

per weight to represent a ton. This is known as the assay ton. As the bulk of this weight of pulp is a trifle large for the ordinary crucible; only one-half of the amount is usually taken, and the gold and silver results multiplied by two. For example: suppose that we have a reading of 2.2 milligrammes for gold and 60.2 milligrammes for silver. These figures signify 4.4 ounces of gold and 120.4 ounces of silver to the ton.

To return to the preparation of the assay. The one-half assay ton of pulp is placed in a small fire-clay crucible, care being taken that the latter is perfectly clean. If the determination is for gold alone and the assayer suspects that the ore carries little or no silver, a small piece of the latter metal (which should be chemically pure) is added to the pulp. This is done for the reason that gold and silver are thrown down together and that the gold, which often appears as a mere speck, might otherwise be difficult to find, or in greater probability lost.

In the succeeding operation the assayer's knowledge of chemistry comes into play. I refer to the fluxing of the charge; that is, the addition of materials which will remove the non-essential ingredients of the ore. Among the various fluxes in common use are the following: Sodium and potassium carbonates, which are used for the decomposition of silicates; lead oxide, otherwise known as litharge, which not only supplies the lead for the mechanical carrying down of the gold and the silver, but which acts as a powerful oxidizing and desulphurizing agent; flour and argol, which, by means of their carbon, act as reducers—that is, they take oxygen from other parts of the ore; niter, which freely supplies oxygen; and, lastly, iron, generally in the form of nails, which acts as a desulphurizing agent. Borax is a most important factor in most assays, both on account of its strong acid reaction and its use in preventing too vigorous a boiling of the crucible's contents. Salt is very often substituted for the latter purpose.

The fluxes, which have been mixed in the proper proportions, are intimately mixed with the pulp. The charge, having been covered either with a layer of borax or salt, the crucible is introduced into the white hot muffle of a reverberatory furnace. It is at this point that many an inexperienced operator fails. Success is due to his ability to keep his furnace at a high uniform heat. If he is unattentive in this respect, he might as well abandon his task at once. A view of a typical furnace, with asbestos doors to prevent the escape of heat from the muffles, is shown in the photograph. Coal is fed into the furnace from the rear.

When all sounds of boiling of the crucible contents have ceased—that is, in about forty-five minutes, if the fire has been favorable—the glowing charge is removed and carefully poured into a mold. The lead (supplied either from the litharge or from the ore itself) sinks to the bottom and carries with it the gold and silver. When the whole has cooled, the slag is broken off and the lump of gold and silver bearing lead pounded with a hammer into a convenient cubical form.

The separation of the precious metals from the lead is the next problem. The procedure is based upon the fact that lead oxides at a temperature not sufficiently great to cause serious losses from the gold and silver by volatilization.

The lead cube just mentioned is placed in a small bone-ash dish called a cupel, which has already been heated in the muffle. The heat should be carefully watched during the process of cupellation. Until the lead is melted, the muffle door should be closed. It is then opened; not only that the temperature may be reduced to the proper degree, but that a current of air, for the purpose of oxidizing the lead, may pass over the cupel and out of a small aperture at the back into the chimney. Thus a portion of the lead is oxidized and carried off as fumes, while the remainder is absorbed by the bone-ash of the cupel.

As the last of the lead disappears, the mass of gold and silver which remains suddenly solidifies and becomes dull, or "blisks"—an action which warns the operator that it is nearly time to remove the cupel from the muffle.

If no silver has been added to the original charge, and it is desirable to obtain the silver result, the button of associated gold and silver, which we will call bullion, is weighed on the button scales. The amount (multiplied by two, as before explained) read off in milligrammes represents the number of ounces of bullion to the ton.

The determination of the gold value is the next step. The bullion button is transferred to a small porcelain dish and covered with dilute nitric acid. It is then gently heated. If the amount of gold is not excessive it takes but a few moments for the silver to dissolve. The residue of nitric acid and nitrate of silver (in solution) is then decanted off, leaving a black spongy mass of gold. After the latter is dried and annealed to its yellow color in the muffle, it is carefully weighed. This amount is subtracted from the bullion weight, the difference representing the silver value.

While to some assayers the crucible method is quite satisfactory, others claim that it fails to recover the full amount of silver. In many localities, notably in Colo-

rado, where a close saving of this metal is desired, what is known as the scorification assay generally accompanies the former.

