The Chinese Oil Tree.

Elæococca vernicia, the oil tree of China and Cochin China, is a plant of the family of the *euphorbiaceæ*. Its seeds, when submitted to strong pressure in the cold, yield about 35 per cent of a liquid oil, colorless, inodorous, and almost insipid. Its specific gravity at 59°Fah. is 0·9362. At —32° it thickens, without losing its transparency or crystallizing. By treatment with ether, 41 per cent of oil can be extracted from the seed, slightly colored, but presenting otherwise all the character of the oil obtained by pressure. If, instead of ether, purified bisulphide of carbon is employed, the fatty matter remaining after the solvent has been evaporated off at 212° solidifies on cooling, forming a number of small reniform masses, which present under the lens a decided crystalline texture. This solidified fat has the same elementary composition as the liquid oil obtained by pressure, and melts at 93°. The oil extracted by pressure in the cold is rapidly solidified by light in the absence of air, an effect which, on further experiment, was found due to the more refrangible rays of the spectrum alone. The oil of *elæococca* is the most drying of all oils. If spread on a plate of glass or metal, it dries in a few hours, on exposure to the air.—*M. S. Cloëz.*

ENGINEERING STRUCTURES.

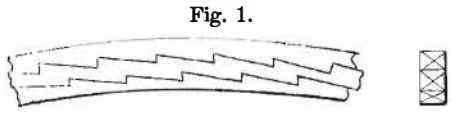
Under the above heading we classify the following descriptions of caissons and arched edifices, extracted from the pages of Knight's "New Mechanical Dictionary."*

The modern or pneumatic caisson, sunk through quicksands or submerged earth or rock, is the invention of M. Triger, who contrived, by the aid of air pumps, to keep the water expelled from the sheet iron cylinders, which he sunk through quicksands in reaching the coal measures in the vicinity of the river Loire, in France.

ARCHED ROOFS.

The largest roof of one span in its day was that of the Imperial Riding House, at Moscow, built in 1790. The span is 235 feet. The members of the arched beam are notched together, as shown in Fig. 1, so as to prevent their slipping upon each other. The ends of the arched beam are held

Fig. 1.

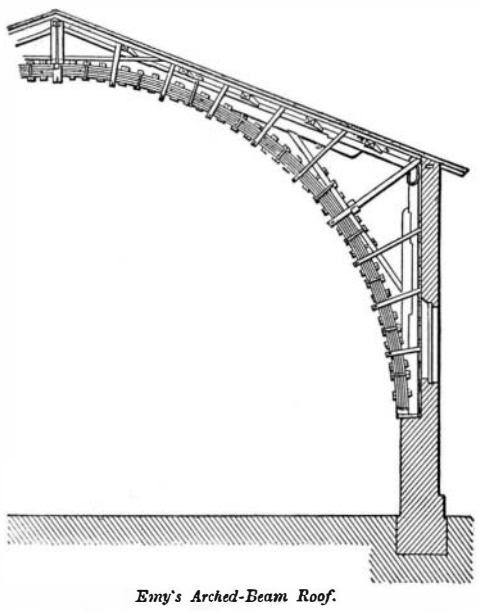


Notched Arch-Beam

from spreading by a tie beam, and the arch and tie are connected together by vertical suspension rods and diagonal braces. Emy's arched beam roof, which is represented in Fig. 3, is constructed on a different principle. The ribs in this roof are formed of planks bent round on templates to the proper curve, and kept from separating by iron straps, and also by the radiating struts, which are in pairs, notched out so as to clip the rib between them. The principals, wall posts, and arched ribs form two triangles, firmly braced together, and exert no thrust on the walls; the weight of the roof, being thrown on the walls at the feet of the ribs and not at the pole plate, permits the upper portion of the walls to be comparatively light. This principle has been extensively adopted in wooden bridges in the United States and Europe.

Another form of arched beam is exemplified in the roof of the dining room of the Charter House School, London, England, shown in Fig. 2. The roof is formed with circular ribs in four thicknesses of inch and a half deal, four inches wide, with saw cuts half an inch in depth on the under sides, and put together with marine glue on a cradle center. The dotted lines show the collars, which are dovetailed one inch into the sides of the principal rafters. The latter, being five

Fig. 3.



