valve, and the articles rest upon the slab untouched by the flame. This does the work ordinarily executed in large and expensive muffles, and independent of the saving of the muffles, runs otherwise more economically than a muffle furnace.

Fig. 6 shows a large melting furnace. This is used for brass or bronze foundry work. The flame enters tangentially and with a slight downward inclination, and the products of combustion escape from the bottom of the furnace. There is no escape of gas or flame from the top, and when the metal is at its hottest, one can stand over the crucible and look down into it without inconvenience.

Fig. 7 shows one of the special furnaces to which the process lends itself so admirably. It is a modification of the oven furnace just described, and is designed for tempering mowing machine cutters. These are fed to the machine on an endless chain, their bases resting thereon, the cutters being supported in an approximately vertical position. The effect of this is to produce differential tempering, the edges being brought to the higher heat, so that as they fall into a tank of oil or water the cutting edge is made hard and the body is left soft. Fig. 8 is a soft metal furnace. In such furnaces as this Babbitt metal, solder or other of the more fusible alloys may be compounded, or it may be used for melting the more fusible metals for castings.

Fig. 9 shows another interesting apparatus, a furnace for bluing screws or other small articles, such as the parts of a bicycle chain. Within a gas furnace rotates a drum, provided with helical partitions. The screws are fed in at the back and as the drum rotates pass through the furnaces, each one in an absolutely definite time, and a constant stream pours out from the front of the furnace, all blued to the exact tint required. By varying the amount of gas used or by feeding the pieces more or less rapidly, any desired result may be obtained with certainty.

Fig. 10 shows a gas forge. This apparatus provides for the needs of a blacksmith or drop forger. For the latter especially it is designed. The piece of metal introduced at the opening, O, is rapidly brought to the desired temperature. Fig. 11 shows another special apparatus, a furnace for maintaining lead in a state of fusion to be used for hardening steel tools. In this furnace the hotter metal is kept in fusion at any desired temperature, so that uniform results in tempering can be secured by it. This furnace has vertical burners entering opposite to each other at top and bottom, so as to maintain all portions of the metal at an even temperature. Thus a long bar of steel plunged in the metal is heated evenly from top to bottom.

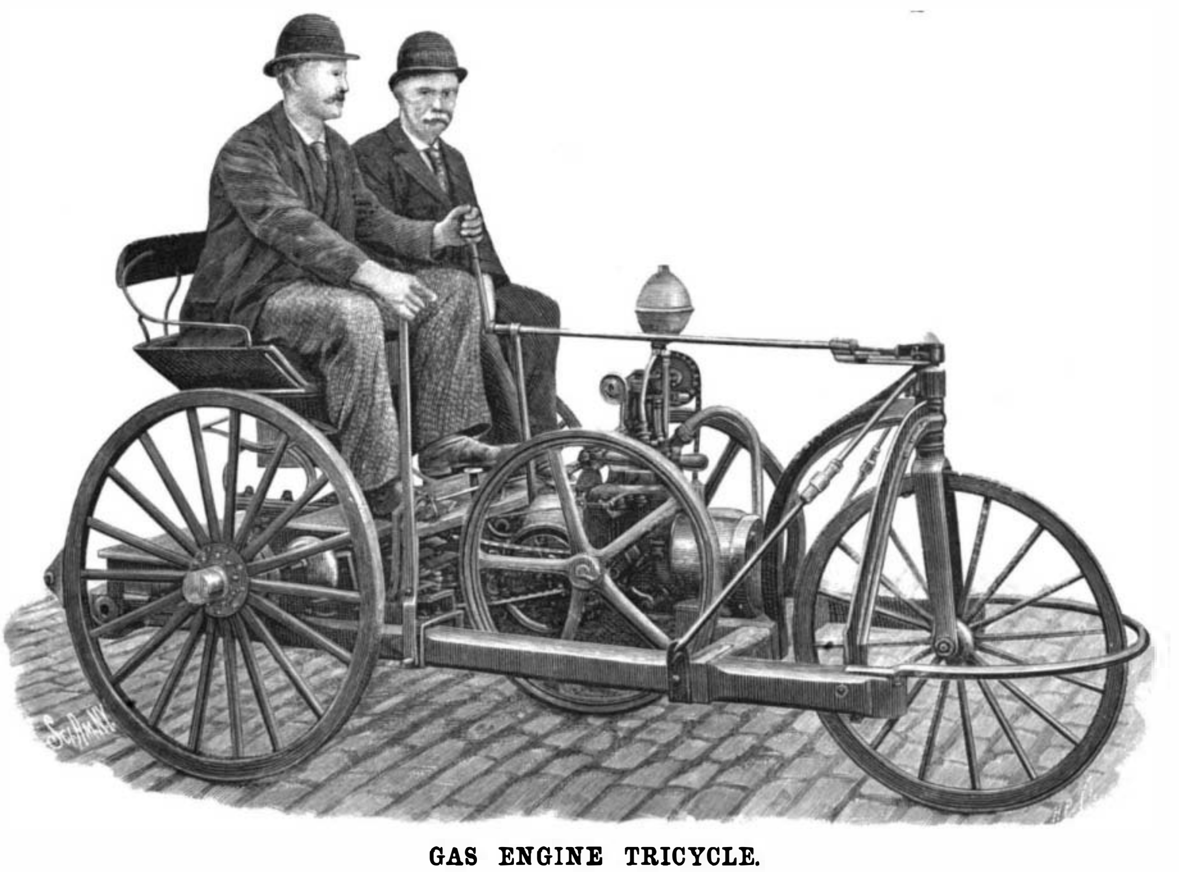
Fig. 12 shows a muffle furnace. This is a more familiar type and is used by assayers, enamelers, and in many classes of operations. It is lined with fire clay and the muffle bottom is protected by an extra slab so that it will not sag. It is found that a muffle with a gas fuel lasts much longer than in the ordinary coal furnace, which also applies to crucibles.

