he swam down to the torpedo, and placed it against the vessel on the starboard side just amidships. He shoved himself off. In five minutes more, had the torpedo been charged, the Garnet would have been blown up.

"This recent midnight prank of Boyton's recalls the attempt of Sergt Lee, of the American army, to blow up Lord Howe's flagship Eagle in the same waters in 1776. It is curious to note how closely that earliest attempt to use a submerged torpedo in actual warfare was imitated by Boyton, save that he was clad in rubber instead of oak, and loaded his torpedo with broken stone and an advertising card instead of gunpowder and means for exploding it. Both adventurers meant business, but not precisely in the same sense.

"Sergt. Lee operated a torpedo boat invented by David Bushnell, afterward captain in the patriotic army. It had been tried with some success experimentally, and gave promise of being useful in serious warfare. The first opportunity for such use was offered when the British fleet of 37 men-of-war and 400 transports took possession of New York harbor. The fleet lay in the lower bay, just inside Sandy Hook.

"From the description given of the Bushnell boat, it would seem to be more like a barrel than a boat. It was of oak, iron-banded, and only large enough for one person. When floating upright, the navigator's head was a little above the level of the water. By means of two force pumps, worked by the occupant's feet, the vessel could be made to sink or rise in the water, by forcing water out or in, and so changing its specific gravity. Its progress horizontally was governed by two revolving paddles in front, turned by a crank inside. The torpedo was fastened to the back of the boat by a screw, the release of which set in motion a clock connected with a gun lock and flint. After the predetermined interval of time had elapsed, the clock would strike and ignite the powder.

"The torpedo carried by Lee against the Eagle was charged with 150 pounds of powder (some say 130 pounds), and the clock was set to explode the charge in thirty minutes after the torpedo was placed. Lee was towed to the neighborhood of the fleet by a party in whale boats, and then proceeded to attack the fleet alone. He succeeded in reaching the Eagle, a 64-gun ship, undetected, and spent a long time in a vain attempt to fasten the torpedo to her bottom with hooks and screws; a band of iron at the edge of the copper sheathing proving an especially serious obstacle. As daylight approached, he was compelled to leave the fleet and return to the city. Off Governor's Island he was intercepted by a British barge, when, to avoid capture, he exploded his torpedo, escaping from his pursuers during the panic which the explosion excited.

"A Bushnell torpedo boat was used more successfully a year later in the harbor of New London, Conn., where a prize schooner, in charge of the man-of-war Cerberus, was blown up and destroyed.

"As an act of discourtesy to a friendly visitor, Boyton's prank has little to commend it. As a practical demonstration of a new risk to war ships at anchor, even in a friendly port, it has a different and wider bearing. Bushnell's idea of matching one man against a ship may, after all, be the true one. It is obvious that one torpedo placer, able to swim Boyton-fashion on or underwater, is much less liable to detection than a torpedo boat, and much less easily guarded against; for he could approach unseen and pass under the booms and networks which suffice to explode or ward off torpedoes of the usual sort. If Sergt. Lee's torpedo had been provided with a strong magnet, the strip of iron which thwarted him would have insured the success of his undertaking, and the use of torpedoes in naval warfare might have been hastened half a century, materially changing the current of more recent naval and political history."

The Hot Blast Furnace Three Thousand Years Old.

Is there anything new under the sun? asks the *Railway Review*, and then adds Solomon was right. The more the past is explored the more evident this becomes. A prehistoric blast furnace is the latest discovery! Professor Flinders Petrie, in 1890, convinced himself that in a remarkable mound called Tel-el-Hesy, in South Palestine, would be found the remains of what was one of the strangest places in the country down to the invasions of Sennecherib and Nebuchadnezzar. The explorations, said Mr. Bliss at the Palestine exploration fund meeting recently, have fully verified this forecast. Amid all the evidence discovered by Mr. Bliss of the civilization of that remote age—wine presses, treacle presses, alkali burnings and innumerable others—by far the most curious is the disclosure of an iron blast furnace, arranged to give strong evidence of being intended to heat, in its descent, a blast of outside air forced through passages before entering the chamber at the level where tuyeres are usually found. "If this theory be correct," says Mr. Bliss, "we find, 1,400 years before Christ, the use of the hot air blast instead of cold air, which is called a modern improvement in iron manufacture due to Neilson, and patented in 1828."

