due in part to the law which grants two years' exemption from military service to those who have passed certain examinations. In 1888-89, the number of students was about 16,000, in 1898 the total had risen to 28,782, of whom 871 were women, and no less than 1784 of foreign nationality. All the faculties show an increase in the number of students during the same period, but those in science (a school which did not exist before the Republic) show the greatest increase. Their numbers have risen in the last ten years from 1187 to 3424.

The Baccalauréat shows the same remarkable increase. Certain changes in the examination do not permit of a comparison being drawn with any year earlier than 1892–93. In that year there were 25,612 candidates for the different sections of the examination, of whom 11,518 passed. In 1897-98 there were 36,922 candidates, of whom 16,688 passed. The other establishments of university rank, the Collège de France, the Museum of Natural History, the École Normale Supérieure, the École pratique des hautes Études, &c., all received an increased grant in 1898 in comparison with the last decennial account. The Collège de France, which is entirely devoted to research work, contains no less than forty-two chairs, and receives from the State nearly 21,000*l.* a year. The Museum of Natural History, equally devoted to research, has a budget of more than 38,000*l.* The school of Oriental languages, which has no counterpart in England, though we have a far greater need of one, receives more than 6000*l.* a year. The École des Chartes receives more than 3000*l.* The École pratique des hautes Études receives more than 12,500*l.*, as well as more than 1500*l.* a year from the City of Paris. The majority of these institutions have enormously developed, if they have not been actually created, under the Republican *régime*.

One word must be said in conclusion for the free universities founded in 1875, when the university monopoly in higher education was abolished. At first permitted to grant degrees similar in name to those of the official world, they have since lost the right. In spite of this they have none the less continued to increase. In 1888-89 their students numbered 726, in 1897-8 they had increased to 1407. It is difficult to say what will be their fate under the present campaign to re-establish the monopoly of the State in education. The higher schools of art and technology being under more or less separate authorities do not figure here in the list of higher education.[1] The present *régime* has been equally liberal and equally successful in dealing with these important branches of national education. Whatever may be the final verdict of history on the Republic, its bitterest critics will never be able to contest the fact that only Prussia after Jena can compare in any way

[1] The schools of art are under a separate department in the Ministry of Public Instruction and Art. The higher schools of commerce and technology are under the Ministry of Commerce.

with the thoroughness and success with which it has reformed and revivified every branch of higher education. CLOUDESLEY BRERETON.

Principal works consulted:—" Ministère de l'Instruction Publique et des Beaux Arts; (1) Statistique de l'Enseignement Supérieur; (2) Introduction à la Statistique de l'Enseignement Supérieur, par M. L. Liard, Directeur de l'Enseignement Supérieur. (Paris: Imprimerie Nationale, MDCCCC.) (3) " Législation et Jurisprudence de l'Instruction Publique. Extrait du Répertoire du Droit administratif." Première partie, Historique et Organisation générale; Deuxième partie, Enseignement Supérieur; Sixième partie, Écoles ne relevant du Ministère de l'Instruction Publique. (Paris: P. Dupont, 1903.)

THE RESUSCITATION OF THE APPARENTLY DROWNED.

IN 1862 a committee, which included several eminent medical men and physiologists—amongst the latter Dr., now Sir, John Burdon Sanderson—was appointed by the Royal Medical and Chirurgical Society to investigate the phenomena attendant upon drowning, and the methods which had been recommended for the recovery of apparently drowned persons. That committee made a number of experiments in man upon the dead subject, and upon animals during life, and the results they obtained were duly published in the *Transactions* of the society. But it appeared important to renew the inquiry with modern methods, and a second committee for the investigation of this important subject was accordingly appointed a few years ago, with Prof. Schäfer as chairman. This second committee attempted, in the first instance, to pursue the inquiry as to the best means of carrying on artificial respiration, in the same manner as the 1862 committee, *i.e.* upon the cadaver, but met with grave difficulties from the outset in the enormous resistance which the condition of *rigor mortis* sets up to effecting changes of volume of the chest, a difficulty which had been also met by the earlier committee, and very imperfectly surmounted. The new committee accordingly decided to discard the cadaver, and to endeavour to determine in the living human subject how great an amount of air could be moved into and out of the lungs by movements imparted to the thorax by the agency of external force. This force was applied either by intermittent traction upon the arms, or by intermittent pressure upon the thorax, the subject being either in the supine or prone position, and remaining perfectly passive during the short period of the experiment. The amount of air taken in and given out was measured in a graduated vessel, or by means of an ordinary gasometer.

The results showed that by all methods which have been suggested for the performance of artificial respiration, viz. the Silvester traction method, the Marshall Hall rolling method *plus* compression of thorax, the Howard method of compression of thorax in the supine position, and also a similar method of pressure upon the thorax with the subject in the prone or semi-prone position, an amount of air can be drawn into and driven out of the thorax which is at least as great as the amount of air exchanged in the ordinary tidal respirations of the individual. This being so, it is evident that, in selecting a method of artficial respiration for restoring the drowned, one should be guided less by the actual amount of air which any given method is capable of exchanging than by other considerations, such as the facility offered for the escape of water and mucus from the air passages, and the preventing of the tongue from falling back and blocking the fauces, both of which objects are better attained by the lateral and prone than by the supine position. It was further clear that it is more easy to effect artificial respiration by exerting intermittent pressure upon the thorax than by arm traction, and although the committee do not give instructions for the restoration of the apparently drowned in their report, it is obvious that their conclusions point to the adoption of the prone or semi-prone position of the subject, and to rhythmically intermitted pressure upon the thorax, as the methods which are likely, in the circumstances of drowning, to yield the best results.

The experiments upon animals (which were performed almost entirely upon anæsthetised dogs) are, it is believed, the first in which all the phenomena connected with the circulation and respiration have been graphically recorded during the process of drowning and subsequent resuscitation by artificial respiration. The chief points which they illustrate are the very large amount of water which can be taken into the lungs and become entirely absorbed into the system within a few minutes, without producing any but quite temporary symptoms, the great amount of vagal stimulation which is produced during drowning, and which is, in some instances, sufficient to arrest the heart's action almost entirely, and the extreme variability in the power of resistance to drowning in different individuals of the same species, so that, while a submersion of two minutes is fatal to some individuals, one of seven or eight minutes, or even more, can be borne by others with a fair chance of recovery as the result of the application of artificial respiration. The experiments all point to the supreme importance of commencing artificial respiration at the earliest possible moment, and are, therefore, condemnatory of all instructions for the recovery of the apparently drowned which direct that, before proceeding to apply artificial respiration, the patient should be divested of clothing, hartshorn should be applied to the nostrils, and various other remedies attempted—all of which merely serve to waste time, every second of which is invaluable for combatting the actual condition which is threatening life, viz. the lack of oxygenation of the blood. Incidentally it was found in the course of these experiments that, without sufficient aëration of the blood, even the most powerful cardiac and vascular stimulant—such, for example, as the extract of suprarenal capsule—is entirely unable to assist recovery.

The experiments upon the cadaver were chiefly performed by Mr. Pickering Pick, Mr. Henry Power, and Dr. J. S. Bolton, in London; those upon the living subject by Prof. Schäfer and Dr. P. T. Herring in the physiological laboratory of the University of Edinburgh. The report of the committee was read by Prof. Schäfer at a largely attended meeting, held on May 26 last, at the rooms of the society in Hanover Square.

NOTES.

WE regret to learn that on Saturday, July 25, M. Prosper Henry, of the Paris Observatory, was found lying dead in the La Valoise Valley near Pomogen at an altitude of 1600 metres, in the French Alps. His death appears to have been due to congestion caused by extreme cold. M. Henry was buried at Nancy, his birthplace, on August 1. A number of astronomers was present at the sad ceremony, among them being M. Callandreau, of the Paris Academy of Sciences; MM. Borchart and Fraissinet, of the Paris Observatory; and M. Trépied, director of the Algiers Observatory. M. Prosper Henry and his brother, M. Paul Henry, were attached to the Paris Observatory in 1865, and their work is well known in the astronomical world. Between 1872 and 1882 they discovered fourteen asteroids, and in the latter year took up the work in celestial photography which has rendered their name famous. It is not too much to say that in many ways they have been the real founders of La Carte du Ciel.