The scorifier is a shallow fire-clay dish, circular in form and about two inches in diameter. In this is usually placed one-tenth of an assay ton of pulp which should be mixed with about twenty grammes of chemically pure test lead. A like amount of the latter is then spread over the mixture and a small quantity of coarse grained borax added. The charge is placed in the muffle and the asbestos door is closed until the operation is well under way. It is then noticed that the melted metals lie in the center of the scorifier as a glowing mass surrounded by a ring of melted slag. When the latter has completely closed over the metals the assay is poured into a mold. The slag is removed, and as before described, the lead button is cupelled. If the ore is known to run very low in gold the bullion weight is accepted for that of the silver, because the almost inappreciable amount of gold in one-tenth of an assay ton in such a case would scarcely warrant a separation of the two metals. A silver result, correct to one-half an ounce to the ton, is generally regarded as sufficiently close.

It cannot be emphasized too strongly that every step in the operations above described must be taken with the greatest care. If there is an exact art, that of the assayer certainly lays claim to the distinction. The possibilities of error are many and only careful men may hope to retain their business or their positions.

COTTON TRADE SCHOOLS IN THE SOUTH.

BY J. A. STEWART.

The progress which the South has been making in cotton manufacturing augurs well for the future prosperity and advancement of the Southern section. While there were 7,160,000 cotton spindles in Massachusetts at the beginning of 1895, there was no State south of Mason and Dixon's line with a million. Now there are two, North and South Carolina, with over that number, thus exceeding all the New England States excepting Massachusetts, Rhode Island and New Hampshire.

The value of the cotton goods manufactured in the eight Southern States in 1880 was \$16,173,222, and in 1890 the returns showed a value of cotton manufactures reaching \$40,165,074 or a gain of nearly 250 per cent.

This splendid growth is bringing the South into prominence through the enhancement thus given to national American industries. Its progress is also bringing it into closer relation and a clearer understanding of the development of the manufacturing interests which comprise so large a portion of the life and prosperity of the nation. Furthermore, this grasp of conditions is shown by the growing realization in the South of the need of trained craftsmen and educated workmen to conduct its colossal manufacturing interests.

Like textile manufacturers in foreign countries, manufacturers in the South are recognizing that the system of training workmen in the mill is ineffective, for the textile mill is an establishment whose chief purpose is production and not instruction. Consequently they have been awake to the necessity of establishing textile schools, from which are to come trained workmen and educated engineers for the carrying on of their large and growing textile industrial enterprises.

The first cotton trade school in the South is that started in 1898-1899 in connection with the Georgia School of Technology at Atlanta, Lyman Hall, president. Clemson College, S. C., has also recently opened a textile department in a building especially erected for its use under the direction of J. H. M. Beatty. By the establishment of these two trade teaching institutions, the South has justified its claim to textile educational enterprise.

The Atlanta institution is very complete. It was designed by a Boston architect, and as it stands it embodies the very latest ideas of mill construction, as well as a convenient school department.

The school is the outcome of the legislative act of December, 1897, which appropriated \$10,000 for the establishment of the Textile School on condition that its friends contribute \$10,000 additional in money and machinery. A wealthy philanthropist, Mr. Aaron French, of Pittsburg, became the chief benefactor of the institution. In his honor it has been named "The A. French Textile School." In December, 1898, the legislature appropriated \$10,000 for two consecutive years for the support of the school. The building is of brick, 150 by 70 feet and three stories in height. The basement floor contains the laboratory, dye house, receiving and finishing rooms, store and washrooms, the engine room, a ginery and a lecture room. On the first floor one finds the department devoted to preparing the warps and weaving. Here are also the designing room, a room for Jacquard designing, an exhibition department besides the principal's office. The top floor is occupied by the carding and spinning department, where the cotton is brought from its crude state up to a finished yarn ready for weaving.

The equipment of the school is complete. In appre-

ciation of the advantage of having the future mill men of the South familiar with their machinery, the machine manufacturers have donated whatever was required by way of equipment to a valuation of \$20,000. The shafting makers, the belting company, the automatic sprinkling company, the ventilating and heating company followed in line, as did the makers of the Drosophore humidifiers—machines very essential to the cotton manufacturing industry in the hot, dry South, where natural atmospheric conditions would otherwise be too unfavorable. Every machine of consequence known to the cotton manufacturing industry is to be found here, and in most cases in considerable variety of makes of manufacture.

