preparatory to the ascent for purposes of signalling. The army on the other side of the mountains has already sent up a similar balloon. The next scene shows a nearer balloon ascended to a certain height. Now the two balloons are about to communicate. You see the flashes of light from the balloon.

Although this invention is not two years old, it has already a short history. It was exhibited in model in the War Department of the Inventions Exhibition, and while on exhibition there the method was referred for Government trial under a Committee of the Royal Engineers at Chatham. During the time the model was being exhibited at South Kensington, some experiments were tried with a balloon of 4000 cubic feet capacity at the Albert Palace. In this balloon were placed six lamps worked to 16 or 20 candle-power. The six lamps took a current of some 9 amperes, and the electromotive force was 24 volts. The source of electric power then used was 25 cells of the Electrical Power Storage Company. During this Exhibition the value of the method for long-distance signalling was well tested, the flashes of light from the balloon being observed as far as Uxbridge, a distance of sixteen miles. This was effected by less than 100 candle-power. I used the same apparatus for the Government trial at Chatham, after which trial I received an order from the War Office to supply some of my apparatus to the Royal Engineers. The system was again tried at Aldershot under the Signalling Department. On the day fixed for the trial there was a snowstorm and a fog, two very unfavourable conditions in a system of signalling, but signals were read and answered from my balloon, in spite of snow and fog, by the signallers stationed some few miles off. As I mentioned the other day at a meeting of the Aëronautical Society, I wish, as the inventor of this system, to see it tried to its utmost capacity, and I purpose to put the system myself shortly to the most rigorous of tests. One of those tests will be, I hope, to signal over the Channel, *i.e.* to send up the balloon on some site on the English coast, probably Dover, and observe whether the balloon can be seen on the French coast. The Channel is by no means the most favourable expanse for signalling, for there are frequent fogs in it to obscure the view. The Channel, however, is a time-honoured and popular measure of distance, and I must repeat here the wish I expressed lately at the meeting of the Aëronautical Society, that, if the flashes of light can be observed over that expanse, I hope the public will look upon the accomplishment, not as a sensational feat, but as showing the practical value of balloon-signalling. Up till lately I have only considered my system as being useful to the army. I think, however, it would be also useful to the navy. I have schemed a method of employing these balloons on board ship. Their greatest use in the navy would be, I think, for coast-signalling—signalling round corners; I have been asked to submit this scheme to the Admiralty, and am preparing to do so. The picture now before you represents its use in the navy on board a ship stationed in a bay, which vessel wishes to communicate with another at the other side of the cliffs which form the bay. It is, as you see, night-time. The ship that is not visible to you sends up the balloon, and now the two balloons commence signalling to each other. [Experiment shown.]

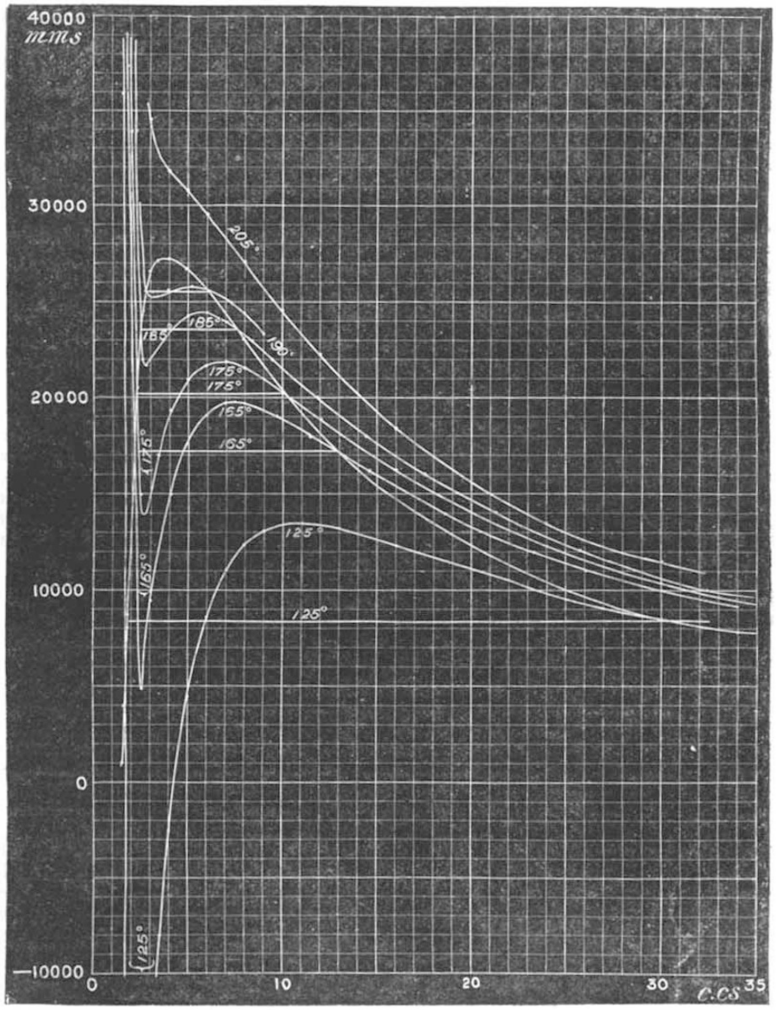
You may perhaps be inclined to think that I ought to mention some one particular occasion in history when this balloon would have been useful. I do not think we need look far back to find one example. But a short while ago there was a brave general shut up in a besieged city with a few followers. Near at hand there were friends ready to help, but ignorant of the immediate necessity of that help. Need I name that general and that city? Now, if from Khartoum there could have arisen such an electric signalling-balloon as I have described to-day, its flashes of light in the skies would have told the tale of the events below—a tale that would have been eagerly read—and perhaps that brave general would then have left Khartoum, a conqueror, and with his life spared for the future service of his country.

