of the metal in tie form is no obstacle to the construction of roofs and floors on the beam principle of concentrated metal, a part of my invention consisting in the making of segmental-arch floors by the use of brick beams combined with the arches. Where bricks are employed in combination with concentrated ties to form brick beams, as for example in the segmental-arch construction, a part of my invention consists in forming them with recesses or pockets to receive the ties, and with serrated, corrugated, or roughened surfaces to interlock with one another and give this additional security to the beam-structure during the period required for the hardening of the cement in the joints. . . .

The constructions thus far illustrated and described refer to buildings of ordinary size; but where the spans are great, as in mills and warehouses, the manner of constructing the beams admits of considerable variation, for they are needed, in part, under these circumstances to be fashioned as girders or short bridges, in order to carry a portion of the flooring in place of a wall. As commonly made of naked metal, such structures are liable to be injured by rust, and the bolts in some cases to be loosened by vibration.

My improvement in structures of this kind consists in protecting the metal by a complete incasement of hydraulic cement or concrete, the effect of which is to both protect the metal from rust and add additional security to every bolt in the structure, the grouting of the hydraulic-cement concrete filling every interstice of the metal portions, and thus producing a perfect union and solidity down to the smallest rivet or pin, making it impossible for any of the parts to work loose. This incasement may bear such relation to the metallic parts as to be a mere shield for the purposes mentioned; or the concrete may be so proportioned to the metal as to become a portion of the mechanical construction of the structure; whether girder or bridge, with reference to comprehessive strains. . . .

In ordinary house-construction it is a common practice to carry the front and rear walls upon girders, the cost of these girders adding materially to the expense of such walls; whereas, by adopting my method of construction, the portion of floor in contact with and underneath the wall may be regarded as a part of it, the metal ties in such portions of the floor serving as tie-metals to the wall itself, converting thus the wall itself into a girder. . . .

Again, it is the practice in common warehouse-building to break the span by a row of columns topped by a girder, to carry the floor in conjunction with the side walls, the whole depth of such girder being seen underneath the floor, and to this extent at that line lessening the head-room of the apartment underneath; but by my method of construction the girder and the floor become one, the girder not being underneath the floor, but a portion of it, and thus, to a large extent, lost to view in it. The consequence of this of course is to give increased head-room to the apartment below, besides improving the appearance of the overhead construction. . . .

In the practical construction of concrete and brick beams with tie-metals, as described, I have discovered by my experiments that these beams may be so made as to either break short, like a cast-iron beam, or give way by first bending, like a wrought-iron beam, the difference resulting from the proportion of tensile strength put into the beam—that is to say, where enough metal is used to make the beam strongest at the bottom.

By this mode of construction all danger of sudden collapse of the structure is avoided, such a floor, like one of timber, giving warning in advance of the final catastrophe. A part of my invention consists, therefore, in making the aforesaid floor, roof, and walking-surface constructions of concrete, or bricks and tie-metals, so proportioned, the one to the other, as to produce relatively the greatest strength at the bottom of the construction, the ties being stronger than the portion of the structure which resists compression. . . .

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MARINE BIOLOGY

Thousands of Animals Used Sponge As House

HUMAN BEINGS who live parasitically are often accused of "sponging," but in the warm waters where sponges grow these soft, inert masses of living tissue are themselves very much sponged upon. The extent to which other sea animals exploit sponges for lodging, and often for meals as well, is strikingly set forth in a recent study conducted for the Carnegie Institution of Washington by Prof. A. S. Pearse of Duke University.

Prof. Pearse removed an enormous sponge, as big as a washtub, from the waters near the Tortugas Laboratory of the Carnegie Institution, out beyond Key West in the Gulf of Mexico. He cut it up into thin sections, as one would slice a loaf of bread. Each slice was carefully examined for animals that might be lurking in it, and all these small uninvited lodgers were counted and identified. The total number of individuals was 17,128, approximately two animals for every cubic inch of the sponge's great bulk.

Highest in zoological rank were five little inch-long fishes, very slenderly built so that they could get about in the sponge canals. There were many worms and a number of barnacles. Most numerous, however, were shrimp of a strange species with one claw much larger than the other—in some specimens, almost as large as its body. There were 16,352 specimens of these shrimp.

A different kind of exploitation of growing sponge for protection is described by Dr. W. H. Longley, in charge of the laboratory at Tortugas. A crab that lives in the waters there tears off bits of living sponge and holds them to its shell until they take hold and continue their growth. Thereafter the crab has the benefit of concealment, enhanced by the inedibility of the sponge, which is full of disagreeable prickles and in addition has a most noxious odor.

Another crab which uses living animals as weapons is also described by Dr. Longley. This crustacean, which is an inhabitant of coral reefs in the Pacific, removes sea anemones from the rocks on which they naturally grow and sets them on its own claws. When threatened by an enemy, the crab shoves these claws with their living weapons in his face. The sea anemones as well as the crab may be regarded as gainers by this strange partnership, because they probably get more food by being moved about than they would if they were anchored to a stationary base like a rock.

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