The World's Columbian Exposition passed out of existence and became a thing of the past with dignified and impressive silence on Monday, October 30. A programme had been prepared for the day which was to be one of the most memorable events of the Exposition, but the tragic death of Mayor Carter Harrison, of Chicago, at the hands of an assassin put a sudden end to all outbursts of enthusiasm.

For several days preceding the closing day the weather had been unusually chilly, and as there were no means at hand of heating the buildings, the attendance was not as large as had been anticipated; nevertheless, on the closing day there were over 200,000 paid admissions. The formal exercises by which the Exposition was declared closed were held in Festival Hall and were of the simplest nature. Following these a national salute was fired on the lake front, and simultaneous with this every flag in the Exposition grounds, save one, dropped from its staff. This one flag that was reserved was the great banner flying from a staff at the east front of the Administration building. This was hauled down with much ceremony, while a band in a stand near by played the "Star-Spangled Banner" and "America."

In the evening the illumination was one of the grandest yet held. Every electric light that could be pressed into service shed forth its rays, and the crowds of visitors took a last parting look at the dreamland effect. At eleven o'clock the last light, except those on the police circuits, was darkened. In the meantime, exciting scenes were being enacted on Midway Plaisance. The rabble let itself loose and marched up and down the broad street blowing horns, tearing away awnings, and becoming more boisterous every minute. Finally, an attack was made on the Chinese theater with a view to looting it, but the Columbian guards called a halt, and the crowd was dispersed.

During the day, Monday, while the crowds were seeing the Exposition for the last time, the transportation department was gathering on the tracks outside the terminal station railway material by the train load, preparatory to begin laying tracks for removing exhibits the instant the crowd vanished. Hundreds of men gathered at the lower corner of the grounds seeking employment, and Tuesday morning the busiest of scenes were enacted as the tracks were ready to be laid across the plaza on each side of the Administration building and elsewhere throughout the grounds. The warehouses containing the packing boxes had been besieged for days previous to the closing, and trains of flat cars were loaded with empty cases ready to be hauled to their destination. Not a moment seems to have been lost.

The attendance at the Exposition falls short of what had been anticipated. The management had counted upon 30,000,000 paid admissions, while the actual attendance was 22,225,000 full admissions and 1,650,000 children's admissions. The free admissions were over 6,000,000. It will be some time yet before the actual receipts can be stated, but they will exceed $33,000,000, so that the Exposition will be able to pay all expenses and probably have between $2,000,000 and $3,000,000 to distribute to stockholders.

The wrought iron gates that stood in front of the German section in the Manufactures and Liberal Arts building were highly commended for the quality of workmanship in them; but this was not the only exhibit of this nature that received high commendation, for back in the northwestern corner of the building, in an unfortunately secluded location, was a magnificent gate of American manufacture. This gate was in the exhibit of the Winslow Brothers Company, and was probably the largest piece of wrought iron work ever produced in this country, as it stood thirty-three feet high and was twenty-three feet wide. Every part of the gate was wrought by hand, the only tools the workman used being a forge and anvil, a hammer and a pair of tongs. It was constructed of Swedish and Norwegian iron, together with open hearth low grade American steel, which was used in the more decorative and ornamental features. Each bud and flower in the delicate ornamentation was shaped from a solid piece of metal, while the leaves of each rose were cut and formed by hand, no rivets being used. The masks and faces were hammered out of solid plates of steel five-sixteenths of an inch in thickness. The workman used no form or mould of any kind, but depended upon his skill and his eye to produce the fine results.

