

THE FRENCH CAPTIVE WAR BALLOON.

ITS USE AT CASABLANCA.

THE French are making use of captive balloons in their operations in Morocco. They have a wholesome dread of any of their men falling into the hands of the Moors, and a captive balloon acts as the "eyes" of the army in lieu of scouts. In the rough, low-lying, but undulating country round Casablanca it is easy for bodies of men to move without being seen by watchers on the ground, but the captive balloon searches the hidden valleys and signals the news to the French general. Many French sorties are made at daybreak. The balloon is sent up, and by the time the expeditionary force has wound through the intricate wire entanglements that surround their camp the balloon has located the enemy and indicated the direction of the march. The Arabs, as the Moors are called by the French, have no uncertain opinion of the balloon; they believe it is a special invention of the powers of darkness.

The French—pioneers in aeronautics—made use of balloons in 1871. When Paris was besieged balloons were sent up and a fitful intercourse kept with the outside world. It was a risky business in those days; the balloon and its crew might fall on friendly soil, or might drop into the hands of the Germans. Science has progressed since 1871. To-day the French general is in direct touch, by wireless telegraphy, with Paris.

THE INJURIOUS EFFECTS OF LIGHT UPON THE EYE.

By DR. A. BIRCH-HIRSCHFELD.

THAT strong light may injure the eye has probably been known from remote antiquity. Even a brief glance at the sun may permanently affect the sight. On coming into broad daylight after a long sojourn in a dark room we feel pain in the eyes and involuntarily close them, and eyes accustomed to diffused daylight are similarly affected by looking long at the sunlit surface of snow or water or at bright artificial lights.

Two distinct varieties of partial blindness are caused by exposure to light, one by luminous, the other by ultraviolet rays. The type of the first variety is the sun blindness which is produced by looking at the sun with the naked eye. Many such cases occur at every solar eclipse and Galileo's blindness has been attributed to his observation of sun spots.

The symptoms of sun blindness are very characteristic. Soon after the exposure the sufferer notices that objects which are looked at directly are indistinct, veiled or quite invisible, while the rest of the field of view appears as usual. On looking at a white surface he sees a dark spot surrounded by a shimmer.

In mild cases the ophthalmoscope reveals no change, but in severe cases a pale gray circle fringed with pigment cells is found in the place of the "yellow

spot" in the center of the retina. In many cases the sight gradually improves, but as a rule it remains permanently more or less impaired, and total blindness sometimes results.

My experiments on animals show a progressive le-



THE FRENCH FOREIGN LEGION ARE INTERESTED SPECTATORS.

sion of the retina, beginning with the superficial layer, and consisting of oedema, exudation of fluid, and atrophy of the nervous tissue, due to disturbances of circulation in the choroid and retina.

Sun blindness is evidently caused by the luminous rays. Sunlight, except on high mountains, contains few ultraviolet rays and these are largely absorbed by the lens and humors of the eye. In animals the symptoms can be produced by luminous rays alone but not by ultraviolet rays alone. Ultraviolet rays cause blindness of a different character.

Slight sun blindness caused by reflected sunlight is of common occurrence. There is no serious impairment of vision but the eyes are abnormally sensitive and there is a feeling of fatigue and pain. Individual differences in quantity of pigment and size of pupil here come into play and general bodily weakness may so affect the retina that it is injured by an illumination that is harmless to a normal eye.

Night blindness is a peculiar condition which is caused partly but not wholly by exposure to light. The patient sees very well in strong illumination but

cannot detect slight differences of shade in a dim light. The same condition occurs, transiently, in normal persons on going from a highly lighted room to a dark street. Night blindness is usually epidemic and chiefly affects young persons who are overworked and insufficiently nourished. It is very common among the Russian peasantry after the rigid Lenten fast, and Vaucel tells of a French garrison town where a search party was sent out every evening to bring in soldiers who were helpless after nightfall.

The explanation of night blindness is that the visual purple, which gives the retinal rods sensitiveness for very weak light, has been bleached and destroyed by light and has not been restored, owing to malnutrition. Practically, it is found that attention must be given to the general health. Cod liver oil is said to be very beneficial, and in many parts of Russia it is known as "oil for blindness."

