by a long but easy calculation, the amount of £1 laid up at 5 per cent. compound interest for a thousand years will be found not to differ very much from £1,546,318,920,731,927,238,982. An answer of this sort is of course of no practical utility whatever, but it brings vividly before us an important point in political economy—the accretion of wealth in the hands of corporations. It was computed that just before the Revolution more than half the soil of France was owned by the Church. Looking at this array of figures, and remembering that since the Church could never alienate its property all surplus income must be regarded as at compound interest, we can only wonder that it was the half and not the whole.

The first table for facilitating the computation of logarithms was one given by Long (Phil. Trans., 1724) of the decimal powers of 10 to nine figures. Thus, to find the number the logarithm of which is

$$30103 = 10^{\cdot 3} \times 10^{\cdot 001} \times 10^{\cdot 00003} = 1{\cdot}99525231 \times 1{\cdot}00230523 \times 1{\cdot}00006908 = 1{\cdot}99999997, \text{ or } 2.$$

This method is cumbrous, but it is perhaps one of the most simple for explaining the calculation of logarithms to beginners.

A much more convenient method has been well worked out by M. Namur, but, unfortunately, only his twelve-figure table seems to be still in print. The table contains the logarithms of numbers from 433300 to 434300 to twelve figures, and the numbers corresponding to logarithms from 637780 to 638860. By the aid of certain factors which are tabulated with their complementary logarithms, any number or logarithm can be reduced between these limits.

Thus, to find log π—

	314 159 265 359	× 1·3
	94 247 779 607 7	
	408 407 044 956 7	× 1·063
	24 504 422 698 0	
	1 225 221 134 9	
	434 136 688 799 6	
log from table	637 625 800 474	Δ = 1·000364
	206 4	
	41 3	
	2 4	
	637 626 489 524	
	973 466 735 477	complementary logs of 1·3 and 1·063
	886 056 647 693	
	497 149 872 694	= log π.

The last method I shall mention is generally known by the name of Weddle; it was probably used by Briggs, and published by Flower in 1771. It consists in multiplying the given number by a series of factors of the form $1 \pm \frac{x}{10^n}$, until it is reduced to one. The complement of the sum of the logarithms of the factors is the required logarithm. The logarithms of the factors are easily calculated by the first series; they have been tabulated to about thirty places.

Thus to find log 3550·26:—

355026 × 2	30103
	11394 3
710052 × 1·3	3342 4
2130156	130 1
	3 9
9230676 × 1·08	44973 7
738454	55026 complement.
9969130 × 1·003	
29907	
9999037 × 1·00009	

Hence log 3550·26 = 3·55026, or we have a number which is expressed by the same figures as its logarithm.

It is the present fashion, while depreciating our own country men, to extol all Germans in matters connected with education, and especially to award them the palm for patient plodding. It will be some time before a German rivals Prof. Adams, and even then there is a height beyond. Of all monuments of calculation the value of π, or the number of times the circumference is longer than the diameter of a circle, is most astounding. Archimedes found it to be $\frac{22}{7}$, Wolf calculated it to 16 places, Van Ceulen to 35, Machin to 100, Beerens de Haan to 250, Richter to 500. But in 1853 Mr. Shanks threw all these results into the shade, and excited the admiration even of De Morgan by calculating π to 530 places, "throwing aside as an unnoticed chip the 219th power of 9"! Two printers' errors were pointed out by Mr. John Morgan, which Mr. Shanks corrected from his manuscript, and in 1873 gave a new result to 707 places. Hence the value of π is known to within $\frac{1}{3 \times 10^{707}}$, an exactness which is useless from the inability of the human mind to comprehend the figures which express it.

Clerk Maxwell proposed, possibly in irony, to take the wave-length of a certain light as the universal unit of length. Choosing for this purpose about the middle of the violet, a mile would be expressed by 60000 × 63360 = 3·8 × 10^9 units nearly. Suppose that Sirius, the brightest star in our firmament, has an annual parallax of $\frac{1}{5}''$, a quantity perceptible, but barely measurable, by our best telescopes, the distance of the sun from Sirius is about 5 × 206,265 × 92,300,000 miles, or 3·5 × 10^{23} units. Assume again that Kant's fanciful conjecture is correct, and that the sun revolves round Sirius in a circle the length of which is expressed by 7 × 10^{22} × π units. Make the still greater assumption that all our measures are correct, and our arithmetic as it ought to be, so that the only possible error would be in the evaluation of π. The greatest possible error according to Mr. Shanks's determination would be $\frac{7 \times 10^{23}}{3 \times 10^{707}}$ or $\frac{1}{4{\cdot}3 \times 10^{683}}$ of a wave-length of violet light. Whatever metaphysicians may say, I think we have here reached, if not surpassed, the limits of the human understanding.

