ried out under the direction of the Wellman-Seaver Engineering Company, of Cleveland, Ohio.

The blast furnace, which is shown in two of our illustrations, is 50 feet in height, 12 feet in the bosh, 6 feet on the crucible, and has a capacity of 50 tons of iron per day. A battery of four steam boilers furnishes power to drive the ore-crushing and hoisting machinery and the blowers. The gases are conducted from the top of the furnace by a large pipe and are led into the boiler house, where they are burned under the boilers in the manner customary in our Eastern plants. Hot blast is used, the air entering the furnace through the five tuyeres shown in the illustration, at a temperature of from 900 deg. to 1,000 deg. The water for the supply of the furnace and steam plant is led by a wooden flume from Chimacum Creek, the flume being 3½ miles in length.

For the present the Irondale blast furnace will make use of the same grade of ore that was used when the plant was first in operation. This ore is brought on scows from Texada Island, British Columbia, which is 130 miles distant, and the Texada ore will be used until the value of the company's own mines has been determined. Moreover, the coke will be brought on scows from the Skagit Coal and Coke Company's ovens. Other cokes from Pierce County and British Columbia will also be tested experimentally. After the experimental work with coke is completed, it is the intention to run the Irondale furnace entirely on charcoal, and hence a great deal of attention has been given to the charcoal-making plant. The kilns of the former company will be used, but a large sum has been expended in improvements and additions and the new company expects to produce fuel at a considerably lower cost than at present.

The charcoal-burning kilns, which were built at a cost of $40,000, are twenty in number. They stand in a double row just east of the main building. They are built of brick, bound with iron bands, and covered with concrete. Each kiln is 30 feet high and 30 feet in diameter at the base, and will hold 75 cords of wood. Originally the kilns were filled by hand, but appliances are now being erected which will automatically feed the kilns with wood, ready for burning, at a cost of fifty-four cents a cord. The log "culls" and "seconds" unsuitable for sawing into lumber will be purchased of the large logging companies on the Sound, towed to the furnace, and placed in a boom in front of the charcoal kilns. The logs will then be towed to a logway by a workman, and from that time until it is taken from the kiln as charcoal there will be no handling of the wood. It is considered that a very promising feature, judged from the standpoint of economy, at this plant, is the cheapness of water transportation and the short distance over which the ores and fuel will have to be brought to the blast furnace.

Although the plant is not a large one, it is large enough to afford a thorough test of the problem of economical iron making on the Pacific Coast. Should it prove successful and lead to the development of this most important industry on a large scale, it would prove to be a factor in the development of the Pacific Coast second only in importance to the construction of the trans-continental railroads.

Infra-Red Spectra of the Alkaline Metals.

M. Hans Lehmann, a German physicist, has lately made a series of researches upon the infra-red spectra of the alkaline metals, in which he uses the photographic method with success. He thus designed to complete the former work of Snow and Lewis in this direction. To make the plate especially sensitive to the red rays he uses a solution containing alizarine, nigrosine, ammonia and nitrate of silver, in which an ordinary gelatine plate is immersed. This makes it sensitive to rays as far as 1,000 μ. He has also used the solution proposed by Burbank, containing cyanine, hydrate of chloral and methyl alcohol together with nitrate of silver and ammonia. The plates are developed with oxalate of iron, using a small quantity of bromide of potassium. The luminous source is furnished by an electric arc formed between two rods of the metal to be studied. A screen formed of a concentrated solution of bichromate of potassium in sulphuric acid absorbs all the rays whose wave-length is less than 520 and allows those of greater wave-length to pass. A two-prism spectroscope was used, provided with a total reflection prism and a plane mirror. The photographs thus obtained were examined according to the data previously furnished by Abney, Becquerel, Snow, Lewis, Kayser and Runge. The principal rays of the infra-red spectra of rubidium and cæsium are given as follows:

