Bokhara a large tract of land on the banks of the Amu-daria, near the Chardjui station of the Transcaspian Railway, for the cultivation of cotton. In the Transcaspian there seems to be a great district suitable for cotton-growing, and there is a general opinion among the commercial classes of Russia that the development of this industry ought to be steadily encouraged by the Government.

THE *Bollettino* of the Italian Geographical Society for November contains an account of a second expedition by Signor E. Modigliani to Nias, which has proved much more successful than his first visit to that island, reported in NATURE, November 16, 1886, p. 60. His primary object was to discover and ascend the Mount Matsua, 600 metres high, seen by Von Rosenberg from the west coast, and figured on his map as the culminating point of the island. But, although no trace could be found of this mountain, the hitherto unexplored south-western district was traversed from Serombu on the west to Lagundi Bay on the south coast. This district was carefully surveyed, and the explorer succeeded in making rich zoological, botanical, and ethnological collections, most of which have been forwarded to the Natural History Museum of Genoa. They include no less than twenty-six human skulls (fifteen of which were obtained at Hili Horo in exchange for a rifle), about 120 birds, 2000 butterflies, 1500 other insects, monkeys, fishes, reptiles, and plants. The journey was made during the summer of 1886, Signor Modigliani's last communication being dated August 10, and forwarded to Europe from Gunung Sitoli, in the north of Nias, where he was then stationed with the intention of continuing his scientific researches in the island.

ON Tuesday evening last Captain Cameron delivered at the London Institution a lecture on "Urua: its People, Government, and Religion." In closing his lecture Captain Cameron said that Urua would shortly come into great prominence, for lately some of the officers of the Congo Free State had followed the river due east, across the great bend of the Congo, showing that it was a navigable river, and that if followed up it would lead to Kasongo's capital. They were frequently hearing of the London Missionary Society's agents pushing up the new great tributary of the Congo on the south, so there could be little doubt that in a short time the Somami would be followed up to Urua, and that traders, missionaries, and others would soon come into the great kingdom of Urua, where there was a great work before them. However, they would have to bear in mind that they would not have to do with a little chief ruling over 200 or 300 natives, but with a powerful monarch who ruled absolutely over his people, and who would allow of no agreement which had not been approved by him. It was to be hoped that, as Stanley had been successful before, he might be successful in his expedition for the relief of Emin Pasha, and also that those who went into Urua would bring civilisation and peace, and be able to do away with the horrors of the slave trade which obtained there owing to the Portuguese and the Arabs. Urua was rich in many kinds of minerals and other products, and the people were a fine race. When the Europeans came into constant contact with them, if they were wisely managed, there would be a great future for them.

WAR AND BALLOONING[1]

THE object which stimulated the practical invention of the balloon was its use in war. I say practical invention, because in theory the balloon was invented before the experiment of Montgolfier. Theory is ever the soil of practice. The idea of the balloon has its starting-point in the principle of the pressure of fluids elucidated by Archimedes, of Syracuse, 200 years before the Christian era. The discovery of hydrogen gas by Mr. Henry Cavendish, in 1760, led Joseph Black, the Professor of Chemistry at the University of Edinburgh, to suggest in one of his lectures that a weight might be lifted from the ground by attaching to it a sphere of hydrogen gas. A fruitful idea once expressed is rarely lost, however casual its first expression. Some years later, Tiberius Cavallo, an Italian merchant, remembered the remark of Dr. Black, and, in 1782, tested its truth by experiment. He first manufactured some paper bags, which he filled with hydrogen gas: to his disappointment, the subtle gas escaped through the pores of the paper. He then collected the gas in soapy water, and the bubble of gas ascended. A soap-bubble filled with hydrogen was therefore the first balloon. The experiment seems to have been repeated by Cavallo at one of the meetings of the Royal Society, and described in the Transactions of that Society; but neither Cavallo nor his colleague pursued the experiment further, and there was still to be found the peculiar kind of energy that would transform the laboratory experiment into a practical reality. Books are indeed the carriers of thought. It is probably due to a work of Priestley, in which were described those discoveries of Cavallo, and which was translated into French, that Montgolfier, the paper-maker of Annonay, was fired to perform an experiment that is historical. He, as most of you know, filled a paper bag with heated air, the consequence being that the bag rose to the ceiling of the room. Montgolfier was not content with such trifling efforts: a patriotic motive stimulated him to attain greater results—the desire to make the invention of use to France in her wars; and the paper bag of 40 cubic feet capacity was succeeded by one of 680 cubic feet; this, again, by one of 23,000 cubic feet. Montgolfier seemed on the high-road to a brilliant success. There was, however, another brain actively employed in eclipsing the fame of Montgolfier—that of Charles, the Parisian, who realised that heated air would never become a satisfactory method of filling balloons, heated air being three-fourths the weight of the air at the ordinary temperature. He therefore took up the experiments with hydrogen gas where Cavallo had left off. Hydrogen gas being thirteen times lighter than air, its superiority in filling balloons was, to his mind, indisputable. He succeeded in making a material gas-proof, and consequently produced the first practical gas-balloon.

