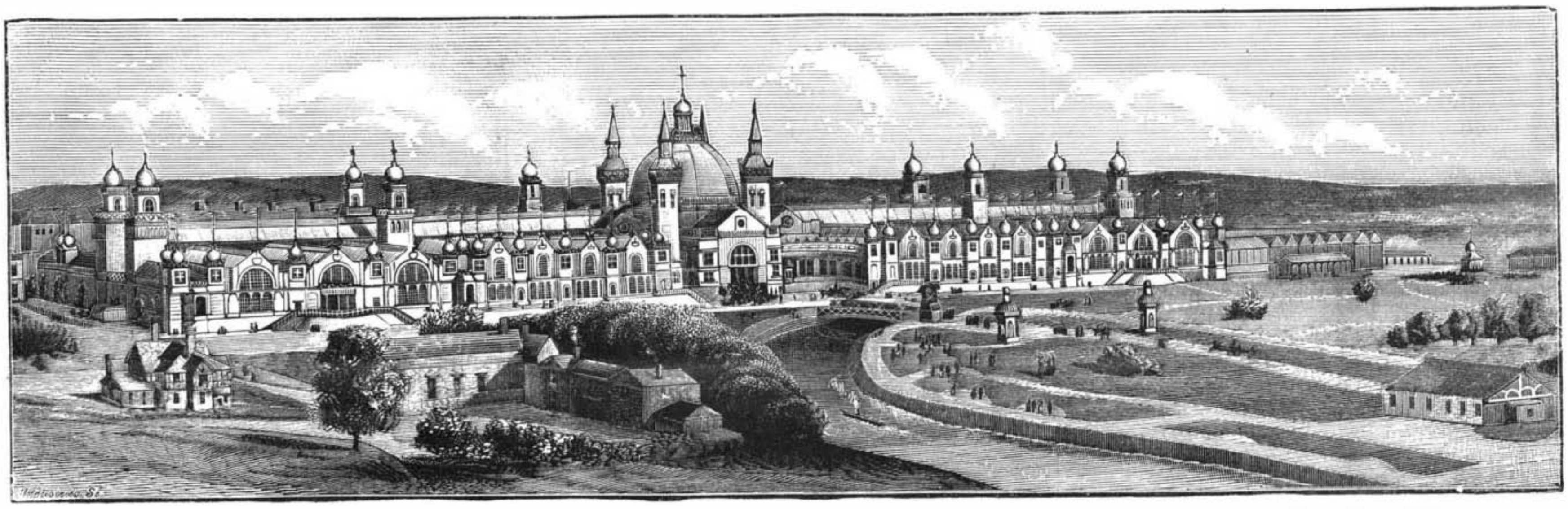
INTERNATIONAL EXHIBITION AT GLASGOW.

The buildings are now in course of erection for the great exhibition to be held at Glasgow next summer, and our illustration represents the main structure, which will be semi-Oriental in design, and which will be surmounted at the center by a dome 120 feet in height and 90 feet in diameter. The buildings will, in all, cover about ten and a quarter acres of ground. Everything relating to the exhibition is being attended to with much energy, and judging from the fact that Glasgow is the second largest city of Great Britain, with a population, including its suburbs, of nearly 1,500,000 people, and inasmuch as it is visited annually by thousands of tourists *en route* for the Trosachs and the Scotch lakes, there is no reason to doubt of the success of the enterprise. The executive council includes some of the leading nobility and most prominent citizens, and the chairman is Sir James King, Lord Provost of Glasgow. A guarantee fund of over $1,200,000 has been subscribed.

The exhibits will be of a widely different character, and will include such classes as: Agriculture, including horticulture and arboriculture. Carriages, including bicycles, tricycles, and ambulance appliances. Chemistry and chemical and philosophical apparatus and instruments. Civil engineering. Cutlery, firearms, etc. Educational appliances and apparatus for physical training. Electricity, fine arts, fishery, food, furniture, gas, and other illuminants. Heating and cooking apparatus. Jewelry machinery. Mining and metallurgy. Musical instruments. Naval architecture and marine engineering. Paper, printing, bookbinding, and stationery. Pottery and glass. Railroad appliances. Textile fabrics, leather, India rubber, gutta percha, clothing.