The student who has mastered the technicalities of the plant in a school of this sort will have no trouble in manipulating or caring for any machine he may find in any up-to-date mill in actual business. There are four types of cards; a Winship 60 saw cotton gin, gin feeder and condenser; two kinds of drawing frames, a railway head, a ribbon lapper, a comber, five processes of fly frames, three types of ring spinning frames, four spoolers, three winders, and a wet and dry twister. The student learns the process of weaving on about fifteen different kinds of looms, from those making heavy coarse cloth to the finest Jacquard products. Among these looms are Whitin, Mason, Crompton & Knowles, Kilburn, Lincoln, Northrop, Calvin and Jacquard looms.

The curriculum of the school is as broad as its equipment is complete. There are courses in mathematics, English, drawing, mechanics, textile design, chemistry and dyeing, millwork and shopwork to be studied in four years. Special courses of two years in designing and weaving, carding and spinning, chemistry and dyeing are provided. Thus the needs of most of the branches of the textile industry in the South are met. The special feature of the textile course in the Georgia school are the courses given in the different shops synchronously with the work in the cotton mill. Special prominence is given to the elements of practice of every department. Although this is the first year of practical operation of this department one hundred and twenty-five young men have matriculated.

Clemson College Textile School, also inaugurated last fall, provides a similar four year course in which the textile instruction is incorporated in the regular college work, the increasing development of cotton manufacturing in South Carolina having brought about a demand for more complete textile training. At Clemson the purpose is to expand into a broader curriculum of textile industrial art, to include the manufacture of wool, silk and linen products. The textile building at Clemson is a two-story brick structure of modern cotton mill design, lighted by electricity, heated by steam and protected from fire by automatic sprinklers. On the first floor are the recitation rooms, the carding and spinning departments and the office. The dyeing and weaving departments are on the second floor. The equipment is fully as comprehensive as that of the Georgia institution.

It is well held that three years spent wisely in a school are equal to twice that time in a mill. These two schools may be looked on as pioneers in a group that will cover the whole cotton growing requirements of the South; to which learner and manufacturer can turn alike for information and for assistance, and from which trained experts will graduate, whose knowledge and skill will be devoted to the further development of the great textile industry.

Without a doubt, the expansion of textile education in the South will be coincident and contributory to the new era of southern industrial progress. The time has come when the manufacture of those textiles which are now imported from abroad to an extent exceeding one hundred million dollars' worth annually will be conducted in this country; and when the South's vast product of cotton will no longer be chiefly shipped in the bale to be manufactured into cloth in foreign mills, but will be wrought into fabrics in this country, thus giving industrial impetus to a large section greatly in need of it.

ON May 12 ended the British tour of the Automobile Club. All the cars which went through the trial traveled a minimum of 1,059 miles, and some of them made a distance of 1,107 miles. There were eleven actual running days since the competing vehicles left London, the balance being made up of Sundays and one-day exhibitions. The longest day's journey was the last, the trip up to London being made from Nottingham, a distance of 123½ miles. The shortest day's trip was the run between Kendal and Carlisle, a distance of 61½ miles. It is impossible to state at present, until the official figures are published, how many cars went through the trial from the start to the finish.

IN the harvest of 1899 there were 1,265,601,664 gallons of wine produced in France; 766,107,500 gallons produced in Italy; 594,393,750 gallons produced in Spain, and 158,505,600 produced in Roumania. The total production of the old world is estimated at 3,388,101,704.