Musicians had a feast in studying the collection of keyed and stringed instruments in the display of historical instruments exhibited by M. Steinert. This exhibit contained a fine collection of clavichords, spinets, virginals, harpsichords, hammerclavieres, and piano fortes. One clavichord, which dates back to 1500 and something, was four and one-half octaves, and was so constructed that two different tones were produced upon each set of strings. Another clavichord, with the same size of keyboard, was incased in a case of rococo style, in white enamel and gold. It is only a century older than the previous one mentioned and of the same general type. The most interesting and valuable spinet exhibited was a double one, each board of four octaves, made and painted by the famous Hans Ruckers, of Antwerp, before the year 1600. The small spinet at the left in this instrument sets into the case of the spinet proper, and was tuned one octave higher than the other. In performing upon both instruments at the same time, the smaller one could be removed from its case and set upon a table. The painting on the inner side of the lid represents a contest before the gods between Apollo and Marsyas, the former playing a viol and the latter a pipe. The rest of the case is elaborately painted. With the exception of a similar spinet at Nuremburg, this is probably the only other double one in existence. Another spinet exhibited is similar to the favorite one used by Handel.

A harpsichord that was very complete was one of two keyboards of five octaves, made in London in 1769 by Jacobus Kirkman. This had seven registers, two of eight and one of four-foot tone, one harp, one lute, and one machine stop. Another instrument, somewhat similar to this, with a very rich inlaid case, was formerly owned by Napoleon Bonaparte. The oldest harpsichord exhibited had a single keyboard of four and one-third octaves, and was made in Pisa in 1626. The case to this was elaborately painted. It is one of the oldest instruments in existence. An upright hammerclaviere which attracted much attention was one of four and one-half octaves with two knee pedals, which had a case much like an old-fashioned secretary in shape. The strings ran in a horizontal direction, just opposite to the usual upright piano. This instrument is tuned to the right. The most peculiar-shaped instrument shown was a piano forte of four octaves, made in the form of a lady's sewing table.

Three pianos of early American manufacture were exhibited, the oldest one having been made in New York in 1815 by John Geib. This instrument is inlaid with brass and rests upon a frame of claw feet, which are finely carved and gilded. Among the concert grand pianos exhibited was one that was the property of Haydn. Another similar instrument is the exact counterpart of the one used by Mozart. A concert grand piano that was used by Beethoven attracted more attention than any other instrument in the exhibit. This was not very unlike the others, although it was six and one-half octaves in size. A piano violin was one of the most peculiar instruments in the collection. This was upright and the strings were made of wire, as in an ordinary piano forte, but of greater relative thickness and with one to each note. These wires run in a vertical direction and had attached to each a small bundle of bristles projecting in front about an inch. A metallic roller, with resin on it, is made to turn by means of treadles, and when the keys are pressed down a tangent, holding a piece of whalebone, presses the bristles toward the roller, and motion is communicated through them to the strings and musical vibration is excited. The effect of this on the ear is not unlike that of a string orchestra.

The Columbian Museum, which has been talked about for some weeks as an institution that should be organized to retain some of the exhibits at the Exposition, has now become a tangible and assured success by the donation of $1,000,000 toward a fund to support it by Mr. Marshall Field, of Chicago, and $100,000 by George M. Pullman. There are many valuable exhibits in nearly all of the departments that were either purchased outright by the Exposition or solicited in such a manner that the Exposition has the disposal of them. This is especially true in the Anthropological department. There are also many exhibits that are very valuable in themselves as features in such a museum, but which do not have the intrinsic value to make it worth while to return them to their original location. To secure all these exhibits will make it possible for the museum to be among the most complete in the world in certain departments. Probably more than half of the finest exhibits in the Anthropological building and in the Mining building have already been secured, while valuable donations have been made from other departments. The only building on the grounds that is of such a permanent nature as to be suited to the purpose of containing such a museum is the Gallery of Fine Arts, which is constructed almost wholly of brick and structural iron, and which was built with this possible purpose in view. The Legislature of Illinois at its last session made it possible to retain this as a permanent structure by passing an act with this purpose in view. Some of the exterior ornamentation is of a temporary nature, but it can be remedied by putting

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Notes from the World's Columbian Exposition.

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a new surface on the building at not very great expense. The building is regarded as one of the masterpieces of architecture of modern times, and its location at the north end of the lagoon is an ideal one.

