### THE LIQUEFACTION OF OXYGEN.

Upon boiling in the open air, liquid ethylene produces so low a temperature that compressed oxygen reduced to that degree of cold exhibits, when its pressure is diminished, a tumultuous ebullition that lasts for an appreciable length of time. Upon hastening the evaporation of the ethylene by means of an air pump, as was done by Faraday for protoxide of nitrogen and carbonic acid, its temperature is lowered sufficiently to bring oxygen to a liquid state.

I have endeavored to overcome the inconveniences and complications that result from the necessity of operating in a vacuum, and, with this object in view, have already suggested the use of liquid formene, which permits of effecting the liquefaction of oxygen and nitrogen in a trice.

I have, nevertheless, thought that, despite such advantages, ethylene, which is now so easy to prepare and manipulate, should be preferred to formene, and I have succeeded in obtaining, by means of ethylene boiling in open vessels, a sufficient reduction of the temperature to effect the complete liquefaction of oxygen.

The process that I employ is exceedingly simple, since it consists in hastening the evaporation of the ethylene by passing through it a current of air or hydrogen reduced to a very low temperature.

In the apparatus that I have constructed the steel receiver, R, which contains liquefied ethylene, is fixed upon a vertical support with its orifice downward. To this latter is adapted a copper worm, of 3 or 4 millimeters diameter, closed by a screw cock and placed in a glass vessel, S.

Upon chloride of methyl being poured into this vessel, the temperature falls to —23°, but if air that has been carefully dried by passing it through a bottle containing chloride of calcium be forced into it, we shall soon obtain a temperature of nearly —70°.

The ethylene thus cooled condenses and fills the worm. When the cock at the lower part of the vessel, S, is opened, the ethylene flows under a slight pressure, and without perceptible loss, into a test glass, V, arranged (as shown in the figure) in a vessel that contains pumice stone saturated with sulphuric acid designed to absorb the aqueous vapor. It is, in fact, indispensable to act in absolutely dry air, for, without such precaution, the humidity of the atmosphere would condense in the form of a layer of ice upon the sides of the test glass, and make them absolutely opaque.

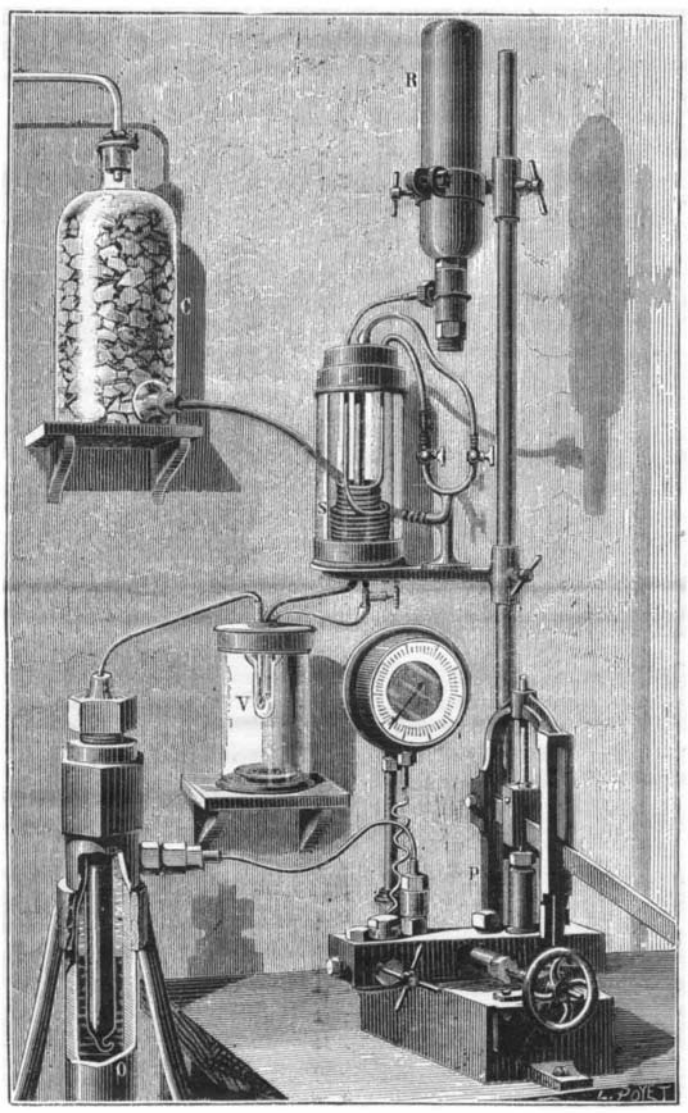
It suffices, then, to hasten the evaporation of the ethylene by means of a rapid current of air or hydrogen cooled in a second worm placed in the vessel, S, of chloride of methyl, in order to allow the compressed oxygen in the glass tube fixed to the upper part of the reservoir, O, to resolve itself into a colorless, transparent liquid, separated from the gas that surmounts it by a well defined meniscus. Upon the pump, P, being worked, the injected water acts upon the mercury in the receiver, O, and forces it to enter the test glass that contains the oxygen. The gas thus compressed becomes liquefied, as we have said, in the branch of the tube contained in the glass, V. This tube dips into the ethylene at a temperature of —125°. The mass of liquefied oxygen, which is as limpid as ether, is figured in black in the engraving, in order to render it visible.