Fig. 13 shows the brazing table, where two blowpipes fitted on adjustable supports bring their flames to impinge on the object to be brazed. This was originally built for bicycle work, but its operations have been found to be so good that it has been adopted by the brazing trade in general. Although our illustrations represent the works at Elizabeth, N. J., the general offices are at 80 Nassau Street, New York.

Space is not permitted us to go into details of the American Gas Furnace Company's apparatus as fully as we might desire. It is enough to say that a very large variety of furnaces for every conceivable kind of work is furnished, and that by the use of their gaseous fuel a great direct economy is secured, as well as the indirect one due to a more perfect regulation of heat and to less wear and tear upon the furnace.

Every apparatus is evidently the result of painstaking care and thorough technical knowledge, and their aim appears to be to produce the best, irrespective of immediate profit. Their work has received flattering recognition from the Franklin Institute, and the fact that these furnaces have been recognized as most efficient for certain grades of work is evidenced by the fact that a number of these furnaces are exported annually to foreign countries.

In the factory at Elizabeth, and elsewhere, the gas is used to supply incandescent burners. It also is used in radiators to heat rooms. Thus the Elizabeth factory is lighted and partly heated by the gas as well as given its power.



GAS ENGINE TRICYCLE.

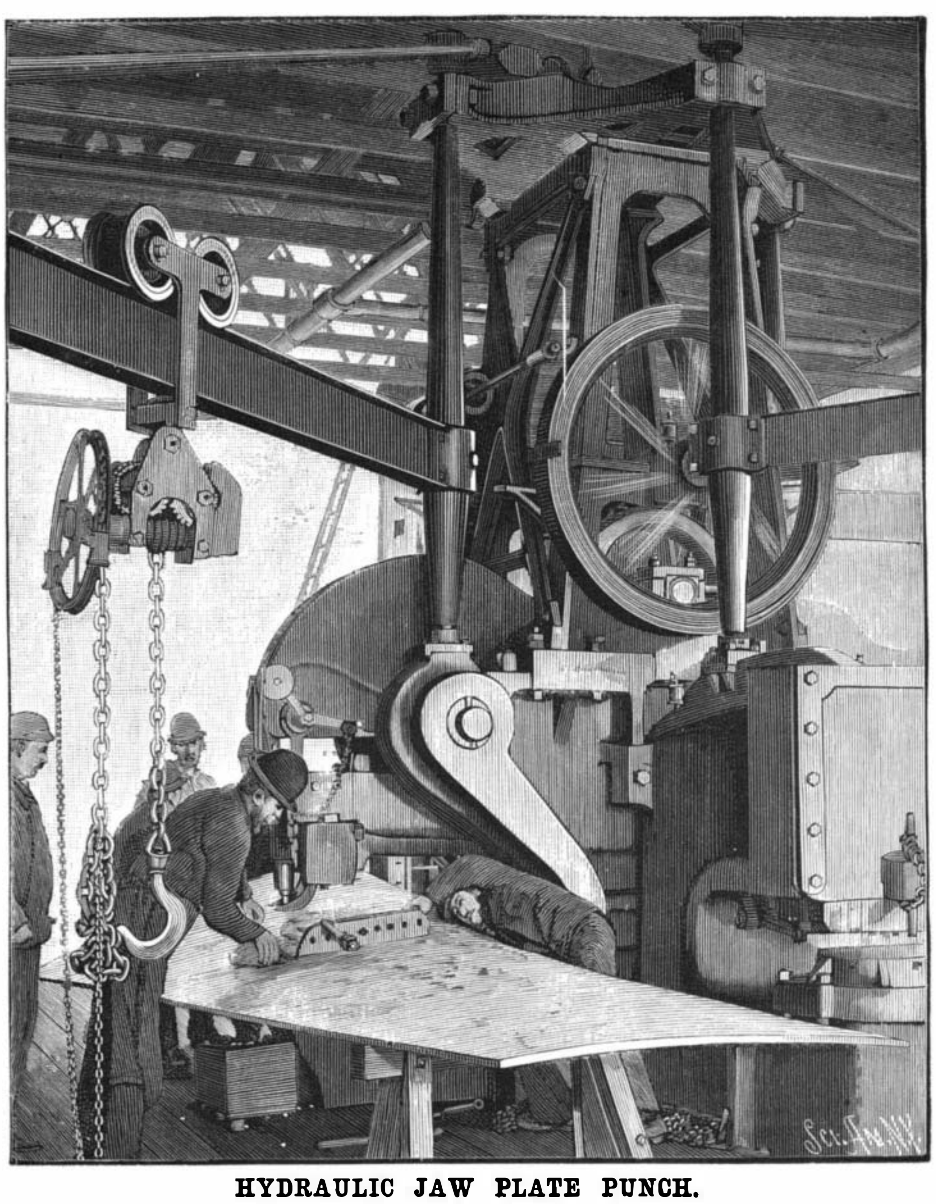
GAS ENGINE TRICYCLE.

Verily, the field of usefulness formerly held by the horse is narrowing daily. To steam, electricity, and the ubiquitous bicycle comes an ally in the form of explosive gas, so cunningly applied to the propulsion of vehicles as to threaten his utter rout. The accompanying illustration shows the latest improvement in adapting the gas engine to the running of wagons on ordinary roads.