SOCIETIES AND ACADEMIES

London

Royal Society, January 6.—"Preliminary Note on the Continuity of the Liquid and Gaseous States of Matter." By William Ramsay, Ph.D., and Sydney Young, D.Sc.

For several years past we have been engaged in an examination of the behaviour of liquids and gases through wide ranges of temperature and pressure. The results of our experiments with ethyl alcohol have recently been published in the *Philosophical Transactions*; those with acetic acid in the *Transactions* of the Chemical Society; and the Royal Society have in their hands a similar investigation on ether. We have also finished a study of the thermal properties of methyl alcohol.



In consequence of a recent publication by Wroblewski, of which we have seen only the abstract (*Berichte*, 1886, p. 728, abstracts), we deem it advisable to communicate a short notice of an examination in which we are at present engaged.

We find that with the above-mentioned substances, acetic acid excepted, whether they are in the liquid or gaseous state, provided volume be kept constant, a simple relation holds between pressure and temperature. It is $p = bT - a$. This is evidently a simple modification of Boyle's and Gay-Lussac's laws; for at low pressures, where volume is large, the term a approaches and finally equals zero, while b diminishes and finally becomes equal to the value of c, calculated from the ordinary equation,

$$p = \frac{cT}{v}.$$

We have as yet only had time to apply this formula with ethyl ether to the liquid state; and as we are not yet quite certain whether the relation holds for volumes between 4 and 20 c.c. of 1 gramme of ether, we are at present engaged in measurements of volumes and pressures at temperatures between 220° and 280°. Assuming the above relation to be true (and it is at all events a close approximation to truth), it is possible to calculate those portions of isothermals included within the liquid-gas area, and represented in Andrew's diagram by horizontal straight lines. We have calculated a few of these isothermals for ether, and find that the areas above and below the horizontal lines (see woodcut) are equal, when measured by a planimeter.

Reserving a full discussion of the subject until the completion of our experiments, we would here point out the similarity between the equation $p = bt - a$ and those proposed by Clausius and by van der Waals to represent these relations. Clausius's formula is

$$p = \frac{RT}{v - \alpha} - \frac{c}{T(v + \beta)^2},$$

and van der Waals'

$$p = \frac{RT}{v - b} - \frac{a}{v^2}$$

In these formulæ Clausius's α and c are equivalent to van der Waals' b and a respectively, but R has a different signification.

We find that a somewhat similar formula agrees better with experiment than either of the above; it is

$$p = \frac{RT}{v - b} - \frac{a}{Tv^n},$$

where R, b, and a have the same meaning as in van der Waals' formula. This formula expresses the results of experiments with great accuracy, where the volume of 1 gramme of ether occupies not less than 25 c c.; but at smaller volumes it ceases to represent the facts.

