fuel, nitric acid, and pyrites. The method has been in use at the works of the "Lawes Chemical Manure Company" at Barking, and the returns show that a saving of coal to the amount of $\frac{2}{3}$ of the quantity formerly burned has been effected—the total saving in steam, nitric acid, and labour during three months, amounting to five shillings per ton of acid of sp. gr. 1·6 made from pyrites. The patentee just points out that a saving of even one shilling per ton means in this country an annual gain of 50,000*l.*

THE Rev. N. M. Ferrers, of Cambridge, author of "A Treatise on Trilinear Co-ordinates," is preparing for the press a work on Spherical Harmonics. The plan adopted in this work will be first to discuss thoroughly the properties of the Zonal Harmonic, for which various expressions will be given, and general formulæ investigated, by which any rational integral function of one independent variable may be expressed in a series of Zonal Harmonics. The properties of Tesseral and Sectorial Harmonics will then be deduced from these. The expression of a discontinuous function by means of Spherical Harmonics will be discussed; and various examples will be given of the use of Spherical Harmonics in their applications to the theories of attraction, and of electricity and magnetism. The book will be published by Messrs. Macmillan and Co.

"PYTHAGOREAN Triangles" is the title of a paper which was read by W. Allen Whitworth, M.A., before the Literary and Philosophical Society of Liverpool in February of the present year. A Pythagorean triangle is a right-angled triangle having all its sides commensurable. The most familiar instance is that triangle whose sides are in the ratio of the numbers 3, 4, 5. The author shows that one of the sides must be even (a multiple of 4), one a multiple of 3, and that either a side or the hypotenuse must be divisible by 5. Making use of a discovery of Fermat's, he further shows that every prime number of the form $4N + 1$ is the hypotenuse of such a triangle. The most general results obtained are "the product of n prime hypotenuses, all different, will be itself the hypotenuse of 2^{n-1} Pythagorean triangles;" this result is modified if m only are different, to 2^{m-1} Pythagorean triangles. With the aid of these results he presents, in a tabulated form, 395 such triangles, with hypotenuses less than 2,500. We may mention that in Tebay's Mensuration a table of some 200 of these triangles is given, but with no indication as to how they are obtained. A great deal of information on the subject of these triangles is given in vol. xx. of "Mathematics from the *Educational Times*," at pp. 20, 54, 75, 76, 87, 97–100, to which we refer such of our readers as may be interested in the matter.

THE West Riding Consolidated Naturalists' Society have published the first number of a new monthly journal, the *Naturalist*. A journal with a similar title was published in the same district during the years 1865-6-7; we hope the present one will have a much longer life. Its principal object is to afford a means of communication among all Natural History Societies, either within or outside the county of York.

FROM the fourth Annual Report of the Chester Society of Natural Science, we are glad to see that the Society is prosperous and in good working order. The members now number 541, and during the past year several excursions have been made, several general meetings held for lectures, and the regular work of the sections carried on. Altogether this Society seems in a hopeful condition. The same Report contains a brief report of the Wrexham Society of Natural Science, which seems to some extent to be under the fostering care of its more prosperous Chester sister. It seems to be, on the whole, doing well.

MAJOR WOOD has sent us a reprint of two papers, with a map, on the Aralo-Caspian region; they originally appeared in the *Globe*, the journal of the Geographical Society of Geneva. Ramboz and Schuchardt, of Geneva, are the publishers.

THE additions to the Zoological Society's Gardens during the past week include a Red Deer (*Cervus elaphus*), European, presented by Mr. Samuel Carter; a Malabar Squirrel (*Sciurus maximus*) from S. India, presented by the Chevalier Blondin; two Purple Cow Birds (*Molothrus purpureus*) from Peru, presented by Prof. W. Nation; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, presented by Mrs. Bolton; a Crested Peacock Pheasant (*Polyplectron chinquis*) from Malacca, purchased; three Hoffmann's Sloths (*Cholopus hoffmanni*) from Panama; three Spotted Cavies (*Cœlogenys paca*), a Coypu (*Myopotamus coypus*) from S. America, an Argus Pheasant (*Argus giganteus*) from Malacca, deposited.

