ago. Only last week a leading Russian newspaper, the *Novosti*, frankly stated that "the Franco-Russian Alliance is a guarantee of the political equilibrium, not only in Europe, but also in Asia, inasmuch as it enables the two powers to counterbalance British influence in Afghanistan and Siam." Of course we know what the Russian idea of "political equilibrium" in Asia means, and we have lately had a striking illustration on the Mekong of the Russification of the French in this respect. But the danger of the Franco-Russian Alliance with regard to ourselves is not altogether prospective. Already it has out-manuevered us to our hurt. In Asia it has placed us between two fires, and we have now on the Burmese frontier a menace analogous to that which stares us in the face through the Hindoo Kush. In Europe it threatens our command of the Mediterranean, which is one of the conditions of the integrity of our empire. One eminent naval critic at least is of opinion that, when the Russians have a *piéd a mer* in the Mediterranean, we shall have to play second fiddle in that sea to the Dual Alliance. This is, beyond question, a serious state of affairs, and it is scarcely sufficient to be assured—as we have been lately by means of the Taranto and Spezzia festivities—that the government is alive to the dangers of the situation. So much, however, is shown by the visit of the British Mediterranean Squadron to Italian waters, and by its enthusiastic reception by the Italian people, if the necessity should ever arise Great Britain would easily find means of defending herself in the present grouping of the powers. Is it, however, quite worth the while of France to make Englishmen contemplate even the possibility of ranging themselves with the Triple Alliance?—For the above and for our illustration we are indebted to *The Graphic*, London.

AMERICAN GRAIN ELEVATORS.*

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THE handling of cereals on a vast continent naturally becomes a problem of not only national but universal prominence, and ever since the forties it has been considered one of the principal problems encountered by the commercial element of the United States. Realiz-

weighed in farmers' wagons and dumped into a pit, elevated, stored and for shipment re-elevated, weighed in a hopper scale and spouted into a car. The accompanying plates explain themselves, and, as there is nothing that can interest an engineer in their construction, no further reference will be made to them.

The Construction of Storage Elevators.—The want of additional storage at a railroad terminal is usually dictated by immediate demand, and for this reason this class of elevators is constructed usually with greater attention to cheapness and rapid completion, combined with strength, than to mechanical details. There have been cases where the problem has been put to an elevator builder in this way: "We want 3,000,000 bushels of storage, with a handling capacity of 200,000 bushels per day, constructed complete within 45 days; can you do it; and at what price?" If the builder says, "Yes; I can do it at 5 cents per bushel," the contract is signed and operations commenced at once. An excavation is made about 18 in. deep, if in clay or sand, and the same covered with hewn railroad ties in such manner as to get the entire surface as a basis for the superimposed load. Three or four timbers are laid side by side in bents from 11 to 14 ft. apart across the ground, and from 12 to 50 ft. longitudinally. Short cross corbels are rested thereon, supporting cross and longitudinal timbers, upon which the cribbing is spiked. The cribbing consists of pieces of 2 × 8 or 2 × 6 common pine or hemlock, usually surfaced one side and one edge, laid flat on the top of each other and spiked with 30d. spikes every 12 in., zigzag. The first two cross bents of the elevator are usually built on posts, so as to form a working floor from 20 to 28 ft. wide across the width of the elevator. Here are located the elevator legs or vertical grain conveyors, at a distance of from 36 to 40 ft. from center to center, according to the length of the freight cars. These legs extend into the ground about 12 ft. from the working floor, so as to be able to take grain from a receiving hopper, extending to a point between the rails of a track running alongside the front of the elevator as close as the cars will permit. The angle of the receiving hopper with the horizontal is in the neighborhood of 35°, or 2 to 3, so that the corners of the receiving hoppers will clean themselves of oats. The height of the planking in the rear or storage part varies considerably, according to the value of the building site, and runs from 40 to 85 ft. in height. Above the planking, *i. e.*, above the bin floor, a so-called cu-

good practice to drive a few piles on each side of each tank and cap them with timber in such a manner as to bridge the tanks.

As for the time, the principal item in rapid construction of this kind is to get the material on the ground. The planking or cribbing can be done at the rate of 6 to 7 ft. a day; so the main structure, from the top of foundation to the bin floor, can be finished in 12 to 15 working days, when properly managed.