It is to be noticed that both Clausius's equation and ours introduce T into the denominator of the second term; they evidently differ from our first equation $p = bt - a$, in which a is independent of temperature.

We shall soon be in a position to communicate the results of this investigation, giving full data.

Paris

Academy of Sciences, January 3.—M. Gosselin, in the chair.—A new method of determining the constant of aberration, by M Loewy. M. Nyren having shown that none of the methods hitherto adopted are free from systematic error, the author here proposes a process by which all instrumental errors may be avoided. It also eliminates the effects of precession and nutation, and enables the observer to take accurate account of the proper movements of the stars without depending on their approximate values drawn from the catalogues. Lastly, it neutralises the parallactic effect of the stars, dispensing with the numerous experiments needed to determine the instrumental constants. In a word, it calculates directly the phenomenon of aberration itself, without employing any physical constant.—On the relations of the lactiferous vessels with the fibro-vascular system, and on M. J. Vesque's aquiferous apparatus of Calophyllum, by M. A. Trécul. Further researches are described confirming the conclusion already announced by the author regarding the numerous points of contact between the milk-yielding vessels and the various elements of the fibro-vascular system in a large number of plants. It is further shown that the anatomical results described by him in the year 1865 are amply confirmed by M. Vesque's recent note on the aquiferous apparatus of *Calophyllum Calaba*.—Actinometric observations made during the year 1886 at the Montpellier Observatory, by M. A. Crova. The comparative study of these observations (made by M. Houdaille with the author's actinometer) with those of the three previous years confirms the conclusions already arrived at regarding the annual variations of calorific intensity in the solar rays.—Note on the diurnal nutation of the terrestrial globe, by M. Folie. The important consequences of the existence of this phenomenon for geology, astronomy, and geodetics are pointed out, and it is shown that it places beyond doubt the fluid state of the interior of the globe surrounded by a relatively thin outer crust.—Note on the Maclaurin series in the case of a real variable, by M. O. Callandreau.—On a class of differential equations, by M. Emile Picard.—Observations relative to M. P. Serret's recent note on a geometrical theorem, by M. L. Lindelöff. A slight error is pointed out in M. Serret's calculation establishing the correspondence between the lines of curvature in two surfaces with reciprocal vector rays.—Note on the problem of electric distribution, by M. H. Poincaré. The author points out the defective character of the method proposed by MM. Neumann, Schwarz, and Harnack for solving this difficult problem.—Remarks respecting M. Hirn's observations on the flow of gases, by M. Hugoniot. The author returns with regret to this subject, and makes some final remarks on M. Hirn's paradoxical inferences, calling upon him to present a complete statement of his experiments, and of the causes of the errors he professes to have detected in the calculations of the upholders of the kinetic theory.—Note on the specific heats of a perfect gas, by M. Félix Lucas. On theoretic grounds it is argued that the two specific heats of a perfect gas become increasing functions of the temperature.—On the nature of the electric actions in an insulating medium (second communication) by M. A. Vaschy. These problems of electro-statics are brought into general relation with those dealing with the equilibrium of the ether regarded as an elastic body. It is hence inferred that the electric perturbations must be propagated with a uniform velocity, just as a mechanical concussion is propagated in an isotropic body, and this velocity must be that of light.—On electric pressure and on electro-capillary phenomena, by M. P. Duhem.—On a phosphate of hydrated silica, by MM. P. Hautefeuille and J. Margottet. From three analyses made with specimens obtained from different preparations it is shown that the formula of this substance is $SiO_2, 2PhO_5, 4HO$.—Action of sulphur on ammonia and on some metallic bases in the presence of water, by M. J. B. Senderens. These researches have been carried out in continuation of MM. Senderens and Filhol's studies in connection with the action of sulphur on the saline solutions and on those of soda and potassa.—Note on the maxima vapour tensions of acetate of soda, by M. H. Lescœur. M. Berthelot's conclusion that there is no isomery either between the solid salts or between the diluted solutions of the various acetates of soda, are fully confirmed by the results here obtained by a different process.—On the preparation of the isobutylamines, by M. H. Malbot. It is shown that the three isobutylamines are formed in proportions differing little from each other, the operation constituting an effective method of preparing all these amines simultaneously.—Isomery of the camphols and camphors, by M. Alb. Haller. Here the author deals with the camphols of madder, of Borneo (*Dryobalanops camphora*), and of yellow amber.—Heat of formation of some alcoholates of potassa, by M. de Forcrand. Determinations are given for the heat of formation of the propylate and isobutylate of potassa.—On some points relating to the action of saliva on the grain of starch, by M. Em. Bourquelot.—Experimental researches on mercurial intoxication, by M. Maurice Letulle. The paper deals especially with the paralytic accidents and lesions of the surface nerves caused by this intoxication (chronic hydrargyrism).—Studies of the relations existing between the cranial nerves and the cephalic sympathetic nerve in birds, by M. L. Magnein.—Note on the red and white muscles in the rodents, by M. L. Ranvier.—Observations relative to M. Maupas' recent note on the multiplication of *Leucophrys patula*, by M. Balbiani. It is shown that the peculiar process of fissiparity in these organisms is not such a rare phenomenon as is supposed by M. Maupas.—On the line of development followed by the embryo of bony fishes, by M. L. F. Henneguy. The author's researches confirm the conclusions already arrived at by Kupffer and Œllacher.—On the amphipod crustaceans of the west coast of Brittany, by M. Edouard Chevreux.—Observations relative to M. Viguier's note on the so-called ophite rocks of the Corbières, and to M. Depéret's communication on the Devonian system of the Eastern Pyrenees, by M. A. F. Nogués.—Microscopic examination of the ashes ejected by the Krakatão volcano, by M. Stanislas Meunier.—A critical examination of certain rare minerals, by M. A. Lacroix. Descriptions are given of pterolite, villarsite, grängesite, and gamsigradite.—The death was announced of M. Francisque Fontannes, a distinguished geologist, who was awarded the Academy's Grand Prize for the Physical Sciences in 1883.