By means of a hydrogen thermometer that I shall make known the construction of ere long, I have measured the temperature of the ethylene, and, in one of my experiments, found it to be —123°. I hope that, by cooling the current of hydrogen with more care, the temperature may be still further reduced.

The copper spirals in which the air and ethylene circulate dip into chloride of methyl, which is rapidly evaporated by means of a previously cooled current of air.

In short, I have found that, by hastening the evaporation of liquid ethylene, by means of a very cold current of air or hydrogen, its temperature is reduced much below the critical point of oxygen, which, in this medium, liquefies in the clearest manner.

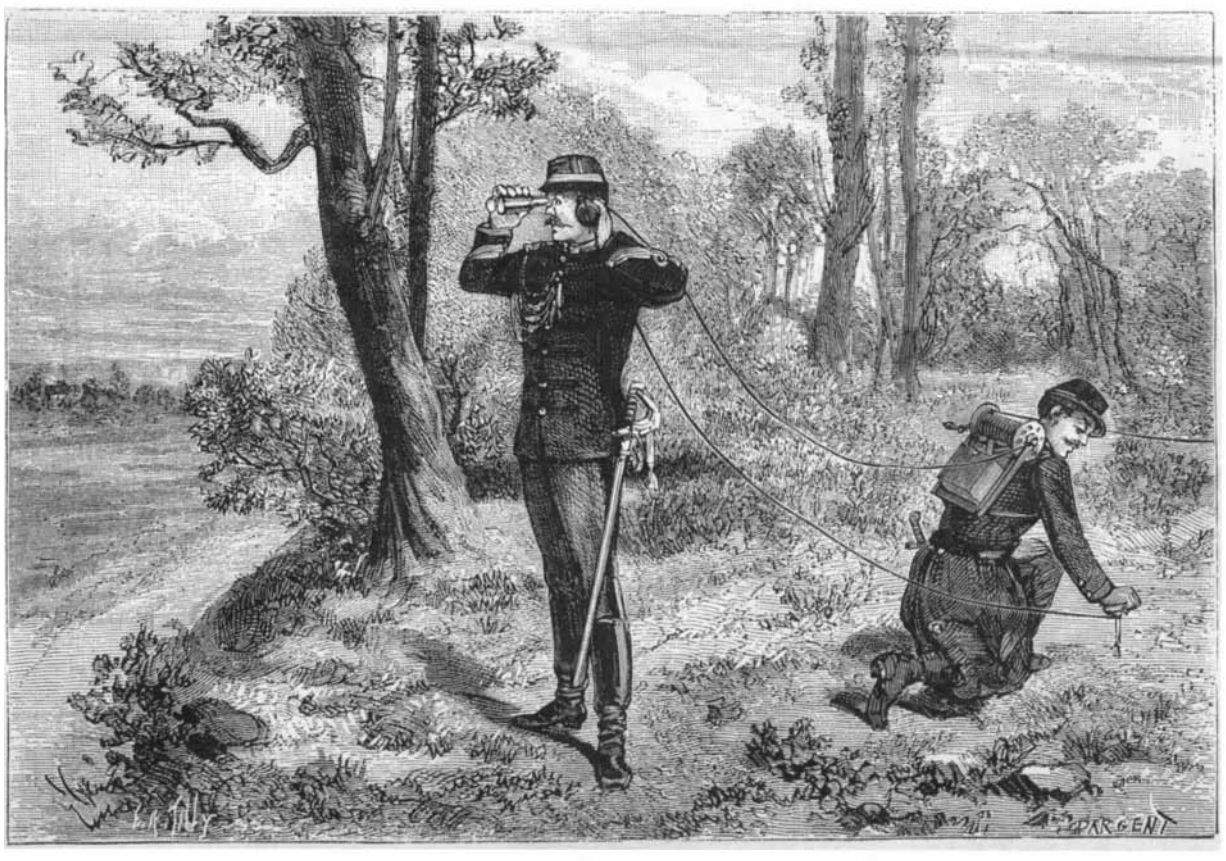
This experiment is so simple and easy of performance that it may henceforth be performed in laboratories, and be repeated in public lectures.—*L. Cailletet, in La Nature.*