Where the bins or grain reservoirs are more than 12 × 16 ft. area, they should be rodded. A good rule for calculating the rodding of a bin is to imagine a bin filled with grain, turned over flat and the side suspended by rods running through the grain. As the rods should not exceed $\frac{3}{4}$ in. or $\frac{1}{2}$ in. diameter steel, it gives a space between the rods in large bins of about 5 ft. square. Formerly the practice was to increase the diameter of the rods toward the bottom of the bin, but it has been proved that the horizontal pressure in a bin is practically constant from within 15 ft. of the top to the bottom. The reason for this is that grain such as corn, wheat and oats in bulk forms a peculiar bridging, leaving the pressure on the bottom, under ordinary circumstances, constant for any height above twice the width of the bin.

Experiments have given the load on an equilateral bin bottom as very nearly equal to the weight of a paraboloid of a height 1.8 times its base, and this fact led the writer to make the bin rods the same diameter from bottom to top of bin, with good results.

In some of the older elevators, where the bin rods at the bottom were from 1½ to 2 in. diameter, it has been found that the down draught of the grain in unloading the bin bent the rods and pulled the washers into the bin walls, while the $\frac{3}{8}$ to $\frac{1}{2}$ in. rod seems to cut through this suction without damage. But for this peculiarity of grain, the construction of bin bottoms would present great difficulties, the static load figuring up to 4,000 lb. per square foot.

Railroad Transfer Elevators.—The second class of elevators are the railroad transfer elevators. Some State legislatures have during the past few years passed acts compelling railroads to give hopper scale weights on transferred grain, and as a result a number of transfer houses have been built, handling from 100 to 300 cars per day. Their construction presents few difficulties, as they have no storage capacity whatever.

Two tracks run entirely through the building, the

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ing the importance of making a *resume* of the progress of construction of American grain elevators as short and concise as possible, owing to the large number of papers to be brought before this distinguished assembly, the writer will confine himself to a description of modern elevators merely, without touching upon the history of grain handling in America any more than is absolutely necessary.

The *modus operandi* of a grain elevator is about as follows:

1. A power car puller sets a string of cars each opposite an elevator leg, or vertical grain conveyor, located about a car length apart.
2. Car doors are opened, two shovelers enter each car and handle each a shovel operated by rope from a power shovel shaft in the elevator.
3. The grain drops into a receiving hopper, is elevated in buckets bolted to a rubber belt 150 ft. to the top floor of a cupola, where it is discharged in turning over a head pulley into an accumulator or garner, and thence into a weighing scale.
4. From the scale the grain is spouted:
 - a. On conveyor belts running horizontally and discharging over movable trippers into storage bins. (Storage elevators.)
 - b. In car spouts for reloading or transferring. (Railroad transfer elevators.)
 - c. Directly into storage bins.
 - d. Into shipping bins with dock spouts, to be loaded into vessels.
 - e. Into car spouts. (Terminal elevators for rapid handling and storage.)
 - f. Into garner above cleaning machinery. (Cleaning elevator.)
5. When the cars are empty the shovelers take with them the power shovels across the working floor (about 14 ft.) to a string of cars set in on the opposite side of the elevator, where the performance is repeated, while the first string of empty is being replaced by loaded cars.

In addition to the four classes of elevators mentioned, we have the marine elevators receiving grain in bulk from vessels—usually by means of one stationary and one movable marine leg—so as to unload two hatches simultaneously. The grain is elevated into a garner, weighed and re-elevated or spouted on conveyors into storage, or transferred into cars.