AN International Conference on Wireless Telegraphy was opened at Berlin on Tuesday. We learn from the *Times* that Great Britain is represented by Mr. J. C. Lamb, Mr. J. Gavey, and Mr. R. J. Mackay, of the General Post Office, Captain H. L. Heath, R.N., Lieut. C. R. Payne, R.N., and Colonel R. L. Hippisley. Herr Kraetke, the Imperial Secretary of State for the Post Office, who opened the conference, said that it was intended "to make a clear road for the further extension of wireless telegraphy in order that, all special interests being set aside, the new means of communication might gradually develop to the common benefit of all seafaring peoples. This could only be brought about by the harmonious cooperation of the States interested in the shipping trade." The business of the conference is, however, only preliminary, the main object being to fix upon matter for discussion at a subsequent international conference. This later conference will probably be largely occupied in considering the possibility of standardisation with a view to intercommunication between different systems. We have often pointed out in these columns the extreme desirability of such intercommunication from the point of view of public safety and convenience. When the problem of syntonisation is solved, it will no doubt be possible for one system to work entirely independently of all others, but until that time it is practically necessary that some working arrangement should be made between the different systems which will allow the public to derive from wireless telegraphy the full advantage that it can, as yet, bestow.

MR. R. LYDEKKER, F.R.S., has been elected a foreign member of the R. Accademia dei Lincei, Rome.

MR. W. R. OGILVIE-GRANT, of the Natural History Museum, has returned from his trip to the Azores with a large collection of birds, insects, and land molluscs, the latter including some forms of special interest.

WE learn from the *Times* that Dr. Ludwig Mond, F.R.S., whose death was incorrectly announced by some papers last Saturday, is approaching complete recovery from a nervous breakdown on the shores of Lake Leman.

THE Civil Service Supplementary Estimates include the sum of 45,000*l*. to pay the expenses of the two relief ships *Morning* and *Terra Nova*, which are being sent out by the Admiralty to the relief of the *Discovery*. The estimate includes provision for the purchase of the *Terra Nova* and for the wages of the crews of both vessels; also for stores, coals, provisions, &c.

SEVERE earthquake shocks were experienced in several parts of Italy and Spain last week. Reuter's correspondent at Rome states that several houses and churches at Filattiera and Mulazzo were destroyed by an earthquake on July 31, and a message from Madrid states that at Albuñon, in the province of Granada, severe earthquake shocks, followed by loud and prolonged subterranean rumblings, were felt on July 26, 27 and 28.

THE council of the Institution of Electrical Engineers has now, with the approval of the Physical Society, undertaken the publication of *Science Abstracts* as an Institution publication. In connection with this work, Mr. Louis H. Walter has been appointed editorial assistant to the secretary, and will take up his duties in the autumn.

THE death is announced of Prof. Edmond Nocard in his fifty-fourth year. Prof. Nocard, who was principal of the Veterinary School at Alfort, near Paris, had a world-wide reputation as a veterinary pathologist, and was the author of several important works, of which his "Maladies microbiennes des Animaux" (written in collaboration with Prof. Leclainche) has just reached a third edition. He was also one of the co-editors of the Pasteur's *Annals*. He attended the Tuberculosis Congress in London in 1901, and was a strenuous opponent of Koch's view of the non-transmissibility of bovine tuberculosis to man.

A MEETING of the general committee of the Cancer Research Fund was held on Friday last, July 30, Mr. Balfour, one of the vice-presidents, occupying the chair in the absence of the president, the Prince of Wales. The first annual report, which was submitted, showed that a large amount of preliminary work had already been accomplished during the few months the Cancer Research Fund has been in existence. It was deemed premature to make any detailed statement of the experimental work in progress, but an indication was given that considerable importance is attached to the study of cancer as it occurs spontaneously in the lower animals. For the purposes of this branch of the inquiry, it is sought to secure adequate farm accommodation. Certain statistical data are also in progress of compilation with regard to the proportion of cases in which the clinical diagnosis is verified by the pathological findings, in order that the value of the data upon which existing statistical conclusions are based may be determined and sources of fallacy obviated in future. Sir William Broadbent, in moving a vote of thanks to Mr. Balfour, stated that he thought that in the course of the work now being inaugurated, the nature, cause, and cure of cancer would be arrived at. Whatever method of cure might be proposed, it would receive careful investigation. Mr. Balfour, in his reply, alluding to the interest which everyone must take in the cancer problem, said he was surprised that only 213 persons had contributed to the fund. One anonymous donor had promised 5000*l*. if thirteen other individuals, or groups of persons, would each contribute a like amount, but up to the present this appeal had not been successful. Considering the progress that had been made in all departments of medical science during the last century, he believed that there was every reason to hope that the investigations of the committee would ultimately prove successful. The Cancer Research Fund now amounts to about 52,000*l*., but in order to pay the expenses of the work out of the income of the fund, the amount originally estimated, viz. 100,000*l*., will be necessary.

A CORRESPONDENT of the *Times* states that Lieut. Kolchak has started from the Arctic coast for the New Siberian Islands in search of Baron Toll, the head of the Russian Polar expedition which left St. Petersburg three years ago in the yacht *Zaria*. If Baron Toll be not found on the New Siberian Islands, then Lieut. Kolchak will endeavour to reach Bennett Island, about eighty miles further north-west. A year ago last May Baron Toll, with the astronomer Seeberg and two native Yakuts, left the *Zaria* off Kotlin Island with a view of reaching Bennett Island over the ice. In case the *Zaria* should not be able to follow them, which eventually turned out to be the case, the party hoped to be able to return independently to the New Siberian Islands; but it is supposed that Baron Toll had not dogs enough with him for this purpose, and was therefore obliged to winter on Bennett Island. In regard to food, all the members of his party are excellent hunters, and in case the baron should have succeeded in making his way back to the New Siberian Islands in the spring, he and his companions will have an ample supply of provisions in the stores which he himself left there for Nansen in 1893. According to notes left by Seeberg on New Siberia, which is the last news received of the expedition, Baron Toll's party must have left there about the beginning of July of last year to explore Bennett Island.

IT is announced that a wireless telegraphy station is to be erected at Port Arthur at a place known as Golden Mountain. The object is to establish regular communication with Russian warships in the Gulf of Pechili. The system to be used is not stated.

THE Cable Makers' Association, which represents the chief makers of insulated wire in this country, has decided to put on the market a special quality of flexible cord which shall be quite safe and trustworthy under all conditions of ordinary use. The importance of installing good quality flexible cord cannot be overestimated, as the loose wire is subjected often to rough treatment, and is very liable to be in the neighbourhood of inflammatory material. The cord which the Association proposes to make is to be insulated with pure and vulcanised indiarubber, and will have a minimum insulation resistance of 600 megohms per mile after twenty-four hours' immersion in water; the insulation will also be tested with 1000 volts alternating current for fifteen minutes. The cord will bear a special label and trade mark for the purpose of distinguishing it.

THE twenty-fifth annual report of the Deutsche Seewarte for 1902 will be noteworthy in the history of that useful institution by the retirement of Dr. von Neumayer, who had been director since January, 1876, and of Captain Dinklage, marine superintendent, after twenty-two years of very active work. The long list of meteorological logs received from the navy and mercantile marine shows that this branch of the service has been carried on with great activity; 556 steamships and 198 sailing vessels contributed observations during the year. The results appear in various useful publications, including daily synoptic charts and monthly pilot charts of the North Atlantic Ocean. The department of storm warnings and weather telegraphy has also been conducted with unabated vigour, to the success of which the recent establishment of a telegraphic service at 7h. a.m. has greatly contributed. The daily weather report issued by this department is one of the most valuable publications of the Seewarte, and includes observations from all parts of Europe.

WE have received the report of the Government astronomer of Western Australia, containing meteorological observations made at the Perth Observatory and other places in the colony during the year 1901. Very complete observations are published for the observatory, including temperature of the soil and evaporation, together with monthly means from the year 1876. General summaries are also given for more than forty climatological stations and rainfall statistics for a large number of places. Morning and evening weather forecasts form part of the routine work, and the results show that they have been remarkably successful; the general forecasts issued at noon, for the whole State, attained a complete success of 93 per cent. During the latter portion of the year astronomy also formed a prominent feature of the work of the observatory.

IN the *Zoologist* for July Mr. T. E. Lones discusses the identification of some of the birds mentioned by Aristotle, and shows that certain of the names have a generic rather than a specific sense. It appears that the name *boscas*, now used for the mallard, really indicates the widgeon, while *netta*, now employed as the generic title of the red-headed pochard, properly denotes the first-named bird. In a second article Mr. R. C. J. Swinhoe publishes a fuller account of the *gisement* of the now celebrated chipped flints from Yenangyoung, Burma, and concludes that, in place of Pliocene or Miocene, they are really of late Neolithic, if not of the Iron, age. Mr. Lydekker has a note on the gaur of Burma, which is regarded as subspecifically distinct from the wild ox of India, and named *Bos gaurus readei*.