SCIENTIFIC AMERICAN

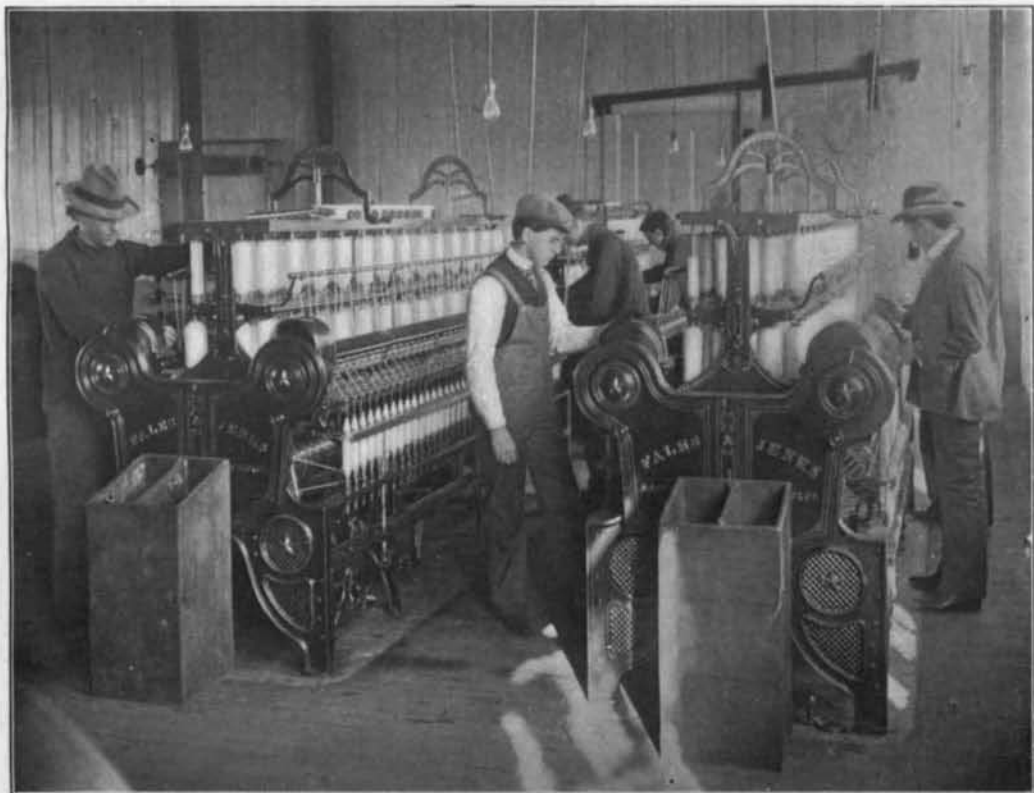
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At the Ring-Spinning Frames.



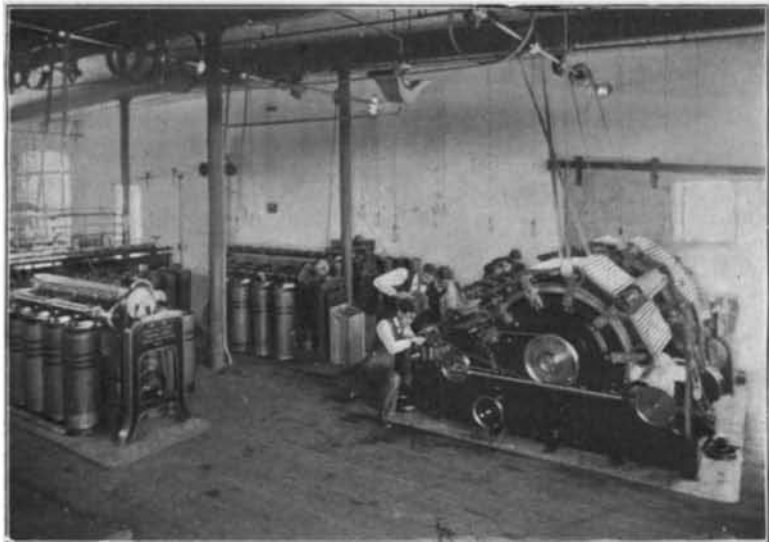
Power Weaving.