Great attention is to be given to the exhibit of naval engineering and architecture, and a special attraction will be the exhibit of model boats, which will be held upon the waters of the navigable river Kelvin, which passes through a portion of the park where the exhibition is to be held.

For the benefit of American exhibitors, it may be said that special rates have been fixed for the transportation of exhibits on most of the principal transatlantic lines, and these have further agreed to carry back, free of charge, all goods that remain unsold at the close of the exhibition. All applications for space, etc., should be made before November 1. The American correspondent is Mr. A. MacCorkindale, of the Mutual Life Insurance Company, New York, who is prepared to give information concerning the requirements and to furnish blanks. It would be possible for exhibitors from this country to ship goods to Glasgow, and, after the close of the exhibition, to send their exhibits from there direct to the Paris exhibition of 1889.



MAIN BUILDING OF THE INTERNATIONAL EXHIBITION TO BE HELD AT GLASGOW, SCOTLAND, IN 1888.

Lake Superior Copper and Iron.

REVIEW BY C. D. LAWTON, COMMISSIONER OF MINERAL STATISTICS.

There has been great improvement in the mining industry since one year ago; this is especially true of the iron mines. The advance in the price of copper from 10 cents per pound to 12 cents, which occurred during the past year, and which price still prevailed early in the present year, caused a feeling of relief in the copper district, the outlook became far more hopeful, and increased activity prevailed. Copper mining in Michigan has become a very uniform industry; prices may vary, but the work at the mines goes on steadily with little apparent change. There is all the while a gradual increase in the magnitude of the operations, resulting in an increased production and a corresponding lessening of cost.

Comparatively few comprehend the scale on which all the work is carried on at our great copper mines. They do not realize the fact that the rock from which the copper is eliminated must be mined far underground at a depth of from hundreds to thousands of feet, and thence be raised to the surface, taken to the rock house, and passed through breakers, whence it must go to the stamp mill—perhaps several miles away—and there it must be pounded into fine mud and sand, which in turn is run over a system of sieves, jiggers, and slime tables, undergoing an elaborate process of mechanical separation of the copper from the sand, after which the copper must be taken to the smelting works, and then cast into ingots, when it is ready to be sent to market.

Few, even mining men, who are not acquainted with the details of the work at our Michigan copper mines are ready to give credence to the statements that rock which has a gross value of but $1.65 per ton, or less than 15 pounds of refined copper, on an average, to the ton, can be mined at a depth of more than 1,000 feet below the surface, hoisted, broken, stamped, washed and separated, smelted, and taken to market and sold, and still leave a net profit of 22 cents on every ton. Yet this was the year's result at the Atlantic mine in 1885, is equally favorable for 1886, and the company paid a dividend of $1 per share to the shareholders.

In order to accomplish this, 800 tons of rock were raised and stamped per day. Each year, as the price of copper has diminished, the daily production has been increased, in order to reduce the average cost. Ten years ago, when there were but 230 tons of rock mined and treated per day, the average cost was $3.90 per ton at this mine. The cost of stamping and washing was then 88 cents per ton, while now it is but 30 cents. The total average cost per pound of copper obtained at the Atlantic mine ten years ago was 22 cents, in 1885 the same was produced for 9⅓ cents. The mine is no richer now than formerly, in fact, there has been, practically, no change in the quality of the rock. The advantage gained is due to improved facilities for mining and manipulation, to a better comprehension of the work.

The Atlantic mine has been referred to simply for illustration. There are others which afford an equally favorable showing, and altogether these results make apparent that no business in the land of equal magnitude is more systematically and carefully conducted than is the copper mining industry of Michigan. There is none more legitimate or that is conducted with more freedom from speculation and from those manipulations of stock which unfortunately too frequently characterize mining.

Copper mining in this State can be made, and is made, as certainly profitable as are other undertakings requiring large expenditures of money. The mineral lodes are pretty well understood; it is known, generally, what they will yield, the conditions are understood, the elements of the problem are in hand. The leading mines have demonstrated their ability to meet all the conditions, and to conduct their operations so that an annual profit shall accrue with assured regularity. Mining, like other enterprises, can be carried on with such recklessness and extravagance that utter ruin must result, and if there are conspicuous instances of failure in the recent history of the copper country, the unfortunate results may be traced to causes that were readily foreseen. The final outcome could have been predicted in advance with all reasonable certainty; while good management in all instances, when the conditions were favorable, has been attended with success.

