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PROPOSAL TO INTRODUCE BALLOONING INTO THE SWISS ARMY.

Message from the Federal Council to the Federal Assembly concerning the formation of a Balloon Company. 24th May, 1897.

TRANSLATED BY

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PAPER VI.

PROPOSAL TO INTRODUCE BALLOONING INTO THE SWISS ARMY.

Message from the Federal Council to the Federal Assembly concerning the formation of a Balloon Company. 24th May, 1897.

(Translated by Captain R. F. Edwards, R.E.).

In our scheme of organization of the 6th December, 1893, we included a proposal for the formation of a Balloon Park, and the Headquarter Staff made a special report on that subject, which was printed and attached to the message of the Federal Council.

After discussing the question, this scheme of organization was rejected. But during these last three years the captive balloon has been greatly improved in foreign armies; it has become an engine of war of great importance, and the necessity of providing our army with this indispensable adjunct obliges us to revert to the subject by laying this new scheme before you; we are, as a matter of fact, convinced that the use of captive military balloons has become a matter of absolute and indisputable urgency for our militia also.

Captive balloons were used more than a hundred years ago in the French army to observe the movements of the enemy; the decree of the 2nd April, 1794, brought into existence the first balloon company.

Balloons were used by the French in the first war of the Republic, at the sieges of Maubeuge and Charleroi, and at the battle of Fleurus. The appearance of this enormous machine produced a great moral effect on the garrison of Charleroi and the governor

demanded a capitulation, despairing, so he said, of concealing his bad situation from an enemy who was in possession of such a means of observation. The battle of Fleurus took place on the 26th June, 1794, and the balloon had its share in the success ; it remained in the air for nine hours, and Jourdan was always informed of the enemy's movements as soon as they were executed, and was enabled to carry out at once the manœuvres necessary to foil them, thanks to the useful and speedy information he received from General Morlot, the chief of his staff, who was in the car.

The Committee of Public Safety, satisfied with the results obtained by the balloon, formed a second company, and shortly afterwards established the National Aerostatic School at Meudon. Aeronauts subsequently accompanied the armies of Pichegru, Moreau and Hoche. Bonaparte sent them to Egypt, where all the aerostatic stores were destroyed at the battle of Aboukir, with the ship in which they were. Balloon companies were then suppressed by the Directory. At this period the means employed to inflate the balloon were very complicated. The gas was produced by furnaces of special construction at a station in the interior of the country, from whence the inflated balloon had to be transported, with much difficulty, to the theatre of war. Therefore, as soon as the great offensive wars of France broke out, it became impossible for the inflated balloons to accompany the armies operating beyond the Alps and the Rhine.

Military ballooning was then almost completely abandoned, and it was not until the year 1870 that it was again made use of, and then once more by France. It was employed in two different ways: at the siege of Paris balloons supplied a postal service connecting the provinces with the capital ; and with the army of the Loire it was attempted to use them as captive balloons for observing the enemy. But, in spite of the very capable men employed, these trials were not a success. It was then recognized that it was impossible to improvize in time of war the aerostatic requisites, which need to be studied with the greatest care, and in their most minute details.

The Germans had no better success in their attempts to use a captive balloon before Strasburg.

The experience of 1870 led the French to study the subject of military aerostation with great care ; the school of Chalais-Meudon was re-established ; the manufacture of gas and all other stores was improved, a continually increasing *personnel* was trained in all

aerostatic manœuvres, and the development of military ballooning in France soon caused neighbouring armies to imitate what was going on in that country.

The want of mobility of the aerostatic *matériel* of the first Republic was lessened by the employment of a hydrogen generator on wheels, which thus formed a movable gas factory, so that the manufacture of the gas and the inflation of the balloon could be carried out on the battlefield. A further improvement, introduced a few years ago, consists of the transport of the gas compressed into steel cylinders, which admits of the balloon being inflated with much greater rapidity.

No great war having taken place since the re-introduction of military ballooning, captive balloons have only been employed in some colonial campaigns.

The English used them in Bechuanaland and the Soudan.

In 1887 the Italian expedition to Erythrea, under General San Marzano, was provided with a balloon park. The detachment consisted of 6 officers and 4 sections of Engineers, with 3 balloons. The gas, made at Naples, was transported in steel tubes. The balloons were used on different occasions at the fortified camp of Saati, and the official despatches of General San Marzano state that from the position at Saati the field of observation visible from the car was greater than that from the outposts.

During the Tonquin campaign balloons were employed, at the request of Admiral Courbet, who considered them the only means of reconnaissance possible in such close country. A detachment of 2 officers and 36 N.C.O.'s and men were included in the reinforcements sent to Tonquin early in 1884. This detachment was strengthened by the addition of 30 marine artillerymen and 80 coolies. In consequence of the almost entire absence of communications in that country, it was found necessary to use special stores of a very light pattern, and to reduce the size of the balloons so that they did not exceed 11,000 cubic feet.

Immediately after its arrival at Hannoi the detachment formed part of the expedition against Bac-Ninh, and the information obtained by it was of great service, both during the advance and at the battle of Tung-Son; and the presence of the balloon helped greatly to raise the *morale* of the troops. It was moved about fully inflated for 13 days, after which it was again filled and used at the bombardment of Hung-Hoa, where it was of great use in watching the besieged town, and reporting the effect of the fire. Lastly, the

detachment formed part of General Négrier's column, where the balloon was successfully used in front of Kep, and the general made an ascent himself, so as to get an exact idea of the ground and the situation. The campaign thus proved that the captive balloon as a means of information for the general in command is of the highest value, and that it can follow troops for several weeks even in very close country.