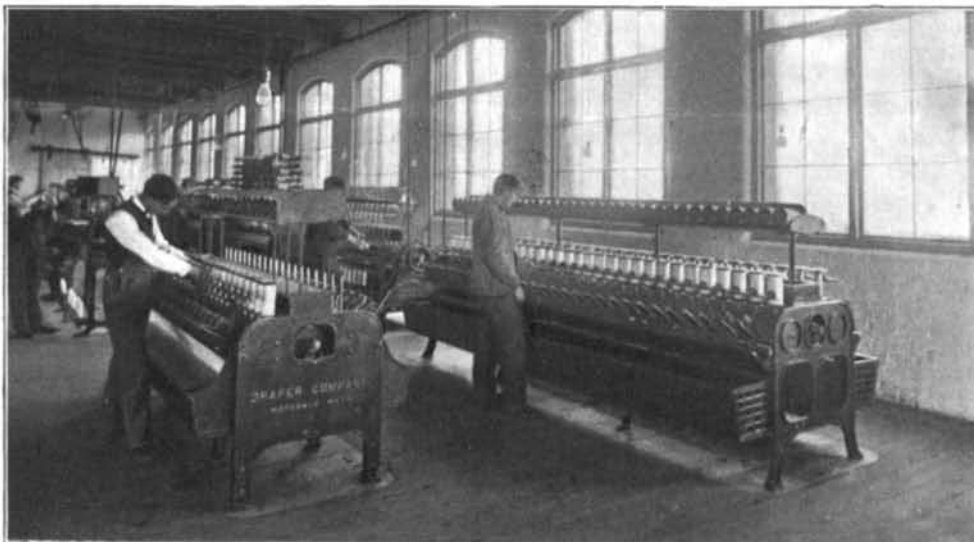
Dye House.



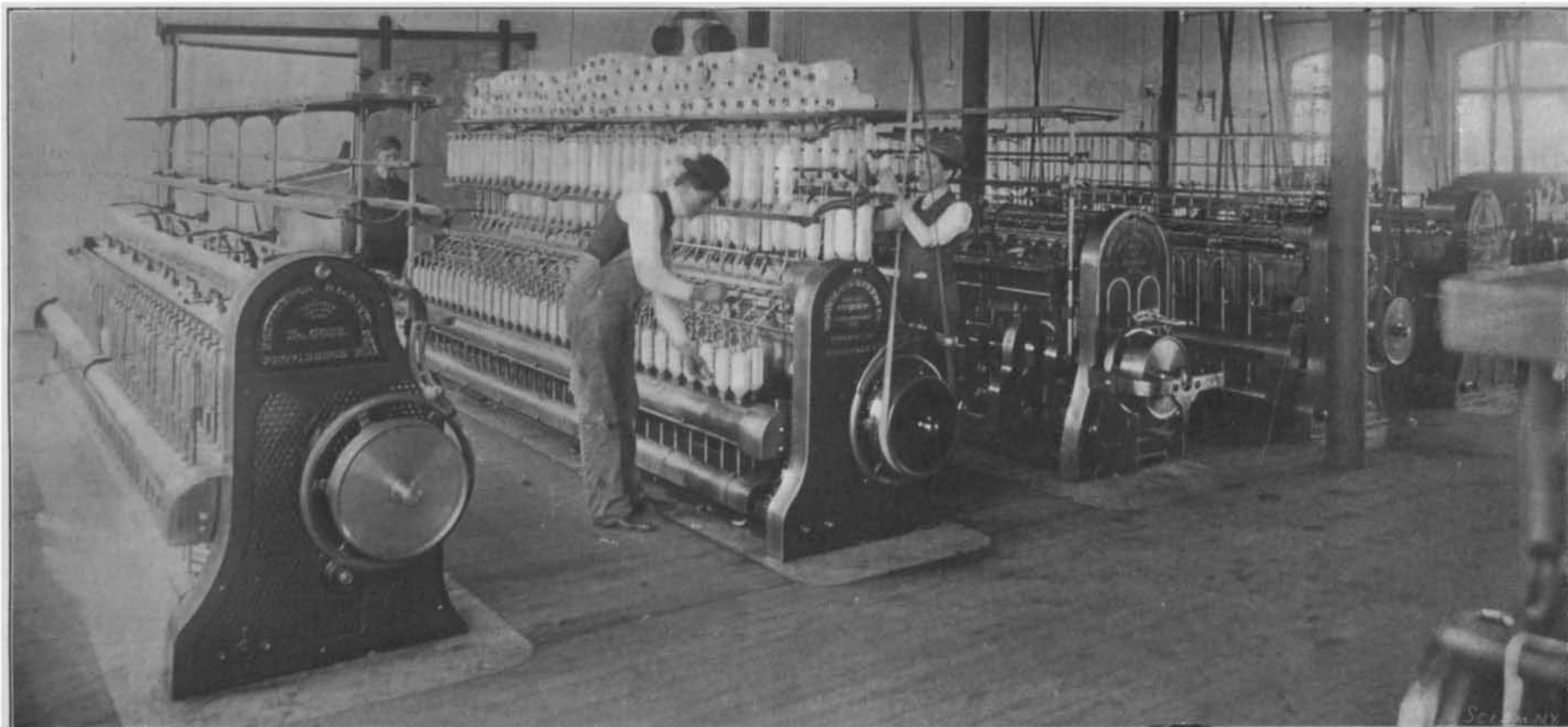
Dyeing Laboratory.