We come now to the effects produced on the eye by ultra-violet rays. The crystalline lens strongly absorbs these rays, and thus partially protects the retina from their action. An eye from which the lens has been removed (in cataract or extreme myopia) is far more sensitive than a normal eye to ultra-violet rays. Glass also absorbs these rays—a fact of great practical importance—and so, to a great extent, do the lower strata of the atmosphere. Injury to the eyes due to ultra-violet solar radiation, therefore, occurs chiefly at great altitudes.

In comparison with sunlight, the radiations emitted by the electric arc, the electric spark, the magnesium light, and the mercury vapor lamp contain a very large proportion of ultra-violet rays.

The injuries caused by ultra-violet rays include snow blindness, electric light blindness, lightning blindness, and erythropsia or "seeing red."

Medical records contain few cases of severe snow blindness, but the less serious and unrecorded cases must be far more numerous. It is most likely to occur at high altitudes where, as we have seen, sunlight is rich in ultra-violet rays. The principal symptom is a violent inflammation of the conjunctiva, cornea, and iris, often accompanied by aversion to light, tears, cramp in the eyelids, and intense pain. In severe cases the cornea ulcerates. Disturbance of vision often occurs. Reich, who studied seventy-three cases in the Caucasus, found the retina and optic nerve congested with blood.

The effects produced by powerful electric lights are very similar to the above. Little discomfort is felt at first, but after a while all objects appear red, and six or eight hours after the exposure the conjunctiva becomes red, swollen, and inflamed. The pain increases, and the sufferer feels as if grains of sharp sand were rubbed under the eyelids. These symptoms abate in the course of days or weeks, but the partial blindness persists much longer, and in some cases through life. Terrien, in his examination of forty-five cases, found that in many the retina and optic nerve were greatly inflamed, while in others their appearance remained normal, although the sight was greatly injured. In no case did he find the circumscribed blind area which characterizes sun blindness.

As lightning is an electric spark of great intensity and peculiarly rich in ultra-violet rays, we should expect its effects to be similar to those of the electric light. A discrimination must be made, however, between true lightning blindness and direct injury to the eye by a stroke of lightning. The former is exactly similar to electric light blindness, but the turbidity of the lens and the profound inflammatory changes in the choroid that sometimes lead to complete atrophy of the optic nerve must be attributed chiefly to the direct mechanical and electrolytic action of the discharge, rather than to the ultra-violet rays of the flash.

A fourth effect of exposure to ultra-violet light is the condition known as erythropsia, in which all objects appear red. It occurs as the first symptom of electric light blindness, and also in other cases. Tourists who arrive at an Alpine shelter after a long tramp over snow and ice are often surprised to find that all light-colored objects look red to them. The condition is transitory and the sight is not injured. Fuchs, who produced the phenomenon repeatedly in himself, explained it by assuming that the visual purple of the retina was greatly reduced by the prolonged action of the ultra-violet rays of sunlight at great altitudes, and that the entrance into the hut was immediately followed by a rapid formation of a layer of fresh visual purple over the retina. But the center of the retina (the yellow spot) contains no visual purple, and yet erythropsia can be produced in an eye of which all except the central portion is protected by a screen. It is noteworthy that eyes from which the lenses have been removed are particularly susceptible to erythropsia.



GETTING READY FOR AN ASCENT.
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The differences between sun blindness, on the one hand, and snow blindness, electric light blindness, and lightning blindness, on the other hand, are very clearly marked. In addition to differences in the disturbance of vision, sun blindness is characterized by the limitation of the effect to a small central area of the retina and by absence of the serious inflammation of the front of the eye, the erythropsia and the long interval between exposure and effect that occur in the other three forms, all caused by ultra-violet rays, as Midmark has proved by experiment.

I have discovered some other interesting facts by employing modern methods of staining nerve cells after exposing the eye to ultra-violet light. The nerve cells of the retina, like those of the brain and spinal cord, contain a granular and scaly deposit, known as the "chromatic substance," or chromatin, which takes a deep stain from certain dyes. In the normal retina these grains and scales are regularly arranged and sharply bounded. They appear with especial distinctness and abundance in the retina of an eye that has long been kept in darkness. The quantity of chromatin is diminished by exposure to bright daylight, and far more rapidly by exposure to light which contains a large proportion of ultra-violet rays.