Several forthcoming expositions in different parts of the world have taken the opportunity to advertise themselves at this Exposition. The coming Midwinter Fair at San Francisco has sought every possible opportunity to make known some of the special features that it will have, and the International Exposition at Antwerp, Belgium, which is to be held from May to November, 1894, has been seeking to secure exhibits as well as attendance by making known its attractions. A national exposition is to open at Kyoto, Japan, in April, 1895, and a picture of the proposed buildings and grounds, with some information regarding the exposition, formed a noticeable feature of the Japanese exhibit in the Manufactures and Liberal Arts building. This exposition is to be held to commemorate the 1,100th anniversary of the establishment of the city of Kyoto as the capital of the Japanese empire.

A feature of some interest, says the *Electrical World*, regarding the relative sizes of dynamos and machines which are used to drive them is shown quite nicely in some exhibits at the World's Fair. In all cases where there is direct driving, or where a single engine drives a single dynamo, it may be assumed that the dynamo and its prime mover are practically of the same horse power. When the prime mover is a steam engine, it will be noticed that the difference between the sizes, floor space, etc., of the dynamo and the engine is very greatly in favor of the former, the proportions being, perhaps, roughly, about as one to three, or at least as one to two; if the boiler is included with the steam engine, as it should be, the difference becomes very much greater. This shows that, besides being a much more efficient transformer of energy, the dynamo has a very much greater output per pound, per volume or per square foot of the floor space, than the steam engine, especially when the boiler is included. The lower the speed, the greater this difference seems to be; or, in other words, the engine seem to decrease less in size at higher speeds than the dynamo. But we noticed that the case was different in the high-speed water wheel that drives the dynamos in the General Electric Company's exhibit; here the dynamo and the water wheel appeared to be very nearly the same size. On making a comparison in the case of the high speed steam turbine, exhibited in the Swedish department in the Machinery building, we noticed that the tables were completely turned, and that here the relative sizes were just about the reverse of what they are in the case of the usual steam engine. Here a small eight inch wheel (illustrated in SCIENTIFIC AMERICAN of October 21, 1893), running at a speed of 20,000 revolutions per minute, developed 20 horse power, if the statements made to us were correct, and we have no reason to believe that they were not. It is needless to say that the dynamo which it was driving was far greater in size, even the gearing for reducing the speed down to one-half occupying a much greater volume than the engine itself. If, however, the boiler is included, the difference is again in favor of the dynamo.

RUSSIAN EXHIBITS.

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The statistics in regard to illiteracy in Russia are so familiar that we are hardly prepared to find her exhibit in the educational department so extensive. There are many portfolios of views of different schools, showing fine buildings, spacious rooms and many students. Herbaria collected by scholars are placed beside the needlework which is conspicuous in the exhibits of all foreign schools.

The Central School of Design, founded by Baron Stieglitz at St. Petersburg, has very interesting work to show, including designs in color for weapons, vases, lace and gold plate for ecclesiastical use.

The prominent place assigned to the Marie Educational and Charitable Institutions, "under the immediate patronage of their Majesties the Emperor and Empress," gives one a desire to know what they accomplish, and the documents which are included in the exhibit furnish much interesting information. It was upon the accession to the throne of Catherine II that attention was first given to the education of women. The history of the movement then begun, the methods used to extend it, and its extraordinary outcome, are not without their lessons for the student of sociology. It may thus briefly be told: In 1764, an "Educational Home for Girls of Noble Birth" was established by the Empress, and within a year a school for girls of the middle class was opened in the same convent, by royal decree. The studies pursued in the first school were religion, three languages besides Russian, music, drawing, arithmetic, dancing, sewing, and knitting. The higher class gave some attention to architecture, heraldry, history, and literature.

For girls of the middle class more instruction was provided in needlework, cooking, and weaving and less in books. A year previous, the Empress had opened a large foundling hospital in St. Petersburg, and one in Moscow. The philanthropist Betski, who from the beginning of the educational enterprise gave valuable aid, and who planned these hospitals, had difficulty in getting all the money necessary to carry them on. To this end he organized auctions and savings banks in both these cities, the revenue from which was devoted to the maintenance of these institutions. Tickets of admission to places of amusement were taxed for their support, and playing cards were made and sold exclusively for their benefit.