A COLLECTION of molluscs from the Vicksburg marls has enabled Mr. T. L. Casey to describe a considerable number of new species and genera in a recent issue of the *Proceedings* of the Philadelphia Academy. In the same journal Mr. A. E. Brown attempts to bring into something like order the various forms of garter-snakes (Eutænia) from the Pacific Coast of North America which have received distinct specific and subspecific names. Much interest attaches to a note by Miss S. P. Monks in the serial under consideration in regard to regeneration in starfishes. It has been stated that a fragment of a ray, without any portion of the central disc, cannot give rise to a new animal. This is disproved by the new experiments, in which the amputated free rays developed new bodies, while the mutilated starfishes produced new rays.

FROM among a series of papers published in the *Proceedings* of the U.S. Nat. Museum, special mention may be made of the following. In No. 1345 Mr. B. A. Bean records from Barbados an example of the small eel, *Ahlia egmontis*, hitherto known only by the type specimen from Florida. Reference is also made to a third example of the species from Florida. In No. 1341 the Rev. T. R. R. Stebbing describes two new species of amphipod crustaceans from Costa Rica. The walking-stick insects (Phasmidæ) of the United States form the subject of a paper (No. 1335) by Mr. A. N. Caudell, while Mr. W. H. Dall (No. 1342) contributes a synopsis of the bivalves of the family Astartidæ, with special reference to the American species. Finally, Mr. S. F. Clarke (No. 1343) shows that the Alaskan hydroid polyp, described by himself as the representative of a new family and genus (Rhizonema), belongs to one or other of the well-known genera Corymorpha and Lampra, the imperfect condition of the Alaskan specimens preventing closer identification.

IN *Animal World Illustrated* (the official organ for the R.S.P.C.A.) for July, Mr. E. V. Windsor, in an article entitled "Reflections by a Lover of Nature," passes an unqualified condemnation on insect collecting, as practised by the school-boy and the amateur entomologist. Stuffed birds as objects of decoration are likewise condemned, and we presume, although this is not stated in so many words, that collections of birds' skins, except in museums, would likewise come under the writer's ban. While we have much sympathy with Mr. Windsor's views, more especially as regards the stuffed birds, we believe that he carries these views somewhat too far. For instance, when he says that "there is little or nothing to be learnt from a creature when dead," we beg to join issue with him. Again, we have the following passage:—"In every branch of natural history this wanton slaughtering is, I fear, practised. In branches other than those I have just referred to it is practised almost exclusively by men who have a real claim to the title of naturalist, because these branches of natural science not being so popular, there are fewer amateurs." If by this the author means to condemn museum collecting, he cannot have our sympathy. As regards the contention that nobody should collect without fully studying the habits of the species collected, we are in full accord with Mr. Windsor; but this by no means implies that collecting, under proper restrictions, should be abolished *in toto*. Were this to be done, it is probable that young collectors would confine their attentions to stamps and such like, whereby many a promising recruit would undoubtedly be lost to science.

THE *Agricultural Journal of the Cape of Good Hope*, the official publication of the Cape Department of Agriculture, is meant to circulate among the farmers of the Colony, and contains popularly written accounts of investigations conducted by the experts attached to the Department, articles on general farming, reports on farmers' congresses, legislative enactments, and other matters of agricultural interest. The current number (vol. xxii. No. 6, June) contains plenty of evidence of the difficulties which beset the South African farmer—infectious and parasitic diseases of all kinds among his stock, insect and fungoid pests among his crops. The two most active branches of the department are evidently those dealing with veterinary medicine and insect entomology; investigations of soil and manure problems are hardly of much consequence to the Cape farmer as yet. While the greater part of this number deals with veterinary matters, we get incidental allusion to one of the questions upon which the future of South African agriculture must depend, the successful introduction of suitable forage crops to carry stock through the winter; such plants as lucerne (alfalfa) or turnips are not in the regular routine of farming, and through the winter, when there is no grass on the veldt, the animals practically starve. We learn, too, that wheat-growing, as in some of the Australian colonies, must depend upon the introduction of rust-resisting varieties; in the absence of sorts remaining rust-proof there is at present little prospect of South Africa contributing to the "Granary of the Empire."

THE geology of the Cheadle Coal-field is described by Mr. George Barrow in a handy pamphlet of sixty-two pages, with a small colour-printed map attached to it, issued by the Geological Survey. The price is 2*s*. The area is an outlying portion of the North Staffordshire Coal-field, and Mr. Barrow gives full particulars of the seams of coal, with records of borings, and remarks on the probable extent of the workable measures. The underlying Millstone Grit and overlying Bunter and Keuper formations are likewise described, and special reference is made to the water-bearing strata. Attention is also directed to the Glacial drift, to the great amount of rain-wash, and to the recent river deposits.

THE fourth part of the memoir on the geology of the South Wales Coal-field, being an account of the country around Pontypridd and Maes-têg, has been written for the Geological Survey by Messrs. A. Strahan, R. H. Tiddeman, and W. Gibson. It is issued at 1*s*. 6*d*., with a separate colour-printed map (without Glacial drifts) also priced at 1*s*. 6*d*. The map, which is very clearly printed, embraces a tract almost wholly of Coal-measures, including much of the Pennant Grit, which forms the bold moorland features of the Coal-field. Millstone Grit, and small areas of Carboniferous Limestone, as well as Lias, Rhætic Beds, Keuper Marl, and Dolomitic Conglomerate are shown on the south. Tracts of river gravel, peat, alluvium, and blown sand are also depicted. The Glacial drifts are represented on another edition of the map, which is at present hand-coloured. The memoir deals chiefly with the details of the Coal-measures, and more especially with the lower measures of the south crop, comparative sections of which are given. The upper or Llantwit measures occur only in two small outliers. The structural geology is fully described, the Pontypridd anticline and other faults and disturbances being dealt with. A study of the Glacial deposits indicates that the main ice-flow had its source in Brecknock. It followed and filled the chief valleys, but failed to surmount the Pennant Grit scarp of Carn Mosyn. Subordinate ice-flows were, however, generated on these higher regions. Economic deposits are briefly described in a separate chapter. The Pennant Grit and the Llynfi rock in the lower measures supply materials for building, paving, and road-mending. The water-supply is obtained chiefly from springs and reservoirs, seldom from wells.

A SOCIETY for spreading information about St. Michael's in the Azores has published an illustrated booklet setting forth the charms of St. Michael's as a health resort and as a station for tourists. The brochure certainly contains much interesting information about this Atlantic island.

A NEW edition, making the twenty-sixth thousand, of Miss Agnes Giberne's "Sun, Moon, and Stars" has been published by Messrs. Seeley and Co., Ltd. A new chapter, part iv. of the volume, has been added, and deals briefly with celestial photography, the planets Mars and Eros, comets and new stars, as well as other topics. With the exception of these additions, the present edition is the same as the last.

A SIXPENNY booklet describing the legends and the story of the building of Stonehenge has been received from Messrs. James Henderson and Sons. In an appendix to the pamphlet a short account is given of recent attempts to ascertain the age of Stonehenge, and a reference is made to the wire fence with which Sir Edmund Antrobus has had the ruin enclosed. This action of Sir Edmund Antrobus is characterised as wise and public-spirited, since it will help in the preservation of this valuable monument of antiquity.

WE have received a copy of the meteorological observations for the year 1902 made at the Rousdon Observatory in Devonshire, which is continued under the superintendence of Lady Peek. The publication was prepared under the supervision of Mr. W. Marriott, of the Royal Meteorological Society, and contains remarks on the weather experienced during each of the months of 1902, and a useful collection of nine tables dealing with such subjects as the pressure, temperature, and hygrometric state of the air, temperature of the soil, wind direction, rainfall, amount of sunshine, &c. The concluding table affords a useful summary of the annual results for the years 1884–1902.

Two more numbers of the "Rural Handbooks" published by Messrs. Dawbarn and Ward, Ltd., have been received; one is by Mr. C. F. Townsend, and is entitled "Heating and Ventilation of Houses," the other is on "Utility Fowl Feeding and Management," and is by Mr. H. Francklin. These little books are simply written, and will serve to supply the principles upon which success in many pursuits depends. The book on ventilation is well illustrated, and contains practical information of a kind to enable any intelligent householder to secure good ventilation. The amateur poultry farmer will find numerous helpful hints in the second handbook as to how to make his hobby a profitable one.

THE current number of the *Quarterly Review* contains two exhaustive articles on subjects of scientific technology. The first is by Mr. J. Nesbit on the improvement of British forestry, and begins with a historical retrospect of the attempts made by legislation and otherwise to encourage tree-planting and to preserve the forests. This is followed by an account of present practice and ideals. The work of the departmental committee appointed by the late Mr. Hanbury is dealt with very fully. The second article is on submarine vessels, and is unsigned. It is accompanied by four plates, and gives a full description of the attempts made to perfect this form of boat, and of the best models now in existence.

