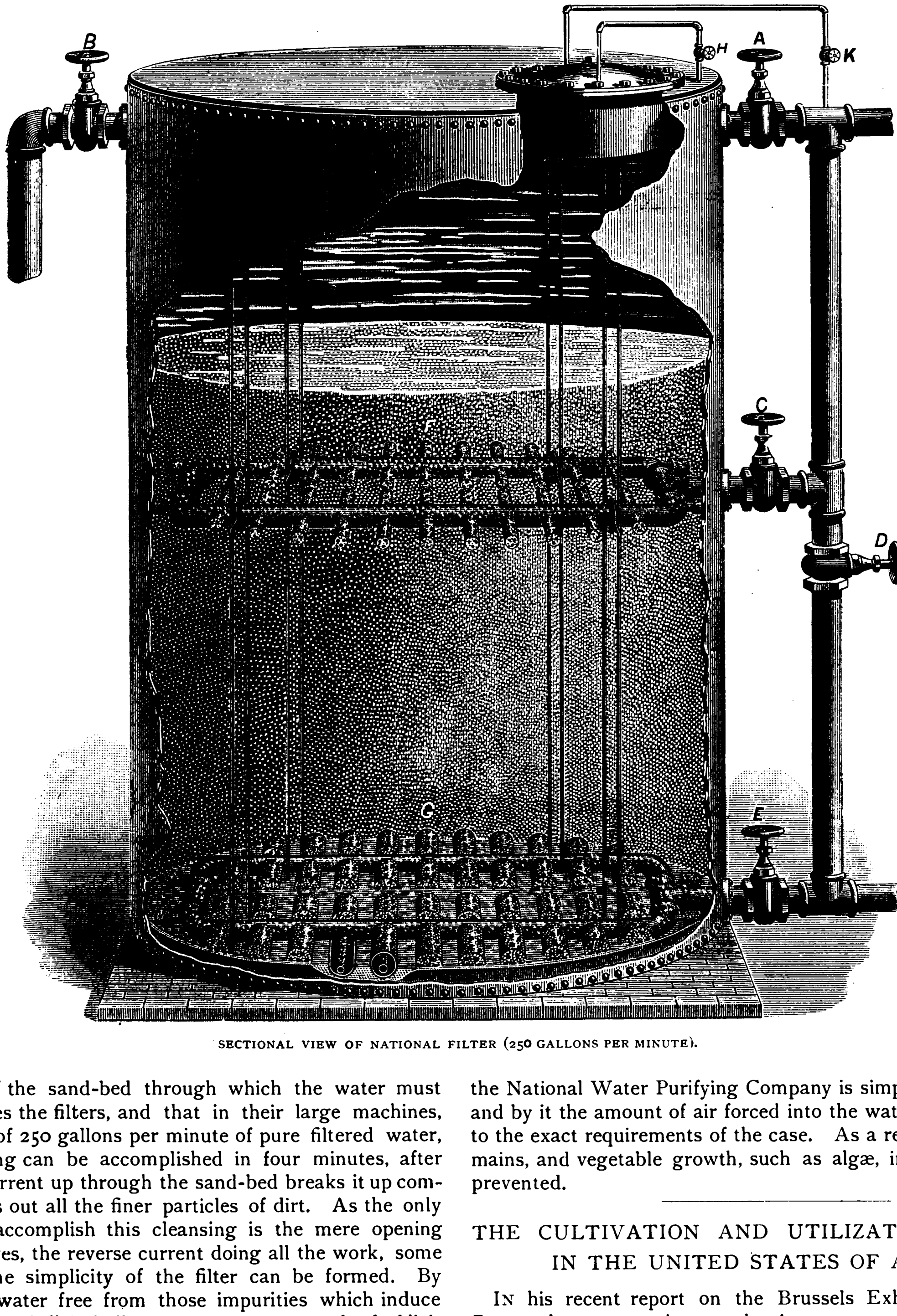
Purifying Company of New York have in their apparatus combined many, if not all, of these requirements; and an extensive plant installed by them at Chattanooga, Tenn., gives conclusive proof that scientific principles have entered into the construction of the plant, which seems to have well stood the crucial test of actual practice. The rapidity and thoroughness with which these filters can be cleaned, and the small expenditure of water required, are qualities in which this company excels, as they seem to have effectually solved the vexed question of surface washing. It has been found, from long experience, that most of the impurities taken from water, in the course of twenty-four hours lodge in the upper six to ten inches of the sand-bed through which the water must pass before it leaves the filters, and that in their large machines, having a capacity of 250 gallons per minute of pure filtered water, this surface washing can be accomplished in four minutes, after which a reverse current up through the sand-bed breaks it up completely, and throws out all the finer particles of dirt. As the only labor required to accomplish this cleansing is the mere opening and closing of valves, the reverse current doing all the work, some idea of the extreme simplicity of the filter can be formed. By creating a feed of water free from those impurities which induce the formation of "scale" in boilers, a great economy of "fuel" is effected; the salts and other deleterious substances being deposited in the sand-bed of the filter, instead of passing into the boiler and shortening its period of usefulness by hastening corrosion; while the sediment that induces foaming, and which, gradually settling in the boiler, necessitates a periodical stopping for its removal, ceases to be troublesome. It has been demonstrated beyond question that the thorough purification of drinking-water can be accomplished by combining aeration, precipitation, and filtration; and it is also reasonably claimed that the thorough aeration of water under pressure has the effect of destroying bacteria and plant-life that would be injurious to health. The aeration is accomplished by means of an air-compressor, whereby air is forced into the water under high pressure, thus producing a chemical action, which destroys the disease germs in the water, making it clear and sparkling. The process employed to attain this end by the National Water Purifying Company is simple and inexpensive, and by it the amount of air forced into the water can be regulated to the exact requirements of the case. As a result, all odor in the mains, and vegetable growth, such as algæ, in the reservoirs, are prevented.