From the efforts of Montgolfier and Charles began the history of ballooning. I do not propose to discuss its general history this evening, with its startling incidents of adventure, nor to enumerate the good service the balloon has rendered to science in the hands of such men as Benedict de Saussure, Robertson, and Glaisher, but to make a few remarks upon its use as an adjunct of war.

By many persons, those who advocate its use in war are looked upon as enthusiasts. With many persons, an enthusiast is synonymous with a fanatic. Now, I agree that enthusiasm is sometimes expended on improper subject-matter—on wild incoherent schemes; but give enthusiasm proper subject-matter, truth, and coherency, and it becomes a noble thing; it is, in fact, the life-blood of science and art. It is, in other words, earnestness of purpose. I think the use of balloons in war is worthy of this earnestness of purpose.

I have to bring before your notice this evening, in particular, a somewhat new departure in balloons, in which electricity is so combined with a captive balloon as to render it valuable for signalling-purposes. Before I describe this special use for balloons in war, which I have had the honour of introducing to the English Government, and for which I hold patents in the principal foreign countries, I will say a few words concerning the general use of balloons in time of war.

The way in which balloons have been chiefly utilised in war is for taking observations of the enemy. In such cases the balloons are captive. As early as 1793 the French Government adopted the use of captive balloons. Such balloons were employed with great success in those wars which the French Goverment carried on soon after the French Revolution. There was a regular company formed, called "Aërostiers," and it seems to me that more practical work with captive balloons was done in actual war at this period than has been accomplished since. It was Napoleon who put an end to their career of usefulness in France, and who closed the Aëronautical School at Meudon.

It is this use of captive balloons for observations that has lately been revived by the English Government, and experiments are frequently carried on at Chatham under a Committee of the Royal Engineers. Notably amongst those who have been prominent in the revival of balloons for war purposes we may mention the names of Major Templer, Major Elsdale, and Lieut. Mackenzie, and the country, I think, has reason to thank these officers for the really good work they have done with the means at their disposal. At the Inventions Exhibition there was an exhibit of balloons in the War Department. Perhaps the more important feature of that exhibit was a balloon made of gold-beater-skin, such as was used in the war in Egypt. Gold-beater-skin is an admirable substance for forming balloons on account of its lightness and capacity of holding gas.

The free balloon has its use in war as well as the captive one.

[1] A Lecture delivered by Mr. Eric S. Bruce, M.A. Oxon., at the London Institution, on December 28, 1886.

At the siege of Paris this use of balloons was demonstrated most efficiently. At the time when the Parisians found themselves cut off from all means of communication there were but a few balloons in Paris, but the successful escape of some aëronauts in these few was considered encouraging enough to establish an aërial highway involving a more wholesale manufacture of balloons than has ever been undertaken, the disused railway-stations being converted into balloon manufactories and training-schools for aëronauts. During four months 66 balloons left Paris—54 being specially made for the administration of Posts and Telegraphs—160 persons were carried over the Prussian lines, 3,000,000 letters reached their destination, 360 pigeons were taken up, of which, however, only 57 came back, but these latter brought 100,000 messages. These facts show that free balloons are useful in war. The utility of a free balloon would be largely increased if it could be steered against a considerable wind. Attempts have been made to navigate balloons on two principles: (1) by using the various currents of the air; (2) by some kind of mechanical propulsion. I will say just a word or two on each of these heads.

