Mr. BRAIDWOOD, in answer to questions from the President, said the system described appeared to be a decided improvement on that of brick arches and iron girders, with timber floors. He objected to iron columns in warehouses: in case of fire, the draught of air and flame either speedily melted them, or so heated them, that they crumbled beneath the superincumbent mass, or else they were split by the water from the engines falling upon them. Under any circumstances they were fertile sources of danger to the firemen, as it was not possible to calculate upon the time they might resist the fire; whereas good solid timber posts endured for a long time, and the men being able to reckon something like their term of duration, felt more confidence in going into the blazing building. The water thrown on a timber support, if it had any effect at all, did good; whereas it generally accelerated the destruction of iron, or stone columns.

The great objection to wood floors, in dwelling-houses, was the facility they afforded for the fire travelling between them and the ceilings: this was obviated by Mr. Barrett's system, and it would thus tend to a greater amount of security, if it was more generally adopted. The number of detached rooms in dwelling-houses was always in their favour, especially if the floors were 'pugged.' Warehouses should, for safety from fire, be always divided into numerous compartments, communicating only through double wrought-iron doors.

Lieutenant JACKSON, R. N., suggested the use of Sir W. Burnett's system of saturating timber with chloride of zinc, which had the effect of rendering even fine fabrics of linen, or of lace, uninflammable. If this was adopted for the supports and floors of warehouses, their duration as well as resistance to flame would, at any rate, be increased at a trifling expense. The coverings of the steam boilers in H. M. Navy were ordered to be so prepared.

Mr. C. MAY did not think that any preparation would enable timber to resist, permanently, the action of flame, although the duration of the wood might be increased, which would be to some extent advantageous. In all the extensive fires he had seen, the iron columns appeared to have been melted with extraordinary

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/12/1853/266/2671556/imotp_1853_23988.pdf by gu

rapidity; but they became insecure long before they were melted; as at a certain stage of heating, cast iron crumbled to pieces. He thought that in warehouses the iron columns might be coated, for a thickness of 4 inches, by moulded bricks, set in cement, lock jointed, or with hoop rings; this precaution would, he believed, guarantee the columns from destruction, and be effective in keeping up the floors, particularly if they were constructed on the principle which had been described. He thought that precautions should be adopted against the effects of the expansion and contraction of so much iron, as these floors would contain, especially as, he conceived, it was meant to build the ends fast into the walls.

Mr. I'ANSON said he was trying this system in a house containing an area of about thirteen squares, with three stories above the ground-floor, and nearly 50 feet high; he employed wrought-iron joists, and when painted on the underside, he had no fear of the oxidation injuring the ceilings. The rigidity of the floors was remarkable, and he thought the system could be extended to the stairs, partitions, &c., with good effect. His only doubts were, whether it was not necessary to increase the usual thickness of the walls used in dwelling-houses, as he apprehended the weight would be considerably greater than timber floors; and also as to the advantages of the use of the system for roofs.

Mr. BARRETT, in answer to questions, explained, that the fusing of the cast-iron columns was occasioned by the unlimited supply of air, afforded by the ordinary timber construction, which occasioned a fierce draught like that of a melting furnace. One of the great features of the new system was preventing the possibility of such access of air to feed a fire.

The extra weight of this kind of floor was so insignificant as not to require thicker walls; the weight rarely exceeded 10 cwts. to 12 cwts. per foot-run of the walls.

It was not necessary that the joists should be painted, as the ceiling was worked upon the 'pricking-up coat' of plaster, and little, or no oxidation of the metal would take place; or if it did, it would not traverse the ceiling.

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/12/1853/266/2671556/imotp_1853_23988.pdf by gu

The comparative weights of various floors were about:—

Wood floor . .	35 lbs. to 40 lbs. per square foot.
Barrett's floor . .	78 ,, ,,
4½-inch brick arch .	70 ,, ,,
9-inch ditto . .	120 ,, ,,

Mr. PENROSE suggested, whether the question of the variations of length due to the expansion and contraction of the iron, merited consideration. Iron raised from the freezing-point to the temperature of boiling water, would, in a building 80 feet in length, expand about $\frac{3}{4}$ inch. Under the changes of temperature usually observed in this country, the alteration of length would not exceed $\frac{1}{4}$ inch, which would be unimportant, except that an ornamental ceiling might possibly crack by that change.