SECTIONAL VIEW OF NATIONAL FILTER (250 GALLONS PER MINUTE).

THE CULTIVATION AND UTILIZATION OF RAMIE IN THE UNITED STATES OF AMERICA.

IN his recent report on the Brussels Exhibition, Mr. Joseph Zervas draws attention to the importance of the cultivation of ramie. During the last thirty years, he says, numerous experiments have been made with a view to finding new plants yielding textile fibres. One of the most promising among these is the ramie, which is obtained from two plants, — *Bohmeria nivea*, yieldng white ramie; and *Bohmeria utilis s. tenacissima*, yielding green ramie. The fibre, which is also called "rhea" and "China grass," has been imported in considerable quantities into Europe, and extensive experiments have been carried on in regard to its utility.

Ramie is a perennial plant, the bark of which gives a textile fibre superior in tenacity and resistance to that of flax and hemp, while at the same time its length, fineness, clear white tint, and lustrous brilliancy, give it a great resemblance to silk. The amount of textile material obtained from a certain quantity of this plant is considerably larger than that obtained from an equal quantity of either flax or hemp.

Although in some respects inferior to silk, it can be used as an imitation of it; while it will undoubtedly supersede hemp, flax, and harl. Like cotton, it will have its centres of manufacture, and the peoples of the earth will be interested in the progress made in its use. The beauty of its products, the fineness and durability of tissue, more especially its clear tint, make it suitable to take the place of linen goods; and its easy manufacture will insure its rapidly gaining supremacy over other textile products.

The cultivation of ramie was introduced into Mexico by Mr. Benito Roezl de Santo Comspan; into the United States, by Mr. J. Bruckner of New Orleans; and into Belgium, by the Josephites of Melle, near Ghent. In Germany and Bohemia the first experiments were made with white ramie, as it was thought to be more advantageous, owing to its readier acclimatization to countries less warm than China or Japan, from which it had before been imported; but so far its cultivation, for reasons which will be shown later, has made but little progress. Recently machinery has been invented which makes its manufacture more successful; and since that time this industry has made rapid progress. Governments of several European nations are taking an active interest in the cultivation of this plant.