SYDNEY LUPTON.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, January 2.—M. Janssen, President, in the chair.—On an objection made to the employment of electro-magnetic regulators in a system of synchronous time-pieces, by M. A. Cornu. This is a reply to M. Wolf's recent communication, in which several objections were urged against the apparatus in question. It is shown (1) that such a regulator does not necessarily tend to stop the system to which it is applied; (2) that in any case the stoppage may be prevented without complication or expense; and (3) that in a public time-distributing service the stoppage should not only not be prevented, but efforts should be made to bring it about whenever the synchronizing system gets out of order. The paper was followed by some further remarks on the part of M. Wolf, who reiterated his objections, and treated M. Cornu's third point as somewhat paradoxical.—Remarks on Père Dechrevens's letter regarding the artificial reproduction of whirlwinds, by M. H. Faye. The author complains that, like other partisans of the prevailing ideas on the subject of tornadoes, typhoons, and cyclones, M. Dechevrens endeavours to suit the facts to the exploded theory of an ascending motion in the artificial reproduction of these aërial phenomena.—On the meteorite which fell at Phû-Long, Cochin China, on September 22, 1887, by M. Daubrée. In supplement to M. Delauney's communication of December 19, the author adds that this meteorite was an oligosiderite of somewhat ordinary type, closely resembling those of Tabor (Bohemia), July 3, 1753; Weston (Connecticut), December 14, 1807; Limerick, September 10, 1813; and Ohaba (Transylvania), October 10, 1817.—Remarks in connection with the presentation of the "Annuaire du Bureau des Longitudes" for 1888, the "Connaissance des Temps" and the "Extrait de la Connaissance des Temps" for 1889, by M. Faye. Amongst the fresh matter added to the "Annuaire" this year are papers by M. Janssen on the age of the stars, by Admiral Mouchez on the progress of stellar photography, and by M. d'Abbadie on his recent expedition to the East in order to determine the elements of terrestrial magnetism in Egypt, Palestine, and Syria.—Observations of Olbers' comet made at the Observatory of Nice (Gautier's 0·38 m. equatorial), by M. Charlois. These observations are for December 25, 26, and 27, after the comet was discovered on December 23, when the nucleus was of the tenth magnitude, surrounded by a bright nebulosity, and with tail from 20′ to 25′ in length.—On the total eclipse of the sun

observed on August 19, 1887, at Petrovsk, Government of Jaroslav, by M. G. M. Stanoiewitch. Owing to the extremely unfavourable atmospheric conditions the observer was unable to carry out any important part of his programme. A chief result of his observations was the conclusion that the gloom prevailing during eclipses is all the deeper the less clouded is the sky and the flatter the ground, especially on the horizon. The sky being on this occasion almost completely overcast, he was able to read the title of a pamphlet printed on a red cover at a distance of 2 metres.—On the variations of temperature of gases and vapours which preserve the same quantity of heat under different tensions, by M. Ch. Antoine. A simple means is proposed for avoiding the laborious calculations required to determine the values Θ and Θ^1 in the formula $y = 25\sqrt[3]{\Theta} - \Theta^1$ deduced from V. Regnault's experiments on atmospheric air.—On the energy needed to create a magnetic field and to magnetize iron, by M. Aimé Witz. The researches here described serve to verify Lamont's statement that the effect produced by a magnetic field on a magnet is greater when the force acts to diminish than it is when the force acts to increase the magnetizing power.—On the rapidity of transformation of metaphosphoric acid, by M. Paul Sabatier. Solutions of metaphosphoric acid are transformed spontaneously with greater or less rapidity. Berzelius and Thomsen suppose that there is at first production of pyrophosphoric acid, which is afterwards changed to orthophosphoric acid. Others, with Graham, think that there is immediate formation of tribasic orthophosphoric acid, and the author's researches tend to show that this is normally the case. It is also established that the rapidity of transformation is at each instant proportional to the mass of transformable substance present in the system.—On an alloy of titanium, silicium, and aluminium, by M. Lucien Lévy. Wöhler indicated two alloys of these metals without giving their composition. The author here determines a similar alloy differing in some of its properties from those of Wöhler. He has also determined its composition, as apparently a mixture of two isomorphous bodies crystallized together with formula $TiAl_4$ and $SiAl_4$. The same preparation with zinc or magnesium substituted for aluminium yielded no results.—On some derivatives of cinchonine, by MM. E. Jungfleisch and E. Léger. The authors were able some time ago to announce that the sulphate of cinchonine being heated to 120° C. for forty-eight hours with a mixture in equal parts of sulphuric acid and water, the alkaloid changes to diverse bases, of which they have isolated the six most abundant. Here they explain the process by which they have succeeded in separating the alkalies.—On the presence of diaphragms in the aëriferous ducts of roots, by M. C. Sauvageau. The transverse diaphragms intersecting the aëriferous ducts of vascular plants have hitherto been supposed to be confined to the middle region of the bark of their various members. But the author has now determined their presence also in the root of at least one such aquatic plant, the *Hydrocharis morsus-ranæ*.