(1) As regards mechanical propulsion. There are some persons who, when they hear any suggestion regarding a steerable balloon, denounce the idea as impossible ever to be accomplished. I think it a wiser course to reserve a definite opinion as to whether such a thing is possible in the future, as the experiments worth anything which have been made in this direction have been few and far between, and it is unwise to draw conclusions on a basis of inadequate facts. I will, however, say this much, that those who have the task in hand have a difficult problem before them, and that the engineer who first steers a balloon against a strong wind by mechanical propulsion will deserve a high place amongst the heroes of science. I will enumerate some of the difficulties in the way of steering a balloon against the wind by mechanical propulsion, and then proceed to give you a short description of some of the latest experiments that have been made.

There is an essential difference of condition between navigating the water and navigating the air. In the former we have a body moving within the limits of two media, air and water. These two media have different densities and elasticities, consequently resistances. In air-navigation the body moves in one medium only, which renders the motion of a paddle-wheel entirely useless in that one medium—a paddle-wheel moving in the air would effect nothing—therefore, the only available means of propulsion in air-navigation is the screw: this cuts into the medium. Now it stands to reason that this medium must be in a state of comparative rest, or else the work of the screw will be overpowered. A moderate wind is sufficient to overpower a strong screw, hence the obstacle to air-navigation by mechanical propulsion. Capt. Renard has recently sent in to the French Academy an account of his experiments with his so-called navigable balloon *La France*, at Meudon. His experiments were decidedly interesting—in fact, they were in advance of anything yet accomplished in balloon guidance, but there has, I think, been a tendency to exaggerate the results obtained. I think anyone who reads carefully the accounts of those experiments which appeared in *La Nature* will see that the old difficulty with the screw still remains. The experiments to which I refer took place in comparatively calm weather. It is said that out of seven performances the balloon returned five times to the place whence it started. This is certainly more than most balloons do. To accomplish this, much care and ingenuity must have been exercised; but on reading the accounts, we find that great care was taken for the selection of that kind of weather that would not make the work of the screw *nil*. A whole month, in fact, had to elapse between the first ascent mentioned and the second, owing to unfitness of weather. On the day of the second experiment the wind blew from the north-north-west from Paris at a velocity of from 3 to 3·50 metres per second, starting from Meudon. The balloon was directed towards Paris at 4.25 p.m. It crossed the railway-line at 4.55, reached the Seine at 5 o'clock; at 5.12 the balloon entered the *enceinte* by Bastion 65. Then the aëronauts decided to go home. The balloon was easily turned, and, aided now by the aërial current, reached the exact spot whence it had started. The journey going had taken 47 minutes, the journey back took 11 minutes. Such experiments as these, to my mind, deserve praise, because they were conducted in a scientific manner, and because some results were attained; although the result of navigating a balloon against a wind of *considerable* power certainly did not come to pass. One must, it seems, still be content with mere bread-crumbs of aërial navigation.

(2) As regards the second means of navigating the air, by a fit selection of those varying currents that are frequently overlying one another blowing in different directions over the same spot. I think a closer and more methodical study of those currents might lead to satisfactory results. Up to the present time but little has been ascertained concerning them. Unfortunately for aëronautical science its Glaishers have been few, its mountebanks numerous. It is true there has always been a difficulty in the way of studying the aërial currents from a balloon, namely, the difficulty of keeping the balloon at a certain elevation. After expending ballast to make the balloon rise to a certain elevation for the sake of reaching a particular current, some change of temperature produced by the sun or clouds will often affect the delicately-balanced machine, and alter its altitude. If it has risen higher, gas must be sacrificed to reach the lower level; if it has descended, more ballast must be expended. In this way gas and ballast, which a celebrated aëronaut has called the "life-blood of the balloon," is quickly exhausted. It is these facts that make the successful experiment carried out by M. Lhoste last August so worthy of note. In his voyage across the Channel he made use of an apparatus which he called a "*flotteur frein*." This acted as a kind of floating anchor or brake. It was a cylindrical iron vessel with a conical air-chamber at the top, 1 metre 60 centimetres in length, 22 centimetres in width, weighing 10 kilogrammes when empty, and 60 kilogrammes when filled with salt water. The *flotteur* was attached to a bar underneath the balloon, on which a small sail was hoisted. The important function of this *flotteur* is, that by its means the same altitude of the balloon can be maintained when the favourable current is once found. By means of this *flotteur* the water itself can be drawn up into a reservoir in the balloon and utilised as ballast, after sunrise, when the expansion of the gas by the heat of the sun's rays would otherwise cause the balloon to shoot upwards. By this method of adjusting the altitude of the balloon, several important observations of the various currents of air about which we know so little might be taken, and it would, I think, be well if Governments organised experiments with these various currents, as well as with elaborate screws worked with power inadequate for the purpose of propelling a balloon against a powerful wind. Perhaps the aërial machine of the future may be directed by utilising in a thoroughly scientific manner these varying currents. In such a system of aërial locomotion perhaps the screw may be used as a kind of makeshift in a dead calm, when a change of level is not desirable, like the oars when there is no wind to fill the sails.