Although the reports on the results obtained by balloons during large manœuvres are very incomplete, still they prove that these results have been on the whole satisfactory.

A very full account was published by Lieutenant Debureaux in the *Revue du Génie*, after the French manœuvres of 1891. "Never," says this officer, "has the use of balloons been so clearly demonstrated; it is true that captive balloons have found a valuable adjunct in the telephone, which greatly increases their efficiency, as by this means the officers in the car can keep up continuous communication with the general in command, forwarding their observations to him, and thus keeping him in touch with every movement of the enemy, even when he is a considerable distance off.

"But the improvements effected are even greater. Thanks to the process of compressing the gas, it is now possible to get a balloon ready for an ascent in half-an-hour's time, and the equipment has been made so portable that the conveyance of a balloon, whether empty or inflated, is a matter of the greatest ease. The detachment marched from Versailles to Brienne, a distance of 120 miles, in 10 days, and on some days moved more than 24 miles.

"The balloon made its first appearance at the fight near Aulnay, under very unfavourable conditions; there was a storm of wind and rain, and the park had to make the best of its way to the farm at La Garenne over broken and hilly roads. In spite of these obstacles, the *Meuse* made an ascent at the time ordered, and was of great service; it was able to warn the officer commanding the VIth Corps that the fierce attack he was defending himself against was nothing but a feint, and to advertise him of the position of the reserve and the real line of attack. Four generals, making successive ascents, were able to appreciate the great advantages of this means of observation.

"General de Galliffet, when at Colombey, remained for two hours and a-half in the car, transmitting his orders by telephone from a height of 1,000 to 1,200 feet, at which the balloon was kept. The troops were extended over a frontage of 7 miles, with a

depth of 2 to 5 miles, in spite of which the general in command of the Western Army was able to note the positions taken up by it, to recognize each unit, and to decide on the positions to be taken up by the artillery. He could supervize an extent of ground nine miles in length as if on a map, and even make a guess as to the movement of troops through woods by the dust raised. After he had come down again, he kept up a constant communication with the observers in the car by means of the telephone.

"At Vendeuvre the balloon was able to notify General Davout of cavalry skirmishes which were taking place 5 miles away. During the night battle on the Voire it was once again of the greatest service. At Margerie it was blowing a gale, and it was not considered wise to run the risk of damaging the equipment, a risk which would not, however, stop an ascent in time of war.

"Some wonderful marches were made with the balloon inflated: it passed through the town of Bar-sur-Aube in the middle of the fight, in spite of many obstacles and obstructions; it went through the forests of Bossican and Grand-Orient without hampering the march of the columns; every obstacle was got over in from two to five minutes, and the balloon, passing over the open ground at a trot, took up its place again with extraordinary precision."

A balloon was employed very successfully in the Italian fortress manœuvres round Verona in 1887. According to the report of the director of the manœuvres, the defenders, thanks to their balloon, were continually kept informed of all the adversary's movements, and were thus able to regulate and concentrate the fire of their guns.

There is no information as to the results obtained in other manœuvres, but the Swiss officers who were present at the great manœuvres near Aquila in 1895 report that there too, the balloon rendered excellent service by being able to reconnoitre from time to time the march of the enemy's columns, and the position of his reserves.

In 1895 a balloon detachment was formed in Austria, which took part in the Imperial manœuvres in Bohemia. Although the equipment was of very indifferent quality, this detachment was of great help. The balloon of 35,000 cubic feet, and two reservoirs of 2,000 cubic feet each, were inflated with coal gas from the gasometer at Budweis, and moved afterwards by night, in very stormy weather, to the manœuvre ground, a distance of 15 miles. On the next day, the 2nd September, the balloon was used by the superintendent of

the manœuvres, and was moved a distance of 7 miles during the afternoon; the day after, the balloon contributed greatly to the victory of the XIVth Corps by discovering in good time the advance of the VIIIth Corps. On the third day the balloon formed part of the advanced guard of the VIIIth Corps, and was of great assistance to the officer commanding it, thanks to the information it was able to give him.

The reports on the last Imperial manœuvres in Germany give interesting details of the employment of "kite" balloons. Each army corps had a large captive balloon, which was kept at a height of 3,000 feet. The management of the drum and cable took 60 men for each balloon, and each section consisted of 6 "tube wagons," with 6 horses each, to carry the hydrogen.

The unloading, inflation and ascent of the balloon took 14 minutes. Communication between the car and the staff of the army was kept up by the field telegraph.

In many armies the balloon detachment consists of a fixed section, whose duty is to produce the gas, and a field section, to follow the army, and use the balloon when desirable.

The ordinary method of producing hydrogen gas is by decomposing water by means of iron and sulphuric acid so as to liberate the hydrogen; water can also be decomposed by red-hot iron, which is the process employed by the best French aeronauts; or else by means of electricity. This last process, electrolysis, is used in many industries, such as those for the production of chlorate, potash and oxygen; the hydrogen is given off as a valueless product, and the German military administration has taken advantage of this fact to obtain the necessary hydrogen for the inflation of their balloons at a very cheap rate. In case we in Switzerland do not possess such an industry, we shall be obliged to manufacture the gas ourselves. But as the installations necessary for the electrolysis of water are very costly, we should use the ordinary method of iron and sulphuric acid. The apparatus should be installed in a central station in the interior of the country; it may be fixed or put on wheels so as to facilitate its removal in case an evacuation should become necessary.