In reviewing Prof. G. P. Merrill's "Stones for Building and Decoration," when the book was first published in 1891, we cited it as affording an admirable example of the value of exact scientific knowledge when applied to the treatment of economic questions. The fact that since the date mentioned, as Prof. Merrill points out in the preface to the third edition which has now been issued, there has been a very notable increase in the output of building stone from American quarries, serves to emphasise the real connection between the scientific treatment of an industry and its success. The present edition differs from the previous ones in containing a revised chapter on methods of testing, a new chapter on the use of drift boulders for building purposes, and five maps showing the geographic distribution of the more important building stones. The new edition is published in this country by Messrs. Chapman and Hall, Ltd., and its price is 21*s.* net.

The additions to the Zoological Society's Gardens during the past week include a Chimpanzee (*Anthropopithecus troglodytes*) from West Africa, presented by Mr. H. Freeland; a Chacma Baboon (*Papio cynocephalus*) from South Africa, presented by General Sir Henry de Bathe; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Mr. H. Baker; a Levaillant's Cynictis (*Cynictis penicillata*) from South Africa, presented by Mr. C. Marsh; an Egyptian Ichneumon (*Herpestes ichneumon*) from North Africa, presented by Dixon Bey; a Nagor Antelope (*Cervicapra redunca*), a Crowned Duiker (*Cephalophus coronatus*), a Serval (*Felis serval*), an African Civet Cat (*Viverra civetta*) from West Africa, presented by Sir G. E. Denton, K.C.M.G.; a Cuckoo (*Cuculus canorus*), British, presented by Mr. J. O. Pickington; a Back-marked Snake (*Coluber scalaris*), South European, presented by Mr. W. H. St. Quintin; a Common Toad (*Bufo vulgaris*), European, presented by Mr. H. Verrall; a Common Mynah (*Acridotheres tristis*) from India, a Chameleon Lizard (*Chamaeleolis chamaeleontides*), two Large Cuban Anolis (*Anolis equestris*) from Cuba, deposited; three Peacock Pheasants (*Polyplectron chinquis*) from British Burmah, purchased.

OUR ASTRONOMICAL COLUMN.

The Spectrum of o Ceti.—No. 41 of the Lick Observatory *Bulletin* is devoted to a discussion of the spectrum of Ceti by Mr. Joel Stebbins.

Using the Mills spectrograph modified to a one-prism instrument, he obtained a series of twenty-five good spectra during the period June, 1902, to January, 1903, in which period the star decreased in magnitude from 3·8 to 9·0. The spectrograms were obtained on Cramer's "Crown" or "Isochromatic" plates, are 28mm. in length, and extend from λ 3700 to λ 5600.

Mr. Stebbins finds that the absorption spectrum of Mira is very different from that of the sun; the calcium lines *g*, H and K are all present, but *g* is much stronger than in the solar spectrum. From measurements of six suitable lines he found that the velocity in the line of sight is constant, with a value of +66km. A summary of the dark lines discovered indicates the undoubted presence of Fe, Va, Cr and Ca, and the Al and Sr lines are prominent, whilst the presence of Mn and Ti is as yet considered doubtful.

The general conclusion arrived at is that many of the lines become broader as the star's magnitude declines, and this is undoubtedly true of the *g* calcium line at λ 4227·84. In the later photographs some new lines, not definitely coincident with solar lines, were observed, the chief of these being λ 3990·64, λ 4045·16, λ 4093·55, and λ 4097·08.

As regards the continuous spectrum, the photographs show that as the star declines in magnitude the continuous spectrum between λ 4300 and λ 5000 decreases in intensity as compared with that between λ 4000 and λ 4300.

Amongst the bright lines the hydrogen series is undoubtedly present, although previous observers have doubted the presence of Hα, Hβ and Hε; the two latter seem to have become stronger, compared with the other hydrogen lines and the continuous spectrum, as the star became fainter. The presence of bright metallic lines is as yet open to question. In 1898 Campbell observed Hγ as a triple line, and it was intended in this research to make polariscopic tests for the Zeeman effect, but, as the line was found to be single on the first spectrograms obtained, no such tests were made.

Mr. Stebbins discusses the principal theories concerning the remarkable variation in the magnitude of Mira, and is led to the conclusion that it is due to internal forces. Numerous tables and diagrams, and several reproductions of the spectrograms of Mira, accompany the dissertation.

Photographic Efficiency of a Short Focus Reflector.—In an abstract from No. 539 of the *Astronomical Journal* Prof. Schaeberle discusses the photographic efficiency of short focus reflectors, and describes some remarkable photographs obtained by himself with a 13-inch parabolic reflector of 20 inches focus. This reflector is mounted alongside a similar one, which is used as a finder and has an aperture of 12 inches, a focal length of 46 inches, and an eye-piece magnifying 360 diameters, on an ordinary English equatorial mounting, the photographic plate ($1\frac{1}{8}'' \times \frac{3}{4}''$) being placed at the focus of the mirror.

The results obtained showed that with less than five minutes' exposure the 13-inch revealed stars which are apparently beyond the reach of the 36-inch Lick telescope, and also revealed all the stars obtained by the 3-feet Crossley reflector with two hours' exposure.

The Ring nebula just shows on plates having had four seconds' exposure, and the central star and Lassell's No. 1 star (mag. 13) plainly show on an eight seconds' exposure. These photographs disclosed the true form of the Ring nebula, showing that it is a two-branched spiral which commences at the central star, and in a clockwise direction emerges on opposite sides near the minor axis. A reproduction of a photograph, which has been enlarged 150 times, accompanies the article, and shows the details of the nebula very clearly; this photograph was obtained on October 30, 1902, with an exposure of 128 seconds.

It has been shown by the photographs obtained that, under favourable conditions and using fast plates ("Seed" No. 27), this instrument can photograph stars fainter than the seventeenth visual magnitude in less than five minutes.

The Godlee Observatory.—In a brochure issued from the printing department of the Manchester Municipal School of Technology, the principal gives a detailed description of the Grubb telescope presented to the observatory connected with the school by Mr. Francis Godlee, of Manchester.

The mounting is of the twin equatorial type, and carries an 8-inch refractor and a 12-inch Newtonian reflector, besides a 6-inch achromatic doublet intended for astrographic work.

The refractor is provided with a filar micrometer, a finely divided position circle, and the usual accessories necessary for delicate visual observations. The polar axis is fitted with two R.A. circles, one of which may be set to sidereal time and rotates with the axis, so that the R.A. may be obtained by finding the difference between the readings of the two circles. The driving of the telescopes is performed by the usual clockwork arrangements, and is electrically regulated by a pendulum having a perfectly *free* movement; the mounting is so designed as to permit the instrument to make the whole circumpolar revolution without interruption.

THE MARINE BIOLOGICAL ASSOCIATION.

THE council of the Marine Biological Association, in the report for 1902–1903, presented to the annual general meeting of the association on June 24, state that the work of the association has been considerably augmented in consequence of the fact that a commission has been accepted from H.M. Government to carry out in the southern British area the programme of scientific fishery investigation adopted by the International Conference, which met at Christiania in 1901. The work in connection with these investigations is being carried out in the southern part of the North Sea and in the English Channel. In connection with the North Sea work, a laboratory has been fitted out at Lowestoft, and the steam trawler *Huxley* has been hired. Some difficulty was experienced in obtaining a vessel suitable for the work with the funds provided by Government, but the council were fortunate in securing the assistance of one of their members, Mr. G. P. Bidder, who himself purchased the *Huxley* from her former owners and let her upon favourable terms to the association. Accommodation for the naturalists has been fitted up in the old fish-hold of the trawler, and a small laboratory has been built on deck.

The investigations in the North Sea include a scientific survey, by means of the s.s. *Huxley*, of the trawling grounds between the east coast of England and about 3° 30′ E. longitude, in connection with which observations are made on the nature of the bottom, the nature and abundance of animal life living on the bottom and serving as food for fish or otherwise, the size and weight of the fishes caught, the food of the more important fishes, the condition of the fishes as regards sex, maturity, or spawning, and the temperature of the sea at surface and bottom. A simultaneous survey is being carried out of the regular fisheries on the trawling grounds, with the assistance of reliable masters of commercial fishing vessels. Experiments are also being made on the migrations of fishes, by marking and liberating fishes in large numbers over wide areas. These experiments are designed to throw light on the extent and direction of the seasonal and other migrations of food-fishes at different stages of their growth, particular attention being paid to the migrations of undersized flat-fish, and also to give an indication of the percentage of fish on the trawling grounds actually caught by the trawling fleets from one year to another. In addition to the above lines of research, special investigations are to be made on the rate of growth, age, fecundity and racial varieties of fishes, on the abundance of floating fish-eggs, and on the variations in the size and weight of fish landed at the various fishing ports throughout the year.