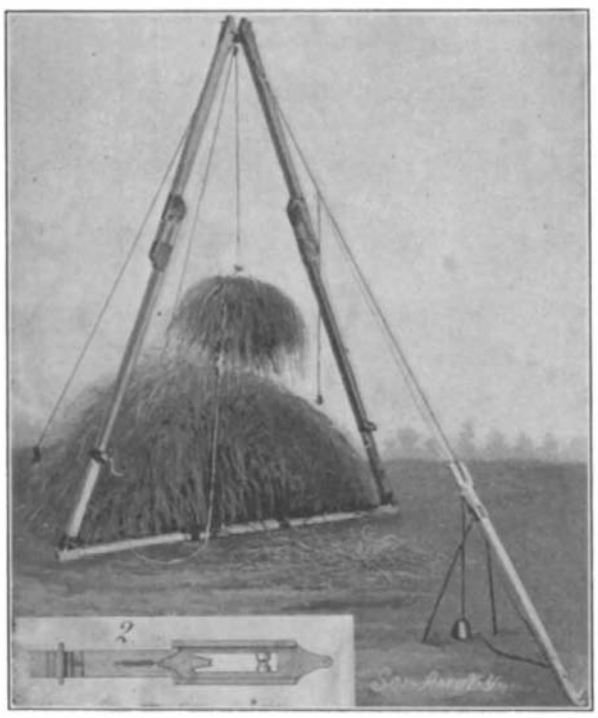
Rubidium.	Cæsium.
λ = 851.326	λ = 921.186
796.046	917.138
780.598	894.992
775.358	876.610
762.666	852.772
740.619	808.202
729.701	801.962
	761.658
	722.748

AN IMPROVED HAY STACKER AND BUILDERS' DERRICK.

In our issue of April 20, 1901, we described a novel hay stacker patented by Marvin C. Hutchings, of Bozeman, Mont. Mr. Hutchings has since improved his invention with the result that the serviceability of the stacker has been very considerably increased.

As our illustration shows, the derrick is held in place by two guy ropes, the upper ends of which are bifurcated for attachment to the ends of the derrick members. One guy rope is securely attached to the ground; the other is provided at its lower end with a weight, sufficiently heavy to draw the derrick back to its normal position whenever it is inclined. The weight serves to bring the derrick back when the load has been discharged. This weighted guy rope passes over a friction roller which, as shown in Fig. 2, is located in a slot formed in the head portion of an anchorage arm. The anchorage arm is supported by connected legs held to turn in a socket adjustably mounted on the body portion of the anchor arm. By reason of this construction, the anchor arm can be carried to or from the ground in order to give the weight more or less drop. The socket in question is secured to a sleeve, which is held in place by passing a pin through apertures in the arm.

It is frequently desirable to check the movement of the weighted guy rope, and to that end a brake is provided, which is mounted on the bottom of the upper end of the anchorage arm, and which is clearly illustrated in Fig. 2. The brake consists essentially of a plate sliding in guides, which plate is formed with an opening corresponding with the opening in the head of the anchor arm. At the rear end of this



IMPROVED HAY STACKER AND BUILDERS' DERRICK.

opening a brake-tongue is formed, which extends forwardly and is arranged to engage the guy rope passing over the roller. The plate is controlled by a coiled spring secured to the anchor arm, which spring serves to draw the plate to its normal position after it has been carried into engagement with the guy rope. The brake is operated by a cord passed through rings supported by the weighted guy rope. The end of the brake cord terminates in a handle which hangs over the load of hay to be stacked, so that the handle is always in easy reach.

The brake can be brought into action whenever it is required. The main object of this brake is to check the derrick and prevent its tilting to the stack too soon, and thereby delivering the fork to the hay too quickly. The brake can also be used to control the rapidity of the derrick's motion to or from the stack.

The sides of the derrick are extensible and are held in position by wire cables winding on drums, so that the sides can be raised or lowered. The base is adjustable, so that its width can always be made to conform with the height of the derrick.

The invention is not exclusively intended for use as a hay stacker, but is equally serviceable for builders' purposes.