In 1774, Prince Demidoff gave 205,000 rubles toward the foundation of a commercial school for boys of the mercantile class, and this was attached to the Moscow foundling hospital. When, in 1796, after the death of Catherine, Marie Feodorovna became Empress and the head of the girls' schools, she endowed them with an annuity of 15,000 rubles from her personal income, and made many changes in their management. She altered the courses of study, and reformed the conduct of the hospitals, savings banks and commercial schools. Then she began to widen the scope of the work in many directions. At her death in 1828, she had established the Kharhof Institute, to which merchants' daughters were admitted, two schools, one at Nicholaieff and another at Sebastopol, for daughters of sailors, and two for daughters of soldiers; a school for the deaf and dumb of both sexes; another foundling asylum, and homes for widows of men in the civil service. The Empress Marie took most active personal interest in these institutions, visiting class-rooms and learning to know the scholars. In memory of her, all the institutions—those founded by her predecessor as well as her own—were made by royal decree the Marie Institutions.

The Emperor Nicholas established government schools for girls of noble birth in provinces most remote from the capital. He also founded orphan asylums, but so far all the schools were for boarding pupils. It was not till 1858 that public day schools for girls were started. They were soon multiplied in towns which asked permission to establish them without government aid, but only those receiving a subsidy from the government are included in the Marie Institutions. Of these, there are now 472 scattered all over the empire; in the year 1891, they aided or relieved 498,108 persons; of these, only 27,417 were in the schools; the others were in the hospitals, asylums and hospices. In the foundling hospitals, 24,424 illegitimate and 579 legitimate children were received, and for them 107 elementary schools were maintained.

A pamphlet which was given me tells the history of the educational movement on behalf of the emancipated serfs, begun in 1861. It took the form of Sunday schools for adults. In two respects they resembled our Sunday schools—the teachers were volunteers and unsalaried, and the pupils were taught in groups. Men and women from the upper classes of society gave themselves enthusiastically to the work, which extended from the centers into the provinces. But, before the first decade had passed, political reasons led to the closing of nearly all of the schools. Finally, but one was left, that at Kharhof, a school for women: this survived because it was maintained by a lady at her own expense. It has now seventy teachers, and three hundred and fifty pupils attend it annually. Since 1880 more liberty has prevailed, and similar schools for both sexes have been opened in many provinces, even in remote hamlets; in St. Petersburg and Moscow it has been done by the municipalities. At present one hundred thousand scholars are at work under ten thousand teachers.

The instruction in the Kharhof school is in reading, writing, the elements of grammar, arithmetic, religion and the Gospel. The scholars are in groups; their ages range from six to forty-five years. The session lasts from ten in the morning to two in the afternoon, with short intervals of rest. At the close of the session, books from the library are given out; these books, some of which are prepared expressly for the purpose—written down to their capacity—are carried to the homes. It has become the custom for neighbors to gather to hear these books read, and thus the influence of the school reaches far beyond the pupils.

The postal service exhibit is curious; its chief value, perhaps, is to impress upon the visitor the extent of the empire and the widely differing conditions which exist in the different sections. For instance, here is the miniature model of a Siberian mail wagon in the form of a sled drawn by seven tiny dogs; one man drives them and another guards the mail; again, a sledge is the vehicle and a reindeer the power. In Archangelsk, we see the mail carried in a boat rowed by four women, while a man at the helm guards the precious box. The Caucasus Mountains are represented in miniature; on the lower heights a camel, loaded with five bags, is conducted by two men; but in the upper regions, where snow and ice offer serious obstacles, a procession of men is shown. The one in advance carries a pick; the second, a shovel; the third, the mail bag; the fourth and fifth are armed with swords.

It is a significant exhibit, when we consider how much it has cost to send these little figures from the other side of the globe, and set them up here in life-like attitude and suitable environment.

Photographs of bridges, drawings of various internal improvements, and the monograph of Lieut.-Gen. Jilinsky on "Irrigation in the South of Russia," are other evidences of the progress of the empire.