The sixth class of elevators are the small country houses or railroad station elevators, where grain is

polished is erected directly over the space before designated as a working floor. In this cupola a series of scales for weighing the grain received or shipped is located, and inasmuch as, particularly in shipping, the elevator legs, receive grain all the time, it is usual to locate, immediately beneath the discharge spouts of the elevator legs, a garner or accumulator above each scale, for the purpose of receiving the grain while the scales are weighing and unloading. Another system of somewhat older date is to use two scales, called twin scales, for each elevator, accomplishing the same purpose. On the bin floor immediately beneath the scales and extending longitudinally with the elevator is a series of grain conveyors, consisting simply of endless belts varying in width from 16 to 40 in., on the upper line of which is located a so-called tripper, which is movable on a track running from one end of the elevator to the other. In receiving grain it is spouted down on said conveyors, and the tripper is located above the bin or reservoir in which the grain is to be stored. The speed of these belts in modern elevators is about 700 to 800 ft. per minute, and although the surface of the belt is perfectly flat, the cohesion between the kernels of grain is such as to gather the grain toward the center of the belt in such manner that from 2,000 to 20,000 bushels per hour can be conveyed. The bin bottoms in a storage elevator of this kind are usually flat, consisting of 3 × 14 joists, placed about 9 in. on centers, and covered with 2 × 6 dressed and matched flooring. Sometimes this floor is laid directly on the ties on sills, but this practice is not to be recommended, as it leaves less chance for ventilation. For unloading the grain from the elevator, belt conveyors are located along the bin bottoms at convenient distances, so as to reach the front receiving or shipping legs, and are covered with planking or cribbing, or planking on the sides with timbers overhead, in such manner as to form tunnels extending from the working floor to the end of the elevator.

In receiving grain from the cars, a train consisting of as many cars as there are receiving legs is detached by means of a power car puller from a string of from twenty to thirty cars sent in by a switch engine. Owing to the different lengths of the cars, they are detached and "spotted" or located each opposite a receiving leg. The exterior covering of a storage elevator is usually of corrugated iron, with a tin or aluminum alloy roof.

Inasmuch as the elevator legs must extend some 8 or 10 ft. into the ground, they are located in steel tanks of $\frac{1}{2}$ to $\frac{3}{4}$ material, and, to prevent the collapse of these by the pressure from the superstructure, it is a

elevator machinery being placed in the platform space between the tracks. The cupola, with the elevator heads and scales, is located exactly above the first floor, at a height to give sufficient fall, through car spouts, to trim or fill the cars without the use of manual labor in the cars.

Terminal Elevators.—The third class of elevators refers to terminal houses for storage, rapid handling and shipping, either by lake and rail or both. In general, these houses are termed "up houses," *i. e.*, they are entirely built on posts, in such manner as to form a large working floor beneath the entire storage area. From three to four railroad tracks are run through the entire length of the house, and, according to the number of cars the house can unload simultaneously, they are termed 5-car, 8-car, 10-car houses, etc. The most modern construction locates all receiving and shipping elevators in one line, with receiving tracks on each side, thus occupying the three center bents of the elevator. The loading tracks are usually located in the outside bents, while, of course, the center tracks are arranged for shipping purposes. Owing to the size of the car, the transverse bents in the house are at least 13 to 14 ft. each, which makes the house either 56, 70, 84 or 98 ft. wide. Longitudinally the bents usually are in succession, 12, 12 and 14 ft., leaving the elevator legs at a distance of 38 ft. from centers. At the end of the elevator the power house is located, in such manner that one of the loading tracks passing through the house also passes the engine house, so that coal may be received from one end while grain is loaded into cars going in an opposite direction. All bin bottoms in a house of this description are hopper bottoms, and all bin openings of a diameter sufficient to fill elevator legs or conveyors to their full capacity.

A modern rapid working terminal elevator is equipped with the very best machinery, electric lights, fire pump and service, passenger elevator, dust collectors and floor sweepers—in short, all contrivances that will lighten or lessen labor and promote rapid handling of the grain. As the entire building rests on posts, the loads are concentrated at certain points. The load per pier varies from 300 to 450 tons, and as the safe bearing capacity of the soil seldom exceeds 2½ to 3 tons, piling is resorted to, with cross and longitudinal oak grillage and stone piers. As the entire load of grain is thrown on the bin walls, the girders supporting these walls between the clusters of posts must be of a very strong construction, usually two 12 × 14 long leaf yellow pine or oak sticks, on top of each other, supported by white oak corbels braced back into the

* From the Transactions of the American Society of Civil Engineers.

posts below. Formerly the entire basement was taken up by stone piers and elevator tanks, but the tendency is now toward using less stone and extending the posts into the basement, leaving it open and concreted smoothly, so as to enable the removal of the dust and the admission of light below the first floor. Fireproof construction of the first floor and basement is much to be recommended, although it materially increases the cost of the elevator.