The normal chromatin structure is regained in the course of a few days, but exposure to intense ultra-violet radiation causes the nerve cells to wither and disintegrate, and permanent injury results. The effect of ultra-violet rays is distributed over the entire retina and is most marked in its inner layers, while the atrophy associated with sun blindness is confined to the superficial layer of the center of the retina.

Light, radiant heat, and ultra-violet rays have been held accountable for other diseases of the eye, including gray cataract. This disease is said to occur more frequently and earlier in life in the country and in the tropics than in cities of the temperate zone, and it is notoriously common among glass blowers and other workers with fire, but exposure to radiation is only one of its causes.

Roentgen and radium rays may also produce very injurious effects, both inflammatory lesions in the front of the eye and disintegration of the nerve cells of the retina, though the chromatic structure is less affected by them than by ultra-violet rays. In working with Roentgen and radium rays the eyes should be protected by screens of sheet lead or lead glass, and the rays should never be sent directly into the eye.

The best protection against solar and other luminous rays is given by smoke-colored glasses. Blue glasses are less effective, as they transmit the short waves which exert the strongest chemical action. When the eyes are exposed directly to intense light, as in observing solar eclipses, tending arc lamps, etc., very dark glasses should be used. Glasses of lighter shade afford sufficient protection against reflected sunlight.

As a protection against ultra-violet rays the color of the glass is less important than its thickness, as all glass strongly absorbs these rays. But as no glass stops them completely, Schulek has devised hollow eye glasses containing a liquid which is entirely opaque to ultra-violet rays. Such complicated devices, however, are neither practical nor necessary.

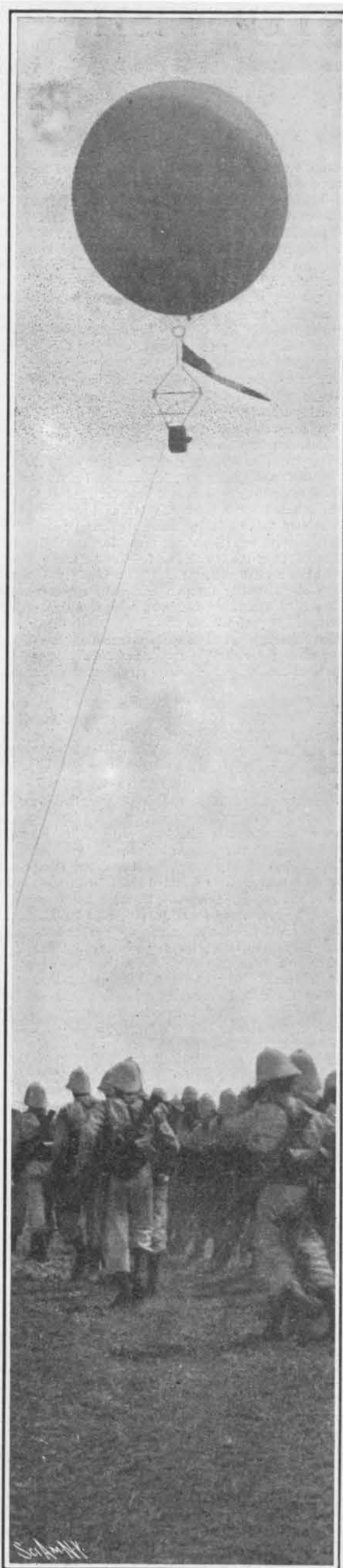
Eyes already diseased and the eyes of sensitive, nervous, anæmic, and ill-nourished persons especially require protection. Such persons should avoid intense light, and wear dark glasses when they are necessarily exposed to it. Reading and working in direct sunlight should be absolutely forbidden. Good results often follow the use of colored screens, for some colors are more acceptable to one person, others to another.

Yet we must not forget that excessive sensitiveness to a degree of illumination that is borne by a normal eye without inconvenience is often only a symptom of a constitutional disease, which calls for diagnosis and treatment. It is certainly wrong to accustom the eye to darkness, for the eye requires light as the stomach requires food. Hence a weakened eye should be gradually accustomed to stronger illumination until it can endure full daylight, as weakened muscles are strengthened by judicious exercise.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from Umschau.

FREEZING OF WELLS.