The fiftieth scientific anniversary of M. Berthelot (he began his career as a chemist in 1851) is to be commemorated by the presentation to him of a metal plaquette by his colleagues of the Institute of France. On the front of the plate, which is the work of Chaplin, the engraver, the recipient's portrait will be reproduced in profile, and on the back M. Berthelot will be portrayed seated at his laboratory table, "Truth" illuminating him with a torch, and "Patrie" protecting him under a flag and offering him a crown of laurels.

Correspondence.

A Universal Language.

To the Editor of the Scientific American:

In your issue of December 7 Arcadius Avellanus of Philadelphia says the world should adopt Latin as the universal tongue of cultured people. That no one knows how Latin was pronounced, exactly, is a serious objection. But even laying that aside and pronouncing it some way or other, as the world does, what is the use of learning a language that not a thousand people in the world now speak, when there is already an international language spoken by forty or fifty millions at the very least?

There can never be a universal language. There is a physical reason for it. Give the English language to the Chinese, and come back in a century and you would not know it. The vocal organs are so different in different races that a language will change too greatly for the different races using it to understand each other. Furthermore, people in the North speak so as to keep the cold air in winter from going into their throats. This is especially the case with Russians. This is why the Northman says *hem* (hame) and the "High" or inland German says *heim* (hime). One is in a cold climate and speaks with the lips nearly closed, the other in a mild climate where it is as good a thing to get warm pure air into the mouth as into the house. French comes nearer to being a compromise language for use in cold as well as warm climates than any other language, perhaps because the French are a mixture of the Baltic white and the Mediterranean brunet races. At the same time I learned by dear experience in tie and lumber camps at great altitudes and low temperatures in Wyoming and Utah that it is deadly to open the mouth wide in talking outdoors in winter. I learned that the French stand the worst cold as well as they stand the heat of Algiers. But even their language is affected, and *froid*, cold, instead of being spoken liberally as *frwahd*, ending with the mouth open, is cut to something as short as and nearly like *fret*, spoken with nearly closed lips.

Though the dialect of "Low" or coast German that we call English (from the Engoa or plainsmen of ancient Denmark and other Baltic shores) is my mother tongue, I can read to myself in French faster than in it, and it is in the language, not in me. English as spoken in England and Scotland is so far from our form of it that I understood Germans speaking their own tongue better than I understood the English of England and Scotland. English can never become the universal language; French could as nearly as is possible for any.

It is a pity for a large number of persons to dissipate or expend a vast amount of energy in attempting the impossible—such as a universal language. It would not stay universal, but would break up into dialects recognizable as akin only by keen philologists.

In gathering material for my "Principles of the Science of Money," I found several of the words in commonest use in the tongues of the branches of the Baltic races come from originals on the Babylonian tablets. And if the "Slav theory" of Gesenius is true, perhaps they were received from the north of the Caspian from the blue-eyed blonds in Siberia before they were handed back to their kin in Denmark by Phenician traders.

George Wilson.

Lexington, Mo.

Award of the Nobel Prizes.

The award of the Nobel Science Prizes has just been announced as follows: Physics, Prof. Roentgen, of Munich; chemistry, Prof. Vanthoff, of Berlin; medicine, Dr. Behring, of Marburg, and literature, M. Sully-Prudhomme, of Paris. The recipients will each receive 208,000 francs.

The Nobel prize for the persons who had most benefited humanity during the past year is to be equally divided between M. Dunant, the founder of the Geneva Convention Red Cross Society, who is now very poor, and M. Passy, a French deputy and peace advocate. The announcement of the peace prizes in the Storthing was made the occasion of speeches paying tributes to M. Nobel and exalting peace. M. Lovland, Minister of Public Works, said he hoped the proceedings would encourage the nations and national assemblies to cooperate in promoting peace and arbitration. In the evening Crown Prince Gustav presented the prizes.

The first town in England to effectively display the possibilities of the motor fire engine for fire brigade purposes is Eccles in Lancashire. The engine was constructed by a local firm and has proved a conspicuous success. It carries five men, 300 yards of hose, two standpipes, scaling ladders, jumping sheet, and other necessary apparatus. It is propelled by a 6 horse power electric motor. It is remarkably silent in motion, and averages a speed of 14 to 16 miles per hour on the level. It has also established its ability for climbing stiff gradients with facility.