ON THE ACTION OF URARI ON THE CENTRAL NERVOUS SYSTEM

SINCE the introduction of urari twenty years back it has become more and more employed as an anæsthetic for physiological experiments. Its effects on the peripheral portions of the nervous system have been carefully studied, and are most distinct and peculiar, so much so that they seem to have diverted attention from its action on the central organs. Its effect, briefly, when injected subcutaneously, is to produce a paralysis of the motor nerves by attacking their ultimate branches. Dr. Foster, at whose suggestion these experiments were undertaken, and to whom I am indebted for much assistance, in the "Handbook for the Physiological Laboratory" establishes the following propositions:—1. "The effect of urari is to destroy or suspend the irritability of nerves, but not of muscles." 2. "With moderate doses of urari the small branches appear to be poisoned and to have lost their irritability, while the trunks are still intact." He also points out that "in order to bring these results out well, the dose of poison must not be more than sufficient to poison the motor nerves. Subsequent or stronger action of the poison affects the central nervous system as well." Now it is perfectly clear that the poison produces no appreciable effect on the sensory nerves, and in consequence rash conclusions have been drawn that it also has no effect on the sensorium, and is, in fact, not an anæsthetic at all.

The method of investigation employed was to take two frogs, as nearly as possible alike in size and vigour, and to pass a ligature round the whole abdomen (on Bernard's plan), taking care to exclude from the ligature the sciatic plexus and to include the blood-vessels. To one of the frogs a dose of urari was then administered, and the two placed under similar conditions and watched. The ligature in the poisoned frog of course prevented the urari from gaining access to the hinder limbs, while it could act fully on the nerve centres; and the behaviour of this frog could be compared with one which had merely undergone the operation, and was clearly possessed of consciousness and volition. We will call the two frogs A and B, B being the one which has the dose of urari. Now as soon as the poison took effect, movements of respiration of course ceased, and the frog lost control over its fore-limbs. On placing them side by side in an unconstrained position, A constantly moved, executing large and small movements with precision; its actions seemed in no way different from those of an uninjured frog. During this time the frog B never moved, and although quite capable of using its hind limbs, never did so; at rare intervals (perhaps half an hour), however, a movement was executed, but of a very distinct kind, a mere kick, such as a frog gives after the removal of its brain, in virtue of pure reflex action; now the innervation of the hind limbs was quite intact; the animal, if possessed of any wish to move them, was quite able to do so, so far as its structural arrangements were concerned. Indeed, the frog bore a striking resemblance to one which had had its brain removed; it behaved in almost every respect in the same manner.

If the two frogs be now laid on their face, a most convincing experiment can now be tried. If the leg of A be forcibly extended and let go, it is drawn up; it it be extended and held for a short time, it is again drawn up. Now if the leg of B be extended and at once released, it is also drawn up; but if it be held for a second against the efforts of the animal to withdraw it, these efforts cease and the limb retains its position for an almost indefinite period. Now there can be only one explanation of the behaviour of the frog B, namely, that the urari destroys consciousness and volition at an early period; that on extending the hind limb the mere act of extension is sufficient stimulus to call forth a definite amount of response which takes the form of a simple contraction, but that if the limb be held until this reflex act has passed off there is no consciousness on the part of the brain that the limb is in an unusual position, and consequently no volition is exerted to remove it.

It cannot be objected to this experiment that the stoppage of the circulation in the hind limbs has diminished their irritability because the frog A has perfect control over his; and, moreover, the vigour with which the reflex acts are executed in B precludes this idea. Again, it might be said that the stoppage of the respiration by the urari, and consequent supply of ill-aërated blood to the brain has injured the volition of the animal; to meet this, two counter experiments have been tried: in one a frog was gagged so as to keep its mouth open for some hours, and in the other a frog was kept under well-aërated water for two hours (a period equal to the duration of the chief experiment), and in neither case did the frogs seem to suffer any inconvenience whatever, least of all did they lose their volition.

In order to investigate the action of urari on the spinal cord, two similar frogs were taken as before; but previously to being ligatured they were pithed and had their brains destroyed; they were then suspended, and the state of the cord, as manifested by reflex action, tested; dilute sulphuric acid was used as stimulus; the numbers represent quarter seconds.

	h. m.	A*	B	
α	3 30	9	8	
	3 35	7	6	
	3 40	8	6	
		A* Lost blood.		
β	3 40	Urari was given to B.		
	4 15	8	5	
	4 20	8	7	
	4 25	8	6	
	4 30	8	8	
	4 35	9	9	
γ	4 35	A second dose to B.		
	4 40	7	14	
	4 45	8	26	
	4 50	9	22	
	4 55	7	27	Not strong.
	5 0	9	60	Weak.
	5 5	8		No action after 220.
	5 10			

From this it would appear that the first effect of urari is to make the action of the cord uncertain, then to delay the reflex action, and finally to destroy it entirely. The table has been divided into three parts, α, β, and γ, which seem to represent in a tolerably typical manner the three stages into which the phenomena are always divisible; sometimes the animal recovered after the stage γ.

This short account of the above experiments is intended as a preliminary notice. I am continuing investigations on mammals, and purpose hereafter to publish a more complete account of my results.