The gas produced by the generator is at once compressed to a pressure of from 120 to 150 atmospheres, so as to reduce its volume as much as possible for transport purposes, and is kept in steel tubes two to four yards in length, which are carried on specially constructed wagons.

The movable equipment consists of the balloon, the drum wagon which is used for uncoiling and coiling up the cable, a wagon to carry the empty balloon and spare stores, and the "tube wagons" required for inflating purposes.

The envelope of the balloon is made of silk or skin, and is surrounded by hemp netting, to which is attached the car carrying the observers.

A sphere is the most natural shape for a balloon, and is that adopted by all armies following the French model. The balloon sections of the German army have tried an elongated balloon that is kept up by the wind like a kite, and which is thus supposed to offer special resistance to gusts of wind.

The "drum-wagon" is used to hold the balloon by a cable of hemp, silk or steel. The cable is coiled or uncoiled on the drum as the balloon is required to descend or ascend; thus the height of the balloon is regulated by the drum, which is itself controlled, according to circumstances, by a steam or oil engine. The length of the cable is from 500 to 1,000 yards.

The second wagon is used for transporting the envelope of the balloon with all its accessories and the spare equipment.

The "tube-wagons" are to carry the tubes filled with compressed hydrogen. They are made of a frame, on which the tubes are placed; a "filler" is used as an intermediate reservoir to contain the gas passing from the tubes to the balloon. The number of wagons required for an inflation depends on the size of the balloon and the tubes.

The field section thus consists of the balloon wagon, the drum wagon, and a certain number of tube wagons; when the construction of these wagons has been carefully studied, and if their teams are sufficient, the mobility of this section is as great as that of a field battery.

The Russian, Italian, Danish, Spanish, Portuguese, Belgian, Dutch, Roumanian and Swedish armies have balloon parks similar to that of the French army. The German, English and Austrian armies are provided with special equipment manufactured by the nation.

The balloon service of the French army consists of the central establishment at Chalais-Meudon and four balloon companies, each attached to a regiment of Engineers, and quartered at Versailles, Arras, Montpelier and Grenoble.

In time of war the strength is doubled by calling out the

reservists, and then consists of 13 parks and detachments, allotted partly to the armies (one park to each army), and partly to fortresses.

A field balloon section consists of 3 officers, 14 N.C.O.'s, 2 trumpeters, 74 balloonists, 2 N.C.O.'s and 28 drivers of the train, 6 riding and 52 draught horses.

An army park consists of 28 wagons, as under :—

1 "drum wagon" with 6 horses.
1 "equipment wagon" with 6 horses.
1 cart with 4 horses.
2 provision carts with 2 horses each.
1 artillery wagon with 4 horses.
2 store wagons with 2 horses each, and
20 "tube wagons," of which at least 9 have 6 horses each.

The instruction of the officers and men is carried out at the school at Chalais-Meudon according to the directions laid down in the regulations dated 8th December, 1890. The officers are given the necessary technical instruction, and are practised in observing; the diploma of "balloon officer" being only given to them after they have made five or six free runs.

The development of this service in France induced the Germans in 1884 to form a school at Berlin for the study of captive balloon work, having a *personnel* of 4 officers, 4 N.C.O.'s, 29 rank and file, and 1 aeronaut. This school is attached to the First Railway Brigade; its establishment has been increased several times, and now consists of 6 officers and 141 N.C.O.'s and men.

Another balloon section was formed in 1890 at Munich, with an establishment of 3 officers, 4 N.C.O.'s, and 26 men. The composition of the parks of these sections and their number in war time is not known.

A Commission was appointed in England in 1871 to study the subject of military ballooning, and to make experiments, with the result that the Secretary of State for War decided in 1879 to introduce ballooning into the army. Balloons inflated with coal gas were first tried, then hydrogen was used, and immediately afterwards, in 1880, experiments with the transport of compressed gas were carried out.

In 1884 a balloon section was formed at Chatham, and in 1888 the establishment of the balloon park was fixed at 3 officers, 30

N.C.O.'s and balloonists, 20 N.C.O.'s and men as drivers, 3 riding horses, and 6 four-horse wagons as under :—

1 balloon-wagon with 2 skin balloons of 10,000 cubic feet and 1,000 yards of cable.
1 equipment wagon with 2 balloons and stores.
4 tube wagons with 35 tubes each.

In 1890 a balloon depôt was formed, consisting of 1 inspector, 1 engineer, 1 mechanist, and 6 men, for the manufacture and compression of hydrogen. The balloon section forms part of the Engineers.

In 1895 Italy decided to introduce military ballooning into its army, and formed an experimental station. The stores were provided by the Parisian engineer Gabriel Yon, and since then have undergone no important changes, with the exception of the purchase in England of the pumps and tubes required for the compressed gas. A company of specialists was formed in 1887 from the 3rd Regiment of Engineers, and given charge of the balloon and electric light services ; another company was formed later for the same duties.