Emy's Arched-Beam Roof.

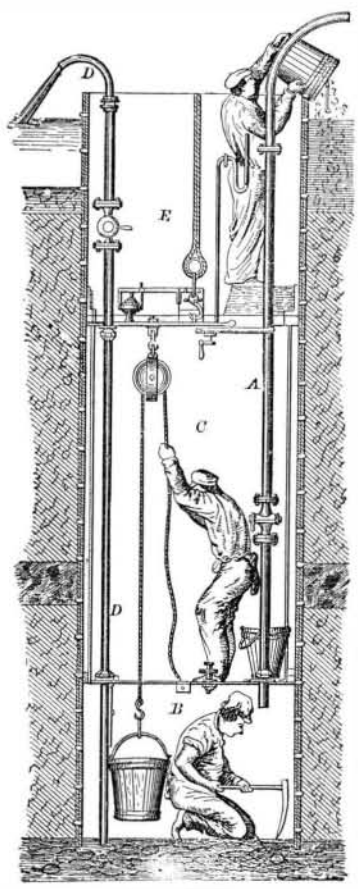
inches wide, project on one side, an inch before the face of the circular ribs, which are only four inches wide. On the collars rest the purlins supporting the rafters. The ceiling joists are spiked up to the circular ribs.

Fig. 4 illustrates

TRIGER'S CAISSON,

and shows the comparatively simple form which the apparatus assumed when sinking a shaft.

Fig. 4



Triger Caisson.

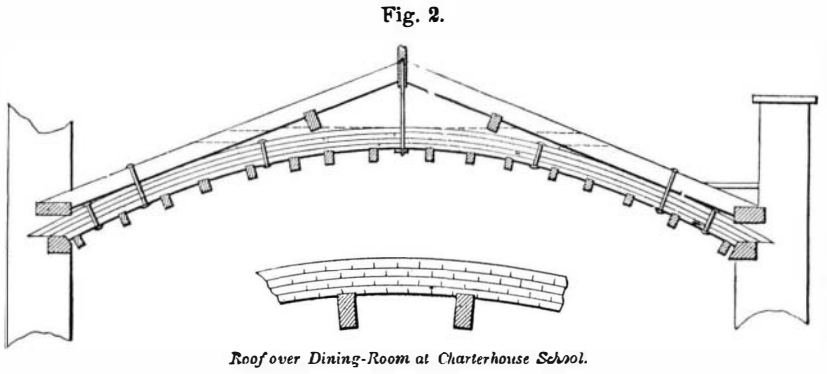
Air is forced in through the pipe, A, to the working chamber, B, which has a manhole in the floor above. C is the middle chamber, which has also a manhole in its ceiling. D is a pipe by which sand and water are ejected from the chamber, B, under the pressure of the compressed air in the latter. The said air pressure being such as to exclude the water, the workman descends through the manhole in the floor of the chamber, E, and closes the door behind him. Admitting air in the chamber, B, until the pressure is equal in the two, he opens the door in the floor of the chamber, C, and descends to his work. The buckets are similarly managed, the middle chamber, C, acting as the means of communication, being filled with air at normal pressure, or with compressed air, according as it is in communication with the open air of chamber, E, or the compressed air of chamber, B. The device, which thus acts as an intermediate, is termed an air lock, and is the notable point of invention in the apparatus.

