SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) .... $3.00 a year
Scientific American Supplement (Established 1876) .... 5.00 "
American Homes and Gardens .... 3.00 "
Scientific American Export Edition (Established 1878) .... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, APRIL 28, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

EARTHQUAKE-PROOF CONSTRUCTION.

In the presence of the awful tragedy which has involved the wiping out of the capital city of the Pacific coast by earthquake and fire, it may seem like a trifling with terms to suggest that, in the rebuilding of San Francisco, it would be possible to render the new city earthquake-proof. In the broadest application of the term, such reconstruction would, of course, be impossible; but after a calm review of such facts as have come to hand regarding the behavior of the various types of construction which have passed through the ordeal, there are certain data which indicate that it will be within the power of the engineer and architect to build a second San Francisco, which, if called upon to do so, could pass through such another seismic disturbance without being completely overturned, or utterly ravaged by fire.

The most hopeful promise for the future is found in the admirable manner in which the steel skeleton of the modern steel-and-masonry building has passed through the terrific shock and wrenching of the earthquake. Although this result has been a matter of surprise to the average layman, it is not so to the engineer. Modern structural steel is possessed of such elasticity and toughness, that it will submit to the most severe and complicated stresses before it can be brought to the point of rupture. Evidence of this may be seen in the case of ships which have been in violent collision, or have been battered for weeks together on a rocky coast, and yet, after temporary patching up, have been brought into drydock for repair, and ultimately restored to first-class condition. Steel cars, which had been bent out of all semblance of their former shape in heavy freight wrecks, have been hauled to the shops and straightened out, to be again put in useful service. So with the skeleton frame of a steel-and-masonry building. If it has been properly designed, and if due attention has been given to the riveted connections at the intersection of the various members, it will stand an astonishing amount of rough usage before total collapse occurs. According to information at present available, it would seem that in buildings of this type at San Francisco, the wreckage directly due to the earthquake was confined to the loosening, and, in some cases, throwing down, of the brick or stone façades with which the buildings were covered in. Probably, also, it will be found that the interior partitions and the floors have, in many cases, suffered a similar fate. The loss of the walls, or paneling, was due to the fact that they were not homogeneous with the steel frame, but were merely attached to it by methods which were never intended to resist the enormous inertia stresses that were set up when the whole building was rocked by the earthquake. Evidently, if this disruption of the walls is to be prevented, they must either be bonded in more completely with the steel frame, or better yet, they must be made homogeneous or monolithic with the frame.

Now the last-named conditions are ideally present in the new form of concrete-steel or armored-concrete construction, which has made such rapid strides of late years in structures of the larger and more important class. As the results of most elaborate engineering tests, concrete steel has been proved to possess in the highest degrees those qualities of elasticity, toughness, and homogeneous strength which, when combined in a monolithic mass, present a structure as nearly earthquake-proof as our present methods and materials can make it. Similarly, and in even greater degree, the buildings of lesser height may be rendered proof against overturning or serious rupture; for the bending and shearing moments introduced by the sudden lateral movements of the earth decrease with the decrease of height.

It will be urged, however, that the earthquake was, after all, only the remote cause of the destruction of San Francisco, which is to be attributed immediately to the rupture of the water mains and the breaking out of simultaneous fires throughout the shaken district. But, on the other hand, it should be noted that if the buildings of the new city, and particularly those in the business portion of it, be built exclusively of armored concrete, with doors and windows of metal or fireproof wood construction, the initial fires would find so little that was combustible to feed upon, that the chances of a general conflagration would be very remote. Moreover, the ability of the Fire Department to cope with such local outbreaks would be greatly assisted by an elaborate provision of an independent fire-service tank, of extra large capacity, at the top of every building. It may be taken for granted that no system of underground water mains will be able to withstand an earthquake shock of this magnitude. Therefore, all measures that are devised for the future protection of the city should include as an indispensable feature the provision of an independent water supply for each building. If the new city be built of absolutely fireproof construction, this system of local water supply should prove equal to any emergency.

As regards the residential and suburban districts of San Francisco, which as we write are being steadily swallowed up by the ever-increasing circle of conflagration, it would be advisable, for similar reasons, to build the hotels, apartment houses, and more pretentious private residences of reinforced concrete. This could be done for the same, and possibly less, cost than if they were rebuilt in stone or brick (to build them in wood, after the present experience, would be simply suicidal). There is nothing in the nature of concrete construction to prevent the incorporation in such buildings of ample decorative and architectural effects. As regards the more modest suburban homes and cottages of the remoter suburbs, the question of building even these of concrete or concrete-steel will be well worthy of consideration by the municipal authorities. The relative cost of wooden and concrete cottages and villas is, of course, determined largely by local conditions, and depends upon the cost of cement and the availability of sufficient supplies of sand, and stone suitable for crushing. Here, in the East, where lumber is more costly than on the Pacific slope, it has been found that in suburban homes the increased cost of concrete construction runs about 15 or 20 per cent. On the Pacific coast, where lumber is cheaper, the difference would be greater; but should it be decided to rebuild San Francisco on the lines suggested, the enormous market for cement that would be thus afforded, would probably result in a competition that would lead to a considerable lowering of the price.

In any case, it is sincerely hoped that before beginning the reconstruction of San Francisco, the municipal authorities will lay it down as an indispensable condition, that the city must be built with special provision for the recurrence, in their most violent form, of seismic disturbances. First among the building restrictions to be improved should be one prohibiting, at least in the business sections of the city, any but the most approved fireproof construction.