A field balloon park consists of 2 officers, 52 N.C.O.'s and sappers of the Engineers, 27 N.C.O.'s and men of the train, 2 riding and 36 draught horses, and 9 wagons, as follows :—

1 wagon for balloon equipment.
1 drum wagon.
1 transport wagon.
6 tube wagons.

The equipment actually in possession of the Italians consists of 2 field parks and 1 fortress park.

The Austrian Imperial War Ministry hesitated for a long time before deciding to introduce ballooning into the army ; it was, however, found impossible to delay it any longer, and an experimental station was formed in 1893 which carried out a very complete series of trials on the use of the balloon in war. The permanent establishment of this station consists of 2 officers and 6 men ; every year a certain number of officers and men of all arms receive six months' instruction there, so that as early as 1895 it was found possible to use a balloon detachment in the Imperial Bohemian manœuvres with great success. The Austrian army as yet possesses no definite organization of field-parks ; but as a fairly large sum of money was

voted for military ballooning in the 1896 estimates, it is probable that the formation of a proper field park will not be much longer delayed.

A commission was appointed in Russia in 1884, with General Boreskoff as president, to study military ballooning, and to form balloon parks. In 1886 the necessary equipment was purchased at Paris from the firm of Gabriel Yon. This new engine of war was quickly appreciated in the army, the purchase of stores was continued, and the establishment increased, and in 1890 the following organization was approved :—

One central instructional balloon park for the purpose of forming a permanent experimental school, of giving theoretical and practical instruction to the officers and men detailed for this service, of serving in time of war as a base for the formation of field balloon sections, and of making and keeping in repair during peace time the equipment for these sections.

A certain number of fortress balloon sections, with their equipment, are allotted in peace time to fortresses.

The field sections are not kept up in peace, but are formed on mobilization by the instructional depôt, as already stated.

The permanent establishment of the instructional depôt consists of 7 officers and 88 N.C.O.'s and men. The equipment consists of

4 captive balloons of 22,600 cubic feet.
3 free balloons of 35,320 cubic feet.
2 "signal" balloons of 4,240 cubic feet ; and other stores.

The composition of the four fortress parks actually in existence shows the importance attached to military ballooning by Russia ; each of these parks comprises

6 captive balloons of 22,600 cubic feet.
3 free balloons of 35,320 cubic feet.
3 movable reservoirs containing 8,830 cubic feet each.
1 steam drum on 2 wagons.
1 hand drum ; and
The stores necessary for producing the gas.

Having thus passed in review the development of military ballooning, we may now consider this question : What is it that renders this engine of war so important that it has been adopted by almost every army in the course of the last few years ?

The balloon is a very high movable observatory, which can be employed almost immediately at any point whatever on the battle-field; it follows, therefore, that the captive balloon is, during a battle, the surest means of information an army can possess. The officer in the car can see the country round him for a distance of nine miles, irregularities of ground disappear almost entirely for him, he can see over every undulation and every obstacle; from the balloon he can give information in the quickest way to the officer in command, whether of the movements and distribution of the enemy's forces, or of the position of his own troops.

The captive balloon thus gives to the general possessing it a great superiority over an adversary without one, for it permits him to know his adversary's intentions beforehand, and consequently to take the necessary measures in time. The inferiority of the general who does not possess a captive balloon is evident, and the knowledge of this disadvantage paralyzes the energy of the commanders and of the troops, as is shown by the siege of Charleroi during the first Republican war. Taking into account the equipment in possession of neighbouring armies, we have reason to fear that, in case of war with one or other of these Powers, our adversary would employ this useful means of observation against us.

No other method can take its place; neither the most complete system of obtaining information, clever spies, a strong cavalry force, daring patrols, nor posts of observation on heights.

The best organized system of spies has always been found insufficient during a battle, for, under these conditions, a single man cannot get a general view of the movements of large bodies of hostile troops, and even if he could succeed in doing so, the means of communicating his information in time would still be wanting.

In the same way cavalry, whether in large masses or as patrols, cannot penetrate the enemy's lines and see what is going on behind them. Infantry, thanks to the power of its weapon and the use of smokeless powder, can frustrate every attempt made by cavalry to lift the veil spread out before it. Cavalry may come in contact with the enemy, and thus discover the extent of his front, but it will always remain in ignorance of the strength of the troops before it, and, above all, will never succeed in discovering the position of the enemy's reserves. And even if a bold and energetic cavalry patrol succeeds after a long detour in finding out the position of the reserves, and the number of columns on the march, it has still to transmit this information, which is unlikely to reach the commander-

in-chief early enough to be of use to him, even if it is so fortunate as not to be intercepted by the enemy.

It is the same with regard to posts of observation on heights. If the extent of the battlefield of two armies fighting each other, and the strategic conditions under which these encounters occur, be taken into account, it is easily seen that it would be very difficult to find near the battlefield a point of such an elevation that the whole or even a part of the ground would be visible from it; and in very few cases indeed would this point be found so situated that it would be a good one both for purposes of observation and for the transmission of information to headquarters. It is, therefore, not possible to rely on so remote a chance when considering the best steps to be taken, especially as the fate of an army may depend on it.