One of the most practical uses of balloons in war is for signalling. The utility of balloon-signalling consists in the elevation obtainable. Any accepted method of signalling may be used in the car of an ordinary captive balloon, *e.g.* flag-signalling or lantern-signalling. But signalling from the car of a balloon necessitates the use of a balloon of considerable size to secure the required lifting-power. This limits the practicability of such a method. About a year and a half ago it occurred to me to so apply electricity to a captive balloon that a method of flashing signals from a balloon is practicable while the operator remains on the ground. Thus the weight of the operator is obviated, and consequently the balloon can be of such a size as to be extremely portable. It is my wish to thoroughly explain to you this method. In the interior of a balloon which is made of a material that is perfectly translucent and filled with hydrogen or coal-gas are placed several incandescent electric lamps. The lamps are in metallic circuit with a source of electricity on the ground. In the circuit on the ground is an apparatus for making and breaking contact rapidly. By varying the duration of the flashes of light in the balloon, it is possible to signal according to the Morse or any other code. To thus place a source of light in the midst of the gas inside a balloon would not have been possible until the development of the electric light. Many persons even now seem to think the proceeding of showing a light inside a balloon a dangerous one. Therefore, before I describe my invention in detail, I will show you a few experiments, after which I think you will realise that the placing of the incandescent lamp inside a balloon is not attended with danger. [Experiment shown.] If I take a jar of hydrogen in my hands, and insert a taper at the mouth, the gas catches fire, but the taper goes out when I thrust it upwards in the jar. You see, hydrogen gas takes fire under certain conditions, but is incapable of itself of supporting combustion. The flame you have seen burning at the mouth of the jar is the effect of the great affinity which exists between the atoms of hydrogen and the atoms of oxygen which, in the atmosphere of the room, borders upon the hydrogen of the jar. Further up in the jar the hydrogen atoms have no oxygen atoms wherewith to combine. Now, it may seem a surprising assertion to make, but it is nevertheless true that one could place a red-hot poker in the body of gas in a balloon without setting fire to it. If I were to ask anyone here so to do, I am sure he would decline, and say the gas would catch fire as he placed the poker in the mouth. That is quite true; and, to perform the experiment successfully, he would have to avoid the borderland altogether. Here is a puzzle to put to your friends:—How to put a red-hot poker into the body of a gas-balloon without setting fire to the gas. Now, I will show you how to do this. [Experiment shown.] Here is a glass globe, through which a continuous stream of coal-gas is passing. You see this must be so, for I have ignited the gas jet at the top of the globe. Now I have stretched a little piece of platinum wire across the terminals of an electric battery, and placed these terminals inside the globe. Now I will cause the electric current to pass through the piece of wire, and it becomes white-hot, and we have this condition of things: a piece of white-hot metal unprotected inside a globe filled with gas. Now, if we were to substitute a balloon for the globe, and have a battery of exceeding power, and if we were to place a poker between the terminals of the battery, the red-hot poker in a balloon would be a *fait accompli*. The incandescent lamps which we place inside the balloon consist of a thin filament of carbon inclosed in a glass globe exhausted to a high degree of air. This filament of carbon is raised to a white heat by the electric current. [Experiment shown.] I have thrown the image of a filament of carbon upon the screen, rendered thus incandescent. On my table I have another globe filled with gas inside, which is our incandescent lamp. This is the condition of things we have in the balloon. [Experiment shown.] Now, some person may say: "Suppose by accident you get an explosive mixture of oxygen and hydrogen inside the balloon, and that this fragile little bulb breaks." Well, if it does break, one lamp will be lost; that will be all the damage done, for the oxygen present will at once destroy the carbon filament. [Experiment shown.] I will show you this experiment by breaking an incandescent lamp in the midst of this inflammable piece of tow; you see, as I break the lamp, the light instantaneously goes out, as the action of the oxygen is to destroy that delicate carbon bridge which you have seen depicted on the screen. Now, one more of this series of experiments. [Experiment shown.] Here is another globe filled with gas; in this I discharge a naked electric spark between two platinum points. I perform this experiment to show you that, even if there were a bad connection in the electric arrangements inside the balloon, there would be no danger of firing the gas. However, in the special form I provide, I obviate all chance of any sparking, so that, in case of the contingency of there being an explosive mixture of oxygen and hydrogen inside the balloon, there would be nothing to determine it. That an electric spark can fire a mixture of hydrogen and oxygen in certain proportions I can show you by producing this respectable electric spark by means of this induction-machine, and then bringing near it a jet of coal-gas. [Experiment shown.]