The utilization of ramie fibres is of great antiquity. Their virtues are recorded in the poems of Ramagana and of Kalidasa, who sing the praises of the stuffs made from ramie, which seems to have been grown at that time in the Himalaya Mountains. Pallas contends that the Chinese frequently deceived the Russians by selling them stuffs manufactured from ramie-thread (the woof alone being of real silk) as real Damask silk. We find in the annals of Nestor, of the year 904, that the sails of the Volga vessels were nearly all manufactured from ramie fibre.

Various kinds of nettles, or ramie, were cultivated in Russia, Siberia, Kamtchatka, and Japan. Dr. Boyle says that in 1810 the first tests of Sumatra ramie were made in India. In 1851 experiments were made in the spinneries of Leeds, which proved very encouraging. In 1868 the price of the raw fibre was £20 per ton at Calcutta, and £40 at London.

Although the cultivation and industry of ramie are still principally limited to the countries to which its growth is indigenous, the attention of every agricultural country, and of every textile manufacturer, should be drawn to its value with a view of determining as to the benefits to be derived from its introduction.

No country is better adapted for the introduction and cultivation of ramie than the United States, which, owing to its extensive territory, affords all possible conditions for cultivation as regards either soil or climate, and where the power of capital conduces so favorably to the development of enterprises.

It is not difficult to imagine the importance which this new industry may gain in the United States, when we consider that in 1887 the total importation of textile material (flax, hemp, jute, and other vegetable substances) from foreign countries into the United States amounted to about one hundred and twenty-three thousand tons, representing a money value of fourteen million dollars.

The exportation of vegetable fibres of every kind to the United States from the consular district of Brussels (Belgium) amounted, in 1880, to $54,411.88; in 1881, $58,307.68; in 1882, $34,065.78; in 1883, $41,989.20; in 1884, $37,041.14; in 1885, $51,004.56; in 1886, $62,587.30; in 1887, $39,245.92. The falling-off in the exportation of last year is due to the probable change in the tariff.

It has been inferred above, that, as a result of experiments made towards acclimatizing ramie in foreign countries, there has not been any extraordinary industrial success, although remarkable progress regarding our knowledge of the plant, and the best methods of treating it, has been made. Even in the utilization of the fibre for spinning purposes, many difficulties were encountered until lately. The obstacles in the way of the cultivation of ramie arose principally from the fact that the plant itself, and the practical utility of it, were unknown; that statements regarding its use had been found erroneous, exaggerated, and untrustworthy.

No knowledge whatever of the soil suitable for its growth and cultivation, nor of the proper climate, was possessed. The culture of an inferior kind of ramie was introduced into northern countries, and its merits were so highly exaggerated that its partial failure prejudiced many of its warmest adherents. This species, the white ramie, is not nearly as good as the green.

Among the different kinds of ramie experimented upon with a view to their introduction into Europe and America, only these two species are accepted as being useful and suitable for acclimatization. The *Bohmeria nivea* (the white ramie), of Chinese origin, belongs to the temperate zone. The under part of its leaves is of a nacreous white color, with green veins, the leaves and stalks being very vigorous. The ripe stalk is of a red-brown blood color. Its fibre is greatly inferior to that of the green ramie, it is rougher to the touch, is not so full, and bears less resistance to tension. The stalks do not grow so high, and they have less tendency to run to seed. The plant also resists the cold better; for, while one has to be protected in severe weather, the other has not, and can be left in winter in a meagre soil. The *Bohmeria tenacissima* (green ramie) comes originally from an equatorial district, Java. Its fibres are very strong, and the plant is more hardy, and more prolific in fibrous textile, than the other.

The average height of the stalk of the green ramie is about five feet and a half to six feet, while that of the white ramie is of considerably less height, being about four feet and a half. In addition to this, the latter plant grows numerous side branches, which renders pruning more difficult. Accordingly, the product of the green ramie is shown to be superior to that of the white ramie.

It would seem, therefore, that it is a mere question of climate, which favors white ramie, though a recent cultivation of green ramie in Italy, in the province of Padua, shows it to have withstood a temperature of —9° C. or 16° F. In Algeria green ramie has been cultivated exclusively for some time.