BERLIN

Physical Society, November 19, 1886.—Prof. du Bois-Reymond in the chair.—Prof. Liebreich reported on phenomena he had observed in the course of experiments respecting slowly-proceeding chemical reactions. If hydrate of chloral were mixed with an alkaline solution, then was chloroform formed in the shape of a white precipitate. This reaction occurred with all alkaline solutions, only the time varied according to the alkali. While, however, chemical reactions usually ensued in the whole mass of the reacting substances, it was here observed that, when the process of mixture was effected in a test-glass, the uppermost layer remained clear, no turbidity and precipitate formation occurring in it. This layer, which the speaker named the "dead space" ("todter Raum"), was bounded on the upper side by the meniscus of the fluid, and on the lower side by a sharp boundary, having, apparently, a curve opposed to the meniscus. In the capillary space between two glass plates, the dead space displayed itself in very beautiful formation. In horizontal capillary tubes the dead space came into shape at both ends, and in very short capillaries the reaction failed entirely. If from the dead space a little clear fluid were withdrawn and warmed, then did the reaction set in. This showed that in the dead space both fluids were contained, and that it was only their chemical action that was prevented. The dead space showed itself in drops at the edge of the curve. In the capillary space between two menisci was found an external ring, and the middle clear, while reaction occurred only in a small ring. If tubes were closed by a membrane above and below, and filled with the mixture of hydrate of chloral and alkali, then did the dead space appear both at the top and the bottom. The same phenomenon presented itself likewise in animal membranes—for example, in a rabbit's bladder or in an intestine. On the other hand, the dead space was observed neither in a gutta-percha alembic nor in a similar shaped glass retort. The speaker also discussed many other sorts of phenomena in respect of the dead space, both with the fluids already named and with other fluids, demonstrating a large part of them by experiments. In conclusion, he set up the hypothesis that, in the experiments referred to, the chemical reaction was hindered by phenomena of surface-tension, a matter which should be further investigated by additional experiments. A lengthy discussion followed this paper.—Dr. Weinstein then reported on a publication of the Normal Standard of Weights and Measures Commission, "Construction and Repeated Trial of the Principal Standards and the Control Standards" ("Die Herstellung und Wiederkehrende Prüfung der Hauptnormalen und der Controllnormalen"). He brought out that in this publication the idea of weight was officially defined by a mass, the unit of which, the kilogramme, was equal to a cubic decimetre of distilled water at 4° C. The trial of the normal metre of platinum resulted in the establishment of its invariability. The kilogramme of platinum was likewise unchanged, while, on the other hand, the control standard-kilogramme showed a slight increase of weight through oxidation. The examination of the dry measures resulted in showing a considerable diminution of volume, a fact which would have to be ascribed to elastic and thermal after-effects in the material that had been employed for the standard dry measures.