C. YULE

Physiological Laboratory, Cambridge

P.S.—Since writing the above my attention has been called to a paper by Dr. J. Steiner, in *Reichart's und Du Bois-Raymond's Archiv* for July. He investigates the action of urari on Invertebrates and fishes, and finds that among the latter its effect is to destroy volition before the peripheral motor fibres are attacked.

*WEATHER AND EPIDEMICS OF SCARLET FEVER IN LONDON DURING THE PAST THIRTY-FIVE YEARS**

THIS paper gives the results of an investigation, the purpose of which was to determine whether the seasonal influence of weather on deaths from scarlet fever, as shown by the curve constructed from the figures of thirty years, would present itself if the period were broken up and curves constructed for the several smaller periods embraced in the long one. In other words, the object was to determine whether, in the case of a disease which is strongly epidemic, the obedience to seasonal influences, would exhibit a steadiness and uniformity of character, such as is presented in the case of pulmonary diseases. In London there have been six epidemics of scarlet fever during the last thirty-five years, reaching their maxima in 1844, 1848, 1854, 1859, 1863, and 1870. Curves were constructed representing the average weekly deaths from scarlet fever for each of the six periods embracing these epidemics. These curves were then compared with the curve for the thirty years, 1845–74, the leading features of which are that it is above the average from the beginning of September to the end of the year, and below the average during the rest of the year; and that the period of highest death-rate is from the beginning of October to the end of November, when it rises to about 60 per cent. above the average, and the period of lowest death-rate in March, April, and May, when it is about 33 per cent. below the average.

On comparing the curves for the six short portions of the thirty-five years, each dealing only with four, five, or six years, with the general curve for the long period of thirty years, a remarkable similarity is found to occur. They are all substantially the same curve. The description of the general curve given above applies almost literally to every one of the six curves for short periods, and indeed so close is the correspondence that they all cross their mean almost in the same week of the year. In every case the maximum occurs in October and November, and the only point of difference among them is that while the general curve rises at the maximum period to 60 per cent. above the average, during the first epidemic it rose only to 40 per cent., and in one or two of the others it rose to 80 per cent. above the average. The steady obedience to climatic influences in the fatality from a disease so decidedly epidemic as scarlet fever is very remarkable, and the more so inasmuch as no other disease, with the single exception of typhoid fever, attains to its maximum fatality in London under the conditions of weather peculiar to October and November.

* Abstract of a paper read by Dr. Arthur Mitchell at the general meeting of the Scottish Meteorological Society, July 13.

*PHYSICAL PROPERTIES OF MATTER IN THE LIQUID AND GASEOUS STATES**

II.

Law of Gay-Lussac.—That the law of Gay-Lussac in the case of the so-called permanent gases, or in general terms of gases greatly above their critical points, holds good at least at ordinary pressures, within the limits of experimental error, is highly probable from the experiments of Regnault; but the results I have obtained with carbonic acid will show that this law, like that of Boyle, is true only in certain limiting conditions of gaseous matter, and that it wholly fails in others. It will be shown that not only does the coefficient of expansion change rapidly with the pressure, but that, *the pressure or volume remaining constant, the coefficient changes with the temperature.* The latter result was first obtained from a set of preliminary experiments, in which the expansion of carbonic acid under a pressure of seventeen atmospheres was observed at 4°, 20°, and 54°; and it has since been fully confirmed by a large number of experiments made at different pressures and well-defined temperatures. These experiments were conducted by the two methods commonly known as the method of constant pressure and the method of constant volume. The two methods, except in the limiting conditions, do not give the same values for the coefficient of expansion; but they agree in this respect, that at high pressures the value of that coefficient changes with the temperature. While I have confined this statement to the actual results of experiment, I have no doubt that future observations will discover, in the case, at least, of such gases as carbonic acid, a similar but smaller change in the value of the co-efficient for heat at low pressures. The numerous experiments I have made on this subject will shortly be communicated in detail to the Society; and for the present I will only give the following results:—

Expansion of Heat of Carbonic Acid Gas under high pressures.

Pressure. at.	Vol. CO_2 at o_2 and 760 millims. = 1.	Vol. CO_2 at. 6°·05 and 22·26 at. = 1.	Temperature.	
22·26	0·03934	1·0000	6·05	...(A)
22·26	0·05183	1·3175	63·79	
22·26	0·05909	1·5020	100·10	

* "Preliminary Notice of further Researches on the Physical Properties of Matter in the Liquid and Gaseous States under varied conditions of Pressure and Temperature." Paper read before the Royal Society by Dr. Andrews, F.R.S., Vice-President of Queen's College, Belfast. Continued from p. 301.