The progress which has characterized the copper mining industry has also, in an equal degree, entered into the work in the leading iron mines. Copper mining of necessity requires a great preliminary outlay. The work cannot be successfully prosecuted otherwise. The rock, after it is mined, unless it is mass copper, must be crushed and stamped to great fineness, washed to separate the copper from the rock, and the copper finally smelted before it can be sold. All these successive manipulations require mechanical appliances that are elaborate and costly. Great skill and experience are essential on the part of those who have the direction of such work. No copper mine in Michigan can be successfully operated otherwise than by all this necessary outlay. As soon as the deposit has been proved sufficiently to justify its permanent working, then the rock house and stamp mill must be provided for. Hundreds of thousands of dollars must be judiciously expended before the mine becomes established as a working, paying enterprise.

Iron.—Not so with an iron mine. In some of them, in their earlier stages, it is the simplest of excavating work, a mere open pit in which the ore is dug out and loaded into cars. Generally, even when the ore is thus mined from an open cut, more or less stripping must be done before the ore can be reached. But this sort of mining is only applicable to the soft ore mines—hematites—and to these, when true of them, only in the first year or two. There are usually difficulties met with that, to be overcome, require the exercise of skill, experience, and improved appliances to insure economical production. Still the ore only has to be mined. There is no subsequent manipulation required to render it marketable.

Thirteen years ago all the iron mines in the State, with one small exception, were wholly open to daylight, and the aggregate production was 1,000,000 tons. Now nearly all are worked underground, and the aggregate production, annually, has mounted up to 3,000,000 tons. Great change has taken place in the iron mines in the last few years. In the large mines, as the Cleveland, Lake Superior, Republic, Chapin, etc., the old and inadequate machinery has given place to that of the most costly and powerful character for hoisting, for pumping, and for drilling. The wooden buildings in which the machinery was formerly held have been supplanted by stone structures with iron roofs, which are safe, substantial, spacious, and elegant. Ponderous steam engines, air compressors, and immense winding drums are the order of the day in all our great iron mines. The use of electric lighting and electric bells is becoming general. At the Chapin, Ludington, Vulcan, Lake Angeline, Lake Superior, Hematite, and Barnum mines, which have vertical shafts, cages are used instead of the skips ordinarily employed, thus securing important advantages.

The best steel wire rope is used, and catches which hold the cage should the rope break. The men are taken down into the mine or brought up from it nine at a time, without loss of time and without labor.

A New Secondary Battery.

The *Societe Industrielle* of Brussels has constructed a new accumulator, the invention of M. Tamine, a civil engineer. The element is composed of a number of connected plates for a positive and a thin sheet of lead, 1 mm. ($\frac{1}{25}$ inch) in thickness, for negative. The following is the composition of the liquid:

Saturated solution of zinc sulphate	1,000 parts.
Sulphuric acid, 10°	500 "
Ammonium sulphate	50 "
Mercurous sulphate	50 "

The solution of mercury and ammonium sulphates are first prepared. It is poured into the acid, and the zinc sulphate is afterward added. The electro-motive force is 2·3 volts. The element is formed in an acid bath. It is then slowly discharged in the liquid just described. The negative becomes covered with oxide. The discharge on open circuit is prevented by the presence of ammonium.—*Bull. International de l'Elec.*

Balloon Views of the Polar Regions.

A correspondent suggests the possibility of attaining a view of the polar regions, far beyond actual travel, by means of a photographic magnetically directed and electrically regulated (opened and closed) balloon, sent up under favorable conditions, a mile or more. It can surely be done. Of course there might be lenses on all sides of it, so as to give the view all around.

How Stoves are Put Up.