CAILLETET'S APPARATUS FOR LIQUEFYING OXYGEN.

### TELEPHONE APPARATUS FOR MILITARY PURPOSES.

The illustration herewith presented, from *La Lumiere Electrique*, gives a good idea of one of the many uses to which electricity is being put as an aid to modern military operations. The officer standing forward with field glasses to his eyes surveying the country is supposed to be an advanced scout watching the movements of the enemy, while at his ear is a telephone receiver, connected by wire with some point in his own army, probably with the chief of staff or general in command, whence the scout can receive continued directions. This receiver is also a transmitter, through which the scout can, in like manner, telephone back the result of his observations, thus communicating instantly to headquarters information of the designs of the enemy, and giving opportunity for the necessary counter movement of forces. It will be readily seen from the picture how the wire is laid loosely along the surface of the ground, from the reel on the soldier's back; no battery being required, the whole takes up no more space than an ordinary knapsack. The wire is insulated, and is very light, and can be reeled up on return, if desired.



THE MILITARY TELEPHONE.

### Decay of an Iron Bridge.

A phenomenon has been observed in the Callowhill Street Bridge, in Philadelphia, which is of great interest to architects and engineers, although the taxpayers of Philadelphia probably take no satisfaction in it. A few days ago men were sent to repaint the girders of the bridge, and began, as a preliminary process, to scrape off the rust. The attention of the foreman was soon attracted by the unusual size and weight of the scales of rust which fell upon the railroad below, and, on picking some of them up, found that they were solid masses, from one-quarter to three-eighths of an inch in thickness. It is needless to say that plate iron girders which had lost their substance by rust to such an extent as this would have little strength remaining, and the vibration of the bridge under the movement of a horse-car or loaded cart, which was so great as to compel the painters sitting on their swinging stage to cling to the ropes or the braces of the bridge to avoid being shaken off, indicated still further the necessity for an immediate inspection of the whole structure.

The first examination was an informal one, made by persons living in the neighborhood, who found not only that some of the iron work had been nearly eaten through by rust, but that the whole bridge, which is built on a steep rising grade, had moved down hill so far as to tear out the top courses of stone of the upper abutments, and to buckle the struts of the intermediate supports; while the movements of the roadway framework had cracked the asphalt over them, and forced out the paving blocks between the horse railway tracks. The bridge includes one span of 340 feet, and as there can be no trifling with girders of this length, extensive repairs will probably be necessary. The structure was only completed in 1875, so that ten years of neglect have sufficed to bring it nearly to destruction, and those who have to design important iron roofs or bridges will do well to notice by this example how short is the life of such works if not properly cared for. In the case of the Callowhill Street Bridge, says the *American Architect*, the corrosion was probably hastened by the action of the smoke from the locomotives which passed under it; but there are hundreds of bridges exposed to the same action, and the iron roofs of railway stations and manufactories are often subjected to similar or more dangerous influences.

### A Locomotive Struck by Lightning.

A singular accident recently happened at Milnes, Va., on the Shenandoah Valley road, when the locomotive of a freight train, which was standing on a siding, was struck by lightning. Both the engineer and fireman received severe shocks, the engineer being so injured that he did not recover for several days, and the engine was somewhat damaged. Accidents of this kind rarely happen.

Last autumn a bookseller named Meyer, of Ronneburg, tied a waterproof label under the wing of a swallow which had occupied a nest at his house, and had become comparatively familiar. On it he wrote a query in German, to the effect that he wished to know where the swallow would pass the winter. The bird returned to its former nest, bearing an exchange label similarly fastened, saying, in German also, "In Florence, at Castellari's house, and I bear many salutations."