Engineering Notes.

The contract for building the largest cantilever bridge in the world has been awarded by the Wabash Railroad. The new structure will span the Monongahela River from the foot of Ferry Street to the south side and will permit the Wabash to enter Pittsburg.

The project of draining the Zuider Zee has been withdrawn from the States-General by the new ministry, thus being disposed of probably for a long period. The state of the Dutch budget renders such an undertaking at this time unadvisable; besides, the fall in the price of land has diminished the demand for new agricultural holdings.

A new ingenious contrivance for consuming smoke is being utilized in Berlin. When applied to a furnace it saves coal and consumes all the smoke. It has already been applied to several large engineering works in Germany with complete success. The German Naval Department has been submitting the device to severe tests upon a torpedo boat, and the results have been so satisfactory that it is proposed to adopt the system throughout the service.

A small experimental smelter has just been erected at San Diego, Cal. This will use as an experiment oil as a fuel in the reduction of copper and all other smelting ores. Mr. Trapp, the inventor, has perfect confidence in its success. In the ordinary smelter coke has been considered a necessity in smelting, as it generates great heat and has a chemical action on the ore. Shipments of iron and copper ore have been made to the new smelter and experiments will be started at once.

Under date of July 8, 1901, Consul-General Holloway writes from St. Petersburg: The city of St. Petersburg has decided to invite bids for a bridge over the Neva River, near the Winter Palace, to replace the pontoon bridge so long in use at that point. Its length is 847 feet and width 91 feet; the cost is limited to 3,500,000 rubles ($1,802,500). The specifications will be ready September 1, 1901, and the bridge must be completed in one year from that date. There are now two prominent bridges over the Neva—one stone and one iron—about completed.

The American Bridge Company, of Philadelphia, has obtained a contract for the construction of twenty steel bridges along the line of the Uganda Railroad in East Africa. The amount of the contract is about a million dollars. Several English and continental firms offered bids, but the Philadelphia company's bid was not only the lowest, but guaranteed the completion of the work in a shorter space of time than its foreign competitors. The new bridges will replace wooden structures which were built several months ago and were found to be inadequate for the service.

An interesting paper on "Comparison of Recent Battleship Designs" was read on November 15 before the Society of Naval Architects and Marine Engineers, which held a meeting in New York, by Naval Constructor H. G. Gillmor, U. S. N. As the most approved examples of battleship construction he named the United States battleship "Virginia," the British "Duncan," the German "Wittelsbach," the Russian "Borodino," the Italian "Vittorio Emanuele" and the Japanese "Mikasa." By a system of percentage values, the speaker reduced them all to a status of relative naval merit which placed the Italian at the head of the list, the American second and the German following.

The Department of State has received from Minister Merry, of Managua, under date of September 27, 1901, translation of a note from the Nicaraguan Minister for Foreign Affairs, giving notice that in accordance with Article XX. of the treaty of amity, commerce, and navigation, and Article VII. of the convention of extradition concluded between Nicaragua and the United States, the former treaty will expire at the close of twelve months and the second six months from the date of receipt of this notice. This denunciation, it is stated, in nowise affects the friendly relations existing between the two countries, and the Nicaraguan government desires the conclusion of new treaties.

In the opinion of Prof. Thurston the gas engine is a formidable rival of the steam engine, and is capable of further development. Each has given a horse power for about one pound of coal and the efficiency of both, between the coal pile and the point of delivery, is about 20 per cent. The steam engine, he says, has so nearly reached its limit that further progress under commercial conditions would seem to be very slow, but its range may be increased by employing very high pressures and superheating combined with them. In Sibley College work, 1,000 pounds per square inch have been used, and Prof. Thurston expresses the view that twice that pressure may be successfully used eventually, or with sufficient experience in its management. These factors would raise the efficiencies nearly 50 per cent, and reduce the coal per horse power hour to about three-fourths of one pound.

Science Notes.