It had been stated, elsewhere, that the shrinking of timber had torn away piers from walls. Mr. Penrose thought it could not have arisen from contraction endwise of the fibre. In his measurements at Athens, the wooden rods he used were alternately very wet and very dry, and their extreme variation was $\frac{1}{400}$th of their length.

Mr. BARRETT explained, that as the expansion of iron from the freezing to the boiling point was about $\frac{1}{900}$th of its length, and as an ordinary room rarely varied more than 20° Fahrenheit, from the mean temperature, the expansion would not exceed ·03 inch in a length of 20 feet, even if the iron was freely exposed to the heat of the room, which, however, was not the case, as it was imbedded in mortar, which was an excellent non-conducting material; therefore he thought the effect of expansion and contraction might, practically, be disregarded in this climate.

Mr. EDINGTON said he had constructed the iron-work for the mill at Newry, mentioned in the paper; Mr. Richardson, the owner, had been determined, in the adoption of the system, not only by the apparent security it offered, but also by the absolute economy it effected, as compared with the usual construction of cast-iron girders and brick arches. If a thickness of 10 inches was gained in the depth of each floor, and the mill was five stories high, there was an economy of 50 inches of vertical

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/12/1853/266/2671556/imotp_1853_23988.pdf by gu

walling all round the mill. This would more than counterbalance any extra outlay on account of the weight of the floors.

The iron-work being completely buried in the concrete filling, was effectually preserved from being affected by any change of temperature, by oxidation, and even by the action of fire, to which the ordinary cast-iron girders and brick arches were imminently exposed.

The safest construction for warehouses was to have the walls of brick,—to divide the area into small divisions by walls traversing the floors,—to use Barrett's system for the floors,—to cover the whole with one, or several cisterns; and if there were any cast-iron columns, to clothe them with brickwork, and to make them act as water-pipes, with hose, &c., attached, so that the water supply might be immediately available, for extinguishing an incipient fire; this might also be done by a separate series of water-pipes in each staircase, and it would be in the power of a watchman to check a fire until the arrival of the engines. Double doors and shutters of wrought iron, with a body of air between, would materially assist in preventing the spreading of fire.

Mr. BARRETT said, attention was now so much directed to fire-proof construction, that he was certain this system must obtain the suffrage of both architects and engineers, and within a few years it would be a subject of astonishment how merchants, manufacturers, and private individuals could have gone on so long, without adopting such an evidently necessary precaution, as rendering their buildings at least moderately safe from casualty.

He also pointed out one useful application of the system, which had not hitherto been noticed; he alluded to covering the reservoirs of waterworks, for which it was peculiarly adapted. It had been used for a reservoir 60 feet by 40 feet, supported by a wall 9 inches thick, and covered with turf: and had been found to be a much cheaper construction than any other that had been tried.

Mr. J. SIMPSON, V. P., said the covering of reservoirs for waterworks was now becoming an important consideration, as it was required by the legislature, and it was found most advan-

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/12/1853/266/2671556/imotp_1853_23988.pdf by gu

tageous for the consumers of water, that the light and air should be excluded, in order to prevent the germination of vegetable matter, and the generation of animalculæ. He had now under consideration the covering of nearly twenty acres of reservoirs, and as the ordinary cost was about £10 per square, any efficient system offering, at the same time, advantage in price, was important. Some reservoirs had been covered by domes, at very great cost. Groined arches of brick were objectionable, on account of the weight thrown upon the pillars, or piers, which in clay, or even in chalk, sunk and caused leaks in the reservoirs. If Barrett's system could be employed at an expense not exceeding £4. 10*s*. or £5 per square, it would be extensively used for this purpose.

The system of water columns had been tried in warehouses, at Plymouth, and a difficulty had been experienced, in preventing leaks which injured the merchandize.

The proprietor of the New Hotel, at Carlisle, in which the floors were constructed on Mr. Barrett's system, stated, that during the late heavy gales, he had been surprised to observe the firmness and rigidity of the building, even up to the highest floor; while the effect of the wind upon a mill almost close to the hotel, was sensibly felt from the roof down to the ground floor.