Card-Grinding Practice.



Work at the Spoolers, Twisters, and Cone Winder.



Practice on the Fly Frames.

COTTON TRADE SCHOOLS IN THE SOUTH.—[See page 342.]

Science Notes.

Three hundred and twenty acres of land have been purchased in Salt River Valley, the idea being to consolidate, as far as possible, the ostrich industry.

A swimmer who broke his neck last August, and who was successfully operated upon, is now able to write and his hand gained steadiness with each attempt.

The statue of the late Prof. Huxley by Onslow Ford was recently unveiled. It has been placed in the great hall of the Natural History Museum at South Kensington.

A crystal of beryl has been found at Grafton, N. H., which was 2,900 pounds and another from the same locality measuring 45 by 24 inches weighed by calculation about 2½ tons. In Utah crystals of gypsum over 4 feet long have been found. A crystal of spodumene—lithium, aluminium silicate—30 feet long has been discovered in South Dakota.

The question of the stability of the Ducal Palace in Venice is receiving great attention. The alarming reports which are being published are apparently exaggerations. The great library and archaeological museum are to be transferred, thus relieving the weight of the upper stories. The palace was never intended by its builders as a storehouse for books and heavy models.

Vesuvius is becoming more and more active and those who live around it are greatly alarmed. Experts are inclined to consider that there is no immediate danger. The station of the cable road which leads to its summit has been destroyed. Four English travelers, who were making the ascent of the volcano ventured too far and were overtaken by the lava and seriously burned.

An aeronaut was recently poisoned by hydrogen arsenide, which escaped from the balloon. This shows the necessity of purifying the hydrogen used for balloon purposes. The balloon was filled in the ordinary way and nothing peculiar in the odor of the gas was noticed. A few hours afterward the persons who had assisted in the operation were taken seriously ill and one of them died.

A field station in connection with the New York State Museum is to be opened during the summer on Saranac Lake for the study of the biology of aquatic insects. This is believed to be the first station in the United States where fresh water insects will be under investigation. Charles Needham, professor of biology at Lake Forest University, has been selected by the management of the New York State Museum to conduct the work.

In the year 1898-99 the medical faculty of the Paris University graduated 671 doctors, of which 79 were foreigners, besides 13 health officers, 48 midwives and 68 dentists. The number of medical students enrolled is 4,412; of this number 570 are foreigners. The Russians number 180; the Roumanians 79; Germans, 26; Greeks, 25; Swiss, 21; South Americans, 12. There are 129 women students, 100 of which are foreigners, including 91 Russians, 5 Roumanians, 2 Greeks, 2 Swedes and 1 English student.

It is probable that the metric system will be introduced before long in Russia; the bill which has been prepared to this effect by the Minister of Finance has received the approbation of the State Council, with the understanding that the University and the various scientific societies will give their assistance in the verification of the weights and measures necessary for commercial use. The details have been nearly all decided upon, and will be submitted to the Council in the near future. Since 1896 the metric system has been used by the medical service of the army in the compounding of formulas, this having been made obligatory.

On December 27, 1896, there occurred over Melbourne and a considerable area of Victoria an unusually heavy fall of dust of a red color which was carried down by an accompanying rain. Mr. T. Steel examined a sample of the dust after drying it at a temperature of 110° C., and obtained the following results: Organic matter (nitrogen 0.30), etc. (loss on ignition), 10.70; sand, insoluble and undetermined, 66.23; soluble silica, 0.75; ferric oxide, 4.68; ferrous oxide, 0.50; alumina, 15.16; lime, 1.36; and sulphuric anhydride, 0.62 per cent. It is stated that the dust agrees very closely in appearance and composition with volcanic soils from Northern Queensland, New South Wales, and Fiji Islands.