This being the season of the year when multitudes of people are adjusting their heating apparatus, preparing for cold weather, some will recognize their own experience in the following amusing description from the *American Artisan* of the way it is sometimes done:

In the first place, the man puts on an old and very ragged coat. Then he puts his hands inside the place where the pipe ought to go, and blackens his fingers, and then studiously makes a black mark down the side of his nose. Having got his nose properly frescoed, the man grasps one side of the bottom of the stove, and his wife and the hired girl take hold of the other side, and in this way the stove is started from the woodshed to the parlor. In passing through the door, the man carefully swings his side of the stove around and jams his thumb nail against the door post. At last the stove is set down in the proper place, and the man and his wife and the hired girl set out in a triangular search after the stove legs. Two are finally found inside the stove, where they have remained since spring, and the two others are found hidden under four tons of coal. Then the old man holds up one side of the stove, while his wife puts two of the legs in place; then he holds up the other side while the other two are being adjusted, and one of the first pair is displaced. The trick of getting the four legs into their proper place is practiced with varying and indifferent results for some ten minutes, and by this time the man gets excited and reckless, and throws off his coat, regardless of the consequences.

Then the man goes for the stovepipe and gets a cinder in his eye. The stove was put up in first-class shape last year by the stove man, but this year the pipe proved to be a little too long. So the man jams his hat down over his eyes, takes a piece of pipe under each arm, and starts for the tin shop to have it fixed. Then he comes back, steps his muddy boots into one of the best parlor chairs to see if the pipe will fit, when his wife makes him come down. In the act of descending he plants his foot square down on the hollow of the cat's back, and comes within an ace of trampling the baby under foot. Then the man gets an old chair from the kitchen and climbs up to the chimney opening again, and makes the startling discovery that in cutting off the end of the pipe, the tinner had made the pipe too large to enter the hole in the chimney. So the man goes into the backyard and splits one side of the end of the pipe with an old ax, and squeezes it between his hands until he makes it smaller.

Then the man gets the pipe into shape only to find that the stove does not stand true. Then the man and his wife and the hired girl move the stove to the left, and the legs fall out again. The legs are replaced and the stove moved to the right, and there is another *seance* with the legs. Then the elbow is found not to be even with the hole in the chimney, and the man goes into the woodshed after some little blocks. Then the man and his wife and the hired girl essay to put the blocks under the legs, and the pipe comes out of the chimney. The pipe is replaced in the chimney hole, when the elbow commences to topple over. The man's wife is visibly agitated, and the man gets the dining table out of the kitchen and balances an old chair on it, and makes his wife hold the chair while he performs acrobatic feats on the grand combine, in an effort to drive some nails into the ceiling, during which performance the man drops the hammer down upon his wife's devoted head, and she surprises him with a yell worthy the emulation of a Comanche Indian.

Finally the man completes the grand act of driving the nails, constructs a wire swing to hold the elbow in position, hammers the pipe a little on one side and then a little on the other, pulls one joint a little here and pushes another length a little there, gives vocal expression to a series of deprecatory and mildly profane adjectives, takes a long breath, breathes a deep-drawn sigh of relief, and proudly announces that the job is finished.

Fine Threads.

The production of extremely fine threads of glass, quartz, and other materials has been brought to a high degree of perfection by Mr. C. V. Boys. The method which he found most satisfactory in its results was the following: A fragment of drawn-out glass was attached by sealing wax to the tail of an arrow made of a piece of straw a few inches in length; the glass was heated to a high temperature in the middle, and while the end was held in the fingers, the arrow was projected by a cross bow of pine held in a vise and with a trigger that could be pulled by the foot. With every successful shot the thread was continuous from the piece held in the hand to the arrow 90 feet off, a glass thread 90 feet long and $\frac{1}{10000}$ inch in diameter being obtained. The diameter was almost perfectly uniform for the greater part of the length. Instead of holding the glass tail in the hand, a little bead of glass may be fused on the end, and, when the arrow is shot, the inertia of the bead is sufficient to draw out the thread in the same way.

The author has also experimented upon a number of minerals, and found that while some behave like glass, others will not draw at all, being either perfectly fluid like water or when cooler perfectly rigid. Thus corundum, hornblende, zircon, rutile, cyanite, fluorite will not draw at all; on the other hand, emerald and almandine will draw, but care is needed to obtain the proper temperature. Orthoclase draws readily, but quartz, though troublesome and requiring more force, yields remarkably successful threads of extreme minuteness, in some cases tapering down to a size beyond the power of the microscope to resolve. These minute threads have some peculiar properties which the author proposes to investigate; they are highly elastic, and it is suggested that they may be advantageously used for torsion threads. They may also be preferable to spider lines for the cross wires in the eye pieces of microscopes and other instruments.—*Phil. Mag.*

A New Steel.