This tricycle is propelled by a two horse power Golden Gate balanced gas engine. It has been tested on the streets of the city under varying conditions as to grade and roadway, and has proved in every instance satisfactory, being easy to control as regards starting, regulating speed, turning, stopping, etc.

The machine is calculated to carry three persons on the single broad seat, though operated by one, with surplus power sufficient to trail one or two buggies or a loaded wagon, according to the character of the road. It carries twelve hours' supply of gasoline, or two and one-half gallons, and can easily attain a speed of from ten to twelve miles per hour on favorable ground. Being geared in such a manner that the movement of a lever increases or decreases the speed enables the driver to climb grades of considerable pitch.

It is claimed to be perfectly safe and is simple in construction, the design of the inventor being to have as few pieces and parts as possible. The wheels and frame supporting the engine are strong and the entire machine is constructed in the most substantial manner, as if intended to withstand hard usage. It was built on an order from a gentleman in Santa Maria, Cal., by A. Schilling & Sons, 211-213 Main Street, manufacturers of the Golden Gate gas engine.—Min. and Sci. Press.



HYDRAULIC JAW PLATE PUNCH.

HYDRAULIC JAW PLATE PUNCH.

The accompanying illustration represents one of the powerful hydraulic jaw plate punches in use in the William Cramp & Sons Ship and Engine Building Yards in Philadelphia. The punch is one of many similar punches used in constructing the great war ships and merchant marine vessels for which the Cramps have gained a great reputation. This particular form of punch is used to cut the plates which are to form the hulls of the vessels to the desired shape. The punch is situated in the ship yard near the immense stays which hold the great vessels while in course of construction. The illustration has been made from an instantaneous photograph taken while the punch was in operation.