Up to the middle of June the *Huxley* completed twelve scientific trawling voyages in the North Sea. More than 34,000 fishes have been measured, the animal life of the bottom has been systematically studied from the point of view of distribution, and the food-contents of about 3000 fishes have been examined and determined. Plaice have been marked and liberated in different parts of the North Sea. In November and December a number of small flat-fish were marked on the grounds west of the Borkum Reef, and the results obtained are already of great interest and importance. They indicate that during December and January there was a marked migration southwards and westwards of the small plaice previously congregated on the inshore grounds of the northern and western coasts of Holland, the distances travelled being in many cases quite unprecedented, viz. from one hundred to one hundred and sixty miles in six weeks or two months. More than 10 per cent. of the fish liberated have already been recovered.

The English portion of the international scheme of hydrographic and plankton observations, the execution of which has been assigned to the Marine Biological Association, is to be carried out in the western half of the English Channel.

These investigations have for their object the study of the seasonal changes which take place in the physical and biological conditions prevailing over the entire region covered by the international programme, though more particularly directed to a study of the waters entering the North Sea from different directions. They are designed to determine (1) the origin, history, and physical and biological characters of the water found in each locality at different seasons of the year and at corresponding seasons in different years, changes in which must necessarily have a profound influence upon the distribution and abundance of the fish-life in the sea; and (2) the variations which take place in the floating and swimming organisms (plankton) which constitute the fundamental food-supply of the sea.

The investigation is being carried out (1) by means of a series of quarterly cruises made simultaneously over the whole area by the vessels of the participating countries, as a result of which a thorough knowledge, based upon the most accurate available methods, is obtained of the conditions prevailing at all depths at certain fixed stations, together with a less detailed knowledge at intermediate points; and (2) by observations, more especially of the surface conditions, at as many points as possible during the time intervening between the seasonal cruises.

Complete series of observations at twenty stations in the English Channel were obtained during the first fortnights of February and May.

The ordinary work of the association has been carried on at the Plymouth Laboratory during the year. Work on the detailed record of the Plymouth fauna has been continued, the trawling experiments in the bays on the south coast of Devon have been completed, and a considerable number of naturalists have made use of the laboratory for their special researches. The statement of receipts and expenditure for the year shows a deficit of 117*l.* 1*s.*

THE PARSONS STEAM TURBINE.

THE recent launching of the cross-channel turbine steamer, the *Queen*, to which reference was made in our issue of July 2 (p. 209), has directed attention to the efficiency of turbine engines for many purposes. An ideal engine is one which has only one rotating part, and in which the direction of movement is not varied. Engineers have for many years recognised this fact, and much time and money have been expended in their endeavour to perfect a rotary engine. No practical success was, however, attained until 1884, when the Hon. C. A. Parsons, F.R.S., placed on the market his first compound steam turbine applied to driving a dynamo. Since then Mr. Parsons has effected many and various improvements, until, at the present time, the Parsons steam turbine is recognised by engineers to be a thoroughly efficient and practical engine, which, in the larger sizes, has attained an unprecedented degree of economy in steam. In the latter few years, the Parsons steam turbine has been applied to the propulsion of ships with very satisfactory results, and bids fair, in the near future, to supersede the reciprocating engine for certain classes of vessels.

A description of the Parsons turbine was given in NATURE several years ago (vol. lxi. p. 424), with illustrations of its parts. The turbine consists of a cylindrical case with numerous rings of inwardly projecting blades. Within this cylinder, which is of variable internal diameter, is a shaft or spindle, and on this spindle are mounted blades, projecting outwardly, by means of which the shaft is rotated. The former are called fixed or guide blades, and the latter revolving or moving blades. The diameter of the spindle is less than the internal diameter of the cylinder, and thus an annular space is left between the two. This space is occupied by the blades, and it is through these the steam flows.

In the arrangement of turbine machinery as adopted in the turbine Channel steamer the *Queen*, there are three turbines, viz. one high pressure in the centre of the ship and two low pressure, one on each side of the ship. Each turbine drives a separate shaft, with one propeller on each shaft, three in all. Inside the exhaust casing of each of the low pressure cylinders a reversing turbine is fitted. In ordinary going ahead, the steam from the boilers is admitted through a suitable regulating valve to the high pressure turbine, and after expanding about 5-fold, it then passes to each of the low pressure turbines in parallel, and is again expanded in them about 25-fold, and then passes to the condensers, the total expansion ratio being 125-fold.

The *Queen* is the third passenger vessel built by Messrs. Denny and Brothers fitted with the turbine system of propulsion supplied by the Parsons Marine Steam Turbine Co., Ltd. The *King Edward* was the first, and at her trial in June, 1901, this vessel obtained a mean speed of 20·48 knots. The *Queen Alexandra* was the second vessel; she was built in the following year, and obtained a mean speed of 21·63 knots. Both these vessels are now running on the Clyde.

A very important feature of these turbine vessels is the economy of coal consumption. In support of this it is of interest to mention that, at the launch of the *Queen Alexandra*, Mr. James Denny stated that if the *King Edward* had been fitted with balanced twin screw triple expansion engines of the most improved type, and of such size as would consume all the steam the existing boiler could make, the best speed that they possibly could expect would be 19·7 knots, as against the 20½ knots actually attained by the *King Edward*. The difference between 19·7 knots and 20½ knots corresponds to a gain in indicated horse-power in favour of the turbine vessel of 20 per cent.

Mr. Parsons, in a paper before the Institution of Naval Architects in Dublin recently stated that "the engining of larger vessels and liners is not a very long step beyond what has already been proved to be successful. The experience with the marine turbine up to 10,000 horse-power in ships of fast as well as of moderate speed, has tended to justify the anticipation, guided by theory, that the larger the engines the more favourable will be results as compared with reciprocating engines. The saving of weight, cost, space, attendance, and upkeep will become still more marked with turbine engines of above 10,000 and up to 60,000 horse-power, for which designs have been prepared."

It may be added that the results of moderately large turbines have shown an increased economy in steam consumption of 10 per cent. to 15 per cent., as compared with the best triple expansion engine.

Among the principal advantages of the steam turbine compared with ordinary engines are the following:—complete absence of vibration from main engines; increased economy in steam and coal consumption; increased accommodation and stability of vessel owing to low position of machinery; increased safety to engine room staff, owing to absence of reciprocating parts; reduced weight of machinery; reduced cost of attendance on machinery; and reduced consumption of oil and stores.

ANTHROPOLOGICAL NOTES.

TRUSTWORTHY studies on Australian languages are still greatly needed; it is therefore with pleasure that we welcome the elementary grammar, by the Rev. N. Hey, of the language of the Nggerikudi, a tribe of some 400 natives of North Queensland in the neighbourhood of Batavia River. Although Mr. Hey has been connected with the Presbyterian Mission to these people for ten years, he does not yet quite understand all the intricacies of the language. He notes that the aboriginals are fast disappearing. The vocabularies will be of some use to ethnologists who cannot profess to grasp the structure of the language. This study forms the sixth *Bulletin* of North Queensland ethnography that the Department of Public Lands, Brisbane, is bringing out under the editorship of Dr. Walter E. Roth.

The last issue of the *Reliquary and Illustrated Archaeologist* maintains the interest of former numbers. Messrs. Miller, Christy, and W. W. Porteous deal with a selection of Essex brasses that range from the reign of Edward IV. to nearly the end of that of Charles I., that is, almost to the time when the custom of wearing armour and the practice of laying down monumental brasses were both discontinued; the illustrations show clearly the various styles of armour worn during this period, as well as the modifications in the costume of the ladies. Papers of this kind are calculated to form a valuable adjunct to the teaching of history. Mr. J. Romilly Allen describes some late survivals of primitive ornament on wooden spoons, stay-busks, and knitting-sticks which were made for the special purpose of being given away as presents from young men to their sweethearts. Mr. Arthur Watson traces the tumbler's art during the last few hundred years; it was an accessory to the banquet in the middle ages; in the sixteenth century it had risen to a position of greater importance and independence; later it entered a new phase as an accompaniment to the drama; in modern times our streets yet retain traces of the ambulatory troups of performers, and acrobatic performances are still in vogue in the circus and music-hall.