Prof. W. F. Barrett lately read a paper before the British Association on the physical properties of a nearly non-magnetizable steel. At the Aberdeen meeting Mr. J. T. Bottomley draw attention to a new steel recently manufactured by Messrs. Hadfield & Co., of Sheffield, which contained some 13 per cent of manganese, and was almost wholly unmagnetizable. Mr. Bottomley's experiments showed that the intensity of magnetization that could be imparted to it was some 6,000 times less than that which could be given to steel. Hence it was evident that manganese steel is a remarkable body. The author had, through the kindness of Messrs. Hadfield, and after some difficulty, succeeded in obtaining this steel drawn into wire.

One of the most curious properties of the steel is that it is annealed in the opposite way to ordinary steel, which is hardened by being suddenly cooled, whereas manganese steel is softened by this process. The modulus of elasticity of manganese steel determined by Prof. Barrett was 1,680 × 10·6 grammes per square centimeter—a singularly low value, lower than iron. The tenacity of the substance is, however, greater than ordinary steel. The breaking strain of a No. 19 wire of hard manganese steel, Prof. Barrett found, was 110 tons per square inch, nearly double that of ordinary steel wire, and only exceeded by the finest and hardest pianoforte steel wire. The resistance of manganese steel wire was found to be very high, about six times that of iron and three times that of German silver. Its change of resistance for temperature was also determined and found to be much less than iron. The comparison of its magnetic power with that of iron was examined, and in an intensely powerful magnetic field the ratio of magnetism induced in iron and manganese steel was about 1,000 to 3.

In conclusion, the author showed that manganese steel wire did not exhibit the anomalous expansion in cooling nor afterglow which is found in ordinary iron and steel wires, and thus a new connection between molecular condition and the magnetic state was revealed. Many uses of this remarkable material suggest themselves, among others the construction of iron ships with no compass error, the bed plates of dynamos, resistance coils, and non-magnetizable watches.

A New Gas Process.

The American Light and Heat Company's new process for making fuel gas was recently tried at Darby, Pa. Four retorts are used, making 50,000 cubic feet of gas every twenty-four hours. The gas is manufactured by direct process, and delivered to the holder after a simple washing. It is of 22 candle power; and there is said to be absolutely no deposit from the gas flame. The process requires oil, the diffusion of which is effected by superheated dry steam. For illuminating purposes, and on a large scale, 5 gallons of oil are stated to make 1,000 feet of gas; although 6 gallons are required at Darby. The cost is, therefore, about 30 cents per 1,000 cubic feet for 22 candle power gas. This gas has a heating capacity, it is claimed, exceeding considerably that of coal gas made in the ordinary way. At Darby it is taken a distance of 50 to 70 feet to a floor set with suitable furnaces for metallurgical purposes; and there it is used for melting steel, and for forging, welding, shaping, and manipulating iron and steel in every way. It gives a quick heat of the highest degree, 2,000° to 2,500°, cutting down every form of bar iron or bar steel placed in an opening of any one of the furnaces; and this without the use of any solid fuel. The method of developing the heat is accomplished, says a contemporary, "by using an air blast of about 6 ounce pressure, delivered into a combustion chamber from opposite sides. The illuminating gas is delivered through a one-half inch pipe, at right angles to the air pipe, and within a few inches of the outer wall of the furnace. At this point the gas and the air blast mingle, forming an explosive mixture; the combustion and evolution of heat being instantaneous. This instant production of a high degree of heat without other fuel than one volume of illuminating gas with fifteen volumes of cold air is the great characteristic. A perfect heat for melting steel (2,500°) was attained in this instance in 2 hours and 27 minutes by the use of 1,400 cubic feet of gas, as measured by the meter. The crucible on this occasion contained 100 pounds of scrap steel."

Dedication of the New Building of the College of Physicians and Surgeons of the City of New York.