SUBWAY VENTILATION BY AIR VALVES.

The very thorough investigation which the Chief Engineer of the Rapid Transit Commission has been making of the problem of ventilation of the Subway has resulted in his recommendation that a series of louvers, or automatic ventilating valves, be installed in the roof of the Subway. Contrary to the popular impression, based upon last summer's extreme discomfort, it has been established beyond a doubt that the "stuffiness" of the Subway is not due to a lack of purity in the air, which is about as good as that on the street surface, but to the most uncomfortable heat which is developed during the sultry season. This heat cannot be reduced to any appreciable extent by the movement of the trains, for the reason that there is a constant and considerable outflow of heat from the motors of the trains themselves; and this is so great that the limited exchange of air between the Subway and the surface which now goes on is quite inadequate to cope with it. The Chief Engineer, Mr. Rice, has stated to the Commission that to improve materially the conditions, the air must be renewed more frequently than at present throughout the whole Subway, and at the same time, recourse must be had to some method of cooling it. It is recommended that provision be made for exhausting the air at points midway between the stations, thereby causing an inflow of air through the station openings. By this means the freshest air would be found always at the stations, and the iron dust thrown off from the brakes would, much of it, be drawn into the interior and out through the exhaust openings there provided.

The proposed automatic valves, which would be located in the roof of the Subway, would depend for their operation upon the movement of the trains. The greater density of the air in front of a moving train will cause the valve to open automatically, emitting the hot air, and as soon as a train has passed a given valve, the latter will close of itself. The experiments which have been carried on between Columbus Circle and the 66th Street station prove that approximately 20,000 feet of air per minute is discharged through 100 square feet of louvers during the hours of maximum train movement; while from 1 A. M. to 5 A. M., when very few trains are running, only about 5,000 cubic feet per minute is discharged. It is suggested that while, during the busy hours, the train action would be sufficient for ventilation, supplementary means should be provided for introducing fresh air during the night time, when the train action is infrequent. For this purpose it is suggested that fans be installed to operate during the night season, and replace the heated air by the colder air from the outside. It is proposed to install fourteen valve and fan chambers between Brooklyn Bridge and Columbus Circle, and to make them of sufficiently large capacity to serve as exits in case of emergency.

THE "KEARSARGE" DISASTER.

The lamentable disaster which occurred on the battleship "Kearsarge," at the close of target practice, as the result of which seven officers and men were immediately killed, and others are not expected to survive, occurred on the anniversary of a similar accident, which resulted in the loss of thirty lives, on the battleship "Missouri"; and, strange to say, it occurred under very similar conditions. It will be remembered that during target practice on the "Missouri," when the breech of a 12-inch gun was opened, there occurred what is known as a "fire-back"; that is to say, the remaining gases in the bore swept back into the turret, ignited, and set on fire some powder which was in the hoist behind the gun. The burning mass fell down to the handling room, where it ignited other powder bags, and resulted in the terrible loss of life referred to. In the case of the "Kearsarge," whose main battery is in double-deck turrets, with a pair of 13-inch guns in the lower turret, and a pair of 8-inch in the upper turret, it seems that three powder bags were being lowered to the magazine below decks, on the vertical cableway, which forms the ammunition lift. A charge was being drawn from one of the 13-inch guns at the time that this powder was passing through the lower turret. According to a cablegram from Rear-Admiral Evans commanding the Atlantic fleet, it would seem that the accident was probably caused by fused metal from an electric switch, which was short-circuited by accidental contact with a shell-extractor. This metal fell upon the powder as it was passing down the hoist. The canvas bags containing the powder are made of a material which is constructed with a view to its rapid combustion when the charge is fired, and no doubt the canvas quickly caught fire, igniting the charge and producing the disaster.

The "Kearsarge" is one of the older ships of our new navy, whose designs were drawn something over a decade ago; and there is some measure of satisfaction in learning that the improved electric-operating gear in the turrets of our later ships is so constructed that a repetition of this accident would be impossible. The disaster must be considered as one of the penalties that must be paid for the great elaboration of apparatus which has been found necessary for the rapid handling and firing of modern naval ordnance. The presence of electric mechanism in the turret, in close proximity to large charges of powder, constitutes an element of danger, as this accident has so tragically shown. If such accidents are liable to happen during peaceful target practice, it is evident that the risk will be proportionately greater when the turrets are subject to the shock and possible penetration of armor-piercing high-explosive shells. Our naval constructors have paid particular attention to the question of preventing such accidents as have happened to the "Missouri" and the "Kearsarge;" and in the "Louisiana" and "Connecticut" an effective system of automatic fire screens has been installed, which will localize, if it does not entirely prevent, accidental ignition of the powder. There is, in any case, a certain risk involved in passing the unprotected powder bags up and down in close proximity to the breech of the 13-inch guns; and we have no doubt that steps will be immediately taken to thoroughly protect the 8-inch ammunition in its transit through the 13-inch turrets. The subject is of very vital importance to our navy; for, unfortunately, the double turret has been installed on the five large battleships of the "New Jersey" class. The double turret was an experiment which has not by any means proved to be the success that was anticipated. It has been abolished from our latest designs and it is certain it will not be repeated in any of our future ships.

An efficient tool-room is a requisite of a good shop. The machines in this department should be high-class, otherwise their imperfections will be reproduced in the tools. In the larger shops it is the duty of the tool-room not only to see that certain tools are on hand for doing the work, but to see what jigs or other fixtures could be made to cheapen production, and to consider in general the best way to handle any special job.