The annual report for 1901–1902 of the Field Columbian Museum, Chicago, is a record of considerable progress, even for this enterprising museum. The cost of new installation for that year was about 10,000*l*., more than half of which amount was spent on new cases. Attention is directed in the report to the unsatisfactory condition of the fabric of the museum, which, it will be remembered, was one of the admittedly temporary buildings of the World's Fair. Judging from a paragraph in *Science* for July 10, this will soon be remedied, as the park commissioners of Chicago have approved the transfer of the museum from Jackson Park to Grant Park, which is on the lake front in the centre of the city. It is understood that Mr. Marshall Field has agreed to give 1,000,000*l*. for the construction and endowment of the museum. In the department of anthropology all the collections, with the exception of two important purchases, have been derived from field expeditions, consequently they are of unusual interest and of great

FIG. 1.—Salish House Group, Puget Sound, Washington Field Columbian Museum.

scientific importance; this is undoubtedly the most satisfactory manner of stocking a museum. The zoological collections were also augmented in a similar manner. The report is illustrated with excellent plates, which show that this museum is determined to keep the lead in the naturalistic and artistic excellence of its large animal groups. The Salish house group shown in the accompanying figure is an instructive addition to the many ethnological groups in the museum. Specifications are given of the new geological cases, and the botanist describes the reasons why he has adopted dead black labels printed with aluminium ink. Other educational aspects of the museum are its library, numerous popular lectures, and various publications. There is a very large attendance of school children accompanied by their teachers, and there can be no doubt that the schools and colleges are availing themselves more and more of the facilities of the museum as teaching adjuncts to books.

A BURIED TRIASSIC LANDSCAPE.

OUR older rocks have naturally diversified the scenery during many a past period. Bent and hardened by various processes, and ridged up into hilly ground, some of them have so long withstood the assaults of eroding agents as to have fairly earned the title of "everlasting."

This may truly be said of the buried mountains of Charnwood Forest. Visitors to that picturesque and elevated district will have been struck with the curious rocky eminences that protrude here and there from what otherwise is a somewhat rounded, pastoral region. These isolated barren stony tracts, with highly inclined slabs of rock and a fringe of fallen blocks, call to mind descriptions of kopjes.

Prof. Watts, in an interesting essay (*Geographical Journal*, June), shows clearly that here we have the "veritable peaks and arêtes" of a mountain system, formed of slates, hornstones, and agglomerates, with intruded syenites and granites, which jut out from a thick covering of Triassic marls, with basement breccias and sandstones.

Pre-Cambrian in age, these rocks have been subjected to various earth-movements, producing cleavage and jointing, and such intense induration that they appear to be equally strong, and the structures probably were impressed upon them in Cambrian times. Be this as it may, Prof. Watts concludes that they must have formed a mountainous tract in Old Red Sandstone times, and that then the mass was cut up by rapid streams into fiord-like valleys with ever-sharpening ridges. Some features are indicative of marine action, and it is probable that these were formed when the area was submerged in Lower Carboniferous times, and the ridges appeared as islands. After re-elevation in Permian times, subaërial waste contributed the materials of the breccias, and the conditions led on to those of the Trias, when salt-lake and desert, akin to the features of the Great Salt Lake and of Baluchistan, characterised the scene. The landscape which had been blocked out in Old Red Sandstone times, and modified in the Carboniferous period, was now subjected to much weathering, and ultimately the thick deposits of Keuper Marl buried up many, if not all, of the summits, to be partially revealed again by later denudation. Not until the Glacial period is there any positive evidence of the subsequent exposure of the ancient rocks, but blocks from the higher summits do appear in the Boulder-clay of the neighbourhood.

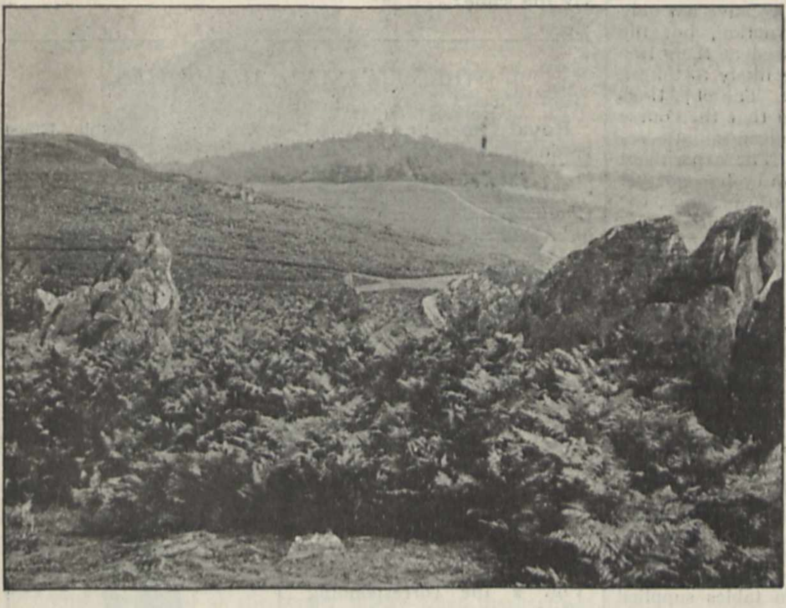


FIG. 1.—Bradgate Park, Charnwood Forest. Crags of Charnian Rock rising from Triassic ground. (From the *Geographical Journal*.)

Of the development of the present features Prof. Watts gives an interesting sketch. The Trias appears to have filled fiords which have been revealed by the present streams, and although they have deepened and altered the character of the older rocks when they excavated to them, the main outlines of the old scenery, uncovered by the denudation of the Keuper Marls, belong to the original Triassic landscape. As he points out, the granite of Mount Sorrel, when unbared for quarrying, shows often a smoothed and terraced surface, which was at first attributed to glaciation. More recently these surfaces have been found to extend beneath coverings of Keuper Marl, and the evidence is conclusive that the rounding and terracing must have been due to wind-erosion in the Triassic deserts before the peaks were buried under the Keuper Marl. H. B. W.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Howard Marsh, surgeon to St. Bartholomew's Hospital, London, and formerly professor of pathology and surgery at the Royal College of Surgeons of England, has been elected to the professorship of surgery, which has been vacant since the death of Sir G. M. Humphry, F.R.S.

Prof. Ewing, F.R.S., has sent in his resignation of the chair of mechanism and applied mechanics, to take effect on September 30.

Mr. C. E. Inglis, King's, and Mr. A. H. Peake, St. John's, have been appointed demonstrators in the engineering department.

Mr. W. E. Hartley, Trinity, has been appointed assistant observer at the observatory, *vice* Mr. A. Graham, retired.

THE eleventh summer meeting of university extension students was opened last Saturday at Oxford, when the United States Ambassador, Mr. Choate, delivered the inaugural address, taking for his subject American university education. After describing how Harvard was founded in 1636, and referring to the rise of the other older universities in the United States, such as Yale and Columbia, Mr. Choate explained that it was found at the beginning of last century that, if American universities were to hold their own, they must greatly increase their numbers, change their methods, and assume new and closer relations with the people. At that time there were only twenty-six colleges and universities in the whole territory of the United States, and many of these were in an undeveloped state. They are now numbered by hundreds, many of them richly endowed, and most of them furnishing an adequate training, adapted to qualify youths for business and for any duty to which they may be called. These new colleges are not all on the same model, but afford a wide choice of courses of study to suit the varied necessities of a diversified community. With the exception of a few of the older States which are already well provided with them by private means, each State in the Union has, by the use of public funds and lands, created a State university; and it has been the ambition of several of their multi-millionaires to create universities by the generous application of portions of their fortunes. By this means powerful institutions of learning have been created in a few years. The University of Chicago, founded in 1892, and endowed chiefly by the generosity of one man, now numbers more than 3000 students. By far the most signal advance in university extension yet made in America is the latest in date—the creation of the Carnegie Institute at Washington—with an endowment of ten million dollars to be devoted absolutely to original research. Another reason for the success of the efforts to improve university education in the United States was brought out by Mr. Choate, who made it clear that the work of the universities, colleges, and technical schools rests on the broad and firm foundation of the common schools, which from the beginning have been the peculiar care of the people, and that educational authorities in America adhere rigidly to the theory that special study for professional or business life should be postponed until a broad and general education has developed the faculties and character. Referring to the Rhodes scholarship scheme, Mr. Choate remarked that it provides that henceforth there shall at all times be at Oxford 100 American youths selected from all the States, there to receive the best fruits of her nurture and instruction. "And now would not some rich American respond to Mr. Rhodes's challenge, and forthwith in his lifetime make a similar and equal provision for 100 young Britons—English, Scotch, and Irish—to be maintained at universities in the United States?"