A convenient size for one of these signalling-balloons is a gas capacity of some 4000 cubic feet, or, if required, they can be made smaller than this. Varnished cambric is a suitable material. I have two separate arrangements for suspending the lamps inside the balloon; the first consists of a holder made like a ladder, the lamps being placed one above the other in multiple arc. Here is this arrangement before you, with the lamps lit up. This arrangement is convenient because of the small breadth of the ladder, which is easily admitted into the neck of the balloon. The ladder arrangement casts a small shadow on the balloon. In my opinion this shadow is of no consequence whatever; but I have an alternative method which obviates the appearance of any shadow altogether. It consists of a ball, from which project lamps at various angles; the arrangement is protected from risk of breakage by a wire framework. [Experiment shown.]

The form of contact-breaker which produces the intermittent flashes of light is in form somewhat like a Morse key. In reality it is essentially different. An ordinary Morse key, such as is used in telegraphy, would not withstand the large currents used to light the lamps. In my latest form of contact-breaker I use carbon-contacts. These can be easily renewed at trifling cost when worn away. [Experiment shown.] I have also on my lecture-table another form of contact-breaker [experiment shown], in which there is a rubbing contact faced with platinum. The leads which convey the electric current to light the lamps must be as light as possible, consistent with the current they have to carry, and [experiment shown] here is a special type of cable I have had manufactured for the purpose. By means of the model balloon before you, I will now show you the action of the key. We will flash the words "A Merry Christmas and Happy New Year to you all." [Experiment shown.] On the switch-board which contains the key I have an arrangement to switch on the lights in the balloon continuously, in this manner, because these portable balloons thus illuminated would be useful for other purposes than for flashing signals, viz. for a preconcerted signal, or as a "point-light" to guide advances or retreat.

The source of electrical power for working the lamps inside the balloon may be varied according to circumstances. It may be: (1) a small dynamo; (2) a storage battery; (3) a primary battery. Each of these three forms of power can be supplied in portable and convenient form. In some cases, where there is a stationary dynamo-machine in close proximity, storage-cells may be conveniently used, as they can be charged from this stationary dynamo, and brought into the field as required. I used storage-cells just now to light up that ladder of lamps and for working the lights in my model balloon. These storage-cells are, you see, arranged at the foot of my lecture-table. A portable way of obtaining power would be, I think, to use a little gas-engine with dynamo combined, such as, by the courtesy of Messrs. Crossley Brothers, I am enabled to show you this afternoon at work. [Experiment shown.] This might be fixed on the waggon, with all the other apparatus connected with the balloon. The engine would be worked by the gas, which is always a necessary adjunct to the balloon. The gas-supply might be a portable apparatus for generating the gas, or else the method of storing gas in steel bottles could be adopted. This has been done successfully by our own Government. At the Inventions Exhibition a bottle of compressed gas was exhibited in the War Department. I now wish to show you how easily gas may be compressed, stored up, and used when wanted. Here is a small bottle of compressed hydrogen, and I will soon transfer the gas from that to this goldbeater-skin balloon, which now rises to the ceiling. [Experiment shown.] There is another method of lighting these balloons—by using a primary battery. There is a very excellent primary battery now in the market, invented by M. Schanschieff. A good primary battery has long been a great desideratum. For some time I have searched to find one that was anything near the mark for electric lighting purposes. This battery which is before you is the best I have had in my hands, and I am applying it to several of my patent arrangements. I am glad to be able to show you one of these batteries in working order. [Experiment shown.] In this comparatively small compass we have 32 cells. The size of each cell is $3\frac{1}{2}$ inches by 2 inches. In the cells we have a single fluid solution—sulphate of mercury acidulated. There is a sample of the sulphur in this bottle. Now, with most single-fluid batteries we have what is technically called polarisation, which means diminution of electric power. Mr. Schanschieff has overcome this polarisation, and in overcoming it he has done a great deal towards the development of electrical appliances. There is one piece of apparatus connected with the balloon worth mentioning. This is the reel for winding the cable. [Experiment shown.] The electric connection is made, you see, as the cable unwinds.