Before placing the plates in position for punching, the exact form of the plate desired is marked on the original plate by a wide chalk line. The plate is then carried to the punch by means of an ordinary traveling hand crane and pulleys, which are clearly shown in the illustration, and to aid in holding the plate in a horizontal position several ordinary wood trestles are generally employed. The steel punch consists of a knife with a very blunt edge which cuts or punches out disks of metal one inch in diameter. By punching the plate so that these disks overlap one another it is of course possible to cut the plate quickly and neatly to the desired pattern. The illustration shows the punch at work in cutting a plate of steel one inch thick. The friction produced by the punch passing quickly through such a plate is so great that it is necessary for an attendant to throw water on the metal as each punch is made. The heat produced by the punch is so intense that each time a cloud of steam arises.

Hydrogen Peroxide.

Anhydrous hydrogen peroxide, says Nature, has at last been isolated by Dr. Wolffenstein in the laboratory of the Technischen Hochschule at Berlin, and the somewhat surprising fact demonstrated that this substance, which has hitherto been regarded as possessing but little stability, is capable of actual distillation with scarcely any loss under reduced pressure.

In attempting to concentrate solutions of hydrogen peroxide in vacuo by the method of Talbot and Moody, and also in the open air upon the water bath, a solution as strong as 66 per cent H_2O_2 was obtained, but with a loss of over 70 per cent of the original amount of peroxide employed. Moreover, it was found that when the common commercial 3 per cent solution is concentrated, the percentage of H_2O_2 may be brought up to 45 without the loss of any considerable quantity of the peroxide by volatilization, but that as the concentration continues to rise above this limit the volatilization of the peroxide increases at a very rapid rate. For the great loss was proved not to be due to decomposition, but to actual vaporization of the substance. Evidently hydrogen peroxide is remarkably stable at the temperature of a water bath. An attempt was therefore made to actually distill it under reduced pressure. A quantity of commercial peroxide which had been further concentrated until it contained about 50 per cent H_2O_2 was first purified from all traces of suspended impurities, and at the same time still further concentrated by extraction with ether. After evaporation of the ether the solution was found to contain 73 per cent H_2O_2.

This solution was then submitted to distillation at the temperature of the water bath and under the reduced pressure of 68 mm. of mercury. The distillate was received in two fractions, boiling at 71°-81° and 81°-85° respectively. The first fraction contained 44 per cent H_2O_2, while the latter was found to contain no less than 90·5 per cent. Upon again fractionally distilling the latter product, a large proportion distilled at 84°-85°, and this fraction proved to be practically pure H_2O_2, containing over 99 per cent of the peroxide. The liquid thus isolated is a colorless sirup which exhibits but little inclination to wet the surface of the containing vessel. When exposed to the air it evaporates. It produces a prickly sensation when placed upon the skin, and causes the appearance of white spots which take several hours to disappear again. As regards the much-discussed and disputed question of the reaction of hydrogen peroxide toward litmus, Dr. Wolffenstein finds that even when the pure liquid is made strongly alkaline with soda and again distilled, the distillate exhibits strong acid characters, so that the acid nature of hydrogen peroxide must be regarded as fully established. It is finally shown that the use of ether in assisting the concentration is by no means essential. Ordinary commercial 3 per cent peroxide can be immediately subjected to fractional distillation under reduced pressure, and a fraction eventually isolated, consisting of the pure substance boiling at 84°-85° under a pressure of 68 mm.

Coin Alloy.

For every bar which is in the vaults of the mint at Philadelphia there is a record on the books of the superintendent. That record shows the weight and fineness of the bar. Many of the bars on storage were bought in 1890, when the Sherman law went into effect. They have remained untouched from the time when the stamp of the assayer was put on them. Now they will be taken out and melted with copper to form an alloy.

The exact proportion of silver to copper should be nine to one, but in melting a little less than the measure of copper is used, so that by adding copper later in small quantities the alloy can be made as nearly as possible of the exact standard. It is easier to work the alloy down by adding copper than it is to work it up by adding silver.

The copper and the bar silver are put in the crucible together. The crucible for melting silver is of hand-wrought iron. These pots cost $45 each. Each of them will hold about 1,000 ounces at a time. Each pot is good for 250 melts. It will cost the mint about $4,500 for crucibles to melt the 42,000,000 ounces of silver.