Cleaning Elevators.—Under the head of cleaning elevators we encounter the most complicated construction and the greatest variety of details. The writer will, however, confine himself to what has been adjudged the most improved arrangement.

The receiving department of a first-class cleaning elevator is practically that of an up-house or handling house, as may be seen by referring to the accompanying sketch. Between the first and bin floors is, however, inserted a cleaning floor, a separate department with garners above and garners beneath. In this manner the grain from the scales is spouted into the garners; thence, by gravity, through the cleaners into the lower bins, whence it is elevated and spouted into storage, shipping bins or car spouts. By enabling a number of small bins overhead and below the cleaning floor to communicate with the cleaners, it can readily be seen that any mixing or grading can be done without difficulty.

If cleaners are located on first floor or bin floor, elevator legs are required for either taking away from or supplying the cleaners, and as the capacity of a leg is 5,000 to 6,000 bushels per hour, while a cleaner only averages 2,000 and an oat clipper 500 bushels, it is clear that there is a waste of machinery in this arrangement.

The dust from the cleaning machinery is blown into separators or cyclones, and exhausted by a powerful

years. The most approved method to-day is a high speed engine with manila rope transmission from the engine to the last piece of machinery in the elevator. In a cleaning house the cleaner shaft should run about 250 revolutions per minute, as the cleaning machinery runs at a speed from 400 to 550 revolutions per minute, and the engine from 100 to 150 revolutions per minute. A direct rope transmission from a main line shaft in the cupola to each of the elevator head pulleys is found to give satisfaction. The usual practice is to have eight strands of 1-in. rope for each transmission, the rope speed being only about 750 ft. per minute. It is very important that all the machinery in an elevator be strictly first class in every respect, as any hitch or slip in the driving gear is sure to cause serious chokings of the grain where it enters the elevator leg.

Grain elevators are usually covered with either brick or iron; in case of brick the unevenness in the settling between the exterior brick shell and the main structure is taken care of by means of anchors with slip joints, permitting the planking to go down 12 to 24 in. without disturbing the tie between both parts. In case of corrugated iron covering, the sheets are put on with corrugations running vertically, and nailed 4 in. from the lower edge only, so that the shrinkage of the planking is taken care of separately for each sheet.

The best roofs are probably the 1. C. old process charcoal tin, although last year a large cleaning elevator was built with a roof of aluminum alloy metal, greatly reducing the weight and having the advantage of not requiring painting.

The principal requirements of a grain elevator, namely, strength, tightness, light and effective and accessible machinery, are such as to invite the attention of engineers; and before closing the writer wishes to say that the handling and storing of grain, both in the interior

in any great tributary. There was no natural cause for this unprecedented and dangerous high water. The condition was artificial; it was imposed upon the river by experimental and unscientific constructions. It was the reflux of waters, caused by the jetties in the mouths of the Mississippi and by the spur dikes in the channel at New Orleans. No other cause can be found under the heavens for the dangerous high water condition at New Orleans on April 5, 1892."

From an intimate knowledge of the condition for nearly twenty years, having had charge as resident engineer of the works in the Mississippi at its South Pass outlet, I can state positively that these works have had no effect whatever upon the flood height of the river at and above New Orleans, or, in fact, between New Orleans and the Head of the Passes, 100 miles distant from that city.

I am equally confident that the spur dikes placed in the river at and near New Orleans have had no effect upon the flood height.

The top of the maximum flood at New Orleans is about 17 feet above mean Gulf level found at the mouth of the Passes, about 115 miles below New Orleans. This mean Gulf level is scarcely two feet below the level of the narrow ridge of land along the immediate banks of the river in its lower reaches, and is about the level of the mud flats just back of this narrow river ridge of deposits. There are two free outlets within a short distance above the Head of the Passes; one, "Cubits" crevasse, three miles only above these "dams" spoken of in the article, which, at the time of building them, was half a mile wide and 60 feet deep. The former was in recent years nearly as large.