The captive balloon is quite another matter, for, with a carefully pre-arranged equipment, the mobility of which should be as great as that of a field battery, it is possible, in less than half an hour (20 or 25 minutes, or even 14 minutes, according to the latest reports of the German manœuvres), to have an observatory 1,500, 2,000, or even 3,000 feet above the ground, connected by telephone or telegraph to a transmitting station at the foot of the cable, or even directly in connection with the commanding officer's headquarters.

From such a height the officer in the car can see all the front of the enemy's line, his field works and his batteries; he can count the latter, and, what is of even greater importance to the officer commanding, he can see all the enemy's reserves, and where they are posted, and can also inform the general from time to time of the arrival of reinforcing troops.

On the other hand, he can follow the march of his own troops, control the action of his artillery, observe the progress of the fight along every portion of the front, and thus inform the general at any moment of the state of the battle.

Several objections to the use of captive balloons have been raised, such as that the balloon will not always be in its proper place and available at any moment.

This objection might have had some weight in the days when the hydrogen was manufactured on the spot, and when the inflation of the balloon was a matter of several hours. But this cause of delay no longer exists, as by the use of gas compressed in steel tubes the inflation and ascent of the balloon can take place at any time on the battlefield in less than half an hour. The tubes are carried on service wagons, in the same way as ammunition for the troops, and

the whole of the wagons for the balloon, its equipment, the drum and the tubes required for an inflation form one unit as does a battery; and to have this unit at the required spot in time, it must be assigned its exact place in the column of march (usually in the main body of the advanced guard). It is then only a question of working in a column, such as is raised every day with artillery, engineers, and auxiliary services. The inflation takes place immediately before the balloon is wanted, and up to that time the empty envelope remains in its wagon.

Another objection that has often been raised is that an observer can see nothing in case of fog, and that it is then of no use.

This is true; but it is just as true for artillery. This state of the atmosphere hampers even infantry, both in its movements and in its fire, and yet no one thinks of considering this inconvenience as an imperfection of infantry and artillery. Besides, fog is a comparatively rare occurrence, and hampers an enemy's balloon to an equal extent; this objection has, therefore, no weight.

The balloon is also charged with indicating the position of the main body, or at least of the commanding officer.

It is not at all necessary for the balloon to be in the immediate proximity of the commanding officer; it is quite sufficient to have a good service of orderlies, mounted or on bicycles, or what is even better, a short telephone or telegraph communication to ensure the quick transmission of messages. In big battles, too, there is no one main body whose position might be indicated by the presence of the balloon; an army marches in several deep columns, and the balloon would be attached to one of these; its ascent only shows the enemy that there are troops at a certain point, which he will have discovered long before by coming into contact with the advanced guard of that column. Thus the balloon will give no indication as to the line of march of the main columns and the position of the reserve; if an enemy were to draw conclusions of that description, he would be liable to make a serious blunder.

When it is a question of a division or an army corps only, as in manœuvres, the balloon would generally be with the advanced guard, whose *rôle* is, above all, a demonstrative one, and would give the enemy no hint as to the movements of the main body.

The distance of the balloon from headquarters being of no importance, provided telephonic or telegraphic communication is established, it may under certain circumstances be used to deceive

the enemy. This was done by General de Négrier at Kep in the Tonquin campaign.

It has also been maintained that captive military balloons cannot make an ascent if the wind is at all strong (15 to 18 miles per hour). This also is not the case, for experienced aeronauts affirm that, with a well-found military balloon, a wind of 33 miles per hour, which is exceptional, may be encountered with safety. The captive balloon at the Geneva Exhibition worked without inconvenience in a wind of 27 miles per hour; and it must be borne in mind that the adversary's balloon is subject to exactly the same atmospheric conditions as ours. The objection has also been put forward that it becomes impossible to take observations in a strong wind, due to the oscillations of the car.

This is a very exaggerated statement. The oscillations depend greatly on the method of suspension, and even when they are very great, they do not inconvenience the observer, provided they have a certain regularity. The experiments carried out with the captive balloon at the Geneva Exhibition have demonstrated that it is very easy to observe through field glasses at distances of 3 or 4 miles, even when the oscillations are as great as 160 or 200 feet.

The important question whether a balloon has anything to fear from the enemy's fire is still to be considered, that is to say, whether it should be kept at such a distance in rear that observation of the battlefield would be more difficult; the answer to this question is also in the negative.

Experiments of the effect of fire on balloons recently carried out, under conditions nearly similar to those that would happen in time of war, have proved that a large expenditure of ammunition would be necessary to put a balloon out of action, even when it was in range from the start.

The following conclusions are now admitted in France:—The bullets from a small-bore rifle are of little danger to the envelope, as the escape of gas through the small holes made by them is quite unimportant. Besides, captive balloons need not come so near the enemy's lines. As regards the effect of artillery projectiles, it has been proved that a balloon is nearly invulnerable at a range of 6,000 yards, and a height of 2,600 feet; and as its radius of observation is as great as 9 miles, there is no reason why the balloon should be placed within 3 or 4 miles of the enemy's batteries.

Experiments with the fire of a battery against a movable captive balloon were carried out at Steinfeld, in Austria, in July, 1895.

After firing 80 rounds of shrapnel, which would give about 10,000 bullets and splinters, the balloon remained intact, and only three small unimportant holes were afterwards found in it.