The advantages which I claim for this method of signalling are, briefly: It facilitates night-signalling; it facilitates signalling to long distances; and in places where the ordinary methods would fail to be of any use, such places as hilly and wooded districts, the apparatus is portable and simple; the balloon shows a large body of light. In order that you may realise the use of a balloon in time of war in a place where ordinary signalling would be of no use whatever, I have prepared the illustrations which my assistants will now throw upon the screen. Here we have a mountainous region. There are supposed to be two friendly armies separated by chains of mountains, and wishing to communicate. Now these two armies might be possessed of every other modern appliance for signalling from the ground without being able to make a signal seen by either side. Therefore, in the scene before you, the signallers of one army are depicted as filling the portable signalling-balloon with gas 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.]

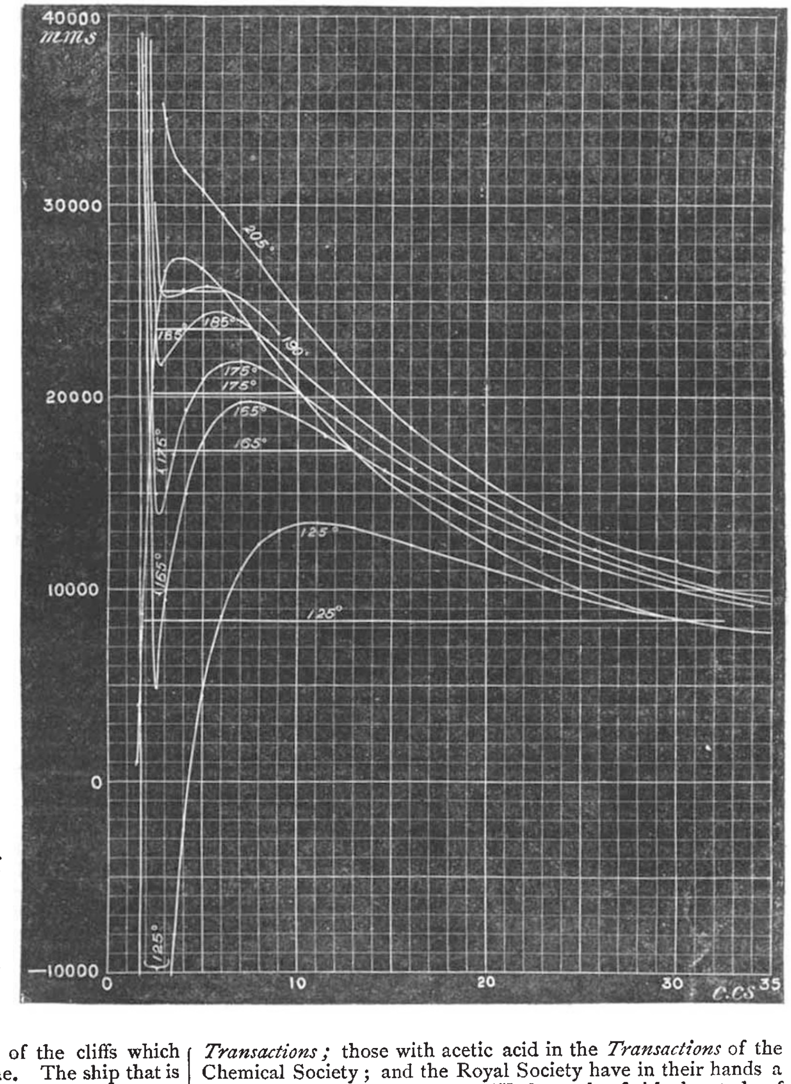
You may perhaps be inclined to think that I ought to mention some one particular occasion in history when this balloon would have been useful. I do not think we need look far back to find one example. But a short while ago there was a brave general shut up in a besieged city with a few followers. Near 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