If the "dams" had raised the water to any appreciable extent and prevented its free flow to the sea by the three passes, it would have at once sought relief

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fan and blown into a large separator located directly above the boiler furnaces, where the dust and chaff form a material part of the fuel. The floor sweepers before alluded to consist of 6 in. suction pipes extending to the floor, where a nozzle is attached, flat-flared out, with a sliding gate. Any sweepings are brought in the vicinity of the nozzle, the gate is pulled out, and the sweepings are, a few seconds later, consumed in the boiler furnace.

In a similar manner the dust from the elevator heads, garners and hoppers is disposed of. The surplus air from the fans in the cleaning machinery is thrown into a couple of large air conduits discharging above the cupola roof.

The storage of a cleaning elevator of this description consists of an annex, loaded and unloaded by means of belt conveyors. The annex should have hopper bottoms, and is shown in the accompanying plate built on ties, while the front or cleaning part is built on piles. Owing to a certain shrinkage in the planking, or cribbing, many difficulties are often met where an up-house joins a low annex, as while the posts in the former retain their length, the planking in the low annex shrinks several inches in the same height. This is usually remedied by giving the cross timbers running into the annex a corresponding camber, so that when the house has settled it will be nearly level.

Some builders erect the entire cupola of any elevator on independent posts extending through the bins, to counteract any influence of the shrinkage on the driving machinery, but the writer's experience is that the cribbing shrinks so evenly that no material trouble occurs on this score, so that he considers it advisable to build the cupola directly on the cribbing.

As to the driving machinery in grain elevators, it has changed materially during the past six or eight

and at the lake and ocean terminals, presents a wide field for future discovery and improvements. Some of the immediate wants are: larger capacity cleaning machinery, adequate drying apparatus, automatic weighing machinery, fireproof bin construction, and pneumatic unloading of cars or vessels with a view of greater capacity per hour than can be obtained at present. And last, but not least, a general use of electricity for driving isolated parts of machinery, or, perhaps, for transmitting power to every piece of machinery in the entire elevator.

The main principles which must be kept in view while making these improvements are rapidity and economy of construction, and a reduction of the labor employed in the handling of grain in American grain elevators of the future.

THE JETTY WORKS AT THE MOUTH OF THE MISSISSIPPI RIVER.

To the Editor of the Scientific American:

In your issue of November 11 is an article on "The Mississippi River," by William L. Elseffer, C.E.

I do not intend to go into the details of the discussion at this time, as these, so far as the river above New Orleans is concerned, can be better stated by some one representing the Mississippi River Commission, which has charge of the work.

I wish to take issue now only with one or two statements of the author of the paper. He stated as follows:

"Here then is presented this most anomalous condition: a dangerous flood beginning in the Mississippi below, near its mouth, while yet no dangerous flood has appeared at any station elsewhere in the river or

through these crevasses and kept them to their full size, which it did not, or made others immediately, for the bed and banks of the river here are composed of material moved with the greatest ease by any acceleration of the current. I stated this clearly in my history of the Mississippi jetties; see chapter x. and elsewhere.

The almost immediate effect of placing obstructions in the head of South Pass was the deepening of the two large passes on each side, which carry to the sea ninety per cent. of the volume of the main river.

The "dams," so called by the author of the paper, but more properly called "sills," for they were only two feet thick in a river 30 feet or more in depth, did no more than restore the natural conditions, for Southwest Pass had deepened over two feet and Pass à l'Ouvre over three feet before these sills were laid. The only object of these sills was to restore to South Pass the volume of which it had been depleted by the dikes that had been built in the head of this little pass.

The above details are given to show how unreasonable is the statement quoted from the article we are reviewing.

From examinations, levels, and continuous study of the abstruse hydraulic problems involved at this point, I can assert that no results whatever in raising the river one inch at New Orleans have ever proceeded from any of the works at any time placed in the passes of the Mississippi River.

And the author is equally in error in treating of the proposed improvement in the Southwest Pass, which Capt. Eads so earnestly desired to improve that his disappointment is not being able to do so was one of the keenest of his life.

All that the company, which is organized for this purpose, desires is that the natural, normal volume of this pass be given it. This the pass now has and will