Ramie can be raised from seed, from suckers, or from layers or pieces of roots. That reproduced by seed-plots requires too much care, and has a greater tendency to run wild. Suckers have various disadvantages: ten per cent die, and the others cannot withstand the cold. The simplest, surest, and most productive mode of reproduction is by pieces of roots, or cuttings of stalks stuck into the ground. This kind is more productive, fuller, is neater and more easily grown, and reaches maturity at an earlier period.

A comparison of the cultivation of the two species in Italy gives the following result as a fair sample of its produce. Ten thousand mother plants on one hectare gave for two cuttings, —

	Dry Stalks. Kilograms.	Pruned Fibrous Textile. Kilograms.	Harl per 1,000 Kilograms Stalks.	Harl. Per Cent.
White ramie	6,000	1,030	172	17
Green ramie	8,000	1,600	199	20

The soil in which ramie should be planted should be light, sandy, well manured and cultured, naturally cool and moist. A good underground is indispensable, as the plant throws out its roots to a depth of from twelve to fourteen inches. It may be said, however, that it accommodates itself readily to almost any kind of soil, but the one indicated gives far superior results. If the soil be too rich, the plant thereby acquires a deleterious amount of ligneous material, which lessens the strength of the plant's fibres. The stalk becomes sappy, more difficult to prune, and hence inferior in quality. A too damp or marshy soil is injurious; although it has been experienced in different districts where it is grown, that a thick coat of mud of a sandy nature, the result of an inundation, has proved rather favorable instead of prejudicial in its effect. A persistent drought gives a thin and sickly crop: therefore it will be found necessary, where the plant is grown under the influence of great heat, to facilitate the vegetation by frequent irrigations, according as the soil is more or less of an absorbing nature. At least two weeks previous to the cutting of the plant, the irrigations ought to be discontinued, to allow the stalks to gather sufficient strength, ripen, and dry sufficiently for use. In order to secure a good crop, and avoid fermentation of the stalk, it is preferable to cut in dry weather. The manner of planting is quite simple. In the soil already prepared, furrows at least three feet apart should be ploughed (similar to those made in planting potatoes). The plants are then placed in the furrows at three inches depth, so that they alternate with those of the next line. Each plant requires a square yard for its development. This space will be occupied by direct shoots or rhizomas from the end of the second year.

In the third year it will be necessary to thin the plants. In order to secure a free circulation of air, the soil should be carefully weeded during the first year of the plant's growth. In the second year it will be found unnecessary, the ramie overgrowing the weed. It is advisable in spring, or after the first cutting, to dig up a little of the soil about the roots. As the plant is perennial, the better the soil is prepared, the better will be the results. Quoting from the analysis of Dr. J. E. Tornidge, the composition of the fibre is as follows: —

Potash	32.37
Soda	16.33
Lime	8.50
Magnesia	5.39
Oxide of iron	.17
Chloride of iodium	9.13
Phosphorus	9.60
Sulphur	3.11
Carbon	8.90
Alumina and silica	6.60
	100.00

Ramie, like flax and hemp, exhausts the resources of the soil rapidly: therefore careful manuring is necessary. The above analysis may be a guide in selecting the fertilizer. In Europe only two cuttings a year can be depended upon; for, even by the use of liquid manure with irrigation, it has been ascertained that a third crop is extremely sickly and weak, even under the most favorable circumstances. In countries where the climate resembles that of regions to which the plant is indigenous, as many as five crops can be obtained if great care be given to its cultivation. The best time for gathering it is when a red-brown color is visible in the lower part of the stalk.

The stalks should be cut at about four inches from the ground, by a clean incision, to avoid damage. It is then necessary to dry them quickly in the sun; and they should be peeled within at least forty-eight hours, after which time peeling would be difficult.