THE Lord Mayor of Liverpool, Mr. W. Watson Rutherford, has received in his capacity of chairman of the university committee the charter of the new University of Liverpool. Since the publication of the first draft of the charter, a clause has been added specifying that degrees representing proficiency in subjects of technology shall not be conferred without proper security for testing the scientific and literary knowledge underlying technical considerations. Mr. Rutherford has addressed a letter to the Liverpool City Council suggesting that the new university "be directly allied with the city, and should be free," and the letter is to be considered by the council as we go to press. In his letter Mr. Rutherford says:—"Let the matriculation examination be as severe as any in the country, and let every degree remain as high a standard of knowledge as that of any university in the world; but let there be no fees, no financial barrier whatever to the poorest citizens of Liverpool obtaining all the advantages of the Liverpool University," and he goes on to point out that a maximum rate of one penny in the pound would cover the students' fees and leave a considerable margin. The letter maintains that another benefit would be a sense of proprietary interest in the university on the part of the citizens of all classes in Liverpool, who would thereby at this juncture have not only elementary, secondary, and technical instruction, but the highest regions of advanced education, placed at their free disposal, and would, therefore, be far more likely to take a keener interest in the Liverpool University. The objections that what is not paid for is not valued, and that the course proposed would discourage private munificence, are regarded by Mr. Rutherford as ill-founded. The experiment of conducting a free university in this country has not yet been tried, and should the proposal be put into practice, the results will be awaited with keen interest by all who desire the spread of higher education. At the first meeting of the council of the university held on Tuesday, Lord Derby, the Chancellor, pledged himself to the utmost of his power to help to lay the foundations of a university in which studies of the arts, science, and other subjects should receive all possible expansion. Mr. E. K. Muspratt was appointed president, and Mr. J. W. Alsop vice-president, of the university council.

THE Board of Education has published "Syllabuses and Lists of Apparatus Applicable to Schools and Classes other than Elementary" for next session, that of 1903–4. The divisions in science and art subjects other than mathematics, formerly described as Elementary Stage and Advanced Stage, are now described as Stage 1 and Stage 2, and the divisions in science subjects, formerly known as Honours Part i. and Honours Part ii., are now described as Stage 3 and Honours. We notice that the examination tables supplied to mathematical candidates have been revised, and that notice is given that the alternative Stage 1 of theoretical inorganic chemistry will probably be discontinued after next session's work. Section i. of the first stage of the hygiene syllabus has been transferred to the subjects in which the Board of Education does not hold examinations. The second part of the volume is wholly devoted to two sets of syllabuses, styled concise and detailed respectively, in a great variety of subjects suitable for evening continuation schools, but in which the Board does not hold examinations.

NEW buildings, for which the sum of 80,000*l.* is required, will shortly be erected for University College, Reading. Of this amount, 30,000*l.* has already been contributed by five donors, including 10,000*l.* given by Mr. G. W. Palmer, M.P., and 10,000*l.* by Lady Wantage. The late Lord Wantage was president of the college from 1896 to 1901.

THE "Year-book" of the Armour Institute of Technology at Chicago for the session 1903–1904 contains not only full particulars of the courses in mechanical, electrical, civil, and chemical engineering, as well as in architecture, at the College of Engineering, but also of the preliminary studies which have been arranged at the Armour Scientific Academy, where students are prepared for the more advanced work of the college. Taking into their own hands in this way the early training of their engineering students, the authorities of the Armour Institute are able to provide the professors with students possessing a sufficiently good education to benefit by the lectures.

THE issue of *Science* for June 19 reprints Prof. R. H. Thurston's address at the dedication of Engineering Hall, Iowa State College. The subject chosen is the functions of technical science in education for business and the professions, and in the course of the address Prof. Thurston pleads powerfully for the full recognition of the importance of scientific knowledge to men whose business is in any way connected with technical matters. Perhaps the part of the address which will most interest the English reader is that which deals with the employment of American students after they have left the universities or colleges. The demand for college-trained men seems to be much greater in America than it is here, the "captains of industry" in that country having apparently realised the value of sound theoretical training in those whom they put in charge of their technical manufactures. "I have a deep file of letters calling for such men," says Prof. Thurston. "There is practically none unemployed unless on the sick list. All the professional engineering schools are thus situated. Turning out a thousand or more annually, the whole output is absorbed by the great industries, and immediately upon leaving the doors of the college." Can English professors say the same?

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—"On a Remarkable Effect produced by the Momentary Relief of Great Pressure." By J. Y. **Buchanan**, F.R.S.

The experiment was made first during the cruise of the *Challenger* on March 27, 1873, in lat. 21° 26′ N., long. 65° 16′ W., where the depth of the sea was 2800 fathoms, and it was repeated on board the yacht *Princesse Alice* (H.S.H. the Prince of Monaco) on March 11, 1902, in lat. 43° 8′ N., long. 19° 48′ W., where the depth of the sea was 3000 fathoms.

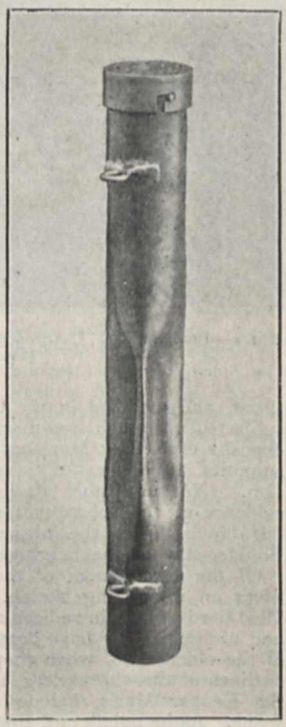


FIG. 1.

Fig. 1 shows the effect produced on a stout brass tube 13 inches long and $1\frac{5}{8}$ inches in diameter, which was perfectly cylindrical before it was exposed to the momentary relief of high pressure which has produced so deep a corrugation. In Fig. 2 the corresponding effect on a copper sphere of 5 inches diameter is shown; it takes the form of a multitude of small creases in place of the single deep corrugation produced on the tube. The experiments were made on the sounding cord on board the yacht *Princesse Alice* on September 10 and 11, 1902. The brass tube contained an ordinary 50 c.c. pipette sealed up at both ends, and empty except for the air which it contained. It occupied the part of the tube which has been so disfigured, and was kept in its place by a loose packing of cotton waste. Water had free access both at top and bottom.

The copper sphere contained a small spherical glass flask of 1 to $1\frac{1}{2}$ inches in diameter, and it was kept more or less in the centre of the sphere by loose cotton packing; small holes at each pole of the sphere admitted the outer water. The brass tube was attached to the sounding cord and sent to a depth of 3000 metres. The copper sphere was sent first to 3000 metres, but with no effect, and then to about 6000 metres, when the effect shown in Fig. 2 was produced. The *rationale* of the proceeding is:—at some depth less than 3000 metres in the case of the brass tube, and less than 6000 metres in the case of the copper sphere, the glass tube in the former and the glass sphere in the latter case collapsed suddenly. Considering, for brevity's sake, only the brass tube; immediately before the collapse the pressure inside and outside the brass tube was equal and uniform. The collapse of the glass tube produced a sudden and very considerable relief of pressure inside the brass tube. In ordinary circumstances the void so produced would have been filled by water from the outside entering through the perforated ends of the tube. But as the glass tube was subjected to a pressure of nearly 300 atmospheres before it collapsed, the difference of pressure produced in a moment of time was between 200 and 300 atmospheres. The deep corrugation shown in Fig. 1 proves that it was easier *in the time* for the pressure to pinch up the stout brass tube than to shove in the plugs of water at either end. The sudden action of the pressure is due, not to the settling of the column of 2000 to 3000 metres of water on the tube, but to the resilience of the enormous quantity of water of high tension produced by the pressure under which it finds itself.

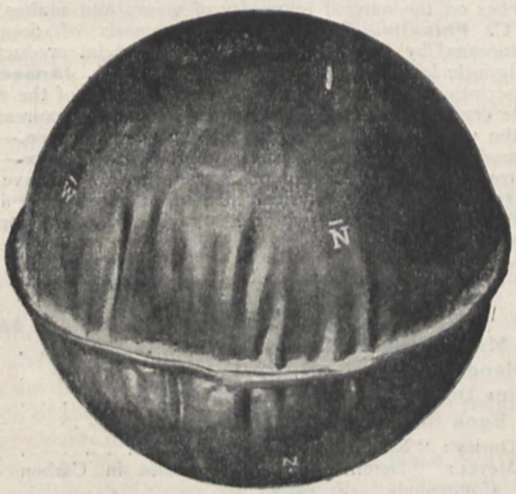


FIG. 2

The effect produced on the copper sphere when the enclosed glass sphere collapsed is of exactly the same kind.

The experiment was originally made on board the *Challenger* on the day after she made her deepest sounding in the Atlantic in the neighbourhood of the West India Islands. On that occasion both the thermometers attached to the sounding line collapsed under the enormous pressure of 3875 fathoms, amounting to 700 atmospheres, and the experiment was made with tubes of three different widths in water of 2800 fathoms in order to obtain data for the construction of future thermometers. Two of the tubes collapsed, only the narrowest, having a diameter of 6 millimetres, withstood both the pressure assisted by the shock of the others collapsing near it. In all three cases the glass tubes were converted into a fine powder like snow.