THROUGHOUT many of the Northern States the freezing of wells and of pumps causes much trouble, and the greatest difficulty is experienced in keeping some wells open for use during the winter. Strangely enough, the shallow open wells give less trouble than the deeper drilled or double-tubed driven wells, in which the inner or pump tube is carried below the outer casing. The determination of the cause of the freezing and of means for its prevention is of so great practical importance that a study of the subject has been made by one of the geologists of the United States Geological Survey.

The freezing of wells is practically confined to districts where the air temperatures frequently go considerably below zero, and where the materials penetrated are either porous or contain actual open-



THE BALLOONIST SEES THE ENEMY, WHO IS HIDDEN BEHIND RIDGES. HE SIGNALS TO THE FRENCH GENERAL.

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ings and passages through which the air can circulate. A recent investigation of the wells of Maine, a large number of which are in granite, slate, and other compact, close-grained rock, discovered no instances of deep freezing. In Minnesota, North Dakota, and Nebraska, on the other hand, large numbers of wells penetrating porous deposits or cavernous limestones freeze every winter. In Wisconsin and Michigan freezing, though less common, occasionally occurs, and also in Iowa, Missouri, Kentucky, and Indiana.

Deep wells that freeze may also exhibit other peculiar phenomena, such as indraft and outdraft of air, producing sucking and blowing, changes in character of water, fluctuation of water level and, in flowing wells, changes in discharge.

A study of the phenomena as a whole shows that they are connected closely with barometric changes. Freezing, indraft, low water level, small discharge and clear water are all characteristic of clear weather and high barometer; thawing of the well and melting of the snow about the mouth, strong discharge and discolored waters always accompany low barometer. The direct cause of the freezing seems to be an indraft of cold air at periods of high barometer. Change of weather, reversing the direction of the air current, produces the thaw.

Many of the simpler devices adopted to prevent freezing are common failures, while others are partly successful. The inherent difficulty lies in the construction of the well. The following suggestions are made by the geologist:

In open wells, where air obtains access through the soil and at the junction of the curb and cover, a cement cover should be tightly fitted to the curb, and the curb itself should be coated with cement for some distance below the surface.

In drilled or double-tubed driven wells the current of cold air drawn in at periods of high barometer between the outer and inner casing near the surface and passing out in a porous bed at the bottom above the water level will cause freezing if the water is pumped so that it stands in the inner tube above the lower end of the outer casing, and a long-continued current of such cold air may cause freezing of the ground water about and in the well tube. For this condition it is suggested that the space between the outer and inner tube near the surface be packed with some impervious material. A filling of cement resting on an improvised plug is probably the most effective. The home-made rag packing sometimes used is too porous to serve the purpose.

The same treatment is suggested for wells with leaky casings, for driven wells passing through rocks porous enough to permit the passage of large currents of chilled air during periods of high barometer and for wells in which the outer casing ends in some cavern or open passage—that is, the space between the well tube and the pump tube near the surface should be plugged tightly with impervious material. About some wells the ground crevices through which the air circulates are so numerous that immunity from freezing can be obtained only by plugging the space about the pump tube from top to bottom with cement.

Preparations are being made to equip all the tramway lines of St. Petersburg with electricity. The city lines now have a total length of 130 miles, so that the undertaking is a large one. Six years is the period allowed for completing the work. The first section of 28 miles is now under way. The Westinghouse Company is charged with the electric outfit, and the section will soon be completed. On the Obvodny canal a large electric plant, which will give the current for the first part of the lines, is building. Here the coal is easily brought by boat to the premises. The boiler outfit comprises six double boilers, and in the dynamo hall there will be three Westinghouse steam turbines of the Parsons type, which drive the dynamos. Working at 1,500 revolutions per minute, the alternators are designed for 2,200 kilowatts and 6,600 volts, with 25 cycles. There are two smaller turbine groups for the exciters, besides a turbine dynamo which charges a storage battery of 1,040 ampere-hours capacity, made up of 130 cells. By underground cable the high-tension current from the main station is sent to different points upon the tramway line, where substations are placed. Five of the latter will be used, receiving the 6,600-volt current by means of two cables, one of which serves as a standby. Transformers reduce the tension to 370 volts and this latter current is used to operate the rotary converters in the substations. The latter are of the 500 or 150-kilowatt size, according to the amount of supply which is needed, or each substation is designed to furnish 1,000 or 2,250 kilowatts. Direct current for the tramway line at 600 volts is given by the rotary converters taken to the trolley wire by sets of feeders. Upon the section of line which is in question here, the rolling stock includes no less than 190 motor cars, using the horse cars as trailers. On the motor cars the electric outfit consists of two Westinghouse motors of 40 horse-power.