In Fig. 5 is given a section of a

MOVABLE IRON CAISSON

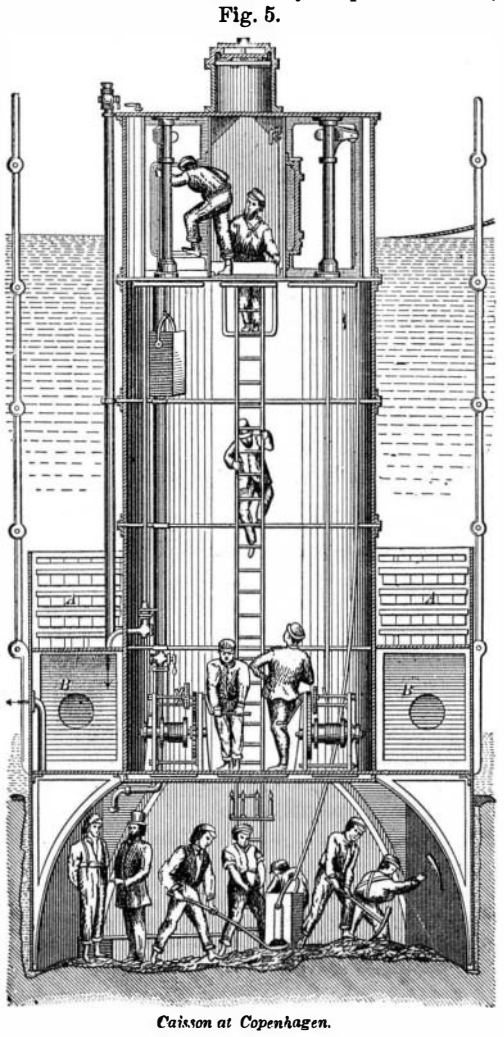
used in building the piers of a bridge at Copenhagen, Denmark. It comprises an upper chamber communicating with the air, an intermediate or air chamber, both equal and cylindrical in section, and a lower working chamber, of larger section than the foregoing and adapted to the shape of the pier: the whole raised or lowered by suspension chains, and ballasted with iron and water contained in two annular chambers, A and B, surrounding the lower part of the air lock. In working, the apparatus was lowered to the bottom, and an excavation made until a stratum capable of forming a solid foundation was reached; upon this a layer of concrete was laid, and then the structure completed with brickwork and faced with granite. The caisson was gradually raised as this progressed; and when it was finished up to the water line, the caisson, with its suspending stage and tackling, was removed to the site designed for another pier, where a similar operation was performed. Caissons of this kind, having an open bottom and provided with air locks, act upon the principle of the diving bell, the pressure of air in the working chamber and air locks being equal to that of the depth of water in which they are submerged. This renders the use of the air lock necessary. The piers of the bridge across the Mississippi river, at St. Louis, Mo., were constructed by means of an analogous device.

Fig. 2.



Roof over Dining-Room at Charterhouse School.

Fig. 5.



Caisson at Copenhagen.

Iron and Steel Rails.

The *Bulletin* of the American Iron and Steel Association reports the following as the rail production of the United States for 1874, in net tuns:

New iron and Bessemer steel rails over 40 lbs.	349,978
New iron rails over 40 lbs.	32,480
Rerolled iron rails of all sizes	323,035
Steel and steel-headed rails other than Bessemer	17,181
Steel rails	6,739
Total	729,413

Of this, 259,288 tuns were made in Pennsylvania, including 55,488 tuns unrolled; 125,103 in Illinois, including 51,234 unrolled; 82,561 in Ohio, and the residue distributed among 16 States.

The whole number of rail-rolling mills in the United States, in 1874, was 91, of which 57 make heavy rails mainly, and 34 make only light or street rails. Of the whole 91 mills, 22 made no rails in 1874. The product of the year was therefore rolled by 69 mills, and many of these ran only a part of the time. The capacity of all the rail-rolling mills of the country is at least double the product of 1874, which was 729,413 net tuns. Of the 67 mills which made rails in 1874, 7 made both iron and Bessemer steel rails, 1 made Bessemer steel rails exclusively, 2 made steel-headed rails exclusively, 2 made steel-headed rails and iron rails, and 1 made solid cast steel rails and iron rails.

It will be observed that almost one half of the total rail product of 1874 was composed of old rails re-rolled.

Bleaching Cotton Yarn in the Hanks.

No 1. Bleaching liquor stock tub.—Pound together 20 lbs chloride of lime and 40 gallons water in a tub; allow to settle five hours, when it is ready for use.