If stored for winter use, it should be kept in a dry place. In the process of drying, the leaves should be stripped. If used for cattle-forage, as is often the case, they should be given while still green. This, however, is an expensive proceeding. When the stalks are dried with the leaves remaining on them, they can be easily shaken off at the end of two days. They can be usefully employed in the manufacture of paper, or left on the ground, for which they form a good manure. The produce of the stalk is, as shown, dependent upon the climate and proper treatment. As no statistics have yet been made in countries where its growth is indigenous, it is necessary to make an estimate from the results obtained in countries less favorable to its growth: therefore the estimates are probably too low. In Italy, in the third year, when the plantation reached its definitive state, the produce of one hectare (2.471 acres) of ramie amounted to about 80,000 kilograms (1 kilogram = 2.2 pounds) green stalks, of which one-half is attributable to leaves. The first cutting gave 41,200 kilograms, the second 39,700 kilograms, green stalks, which together makes 80,900 kilograms. Deducting fifty per cent leaves, there remain 40,450 kilograms of green stalks, or 1,600 kilograms harl. Two thousand kilograms of harl have even been obtained, and 1,800 is not an exaggerated average, per hectare.

Labor, manure, rent, pruning-machines, and general expenses are of course to be counted; and, as such expenses would in America be highly in excess of those in Italy, it could only be by practical trial and experiment that the cost of its cultivation in the United States could be ascertained. The results show, however, that the cultivation is extremely remunerative, and in the United States it would prove still more profitable.

The greatest difficulty yet experienced in the industry is that of properly peeling or decorticating the stalks. With a view of promoting this industry, the Indian Government, in 1870, offered a prize of £4,000 for the best machine manufactured to peel the raw fibre; subsequently a prize of £5,000 was offered in England for the same purpose; and quite recently an exhibition has been decided upon, to be opened on the 25th of September, by the minister of agriculture in Paris, for machines for the purpose of peeling ramie stalks. As in the case of all textile plants, the object is to separate the ligneous part from the herbaceous part; that is to say, the stalks from the bark. The ligneous part is used for manure only. The bark, on the contrary, contains the fibrous matter for the manufacture of harl. Its manufacture is possible in several ways. First, during the first two days after the cutting of the stalk, the viscous liquor which is found between the ligneous part of the stalk and the bark allows it to be peeled with facility. The Chinese and Indians simply employ their forefinger and thumb to peel the bark while in that state. This is of course primitive, and machines based on that principle have always been found unsatisfactory. Second, many inventors proceeded, as in the case of flax and hemp, by a kind of previous maceration called "retting;" but this also has proved unsatisfactory, on account of its speedy putrefaction, hemp being capable of greater saturation than ramie. Third, chemical operation has at all times proved prejudicial to ramie fibre, causing loss of weight and brilliancy of appearance. Fourth, other manufacturers constructed machines with a view to abandoning retting. These are constructed so as to peel the harl, and do the least possible injury to the textile qualities of the plant, and, by working the plant when dried, to completely disaggregate the fibre so as to render it of greater value. When working green, there is apt to be a great loss of fibre, as it is impossible to perfectly peel the stalk. The disaggregation is poor, the fibre leaving the machine in strips, which necessitates its being worked by chemical substances, to obtain the division of the thread: hence a machine working dry, with little loss, is of greater advantage.

Among the machines working green, that of the American, Mr. Berthel, gives a waste of more than one-half of the textile fibres. Requiring a force of two horse-power, it is able to work 150 kilograms (330 pounds) of dry harl per day, the price being $500 for this machine. The machine built by Felix Roland, a French engineer, is somewhat better; but the waste still amounts to two-fifths of the whole. The machine of three-quarter horse-power works 150 kilograms of dry harl, and costs $250; that of one horse-power works 200 kilograms (440 pounds) dry harl, and costs $360. The machine of Messrs. Moermann-Laubuhr, Belgian engineers, which is really an old flax machine, requires a previous maceration of the plant, necessitating thereby inconveniences. It requires four horse-power to work 200 kilograms of harl per day, and its price is $1,200. Among dry-stalk working machines is one manufactured originally for flax by Arthog, which works 100 kilograms (220 pounds) at two horse-power, and its price is $800. Until recently (1875), the best machine originally built for flax was manufactured by Cardow & Son, and improved upon by Huet Lagache, for the treating of ramie; but the harl often rolled up around the cylinder, the brown epidermis was often left, and considerable loss ensued. The produce is 200 kilograms for four horse-power, the price being $2,000. Felix Roland, who was mentioned above, also built a machine for working dry stalk. Little injury, as well as little loss, was experienced by the use of this machine. Of these machines he has three different sizes. No. 1 produces 60 to 70 kilograms (130 to 154 pounds) a day, worked by a man, the price being $300; No. 2 produces 150 to 160 kilograms (330 to 352 pounds) a day, three-quarter horse-power, the price being $440; No. 3 produces 200 to 250 kilograms (440 to 560 pounds) a day, one horse-power, price $600.