Dr. Chavernac, of Aix (France), has just designed a new army stretcher. It is a rigid contrivance made in two halves, and its advantage over the existing French ambulance is that the wounded man can be lifted off the ground without experiencing any shock or pain. The halves of the stretcher are placed on each side of the sufferer and by pressure they fold together under the body of the patient, who is not touched with hands at all in the operation. When loaded the stretcher is mounted on a light bicycle carriage. Under the existing conditions of ambulance work in France, four men are required to lift the wounded man, but by the aid of the new stretcher only two attendants are required.

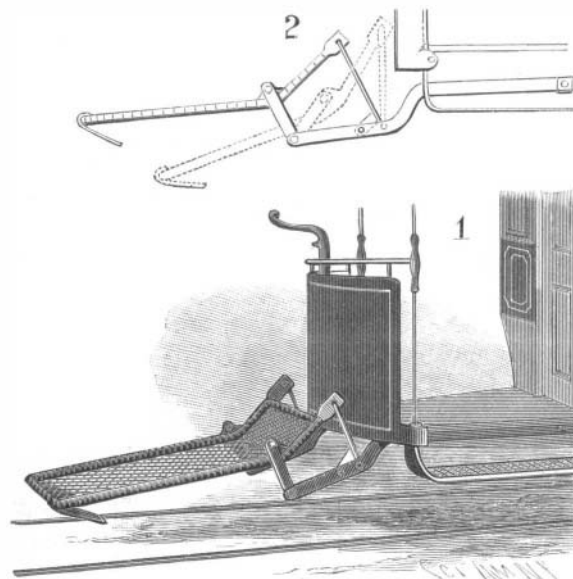
The Paris-Roubaix Races.

The Paris-Roubaix races showed a very high speed obtained by the motorcycles; one of the concurrents, Barras, made an average speed over 262 kilometers of road of 69 kilometers per hour, and in some places reached a speed of nearly 100 kilometers. From Beauvais to Breteuil the distance is 29½ kilometers, and the time required to cover the distance was 18 minutes, giving an exact figure of 98 kilometers per hour. The race was marked by an unfortunate accident, which has caused a great deal of comment, and may result in legal restrictions or even suppression of automobile races. A large crowd of spectators was assembled at a point where two roads crossed, the motorcycles being obliged to make the turn here. In front of the crowd was a row of bicycles. The two motorcycles arrived, and one of the runners made a turn which was somewhat too large, and the other, who was going at a greater speed, tried to make the turn on the inside; the two tricycles became entangled, and ran into the crowd of spectators, who were partially protected by the row of bicycles. Two persons were seriously wounded, one of whom was the wife of a deputy. Some of the French journals made this the occasion to decry automobile races in general, and there is talk of restrictive legislation or prohibition of automobile races in the future.

A NEW FORM OF CAR-FENDER.

To provide a fender for street-cars, so arranged that, normally, it will be held in raised position, and that, upon striking an obstacle, it will be immediately depressed, is the purpose of an invention controlled by the Rodman Car-Fender Company (Mr. Fred S. Pickering, secretary), of Olathe, Kans.

Fig. 1 represents the platform of a car provided with the fender. Fig. 2 is a side elevation of the fender.



THE SAUNDERS-RODMAN FENDER.

The fender consists of a netting stretched on a stout tubular frame, carried by two pairs of links pivoted on supporting-bars attached to the car. One pair of links is pivoted to the forward ends of the supporting-bars and to the side tubes of the fender-frame; the other pair of links pivotally connects the rear portion of the fender-frame with the supporting-bars.

In the normal position of the fender, the links will all be inclined upward and forward, as shown in Fig. 1, and will be thus supported by means of stops engaging the rear links. When the front of the fender comes in contact with a person on the track, it will be forced rearwardly and downwardly, as shown by dotted lines in Fig. 2, so that the shoes on the front portion will engage the track-bed, and the person will be picked up or thrown to one side out of danger. The merits of the device are so obvious that extended comment is unnecessary.

A NEW form of ozonizer has been devised which consists of two long concentric square conduits of thin wood; the space between them is filled with a kind of metallic matting composed of a central web of wire-gage in which are placed vertically a great number of small wires. In the central conduit is placed a kind of continuous wire brush, obtained by fixing to a central core a series of wires which project out radially, their point facing the points of the wire matting in the outer conduit. The two are connected to the poles of a high tension electrical machine and a current of air is passed into the conduit, which at one end opens into a box containing the aspirator. The other end is connected with a chamber through which enters the air to be ozonized; it contains a layer of cotton to intercept the dust particles. The use of metallic conductors of this form has the advantage of providing a great surface of action and at the same time they are sufficiently elastic to take up the expansion and contraction due to the heat disengaged. In practice a number of these conduits are placed together to increase the output.