No. 2. To bleach white 60 lbs. of cotton yarn.—Boil six bundles yarn with 6 lbs. soda ash for six hours, not less. Stir them and wash in one cold water, and wring. Add to warm water 10 gallons of stock liquor; work yarn half an hour, ten turns; wash from this into a cold water for safety, but this is not absolutely necessary. Sour in a cold water with two quarts vitriol. Wash in a cold water from sour; also in a hot water containing 2 lbs. of soap (white preferred). If necessary to be blued, it should be done in soap water, with a little China blue. Wash in cold water from soap, and dry in stove.

No. 3. To bleach 60 lbs. for dyeing.—Boil as above, only dispense with the soda ash, and take a little less time in working, but it is very necessary to wash well off before dyeing.

No. 4. To set a stock tub of red liquor for dyeing aniline and other colors.—Add to each gallon water 1 gill of red liquor. This tub should be kept for further use, and takes about one quart to each 10 lbs. to keep it up to working order.

No. 5. To dye 60 lbs. light lilac.—Bleach as for dyeing, then steep a quarter of an hour in red liquor stock tub, or give five turns. Wash twice in cold water, and wring out; dissolve 1 oz. logwood extract; add this to a milk-warm water; give ten turns, lift, and add 2 ozs. dissolved alum; give three turns more; wash in cold water; dry in stove.

Finer and brighter colors can be got with aniline and many other shades of color by increasing the logwood, etc.

No. 6. To dye 60 lbs. silver drab.—Bleach as for dyeing, then dissolve 2 ozs. logwood extract; add this to warm water; give ten turns with yarns; lift and add 1 gill of black iron liquor; four turns more. Wash in cold water; dry in stove. This color will look uneven in the logwood liquor, but will come up right when black iron is added.

The Education of the Mechanical Engineer.

We continue our extracts from Professor R. H. Thurston's address, recently delivered to his graduating class at the Stevens Institute:

"Never lose an opportunity. Men rarely succeed in life who are neglectful of opportunities, and, in nearly all cases, those who are successful can count upon their fingers the several occasions which formed the turning points at which, seizing an opportunity that other men might have overlooked or neglected, they chose the path which led to their final success. Many men possess ability, intellectual and physical but yet the number who may achieve high positions is small It is the taking advantage of these rare opportunities, which, unobserved by the careless or the obtuse, are seized upon at the right moment and in the right manner by the watchful and the acute, that usually secures most rapid advancement.

* Published in numbers by J. B. Ford & Co., New York city.

Life is short; great opportunities are rare; therefore, make it a principle never to neglect one, whether small or great; seize it promptly, and make the most of it

"Endeavor to keep 'two strings to your bow.' However much engrossed with the work in hand, however secure ap parently your position, however satisfactory your location, keep the fact in mind that life is full of unexpected vicissitudes. Spare an occasional thought to provision against loss of position, failure of business, or compulsory change of location. Do your work so well that you may feel certain that your employer or your clients cannot afford to dispense with your services, and allow none of those about you to excel you. Yet be, at all times, prepared to make a new start, with confidence in yourself and your accumulated resources, should everything fail you. To ensure this, do your work better than can those who mayaspire to your position. Have a specialty in which none can compete with you. Be always on the alert to make acquaintances among those whose character, position, and disposition may enable them to assist you when you find yourselves in need of assistance. Always assist your friends and deserving acquaintances heartily and actively. You will thus gain the approval of your own conscience, and will place a strong anchor to windward. The strongest man is weaker than a child if alone in the world without friends, and few men can say that they do not owe much of such success as they may have attained to the aid and countenance of good friends.

"Endeavor to become thoroughly acquainted with the principles and with all the details of the practice of those trades which are auxiliary to the profession of mechanical engineering. Do not feel satisfied until you can tell the pattern maker how to make your pattern, the molder how to mold it, and the founder of what mixture of metals you wish the casting made; until you can tell the blacksmith where to use the best and where to place the cheapest iron, and how to make his scarfs and welds, and how to preserve the fiber of the iron uninjured; until you can instruct an unskillful boiler maker in the selection of his plate and in testing it, in the spacing of rivets and in the welding of a seam or the turning of a flange. Do not rest until you can take every piece of your machine as it comes from the foundery or the blacksmith's or coppersmith's shop, and fit it to its place, giving it the proper finish, in the cheapest, quickest, and most accurate manner. All this will require time, patience, and perseverance, keen observation, a good memory, and a certain amount of actual practice to bring out that natural sleight, that mechanic's 'knack,' that no engineer in successful practice often lacks.