Gold is melted in a black lead pot which costs about one-tenth as much as the iron pot, but the black lead pot is good for about only thirteen melts.

No silver passes through the iron crucible. A little is absorbed by it and this is recovered when the crucible is melted after it has seen the last of its usefulness. Nothing that could yield any of the waste silver is allowed to get away from the mint without chemical treatment to extract the precious metal. The melting pots, the slag, the ashes from the furnaces, and even the outside pickings from the black linings of the furnaces, are ground and sifted to obtain metallic grains, and these grains are refined.

The residue from the sieves is put into a sweep machine, which extracts the smaller particles; and the very minute particles of metal pass in the water of the sweep machine to settling vats and wells. These wells are cleaned out at very long intervals, and they always yield a little gold and silver.

Peters—Denza—Ranyard.

Astronomical science has lost three of its votaries during the present month. Dr. C. F. W. Peters died on December 2, and Father F. Denza, as well as Mr. A. C. Ranyard, passed away on December 14.

Dr. Carl Friedrich Wilhelm Peters, director of the Konigsberg Observatory, died on December 2, after a protracted illness. He was born on April 16, 1844, at the Pulkowa Observatory, where his father, Prof. C. A. F. Peters, held an appointment under the Russian government. In 1849 his father was appointed to the Chair of Astronomy at Konigsberg, and in 1854 he was made director of the Altona Observatory, which was afterward transferred to Kiel. The son studied astronomy and mathematics at Berlin, Kiel, Munchen, and Gottingen, and was placed on the staff of the Hamburg and Altona Observatories. Between 1869 and 1872 he made some valuable pendulum observations, chiefly for the Prussian government. As Privat-docent at Kiel University he undertook a long series of chronometer tests for the German navy, in the course of which he proved that they are influenced by changes of humidity as well as by changes of temperature. In 1880, upon the death of his father, he edited the Astronomische Nachrichten for a year, after which he was appointed Extraordinary Professor at Kiel University. In 1883 he undertook the direction of the Naval Chronometric Observatory at Kiel, whence he proceeded in 1888 to the directorship at Konigsberg, where he terminated a useful and laborious career.

Father F. Denza died at Rome on the 14th ult. from cerebral hemorrhage. He was well known to the scientific world by his works in astronomy, meteorology and terrestrial magnetism, and at the time of his death was president of the Italian Meteorological Society and director of the Observatory at Moncalieri, which he founded in 1859, as well as of the Vatican Observatory, which was established by the Pope in 1891. It was owing to the untiring energy of Father Denza that the Corrispondenza Meteorologica Italiana was established in connection with the Alpine Clubs, and that the results of observations at a large number of stations in the Alps and Apennines have been regularly published in the organ of the Italian Meteorological Society. He was elected an honorary member of the Royal Meteorological Society in 1870.

In astronomy his chief work relates to the observation of meteors. For several years he issued instructions to observers of meteors previous to every important shower, and he published numerous tables and papers on the observations carried on under his guidance, both in Comptes Rendus and the Monthly Notices of the Royal Astronomical Society. When the Directorship of the Vatican Observatory was taken by Father Denza, a very comprehensive programme was drawn up, embracing investigations in meteorology, terrestrial magnetism, geodynamics, and astronomy. Observations in each of these branches of knowledge have increased in number every year since then, and the fourth volume of the Pubblicazioni of the Observatory, received by us on the same day as the news of Father Denza's death, is even greater in bulk than any of the previous ones. Father Denza was chiefly instrumental in making the Vatican Observatory one of those co-operating in the production of the photographic star chart. He devoted his best energies to the advancement of the scheme, and to the progress of astronomical photography. The reports to which reference has been made contain evidence of his knowledge of what had been done in other astronomical observatories, and of his ability to direct and further the advancement of celestial photography. His services to astronomy have earned for him an honored place in our memory of the sons of science.