Peeling expenses do not exceed three per cent by this system, wages being reckoned at $1.25 per day. This machine was considered the best, as is shown by the fact of the minister of the

French Navy buying one for the colonies of Guinea, etc. Lately, however, in the Brussels Exhibition, the new stripping and peeling machine of Norbert de Landtsheer from Paris was exhibited, and it is the most simple, complete, and inexpensive machine yet used for the peeling of either dry or green stalks. Peeling is accomplished without crushing, and the threads are free from cuts. The disaggregation is perfect, and the machine is free from waste in either dry or green peelings. The daily product is: dry, 100 to 158 kilograms (220 to 330 pounds), a quarter to one horse-power; green, 100 to 200 kilograms (220 to 440 pounds), a quarter to one horse-power, price $240. A machine run by hand-power produces 75 kilograms (165 pounds), price $200.[1]

On a large scale of cultivation, a corresponding series of machines built by Norbert de Landtsheer will be necessary. With this in view, and the value of these machines being established, there is no longer any doubt as to the success of its introduction into the United States, where the conditions of soil and climate are so favorable.

It is not within the scope, nor is it the intention, of this article, to advise agriculturists to proceed to develop this industry on the strength of the information and statements contained in this report, but rather to draw the attention of the United States to the feasibility of its introduction into the country.

[1] At aforesaid September Exhibition at Paris the decorticating machine of De Landtsheer was recognized to be the best.

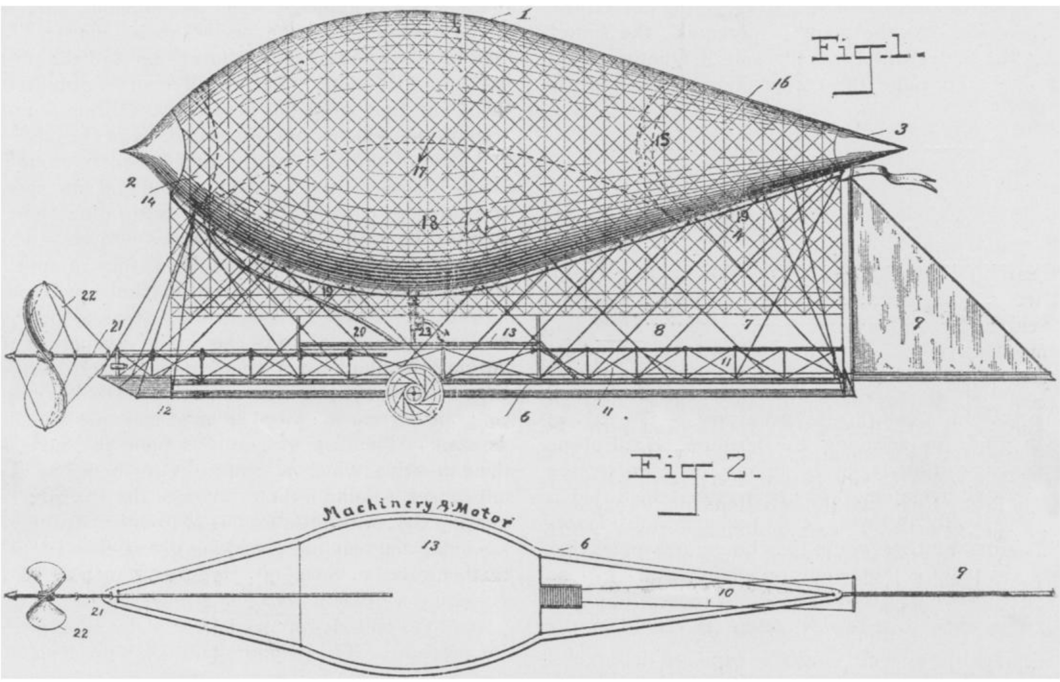
AN AIR-SHIP.