In comparison with Germany, Russia's display in the Mining building is small, but a book case filled with bound volumes of mining reports from 1881 to 1892 is evidence of the extent of the industry.

Nobel Brothers make a large exhibit of petroleum and the derivative oils, from their refinery in Baku. A most interesting one is that of the Briantzewka mine of rock salt and soda. It is near the town of Bakhmont in the government of Ekaterinoslaw. The mine is worked by a company, some of whose members are noblemen, under imperial sanction. The four shafts are from 120 to 164 meters deep; 600 men are employed, and last year's yield was 150,000 metrical tons; these are, in brief, the statistics given. In the show case, there are large and small cubes of salt, a pyramid and fragments in jars, and photographs of the mine. A neat and complete model of the extensive Votkinsky Iron Works in Ural shows the buildings and grounds in minute detail; they form a good sized village. There are samples of steel and iron castings, and models of farming implements and ships built there. From one point of view, the most interesting exhibit is that of the Slavianoff electrical welding process. A table is sometimes covered with broken articles; a cast iron pulley, broken into many pieces; a steel shaft; teeth of a spur wheel; copper tubes; the necks of shafts and other similar castings have all been repaired by this new and secret process of welding by electricity. The chemicals used in the process are inclosed in a case under glass; from their appearance, it is easy to guess what some of them are, but their names are not obtainable. The works where the process is carried on are at Perm in the Ural. The only distinct reference to the Siberian mines, with their broken-hearted toilers, that I could find is in the form of three immense yellow cubes piled in a series, showing the relative production of gold in West Siberia, East Russia, and East Siberia from 1845 to 1891. The largest one represents the amount found in East Siberia, 1.097,232 kg.

In the Fine Arts building, the Russian exhibit occupies a large and a small room, opening from the south court in the central pavilion. It is sent mainly, according to the catalogue, by the Imperial Academy of Fine Arts, which owns some of the pictures.

Among the few pieces of sculpture may be mentioned a bust of Count Tolstoi and statuettes of Tchaikoffsky and Vereschagin, by Gunzbourg. His representation of the soldier-artist is very life-like and true.

An art critic is my authority for saying that the painters show much boldness in the use of color and skill in general technique. It is impossible to escape being deeply impressed by several of the pictures. Among these, that called "Grandmother and Granddaughter," by Tvorojuikof, should be mentioned. It represents an old woman with something slung over her bent shoulders, and a large, coarse muffler tied over her head. The child's head is covered in the same way, and her hands are hidden in the long sleeves of her loose coat. They stand close together, the little girl in the forefront of the canvas, in a dreary spot, near a few dried grasses and leafless bushes, with a waste of snow beyond them. Dull faces they have, and the scene is probably typical of their lives.

No picture is, to me, more impressive than that named "Christians awaiting Death after the Free Supe " It is by Theodore Bronnikov, a native of Siberia. The scene is at night; the only light in the long room where it is laid comes from a hanging lamp in one end. A procession seems to be entering the room, and another to be passing out. The most conspicuous figures are those in long flowing white robes. One of these, a man, is the center of the group in the foreground; his countenance is radiant; with one hand he points upward, the other is outspread toward the sorrowing ones gathered about him. An old woman, with agonized expression, is clasping his neck; a young woman kneeling at his feet holds a baby toward him; another form, perhaps that of a daughter, is also at his feet, with her face hidden in his garments. I have not known where to find an explanation of the historical significance of the picture, and I wish that some one who may chance to read this inadequate description of the solemn scene would be kind enough to supply it to the SCIENTIFIC AMERICAN. "A Drowned Man," by Dimitriev-Orenburgsky, is a work of merit. A group of men in a variety of costumes and in most natural attitudes is gathered about a form prostrate on the edge of a stream. At his head stands a man with sleeves rolled up and legs bare, evidently the one who went to the rescue. The interest of the spectators is divided between him and the poor fellow on the ground.

"The Moscow Rag Fair," by Vladimir Makovsky is a most animated scene; evidently an entire square is occupied by the venders of old clothes, and an eager