Mr. Ranyard was born in 1845. He was educated at Cambridge University, and was called to the bar in 1871. He was one of the founders of the London Mathematical Society, of which he was originally joint secretary with Mr. George de Morgan, Professor Augustus de Morgan being president. He became a fellow of the Royal Astronomical Society in 1864. In 1870 he was assistant secretary of a joint committee of the Royal Society and the Astronomical Society, which organized the expedition dispatched to Sicily, Spain, and Oran to observe the total solar eclipse of December 21. On his return to England he undertook to assist Sir G. B. Airy in the preparation of the report of the observations of the total eclipses both of 1870 and 1860. Ultimately Sir George Airy transferred the work entirely to Mr. Ranyard, and in 1880 the report was published by the Royal Astronomical Society as vol. xli. of its "Memoirs." He observed the total eclipse of July 29, 1878, from Cherry Creek, near Denver, Colorado, and the total eclipse of May, 1882, from Sohag, in Upper Egypt.

In addition to papers on the corona and matters connected with physical astronomy, he also published papers on the "Early History of the Achromatic Telescope," and on "Photographic Action." In conjunction with Lord Crawford and Balcarres, he undertook in 1872 a series of experiments on photographic irradiation; and in 1886 he demonstrated by a series of experiments that the intensity of photographic action varies directly as the brightness of the object photographed, and directly as the time of the exposure. The "Old and New Astronomy," designed by Mr. Proctor, was completed in 1892 by Mr. Ranyard, who contributed to it some very important sections on the structure of the stellar universe.

Protecting Peach Trees.

Many experiments have been tried in attempting to protect peach trees during the winter by covering them with canvas, corn stalks or similar material, or by applying some adhesive substance to the branches themselves. Such attempts have never proved satisfactory, however, and the only practical means appears to be by laying the trees on the ground and covering them over with soil or coarse material of some sort. To many people this, like many other operations with which they are unfamiliar, seems a great task. Experience proves, however, that it is comparatively inexpensive in practice. In setting the young orchard on the college farm last spring this matter was kept in mind, and part of the trees were set with the roots spread out on opposite sides as much as possible, with the intention of laying these trees down every winter as long as they live, if it is found practicable to do this. At least it is hoped to determine how old a tree must be before it becomes too unwieldy to handle in this way. To put down these young trees this fall was a very simple operation. Fifty-five trees were laid down and snugly covered with about four hours' work, thus costing only about a cent a tree. Indeed, the ease with which it was done raises the question whether it would not be well to lay down all young trees for the first year or two, until they become thoroughly established and better able to withstand the winter. Of course, the cost will rapidly increase with each succeeding year until the trees reach their full growth.—Fred W. Card, in Garden and Forest.

English and American Incomes.

The following figures, taken from the last English census, reveal some interesting facts concerning the economical situation of Great Britain.

About 250,000 persons in Great Britain have an annual income of $1,000, and 2,000,000 have an income of $500. Thus it would appear that only one Englishman out of every five is capable of supporting a family. It is to be borne in mind that $500 a year amounts to only $1.37 a day, which is not very much for a family of four persons. On the other hand, there are in the United Kingdom 123,000 families having an annual income of about $3,000, and 5,000 families with an income of more than $25,000.

In the United States, according to the statistics compiled by T. G. Shearman, we have 400,000 families (or about two millions of people) whose annual income amounts to $2,000, and more than 10,000 families having an income of more than $25,000.

Taking into account the difference in population between the United States and Great Britain, it still will be evident that not only can America boast of a greater number of rich people than the United Kingdom, but that wealth is more equally distributed and less centralized in the United States.—Revue des Revues.

Railroad Building in 1894.

According to the records of the Railroad Gazette there has been much less railroad building in the United States during 1894 than in any year since the civil war. Some 1,761 miles of new track have been laid in the year, which makes an addition of less than one per cent to the railroad mileage of the country, which at present is 177,753 miles. From 1880 to 1890 an average of 5,000 miles of new track were laid per year, but from 1890 to 1893 the average has dropped to 4,000 miles. In the three years previous to 1892 the largest percentage of new roads were built in the Southern States. Since 1892, however, the advantage has been held by the Northern States east of the Mississippi River. Illinois, Arizona and Pennsylvania lead in the number of miles of new tracks laid, over 120 miles having been laid in each of these States during 1894. In Maine, Texas, and Montana about 100 miles of new track have been laid in each State. It is reported that the new year will witness a marked revival in railroad building.

THERE are in the United States at present 6,000,000 farms. About one-half the population of the republic, or over 30,000,000 people live on them, and these farm dwellers furnish more than 74 per cent of the total value of the exports of the country.