The new buildings of the above college, the gift of the late Mr. Wm. H. Vanderbilt, with the building entitled the Vanderbilt Clinic, the gift of his sons as a memorial to their father, and the Sloane Maternity Hospital, the gift of Mr. William D. Sloane, were dedicated September 29, 1887. The three buildings, situated on 10th Avenue and 59th and 60th Streets, in this city, represent a total expenditure of more than double the original endowment of $500,000. The main college building, modeled in the general style of the old structure on the corner of 23d St. and 4th Avenue, is devoted to cabinets, lecture rooms, dissecting rooms, and chemical and biological laboratories, all of the most advanced type. The dissecting room will accommodate 36 tables, so that 180 students can work at once in it. It is lighted by skylights, and incandescent electric lamps are supplied for all the tables, so that work can be done in it by night as well as by day. The lecture rooms are large enough to accommodate 450 students each at one time. The clinic intended for demonstrations by actual operations includes the necessary rooms and the amphitheater to be the scene of many conflicts with accident and disease. The Maternity Hospital, severely finished in its interior with white marble, contains 30 beds free in perpetuity. The exterior of the buildings is of brownstone and brick. In the dedication, the leading members of the medical profession and many leading citizens participated.

The Nesting Spider.

Dr. M'Cook gave, before the British Association, the result of observations on the nesting habits of *Atypus niger*, a Florida spider. Referring to the original description of the black atypus of Florida, made by Hentz in his "Spiders of the United States," Dr. M'Cook said that a good drawing of the species had been made by an Englishman, Mr. John Abbott, as early as 1792. Mr. Abbott quite happily described the creature as the "purse web spider," and made a brief and correct note of its habits. The nests of the black *Atypus* are silken tubes of close texture, and various lengths and sizes, which are spun against the bark of trees, nearly equal portions being above and below ground. Some of the tubes are 12 inches to 14 inches long, and one-half inch to three-fourths inch in diameter. Others, the nests of the young, are a few inches long and the thickness of a pipe stem. The inside of the nests is quite white and clean, the outside is weather-stained and covered with sand. The mode of spinning these was described in the paper. The work is done in sections, the length of the tube being accomplished by adding to the original section until the desired length is attained. The new-made tubes were found covered on the outside with sand. The spiders were not seen in the act of sanding their nests, but a similar habit in *Atypus piceus* of England has been well observed and freely described by Mr. F. Enock, who made the interesting discovery that the sand is forced through the texture of the web from the inside.

The close relations were pointed out between the nesting tubes of *Atypus niger* and *Atypus piceus*. The chief differences seemed to be that the former suspends the exterior part of its tube against the trunk of a tree, attaching it thereto by threads, while the latter suspends it to stocks of grass and weeds, or trails it along the ground among the herbage. It was, said Dr. M'Cook, interesting to compare the nests of the group of spiders known as the tunnel weavers, to which *Atypus* belongs. Beginning with the great hairy spider, tarantula, the giant of the order, we have a simple burrow, whose opening is sometimes covering a patch of spinning work. Second in the series may be placed *Cyrtochenius elongatus*, whose nest is a silk-lined burrow, the lining of which is carried above the earth in the form of a funnel-shaped tube. In the nest of *Atypus piceus* this funnel appears at times as a long tube of nearly uniform size, extending horizontally along the ground. Next comes the nest of *Atypus niger*, already described, and then the trap-door spiders of various American and European genera.

After further tracing the tube-making habit, Dr. M'Cook mentioned a fossil spider which he had seen in the British Museum. This fossil was taken from the Eocene tertiary at Garnet Bay, Isle of Wight, and might be the distant progenitor of the present British species. It was evident that the genus has undergone little or no change since this, its first apparition.

The Soda Engine.

Referring to repeated recent statements that "soda" locomotives had been adopted for use in the streets of Minneapolis, Minn., *Wood and Iron*, of that city, says: During last winter and early spring some experiments were made with a so called soda engine, and the "soda engine" did make a few trips with a steam engine in attendance to help it out of difficulties. These "soda" engines were abandoned several months ago, after an expenditure of more than $50,000 in a vain attempt to make them successful. We do not believe that the failure was due to the use of soda, but to poor management, bad designs, and worse workmanship.