"In doing your work, strive to earn a perfect self-approval. From first to last, work as if your sole object were to acqnire a reputation for good work and to assume a leading place in your profession. You may then feel a perfect confidence that, if you earnestly seek to acquire and if you carefully cherish such a reputation for good work, honest dealing, professional skill, and general intelligence, your reputation will be very sure, in turn, to take care of you and to bring you competence and perhaps wealth.

"Make the most of your resources. The greatest skill is frequently exhibited by the engineer in doing inexpensive work. In some cases the production of elaborate designs and graceful forms, the use of the best materials, and the employment of fine workmanship and the adoption of a beautiful finish, are not only allowable but incumbent upon you, and such construction is at once truly economical and most creditable. In other instances, the highest art is shown in accomplishing a given object at the least expense compatible with safety. Even rude devices, cheap materials, rough workmanship, and entire absence of ornament and finish are evidences, at times, of the ability of the engineer to accommodate himself to circumstances and to accomplish large results with small means. The character of your work in this respect should be determined by the nature of the problem itself, by the means at hand, and by the value of capital. Where capital is plentiful and cheap, and where labor and good materials are plentiful and cheap, it would be inexcusable to design and to construct, in important work, anything but the best work that you are able to produce, using the best material and demanding the best of workmanship. Where capital is difficult to obtain, materials ill supplied, and labor expensive, and where the structure is a temporary one, the really good engineer will pursue quite an opposite course. To build cheap railroads and machinery in Great Britain, where capital is worth but four or five per cent per annum, and labor four or five shillings per day, as we build them in our Western and Southern States, where money costs ten per cent and labor is worth twice as much as abroad, would be extremely unwise. If it were stipulated that all new roads in the United States should be given easy grades, curves of large radius or straight tracks, well ballasted, with cut stone masonry and iron bridges, and furnished with station buildings and permanent structures of stone and brick: if it were prescribed that they should be provided with an ample supply of the best rolling stock, heavy locomotives, cars fitted with all the most recent improvements, and with every convenience known on old and wealthy roads, we should have no new roads, and the country would remain undeveloped. A machine designed for temporary use should be made at the least possible cost at which it will certainly serve its purpose. A machine which is expected to work well until worn out, and then to be replaced by another, should be made of good materials and in the best manner. Where it is anticipated that the machine will be superseded by another of improved design before it can be expected to become useless by wear, it is waste of means to build it with a view to durability simply, and regardless of expense. It is for this reason that the light, cheap, but equally efficient machinery, built by our mechanics for some branches of textile manufactures, and some of our lighter tools, are better, on the whole, than the heavier and more expensive machinery supplied by foreign builders. Improvements follow each other with such rapidity that it becomes necessary sometimes to throw out this finely built machinery before it is half worn out. This difference in first cost is thus simply so much capital thrown away. Here, as in many cases that will arise, a good judgment, a strong, practical common sense, guided by experience and enlightened by acquired knowledge, is your only reliance in determining where lies the golden mean.

"Make the interests of your client your own. Let me remind you of the bad policy, of the wrong of which you would be guilty, were you in any case to permit the apparent interests or the wishes of a client to induce you to adopt a plan which your judgment, your knowledge, and your experience condemn. On the other hand, never permit your own interests to dictate a course obviously opposed to the best interests of the client who has entrusted his business to you; and never pursue a line of policy and action of which you know the results will fail to meet his expectations fully in every particular. Present to him every reason, *pro* and *con*; explain the case fully; and if his interests and your own are not identical and cannot be perfectly harmonized, state the matter frankly and courteously, and decline the work. Such a course will always prove to be most correct and most satisfactory in all respects. You will retain the esteem and goodwill of your client, and the small, or even the large, amount of money surrendered will have a full equivalent in the gain of a greater self-respect.