The balloon can thus be secured from the effect of artillery fire, the only enemy it has to fear, by keeping it far enough away from the batteries, by sending it up to a great altitude (the length of the cable has been made from 500 to 1,000 yards in many armies), and by moving it about horizontally and vertically as soon as it becomes exposed to an effective artillery fire.

The difficulty of laying increases with the altitude of the balloon; sometimes it even becomes necessary to dig a hole for the trail, which makes the service of the guns slower and very inconvenient.

We believe that we have proved in the foregoing pages the importance of captive balloons in the leading of armies, and at how great a disadvantage an officer would find himself who, having no balloon of his own, was obliged to carry out an action against an adversary provided with one. We further believe that, for our army, the necessity and importance of the captive balloon are even greater, the numerical weakness of our cavalry being taken into account. It will probably always be in presence of a much larger hostile cavalry force, and will thus find the greatest difficulty in reconnoitring the position of the enemy's largest bodies of men, both before and during an action.

In addition, one reason for the adoption of this engine of war, which alone is worth all the others put together, is the moral effect produced by it.

It has been already related how, during the first war of the Republic, the defenders of Charleroi called on their leaders to capitulate because they considered it impossible to carry on the defence under the eyes of observers in the car of the balloon, despairing, as they said, of hiding their bad situation any longer. It is also reported that the balloon used in the Tonquin campaign was of great assistance in keeping up the *morale* of the troops. Let us consider what would be the effect on our militia were they to see this powerful observatory of the enemy, from which they could hide none of their movements, soaring in the air, had they not the satisfaction of knowing that we have similar means of observing the enemy. Would not our soldiers and their leaders feel discouraged by the indecision in our movements resulting from such a want, while they would be made well aware by each of the enemy's movements that he knew exactly how to carry out the object he had in

view? Would not the spirits of our whole army be affected were they to believe themselves inferior to the army they were called on to fight, owing to their not being provided with so indispensable an engine of war, and their equipment being insufficient to properly conduct a campaign? Such matters of sentiment are of undoubted value, especially to an army such as ours, where discipline depends on the confidence reposed in its officers.

Besides the general objections, which we have already refuted, there are others which apply specially to the use of balloons in Switzerland.

It is claimed, for instance, that the ground is too hilly to permit of good observation from the car. This does not apply to the region situated between the Jura, the Alps, the Lake of Geneva, and the Rhine, which is the only region which need be taken into account when considering large military operations; and in the whole of this region the undulations of the ground are not high enough to mask the view of an observer at a height of 1,000 or 1,500 feet (still less at a height of 3,000 feet). Several officers of the Swiss general staff have made ascents in Switzerland for the express purpose of studying this question, and one of them has recorded his impressions as follows:—

"Even at a height of 600 feet above the ground the view is of great interest; at a height of 1,000 to 1,500 feet one can see perfectly every detail of the country for a radius of about 8 miles. The various features of the ground show up with great clearness, as do the roads, which appear like long white ribands. There is no observatory that can compare with a balloon for giving a general idea of the country, because one has a bird's-eye view, in which each object appears as it really is. The various undulations of the ground and woods are no obstacle to the view, as the line of sight passes over them; so that, up to a distance varying with the height of the balloon, dead angles are almost entirely done away with. One has the impression, and the impression is a correct one, that one has under one's eyes a large model in which every little detail is shown. I am of the opinion that one could quite well see any troops manœuvring within a range of 4 or 5 miles or even more, from a captive balloon kept at a height of 1,000 to 1,500 feet."

This is even truer, and the distances are still greater, if the balloon mounts to 2,000 or 3,000 feet.

While it is maintained on the one hand that the features of the ground in our country would impede the view from a captive

balloon, it is claimed on the other hand that we have enough elevated positions to enable us to dispense with an artificial observatory. A simple study of the map will suffice to disprove this objection ; future battlefields will be found, as already stated, in the Swiss plain ; and unless a battle were fought at the very foot of the eastern chain of the Juras, or at the foot of the Uetliberg, we know of no other ground that could be used as a battlefield near enough to a height which could command a view of the whole field of action. We must not rely on chance in calculating the war equipment necessary for us. What we want is an observatory always ready, which can be used everywhere, and moved as may be required.

It has also been stated that there are greater difficulties in the use of captive balloons in Switzerland than elsewhere, because the wind in Switzerland is stronger than in other countries. This is one of those statements that are based on no proper data, and which are acquiesced in too readily. The wind in Switzerland is no stronger than elsewhere, as is proved by the reports of the meteorological stations.

One last objection that has been brought forward is the difficulty of giving the necessary instruction ; our length of service being so short, it is claimed that it would not be possible to properly train the *personnel* necessary for a balloon park. We believe this to be yet another error ; the service is in nowise so difficult as it appears to be, and the instruction and work of the company can be facilitated by a division of labour. We would have a fixed section for the manufacture and compression of gas, which would be recruited from men whose trade would guarantee sufficient technical instruction, such as engineers, chemists, mechanics and stokers. Then for the actual balloon work, that is to say, for the transport and inflation of the balloon, and for the ascents, we would have a special *personnel* forming the field section ; here, too, we would recruit men whose trade would enable them to properly manipulate this equipment and to carry out the necessary repairs, such as ropemakers, tailors, mechanics, and so on. The non-commissioned officers and men would be instructed in the inflation and management of the balloon, and its transport across obstacles when inflated. The officers would learn, in addition, the practice of ascents and observation, and would be given the necessary theoretical instruction to enable them to always use their equipment with a thorough understanding of what was required. We do not believe there will be any great difficulty in obtaining this result, for the service is no more complicated than

that of a field battery, a company of position or fortress artillery, or a pontoon company, and it may be assumed that professional aeronauts could without difficulty train the *personnel* they would require to assist them.