MR. LOUIS BOISSET, a retired officer of the French army, is now in this country, perfecting an air-ship, an invention of his, and seeking the protection of the United States patent laws.

Mr. Boisset has had some experience in recent years with the air-ships experimented upon by the French war department, the more or less successful voyages of which over the suburbs of Paris were recorded in *Science* in 1884. One trouble with these older forms Mr. Boisset believes to have been due to their symmetrical form, and he seeks to make the equilibrium of his balloon when in motion more stable by giving it, as shown in the figure, an ovoidal form, following in this the dictum of Mr. Dupuis de Lome, — that in general, organisms destined for motion in water or air, be they birds or fish, have such a form, the larger end being the forward end in their movements. To maintain the shape under varying pressure, there are two air-tight conically shaped compartments, — one at each end of the balloon proper, — into which air or other gas may be forced, as occasion may require, to keep them distended.

The buoyant power it is proposed to make just sufficient to raise the ship; and if, on rising higher, the warmth of the sunlight or other cause should expand the balloon, some of the gas would be removed, and condensed, thus doing away with the clumsy makeshift now in vogue of throwing out ballast.

To start with, the balloon is supposed to be filled with just enough coal-gas to cause it to rise. As the balloon rises, a portion of this gas may be withdrawn and compressed, and another portion may be employed to drive the motor, and some part will escape. To replace this loss of buoyancy, there is a reservoir in the car containing a solidified gas, the composition of which Mr. Boisset still keeps a secret, but the basis of which is ammonia, from which



THE AIR-SHIP OF LOUIS BOISSET.

1. Extremity of the inflated part; 2. Front cone; 3. Back cone; 4. Nets; 5. Riggings; 6. Lower parts of the car; 7, 8. Fringe of the net; 9. Rudder or guiding sail; 10. Passengers' cabin; 11. Safety-rail; 12. Front extremities of the car; 13. Machinery and motor-room; 14. Front air-tight compartment; 15. Back air-tight compartment; 16. Large back air-tight compartment; 17. Centre of gravity; 18. Large central compartments for ammoniacal gas; 19. Metallic bar (very light); 20. Gas-pipes for the motor; 21. Shaft of tractive screw; 22. Tractive screw; 23. Throttle-valve for ammoniacal gas; 24. Wheel with air-sails.

a fresh supply of gas can at will be obtained, and introduced into the lower compartment (18) of the balloon.

Mr. Boisset believes that he has made improvements over any thing that has gone before, in the shape and rigging of the ship, in the gas-motor, and in the method of compensation by which the equilibrium of the ship may be maintained. Further, the dividing of the balloon into air-tight compartments is a novel feature, and allows of replacing the consumed coal-gas by the ammoniacal gas, whatever its composition may be, without mixing the two.

Mr. Boisset estimates that a vessel of his construction, capable of crossing the Atlantic, should have a gas-chamber (the balloon proper) 62 metres in length, and with a maximum diameter of 20.33 metres. The height from the top of the balloon to the flooring of the basket would measure 31 metres; and the length from the end of the propeller to the end of the rudder-sail, 82 metres. The weight of the ship, its provisions, crew of ten men, and passengers, the inventor would place at 6,000 kilograms.

AMONG the features of the issue of *Light, Heat, and Power* for Jan. 19, are four photographic plates, illustrating the recent gas-holder explosions at the works of the Citizens' Gaslight Company, Brooklyn, N.Y.