The Manufacturers' Club of Philadelphia has passed a resolution indorsing the metric system, and a memorial will be sent to Congress urging its general adoption by the government.

The jubilee of the fiftieth anniversary of the scientific debut of M. Pierre Marcelin Berthelot, which took place on November 24, almost reached the proportions of a national affair. The ceremony took place at the University of the Sorbonne, and among those present were the President of the Republic and a number of the members of the diplomatic corps.

The gathering of cigar butts is to be suppressed, according to an ordinance recently passed in the Council in the city of Chicago, Ill. The penalty for violation of this ordinance has been fixed at a fine of not less than $10 nor more that $100 for each offense. The law covers the manufacture of cigars, etc., from tobacco thus collected, and no one shall buy or receive such material. There is a movement on foot in New York and other cities to prohibit this nefarious practice.

The Italian government has purchased the celebrated Ludovisi Boncompagni Museum, the most important private collection of antiques existing in Rome, at a cost of $280,000. The purchase price represents about one-third of the value of the museum, which is now open to the public, in the baths of Diocletian, in Piazza Termini. It is intended to gather the many interesting museums of Rome in the Villa Borghese, converted into a National Museum of Italy.

A site has been secured in Washington, D. C., for the building of the Bureau of Standardization. It is what is known as the Children's Home site on Pierce Mill Road west of Connecticut Avenue. Twenty-five thousand dollars, which is the entire amount of the appropriation available, was spent for the site. The latter is said to be particularly adapted for the purpose, being entirely free from mechanical and electrical disturbances, and at a sufficient elevation to meet the requirements of atmospheric conditions. Two buildings, to be erected at a cost of $250,000, have been authorized, and will be begun at once.

The English Antarctic exploration vessel "Discovery" is proving unsatisfactory. Her journey from London to Cape Town proved that she is not a very good sailer. She consumes a great deal of coal, and makes little progress in a head wind. She also leaked badly on the voyage out, and it became necessary to shift all her cargo for repairs. This work proved a severe task to the crew in a tropical sun, but fortunately fine weather prevailed, so that the repairs were effected satisfactorily. A relief ship is going to be sent out to the "Discovery" at the end of her first winter in the Antarctic, and for this purpose a Norwegian whaling vessel has been purchased and is now being fitted up.

Some consternation has been caused among the passengers of the Central London Electric Railroad by the assertion of the Lancet that the air in the tube contains carbonic acid gas of nearly double the amount fixed as the limit of impurity. According to the Medical Officer for Marylebone, Dr. Wynter Blythe, who has analyzed the air at several stations, has found that the carbonic acid gas was not less than 10.3 parts per 10,000, while in the tunnel itself it reached 11.9. These figures have occasioned considerable surprise among the officials of the railroad and steps will be taken to purify the atmosphere. Passengers, it is remarked, persistently complain that the air is oppressive, when, as a matter of fact, the change they notice is really due to the temperature, which is much higher in the tube than it is, at this season, in the open air.

Although the plague and the practical failure of the monsoon have exerted a depressing influence upon both the export and import trade of British India during 1900, the value of the imports was in excess of that of either of the two preceding years; while the exports, though smaller than the two preceding years, were greater than any year previous to 1898. The most important decreases were in metals, machinery and railway material. The trade in matches has greatly increased, but the British article has almost disappeared from the market owing to the spirited competition of the enterprising Japanese. The Japanese matches are cheap, which is a vital consideration to the Hindoo. Great Britain is the principal market for India with 63.8 of the total trade. But whereas Great Britain's share is less than it was in 1899, so also is that of the United States and France, while all other countries have slightly improved their position. With regard to the tea industry, which constitutes the principal export of the country, the Indian growers are establishing markets in other colonies beyond Great Britain, which is still, however, its greatest customer for this commodity. The success of this enterprise is adequately demonstrated by the fact that the increased consumption of Indian tea outside British markets between 1896 and 1900 was over 14,000,000 pounds.

GIANT SAND WHEEL FOR THE CALUMET AND HECLA MINING COMPANY.