It is also sometimes objected that we ought to wait until the problem of aerial navigation be solved. An essay on aeronautics and on all the attempts that have been made to reach this result would be beyond the limits of this paper. Dupuy de Lôme, Giffard, Tissandier, Yon, Renard and Krebs, Professor Langley and the engineer Maxim have made very interesting experiments, but which, so far, are fruitless. It was believed more than ten years ago that Commandant Renard had solved the problem, but this turned out to be a mistake ; similarly, the more recent rumour that Renard had made an aeronef capable of making headway against winds of a velocity of 27 miles an hour has not been confirmed. In spite of all these attempts, it does not appear that there is any certainty, nor even any probability, that the problem of aerial navigation will be soon solved. It is impossible to say to-day whether only a few years or 40 or 50 years will pass before man is able to move freely through the air.

We do not, therefore, consider it necessary to wait for discoveries which may not be made before the middle of next century before we supply our army with balloon equipment. The war *matériel* of our army should be in accordance with its actual wants, and the captive balloon for use as a movable observatory on the battlefield is an absolute necessity for us, not 20 or 50 years hence, but at once and without any delay.

In forming a balloon company we naturally do not desire to start anything new in that line, but we must carefully study what has been done in other countries, and choose what appears to us to be the best and most easily adapted to the needs of our army.

As the result of the consideration we have devoted to this subject, we propose to form a balloon company with the following establishment :—

4 officers, 37 balloonists (N.C.O.'s and men), 34 N.C.O.'s and men of the train, 8 riding horses, 58 draught horses, and 14 wagons.

The company to be divided into two sections—

The field section ; and
The machine section,

the composition of which is shown in the table.

The equipment to consist of—

(*a*). 1 complete balloon of about 22,000 cubic feet, with a spare envelope and net. These are the parts that wear out the quickest, and we ought to have spare articles of this description carried in the wagons to replace casualties as may be needed.

(*b*). A cable and drum with a steam or oil engine, all carried on 1 wagon. The cable to be 2,500 or 3,000 feet in length, and to be of silk or steel. The wagon should also carry a spare cable.

(*c*). 1 generator for the manufacture of hydrogen.

(*d*). A gasometer to hold the gas when made, and before being compressed. This gasometer need not be of metal, which would require too complicated an installation; it should consist of a small auxiliary balloon.

(*e*). 1 compressing machine for filling the tubes.

(*f*). Steel tubes to hold the compressed gas with the wagons necessary to carry them.

The number of tubes required for one inflation would be distributed between 3 wagons of special design; as we are estimating so as to be ready for all eventualities, we must have three inflations or sets, which makes 9 wagons for carrying the tubes.

On the basis of the above scheme, and from the estimates of the contractors and the information furnished by the technical section of our military department, we have calculated the sum required for the above equipment, installations and wagons, the total of which amounts to 153,600 francs (£6,144) divided up as follows:—

	Francs.	£
1 drum wagon with steam or oil engine, and cables 3,000 feet long; 1 hydrogen generator; 1 wagon with balloon complete; 1 spare envelope and net; 1 small gasometer balloon	52,800 ...	2,112
1 boiler for the compressing pump ...	6,000 ...	240
Compressing pumps with steam engines ...	11,000 ...	440
3 sets of tubes (at 18,000 francs per set) ...	54,000 ...	2,160
Tube wagons for carrying the tubes (9 at 2,000 francs)	18,000 ...	720
Wagons to carry stores (3 at 1,500 francs)	4,500 ...	180
Cost of transport and 5 per cent. for contingencies	7,300 ...	292
	Fr. 153,600	... £6,144

It would also be necessary to procure the following for the horses :—

	Francs.		£
27 pairs of collar harness, at 450 francs ...	12,150	...	486
2 ,, breast harness, at 250 ,, ...	500	...	20
5 sets of horse appointments for the N.C.O.'s, at 240 francs	1,200	...	48
	Fr. 13,850	...	£554

The buildings required for a captive balloon, both for storing the equipment and the wagons, and for working in while instruction is being carried out, are as follows :—

(*a*). A shed for the balloon.

(*b*). A shed for the machinery.

(*c*). A shed for the boiler.

With reference to (*a*), the balloon shed. A most important part of the instruction of a company consists not only in practising the inflation of the balloon, but also in the use of the balloon for purposes of observation, and in marching with the balloon inflated. It is impossible, if one wishes to avoid great expense, to inflate the balloon every day for these exercises, which have to be frequently repeated, as the inflation of a 22,000 cubic feet balloon costs £16 or £20. It is, therefore, necessary to keep the balloon inflated for several days while these exercises are being carried out; and it is not possible to leave it without shelter for so long a time, as it would suffer a great deal from the effects of wind, rain and sun.

In order, therefore, to take proper care of the equipment, it is necessary to build a shed in which the inflated balloon can be kept stored.

With reference to (*b*), the machinery building, it should contain—

(1). The generator or apparatus for the production of hydrogen.

(2). The compressing pumps.