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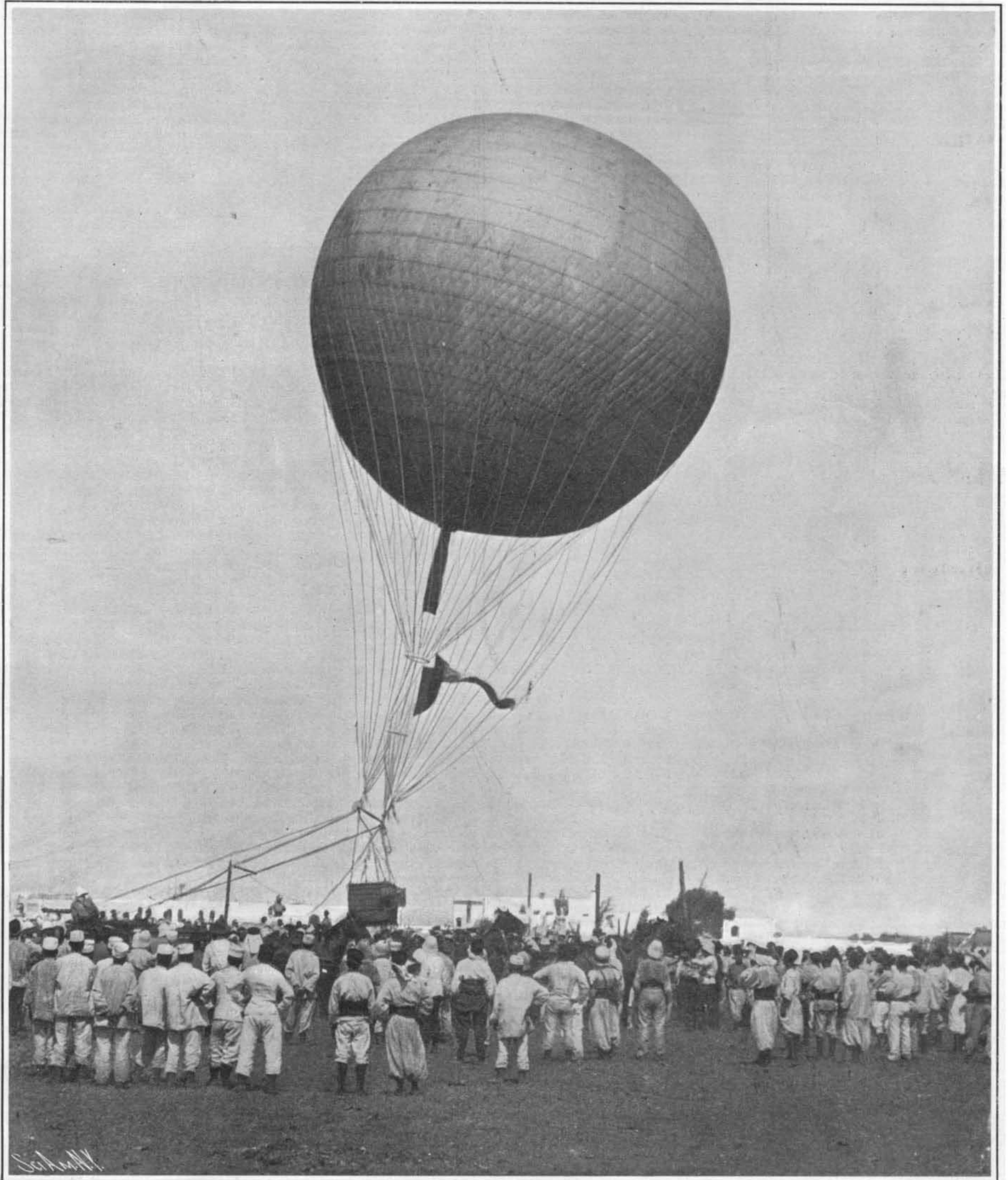
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A CAPTIVE BALLOON IN USE BY THE FRENCH FORCES IN MOROCCO.

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