Engineering Notes.

A château near Prague has been lighted by 1,200 jets of acetylene gas.

Mr. Charles P. Haughian, who died recently, was the founder of the chrome steel industry in the United States.

The total number of compound locomotives built in the locomotive works of America is 1896 up to date. Of this number, 1329 were constructed at the Baldwin Works.

Pullman palace cars are to be used on the Yukon and White Pass Railway from Skagway to Lake Bennett. They are only 40 feet long and weigh 15 tons. The railway company is building 200 freight cars.

The Coolgardie, Australia, water pipe line is a hydraulic enterprise of the first magnitude. It involves the construction and placing of 328 miles of 30-inch steel pipe which will deliver daily 5,000,000 gallons of water.

There has been a marked improvement in the state of trade in Palestine since the opening up of the country by the Jaffa-Jerusalem Railway. The transportation of goods from the coast to the interior is now rendered very easy.

A new kind of map for railway stations is being introduced in England by the Northeastern Railway Company. The map is made up of white tiles and is about 6 feet square and each tile is 8 inches square. The lines are marked in black and burnt Sienna.

The paved streets of New York aggregate 1720 miles of which Brooklyn provides 548 miles and Manhattan 405 miles. There are 745 miles of macadam streets; 339 miles of granite, 238 miles of cobblestones, 230 miles of asphalt, 84 miles of trap, 45 miles of Belgian block, 19 miles of brick; 13 miles of gravel and 0.08 miles of wood pavement.

A ladle full of molten iron was overturned recently on a trestle at the works of the Illinois Steel Company, at Chicago. The cars hold about 10 tons of metal and are operated by electricity on an elevated track, beneath which a number of men were working at the time of the accident; eight of the men were badly burned by the flying metal.

In the German army movable targets are used. The targets are drawn forward by the aid of ropes and pulleys, and the targets rest on small skids. As the trucks move forward the infantry, kneeling down, fires at them. This gives them a practice which enables them to familiarize themselves with the best methods of repelling a cavalry attack.

Arrangements have been perfected by which Russian oil will be distributed in Germany. In the last few years American petroleum has practically monopolized the German market. The German government has now offered facilities to Russian producers in the way of reduction of railway rates, so that it is expected in the near future, the Russian oil trade will make considerable progress in Germany.

An ocean depth of 5,260 fathoms, or 31,560 feet has been found by the United States steamer "Nero," which has lately been engaged in making soundings for a submarine cable between Guam and Manila. In November, 1899, the "Nero" reported a sounding of 4,900 fathoms about 500 miles east of Guam. The deepest ocean sounding heretofore reported was 30,930 feet, northeast of New Zealand and east of the Kermadecs, in the South Pacific.

Experiments are being made in Germany with beech as a material for railway sleepers. It has been found that without preservative treatment such sleepers are apt to rot internally though they may be apparently sound on the exterior. On the Alsace-Lorraine lines, favorable results have been obtained with creosoted beech sleepers, which have shown an average life of 19½ years, while others preserved with zinc chloride have proved still more satisfactory, their life being 21½ years.

The oil engine is growing in favor in Palestine, says The Engineer. The engines are used for drawing water from deep wells and for irrigating the orange gardens where they are extensive and a constant supply of water is necessary. Hitherto there has been employed from six to eight mules for turning water wheels which involve considerable expense. It is found that an oil engine of 6 horse-power, or even less, will raise double the quantity of water in the same time that a horse or mule will, while the expense is about the same.

Recently in making repairs upon the interior of a dwelling house in Boston, the discovery was made that the water pipes were lined with glass. The house was built some sixty years ago, and when Cochituate water was introduced into Boston, the owner of the house with hundreds of others became panic-stricken over the possibility of lead poisoning and had all of the pipes used in bringing city water into his house lined with glass. This was expensive and unsatisfactory, and few attempted to have the glass-lined pipes. It is thought that no other house in Boston has plumbing of this unique nature.