Physiological Society, November 26, 1886.—Prof. du Bois-Reymond in the chair.—After the re-election of the President and Council, in accordance with the statutes of the Society, and the disposal of several business motions, Prof. Falk communicated a case taken from his forensic practice, which was not without physiological interest. A boy was run over by a heavy van and in a few minutes died. A *post-mortem* showed a gaping rupture of the thyroid and of the cricoid cartilage, the entrance of blood into the air-passages—causing death by suffocation—and into the digestive organs. It was, now, a remarkable and physiologically interesting fact that the blood had penetrated not only into the stomach, but into the small intestine, and that, as far as the neighbourhood of the cœcum. Seeing that the abdominal organs were perfectly intact, and the intestines even to a high degree anæmic, the blood must have proceeded from the stomach, and that during the brief time of the agony; for peristaltic movements appeared indeed after death, but in no case in the stomach, and the passage of the contents of the stomach into the intestine was never observed after death had set in. The speaker had, on the other hand, observed very violent swallowing movements as well as increased peristaltic movement in the intestine and stomach in men, and especially in his experiments with animals during the agony of suffocation. In the discussion following, Prof. Zuntz corroborated the fact of the appearance of increased peristaltic movements, and of the abnormally far advance into the intestine of the contents of the stomach during death by suffocation, citing, as he did, some earlier experiments he had not yet published. By way of testing the assertion proceeding from the laboratory of Prof. Ludwig, that acid chyme was normally found in the small intestine of animals, he had instituted experiments in which very soon after death he opened the abdomen of animals, and by a ligature isolated the small intestine from the stomach; he then in every case found the contents of the intestine neutral or alkaline. If on the other hand he poisoned the animals, as in the case of Ludwig's experiments, with curare, then were the contents of the intestine acid. The cause of that, however, was that the animals had died from suffocation, and that the asphyctic blood had induced a lively peristaltic movement of the smooth intestinal muscles not paralysed by curare, and so, therefore, an abnormally rapid propulsion of the contents of the stomach into the small intestine.

BOOKS AND PAMPHLETS RECEIVED

Mind, January (Williams and Norgate).—The Cruise of the *Marchesa* to Kamchatka and New Guinea, 2 vols: F. H. H. Guillemard (J. Murray).—Proceedings and Transactions of the Royal Society of Canada for the Year 1885, vol. iii. (Montreal).—Journal of Anatomy and Physiology, January (Williams and Norgate).—Elements of Harmony and Counterpoint: F. Davenport (Longmans).—Bees and Bee-keeping, vol. i., parts 11, 12, 13; vol. ii., parts 1, 2, 3, 4: F. R. Cheshire (Gill).—Journal of the Chemical Society for January, and Supplementary Number (Van Voorst).—Journal of the Scottish Meteorological Society, third series, No. 3 (Blackwood).—Le Mesure du Mètre: W. de Fonvielle (Hachette, Paris).—Annalen der Physik und Chemie, 1886, No. 12 (Leipzig).—Beiblätter zu den Annalen der Physik und Chemie, 1886, No. 11 (Leipzig).—Text-book of British Fungi: W. D. Hay (Sonnenschein).—Hand-book of Practical Botany: Strasburger and Hillhouse (Sonnenschein).—Historical Basis of Modern Europe: A. Weir (Sonnenschein).—The Primula: Report on the Primula Conference (Macmillan).—Resa till Grönland: Nils O. Holst.—Proprietà Industriale (Roma).—Beiträge zur Statistik der Blitzschläge in Deutschland: Dr. G. Hellmann (Berlin).—History and Biology of Pear-Blight: J. C. Arthur.—An Address before the American Association for the Advancement of Science: T. C. Chamberlin (Salem).—Jahresbericht Am., 25 Mai, 1886, dem Comite der Nicolai-Hauptsernwarte (St. Petersburg).—Grundzüge einer Theorie der Kosmischen Atmosphären: W. Schlemüller (Prag).—Ueber die Allegemeine Beugungsfigur in Fernröhren: H. Struve (St. Petersburg).

CONTENTS