The collapse of the brass tube, in the peculiar circumstances of the experiment, is the exact counterpart of the experiment which is frequently, but unintentionally, made by people out shooting, especially in winter. If, from inattention or other cause, the muzzle of the gun gets stopped with a plug of even the lightest snow, the gun, if fired with this plug in its muzzle, invariably bursts. Light as the plug of snow is, it requires a definite time for a finite pressure, however great, to get it under way. During this short time the tension of the powder gases becomes so great that the barrel of the ordinary fowling-piece is unable to withstand it and bursts.

June 18.—"New Investigations into the Reduction Phenomena of Animals and Plants." Preliminary Communication. By Prof. J. B. **Farmer**, F.R.S., and J. E. S. **Moore**.

In this communication the authors in the first place pointed out that the attention which investigators have recently paid to reduction phenomena occurring in animals

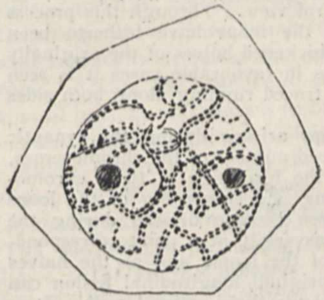


Fig. 1.

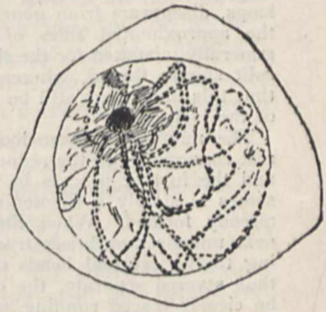


Fig. 2.

and plants has resulted so far in an increasing divergence of opinion, both respecting the nature of this process and its significance. At the same time it was, however, apparent that there were several important points upon which all were now agreed; it had, for example, been clearly shown that, during this process, the number of the chromosomes occurring in the cells affected was reduced by one-half, and that this reduction was brought about during the rest preceding two cell divisions, which appeared to be invariably related to the process. Consequently it was rendered probable that the explanation of reduction was to be sought through a minute study of this, the synaptic rest phase, in a number of selected animals and plants. With this object, the authors had made a close examination of a large number of types, including mammals, elasmobranchs, amphibia and insects among animals, phanerogams, ferns and liverworts among plants, and the results of this investigation are at variance with the common existing conceptions of the process, while at the same time they seem to indicate a possible reconciliation between the different views which have been, and still are, held by other investigators. It will be remembered that there are two main theories of reduction. In the first we have the process regarded as a qualitative division of the chromatin by the separation into daughter nuclei of entire somatic chromosomes.

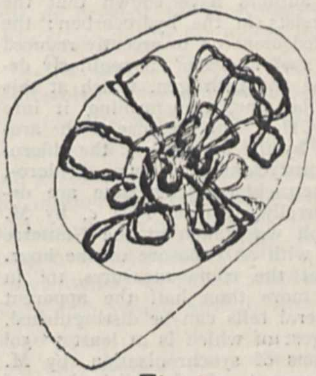


Fig. 3.

Fig. 4.

In the second, the identity of the original somatic chromosomes becomes lost during the synaptic rest, and these are then replaced by half the number of new ones, which, during their formation, become longitudinally split twice in planes at right angles to each other. This double longitudinal division serves for two mitoses which take place almost simultaneously.

The authors find that at the end of the synaptic rest the spirem thread certainly undergoes longitudinal fission. Connected with this there is a stage when the thread is arranged in loops, the split sides of which are approximated together in U-shaped figures. Although at their first formation the sides of these U-shaped loops are far apart, and still show the original longitudinal fission, they ultimately become approximated together, and at the same time the original fission, running throughout the length of the loops, disappears from general view. Through this process the approximated sides of the loops have hitherto been generally mistaken for the thickened halves of the originally split spirem thread, whereas in favourable cases it is seen that this fission can still be traced running along both sides of the loops.

The number of these loops arising during the synaptic rest corresponds to the reduced number of the chromosomes, and the further process in the formation of these chromosomes is simply a thickening and shortening of the loops already formed. When these become divided during the next mitosis they break transversely at a point corresponding to the original bends of the loops, and as the halves thus severed separate, the original longitudinal fission can be clearly traced running along their entire length. It is thus this original fission of the spirem thread, which serves to distribute the halves of the disunited somatic chromosomes during the following homotype division, and the hitherto enigmatical figures described by Flemming Mevès and others in the diaster of the heterotype find their natural explanation.

It would thus appear that the synapsis and the so-called heterotype mitosis constitute a phase which has been specially intercalated in the reproductive cycle. In it the reduction in the number of the chromosomes is produced by their adhesion in pairs, and the completion of the original longitudinal fission of the spirem thread is deferred until the following homotype mitosis.

The authors purposely refrain from discussing the general bearing of these observations, reserving this for a further and more detailed communication.

PARIS.

Academy of Sciences, July 27.—M. Mascart in the chair.—The preparation and properties of a silicide of ruthenium, by MM. Henri **Moissan** and Wilhem **Manchot.** At the melting point of ruthenium this metal combines with silicon with ease, giving a silicide of the formula RuSi, of density 5·40, perfectly crystalline, possessing great hardness, and very stable in the presence of most reagents.—Arsenic in sea-water, in rock-salt, kitchen salt, mineral waters, &c. Its determination in some common reagents, by M. Armand **Gautier.**—On dividing waves, by M. P. **Duhem.**—On cyclohexane and its chlorine derivatives, by MM. Paul **Sabatier** and Alph. **Mailhe.** The authors have shown that the aromatic nucleus really persists in the hydrocarbon; the vapour of cyclohexane directed alone on to recently reduced nickel maintained between 270° and 280° is regularly decomposed, reforming benzene and hydrogen, which at this temperature reacts on the benzene, transforming it into methane, $3C_6H_{12}=2C_6H_6+6CH_4$. The presence of the aromatic nucleus is also proved by the reactions of the chloro-derivatives. One monochlorocyclohexane, two dichloro-, three trichloro-, and one tetrachloro-cyclohexane are described.—Photograph of Borrelly's comet, 1903 *c*, by M. **Quénisset.** The photograph was taken at the Nanterre Observatory on July 24–25, with an exposure of one hour. The photograph shows that the coma measures 16′ in diameter, that is, a little more than half the apparent diameter of the moon. Several tails can be distinguished, the most luminous and longest of which is at least 7° 50′ in length.—On the conditions of synchronisation, by M. **Andrade.**—On the measurement of the dichroism of crystals, by M. Georges **Meslin.**—On the electrical dichroism of liquids containing crystalline particles in suspension, by M. J. **Chaudier.** With the advice of M. Meslin, who has examined the modifications produced in ordinary light by its passage through a liquid containing crystalline particles and placed first in a magnetic field and secondly in an electric field, the author has continued the experiments with other mixtures in an electric field. A certain number of the mixtures presented a decided dichroism, which took a certain time to appear and disappear after the discontinuance of the field. The liquids which entered into the composition of the active mixtures usually contained no oxygen. No direct relation seems to exist between the chemical properties of the solid and the electrical dichroism it is able to cause when associated with a suitable liquid.—On the separation of gaseous mixtures by centrifugal force, by MM. G. **Claude** and E. **Demoussy.**—On the laws and the equations of chemical equilibrium, by M. **Aries.**—On a combination of two bodies which unite as a result of an elevation of temperature then separate below −79°, by M. D. **Gernez.**—Separation and simultaneous determination of baryta, strontia, and lime, by M. Lucien **Robin.**—On the condensation of ethers with alcohols, by M. Ch. **Moureu.**—On the composition of allyl cyanurate, by M. R. **Lespieau.**—Contribution to the study of the quinones-diketones, by M. **Œchsner de Coninck.**—Albuminoid substances in Indian corn, by MM. **Donard** and **Labbé.**—The use of a calorimetric bomb to demonstrate the presence of arsenic in the organism, by M. Gabriel **Bertrand.** With camphor or pure sugar no trace of arsenic was obtained, but a few grams of tortoise-shell, of sponge, of the white or yolk of an egg, gave clear indications of arsenic.—Influence of temperature on the production of sulphuretted hydrogen by albuminoid substances, extracts of animal organs and extracts of yeast, in the presence of sulphur, by MM. J. E. **Abelous** and H. **Ribaut.**—Researches on the natural immunity of vipers and snakes, by M. C. **Phisalix.**—On the spermatogenesis of decapod crustaceans, by M. Alphonse **Labbé.**—Artificial production of gigantic larvæ in an Echinoid, by M. F. A. **Janssens.**—Inscription of the variable state of the tension of the wire of the ergograph: equation of the movement and expression for the work, by MM. A. **Imbert** and J. **Gagnière.**—On the production of gum in tissues, by M. G. **Delacroix.**—On the trenchings of the plain of Sevran, by M. Gustave F. **Dollfus.**—On a new physical method of research and of the determination of the watering of wines, by M. Georges **Maneuvrier.**

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