(3). The gasometer.

As it is not possible to so regulate the production of gas that the quantity produced by the generator corresponds exactly to what the pumps can compress, it is necessary to collect the gas in a gasometer, which serves as a reservoir and a regulator to minimize the loss of gas, and to allow the pumps to work regularly. A small balloon of about 2,000 cubic feet is the simplest and cheapest form of gasometer.

It is necessary to have a special building for these three apparatus, with a space large enough to manipulate the tubes in.

There is room enough in these two sheds to store all the wagons while instruction is not being carried on.

Referring to (*c*), the boiler shed. This building will contain the steam boiler (*loco-mobile*), the coal, the acids, and the iron required in the manufacture of the gas.

The estimate of the cost of these buildings is as follows :—

	Francs.	£
For the balloon shed	24,300 ...	972
„ machinery building	6,700 ...	268
„ boiler shed	4,000 ...	160
	Fr. 35,000	£1,400

To these must be added the cost of a piece of ground of about a square mile in extent ; but as the dimensions and the price of this ground depend entirely on local circumstances, it is not possible here to give the exact figure. This station would be done away with in case these buildings could be constructed on the manœuvring ground of one of our garrisons.

The cost of the first purchases and the necessary installations would amount altogether to about 200,000 or 220,000 francs (£8,000 or £8,800).

The administration is simple, and could be attached to that of an arsenal. As to the instruction, the general regulations already existing for the Engineers would be perfectly sufficient. But it should be notified that there will only be a class of instruction for recruits every four years, which will consist of about 35 men, and will be attached for administrative purposes to a school of recruits.

As the formation of a balloon company is a question of a new unit, it is necessary that this formation should be sanctioned by a special law. It is, however, advisable to leave the Federal Council or the Federal Assembly a certain amount of margin when determining its establishment, as the *personnel* and equipment required can only be exactly settled after we have been able to carry out some experiments on the employment of this new engine of war in our country, and in conjunction with our army.

It is needless to state that the entire organization should be attached to the Engineers, as is the case in France, England and Italy.

In conclusion, we again submit our sincere conviction that our army cannot dispense with so powerful an engine of war for much longer, unless it desires to remain in a condition manifestly inferior to that of other European armies. The necessary establishment of men and horses is so small that it need not be taken into account; and the expense consequent on the formation of this new arm is in nowise greater than the sums that we are constantly giving with no hesitation, and with a complete knowledge of the reasons for so doing, to complete our equipment and our preparations for war.

It is here a question not only of perfecting the technical portion of our armament, but especially of strengthening the feeling of confidence in itself that our army should possess.

The moral effect that would be produced on our troops and their leaders during a fight by the presence of a hostile balloon, when we had not at our disposal a similar engine of war, would be quite incalculable, and might conduce to the loss of the battle which we were fighting for the safety of the country.

Federal Law Relating to the Formation of a Balloon Company.

The Federal Assembly of the Swiss Confederation having considered the message of the Federal Council dated 24th May, 1897, decrees :—

1. A Balloon Company, forming part of the Corps of Engineers, is to be formed.

2. The Balloon Company is raised for duty with a captive balloon and its park. Its establishment is to be in accordance with the subjoined tables.

The Federal Council will always be empowered to bring forward in the budget such modifications of its organization as may appear from further experience to be necessary.

3. The men of the Balloon Company who are passed into the Landwehr will remain attached to the company for work at the depôt, and to make up the complement if so required.

4. The regulations in force for the Corps of Engineers will be used for the instruction of the Balloon Company.

5. The Federal Council is directed, in accordance with the provisions of the Law of the 17th June, 1874, relating to the votes of the people on the Federal Laws and Decrees, to publish this Law, and to fix a date for its enforcement.

Establishment of a Balloon Company.

(*a*). *Field Section.*

	Officers.	N.C.O.'s & Men.	Riding Horses.
Captain in command of the company ...	1	0	1
First lieutenants or lieutenants	2	0	2
Sergeant-major	0	1	1
Sergeants	0	3	0
Balloonists	0	25	0
Quartermaster-sergt. of the train ...	0	1	1
N.C.O.'s of the train	0	2	2
Men of the train	0	27	0
Trumpeter	0	1	1
Medical orderly	0	1	0
	3	61	8

(*b*). *Machinery Section.*

First lieutenant or lieutenant	1	0	0
Sergeants	0	2	0
Balloonists	0	6	0
Corporal or acting N.C.O. of the train ...	0	1	0
Men of the train	0	2	0
	1	11	0

Total—4 officers; 72 N.C.O.'s and men; 8 riding horses.

Wagons and Draught Horses of the Company.

(*a*). *Field Section.*

1 drum wagon with 6 horses ...	6	draught horses.
1 balloon wagon with 6 horses ...	6	,, ,,
6 tube wagons with 6 horses each ...	36	,, ,,
3 tube wagons, unhorsed.		
2 wagons with 2 horses each ...	4	,, ,,
—	—	,, ,,
13 wagons	52	,, ,,
Spare	2	,, ,,
	54	,, ,,

(b). Machinery Section.

One wagon and 4 draught horses; if necessary, the generator can also be counted as a wagon.

Total—14 wagons and 58 draught horses.

(The men of the train and the draught horses belonging to the machinery section are for transport of tubes from the gas factory to the nearest railway station).