One of the mines of the Calumet and Hecla Mining Company on Lake Superior is to be equipped with a sand or refuse wheel which will be the largest of its kind in the world. The wheel, which is now being constructed at the plant of the Robert Poole & Son Company, of Baltimore, has a capacity for carrying 550 sand buckets on the inner surface of its rim, and as the wheel will make ten revolutions in a minute, it will remove 5,500 buckets of refuse in that time, the contents of each receptacle being dumped into a trough to be located at the top of the wheel, in which it will be carried off by sluice water. The wheel measures 65 feet at its greatest diameter, and its estimated weight, exclusive of bearings and supports, is 50 tons. The axle or shaft, which was forged at Krupp's Essen factory, is 27 feet long, 32 inches in diameter, with a 26-inch hole through the center, and weighs 42,000 pounds. All of the finishing work on it was done in Baltimore.

One of the first requisites for building such a structure was a pit in which the completed portion of the wheel might be sunk as it was put together; and it was found that the Poole Company had one suited to the purpose, the pit being 100 feet long, 12 feet wide and 30 feet deep, while the building over the pit is so high that it easily accommodates the completed wheel.

The wheel was built in twenty segments. The rim is box-shaped in cross-section, with the toothed rim cast separate, in segments, and bolted to the wheel by inwardly-projecting flanges.

The structure is built on the same principle as the early bicycle wheels, which were commonly known as "spider" wheels. Toward each end of the shaft are two massive cast-steel hubs, and from these radiate forty steel arms or rods. The rods are arranged in pairs, and at the rim each pair connects to a pair of plate-steel lugs, which are riveted to the inner face of the rim, the outer ends of the arms being formed with an eye and secured to the lugs by means of an eye-bolt. The adjustment of the tension of the rods and the truing-up of the rim are accomplished, as in the old spider-wheel bicycle, by means of threads, nuts and lock-nuts on the ends of the arms where they engage the hubs. A good feature in the design of the wheel is that the stresses are all accurately determined, the arms, for instance, simply being subjected to a tensional stress and not having to resist the tangential stresses due to the load of sand in the buckets at the periphery. These tangential stresses are taken up by means of a system of tangent spokes and tie-rods which extend from the lugs on the rim, already referred to, to the periphery of a tangent-hub, which is keyed at the center of the shaft within the wheel. These tangential rods are arranged in pairs and in opposite directions, so that whether the tangential load at the periphery be right-handed or left-handed, there will be no transverse bending stresses on the main spokes or arms of the wheel. There are turnbuckles in the center of each tangential tie-rod, to enable the tension to be accurately adjusted.

One of the most interesting parts of the work on this wheel is the cutting of the teeth on the outside rim. For this purpose a special milling machine has been constructed, which is set up facing the teeth in the position shown in our illustration. When it is in position at the mine, the wheel will be driven by an electric motor of about 700 horse power.

The Charleston Exposition.

S. C. Mead, president of the New York State Commission which has just returned from a visit to the South Carolina Interstate and West Indian Exposition, said to-day: "We were very much surprised at the extensive plan and scope of the Charleston Exposition. It exceeds Atlanta and Nashville. As far as the beauty of architecture and of the surroundings are concerned, it will be one of the grandest expositions since the World's Fair.

"Charleston is certainly to be congratulated upon its courage in undertaking an exposition of this magnitude. Out of the city's population of 60,000, only 25,000 are whites. This means that there are only 5,000 or 6,000 men upon whose shoulders must fall the burden of financing and carrying through the Exposition. Yet this they are doing successfully.

"As far as we can ascertain, the New York merchants and manufacturers do not seem to be properly represented among the exhibitors. It would seem as though an opportunity of this sort to bring before the people of the South the products of New York ought not to be lost by our New York merchants and manufacturers.

"The New York State Building is just about completed. It is undoubtedly, next to the Art Gallery, the most beautiful building on the grounds, from an architectural standpoint. It is the purpose of the commission to make this building a center of social attraction, thereby appealing to one of the dominant characteristics of the South, namely, hospitality."