"Be guided always, but never ruled, by precedent. Be always ready to accept what seems, all things considered, best in principle and in practice, without a prejudice arising from its novelty. Study newly discovered laws, and examine every new fact in a fair-minded spirit, and be ready to take full advantage of every evident improvement suggested to you. Respect traditional custom and common practice. They are probably founded upon good reasons and the teachings of experience; but be neither hampered nor blinded by them.

"Be radical in theory, but extremely conservative in practice. I would warn you against too free indulgence in experimental practice. Your client's money should never be risked in even the most promising of new schemes, except with most thorough understanding on his part of the uncertainty involved, and except where you are as fully absolved of all blame, aside from an error of judgment, in case of failure. Even the best of men have been misled by such absurdities as perpetual motion and kindred schemes, ingeniously presented and curiously disguised. The greatest deceptions are those which seem simplest and easiest of investigation. Yet do not hesitate to embark your own means in promising experiment or in the development of inventions if you find yourself well able to do so; never forgetting, however, that the perfecting of a new design and the opening of a market is usually a matter of vastly greater expense than at first estimated.

"Help the inventor whenever an opportunity offers to do so with propriety and to do so effectively. Lend him your most effective aid. Encourage him when his schemes appear to promise well. Never refuse to assist him in detecting fallacies or by exposing the errors into which his enthusiasm may have seduced him. Respect him and honor him as one of a class whose services to you and to the world are beyond estimate or recompense, and who are rarely rewarded for a tithe of their freely expended time, means, and health. You will meet schemers, dreamers, and ignorant pretenders, every day. Do not hesitate to expose them to themselves, and, if necessary, to the world. But, as you demand the respect of your fellow men, and expect credit for good intent and earnest attention to duty, see that you yield the same respect and accord the same credit to every honest inventor. Remember that he is a brother of Savery and Newcomen, of Watt and Evans, the inventors of the steam engine, a colleague of Wheatstone and Morse, who gave us the telegraph, and of Stephenson, who made the railroad a daily convenience; that he is of the same race with Guttenberg, who gave us types, and of Hoe, who, with his wonderful printing press, made possible the modern newspaper and that multiplication of books of 'which there is no end.' He is of the same blood with Arkwright, who gave us the loom, and with Howe who responded to the touching 'Song of the Shirt' by producing the sewing machine. He is one of a noble army of the truest benefactors of the human race. Respect the inventor though his hand may be hard and soiled, his clothing worn, his manners rude, and his language ill chosen. He is one whose name may be remembered long after you and I and all of us, who pride ourselves upon fortune of birth, property, breeding, or education, have passed away and are quite forgotten.

"Do not give up your studies, however pressed by business, but see that you make your foundations deep and solid by future acquirements.

"Take care of your health. Keep this wonderful machine which we call the body—this mechanism which is at once the domicile and the servant, the transporter and the feeder, of the soul and of the mind—in the highest state of efficiency. Study the laws of health, and obey them as conscientiously as the laws of morals or of civil and social duty. A mind diseased is often but the exponent of a body diseased. Restore the body to health, and the mind will often be restored to its activity and its intellectual and even moral strength.

"President Porter, of Yale College, gives you terse and sound advice in regard to your conduct and bearing as men 'Young men,' said he to his pupils, 'you are the architects of your own fortunes. Rely upon your own strength of body and soul. Take, for your star, self-reliance. Inscribe on your banner: 'Luck is a fool; pluck is a hero.' Don't take too much advice; keep at your helm, and steer your own ship, and remember that the great art of commanding is to take a fair share of the work. Think well of yourself Strike out. Assume your own position. Put potatoes in a cart over a rough road, and the small ones go to the bottom Rise above the envious and the jealous. Fire above the mark you intend to hit. Energy, invincible determination, with a right motive, are the levers that move the world. Don't drink; don't chew; don't smoke; don't swear; don't deceive; don't read novels; don't marry until you can support a wife. Be in earnest; be self-reliant; be generous; be civil. Read the papers. Advertise your business. Make money, and do good with it. Love your God and your fellow men; love truth and virtue; love your country, and obey its laws."