If floors of this construction were found to have less vibration, under much traffic, than any other kind of floors, they would be very valuable for large public rooms, which it was now the custom to place high up in the buildings, and to light from the roof; this, however, had the effect of rendering all the rooms below very noisy, when the floors were left hollow, and there was a tremulous motion, which would be overcome by this new system.

Mr. H. A. HUNT had not hitherto employed Mr. Barrett's system; he had, however, only been deterred by the fear of the extra expense it entailed on the structure; it was possible, however, that this objection might now, by greater experience, have been remedied.

He had just completed two buildings for poor-houses, at Kensington and at Westminster, and in them he had adopted,

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/12/1853/266/2671556/imotp_1853_23988.pdf by gu

perhaps a less perfect system, but one which he considered effective, as far as regarded preventing the spreading of fire, although it was not of such solidity as to allow it to be employed in warehouses. The plan he alluded to was simply wrought-iron girders with tile and cement arches between them, and the floor above made good with either cement, or flooring-boards, as was deemed necessary for the particular use to which the rooms were devoted. The excess of cost, in a building, the contract for which was £23,000, was £600; and in the other contract of £8000, the excess was £200; giving, in both cases, fire-proof floors.

Mr. BARRETT explained, that Mr. Hunt was correct in supposing the floors could be more economically constructed now, than at the time he alluded to. He was sure that the tile-arched floor would be found more expensive and less durable than his concrete system.

Mr. RENDEL, *President*, agreed with Mr. Braidwood, in the advantage of the subdivision of warehouses, wherever it was practicable, and in the use of timber pillars, in order to secure their longer duration in fires, and to give confidence to the firemen; he had for these reasons frequently employed them.

The best system of construction of floors for warehouses and factories, where first cost was comparatively of little importance, was a subject well deserving more attention than it had hitherto received; and he would suggest a paper being written, giving an account of the principal systems tried in the large warehouses and factories of the maritime and manufacturing towns.

Cast iron was evidently an objectionable material, whether used as columns, or as girders. It remained then to be shown, whether wrought iron could be advantageously adopted; and he would direct attention to the present general use of that material for girders for house construction in Paris; as also to the good effects of the filling-in between the floors and ceilings, the partitions, staircases, &c., with rubble of the oolitic building stone, bound together with plaster of Paris. A floor thus formed was sound-proof, and also prevented the spreading of fire.

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/12/1853/266/2671556/imotp_1853_23988.pdf by gu

The system introduced by Mr. Barrett appeared to merit the attention of both engineers and architects, as there were numerous positions to which it was admirably adapted. He hoped that the subject would be followed by a more comprehensive paper on fire-proof buildings generally.

JENNINGS' SLUICE VALVE.

After the meeting, one of Jennings' Sluice Valves was exhibited in the ante-room. The improvement was stated to consist in simplifying the construction, by casting the "body" and the "faucet" ends in one piece, thus avoiding the use of bolts, nuts, and joints. The slide was first fitted, and made to work properly in the body of the valve; it was then removed, and with two gun-metal faces, was turned, ground, and accurately fitted. The slide, through which a small hole had been previously drilled, was again placed in the valve, the two faces were introduced, and all firmly bolted together. The joints of the faces, which were dovetailed to the body, were then made with lead, or with iron cement; the bolt was removed, the hole plugged, and the valve was completed, at considerable saving of time and cost. These valves were stated to have been extensively used under considerable pressures.

February 1, 1853.

JAMES SIMPSON, Vice-President, in the Chair.

The following candidates were balloted for, and duly elected:—Messrs. Benjamin Burleigh, John Evans, David Forbes, John Jay, Arthur Prentice, and John Trickett, as Associates.

No. 868. "On the Pneumatics of Mines." By Joshua Richardson, M. Inst. C.E.[1]

The necessity for good ventilation in mines is universally acknowledged, but unfortunately, very dissimilar opinions are

[1] The discussion upon this Paper extended over portions of two evenings, but an abstract of the whole is given consecutively.

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/12/1853/266/2671556/imotp_1853_23988.pdf by gu