BERLIN.

Physiological Society, December 16, 1887.—Prof. du Bois Reymond, President, in the chair.—Herr Meyer, from Hamburg, discussed the nature of ventriloquism, and combated the opinion, so widely spread among physiologists, that it consists in speaking while inspiring, and without the cavity of the mouth acting in any way as a resonator; on the contrary, ventriloquists speak while expiring, and do move their mouths. An extended series of laryngoscopic observations on the speaker, who has practised ventriloquism for many years, has shown that in ventriloquizing the vocal opening of the larynx is shortened as it is when producing the falsetto, and that the soft palate is pressed back and that the uvula becomes invisible. Everybody who naturally possesses a high voice can easily learn to ventriloquize. One most important factor in the deception of the listeners is the contrast between the loud, full and metallic tone in which the question is asked and the answer which immediately follows in a high and gentle falsetto. Sibilants and the high I should be as far as possible avoided. The speaker then gave a series of extremely successful examples of ventriloquism, which did not presuppose any particular training, and showed that it is never accompanied by any special action of the abdominal muscles. Prof. Gad has made some experiments on Herr Meyer, and by graphically recording the variations in pressure of the air, has shown that the curve obtained when a certain sentence is spoken in the ordinary way is in all respects identical with the one which is described when the same sentence is spoken ventriloquially. In the latter case the volume of air expired was considerably less than during normal speech; in one particular case it amounted to only 900 c.c., whereas during normal speech the volume expired was 1300 c.c. Dr. Benda expressed his idea that when ventriloquizing the Eustachian tubes are open and the cavity of the tympanum, together with the tympanic membrane, are set into simultaneous vibration. He had not been able to detect any resonance of the tympanic membrane in Herr Meyer; but he believes that this explanation of the curiously veiled tones emitted is not thereby invalidated, since they closely resemble the tones produced by speaking while yawning, in which case the Eustachian tubes are certainly open and the tympanic cavity acts as a resonator.—Dr. Benda gave a further account of his researches on the development of spermatozoa, and referred to several works which have been recently published and do not agree with the results obtained by himself. For his own part he could only confirm his earlier opinions by his later researches. In Marsupials he finds some resemblance to that which holds good in Sauropsida. In general it may be said that the very varying relationships observed in Mammalia between the parent-cell and the spermatozoa-cells which are connected with this may be looked at from one common point of view; it is only necessary to adopt for animals the differentiation of the cells of pollen-grains, observed by botanists, into vegetative or nutritive, and into generative, from which the spermatozoa then arise. These vegetative and generative cells can be made out both in the functioning and not yet active testes of embryos, the cells having extremely varying relations each to the other.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

A Course of Elementary Instruction in Practical Biology: T. H. Huxley and H. N. Martin; Revised Edition, extended and edited by Profs. Howes and Scott (Macmillan).—Early Christian Art in Ireland: Margaret Stokes (Chapman and Hall).—Diseases of the Dog: J. H. Steel (Longmans).—Papers of Fleeming Jenkin, 2 vols. (Longmans).—Practical Guide to Photographic and Photo-mechanical Printing: W. K. Burton (Marion).—United States Commission of Fish and Fisheries, Part 13, Report of the Commissioner for 1885 (Washington).—Mechanics and Experimental Science—Mechanics: E. Aveling (Longmans).—Astronomy for Amateurs: J. A. W. Oliver (Longmans).—Modern Theories of Chemistry: Dr. L. Meyer, translated by Profs. Bedson and Williams (Longmans).—Calendar of the University College of Wales, Aberystwith, 1887-88 (Cornish, Manchester)—The Children: How to Study Them: Dr. F. Warner (Hodgson).

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