well afford to provide its inventor with unlimited resources and promise him a prize in case of success, running into the millions."

But the Government saved \$970,000 and got a machine which eclipsed the most sanguine hopes. The Board of Ordnance and Fortification, strangely enough, allotted the funds which made possible the contract with the Wrights, Congress having failed to authorize the 1908 aeronautical estimate of \$200,000.

Twenty-two bids in all were received within the time limit. This is the first time they have been published. They were as follows:

Geo. W. Schultz....	\$30,000	A. M. Barker.....	\$850
Brown & Swingle...	5,450	A. E. Moline.....	1,389
R. G. Dressler.....	5,000	E. H. Young.....	5,000
O. M. Preston.....	20,000	Jno. M. Kairies....	30,000
A. F. P. Stenzy.....	10,000	Fred C. Schwartz...	10,000,000
W. R. Gordon \$40, \$50 and \$65 per pound		Wm. Harper, Jr....	20,000
L. J. Brown.....	15,000	Frank & Hedden Co.	500
John F. Cavanaugh.	55,000	Chas. B. Nichols...	52,568
J. J. P. Boatman, 7,000 per ton lifting capacity, 1-10 tons		A. W. H. Grieppe...	25,000
Chas. M. Wanzer....	\$1,000,000	James F. Scott.....	1,000
		A. M. Herring.....	20,000
		Wright Brothers....	25,000

One bidder stated his machine would sustain itself in the air without any machinery whatever and ascend from any ordinary place in calm or storm. Only 30 days were required by one man to deliver his machine, while another thought five years ought to be allowed, as it was a big undertaking, this first production of something the world had never seen. One of these, whose bid was extremely low, set forth his specifications simply, as follows:

"Speed 100 miles per hour (arc planes silk, aluminum bands, steel wires and paper). Surface of airplanes two 7 x 11 feet, three ground wheels, two guyre scope wheels, one blower, speed 1,000 revolutions per minute, engine and everything complete, ready for flight with two men, 700 pounds."

Another offered an "airship carrying 15 men at a speed of 40 miles an hour, fuel for 3 days, with a 25-horse-power motor." This is rather better than the record up to 1919, but, as the bidder wrote on his bid, "Bei Gott sind alle Dinge möglich."

Of these offers three were accepted:

Wright Brothers	\$25,000
A. M. Herring's.....	20,000
J. F. Scott's	1,000

None of these bidders save the Wrights have ever flown power machines, so far as is known, and only one airplane was ever delivered for test, though A. M. Herring obtained several extensions of time. Scott was not awarded a contract.

The Wright flights of July 27th and 30th, 1909 were not the first, however, under the contract, for on September 30th, 1908, official flights were begun at Fort Meyer, near Washington, to fulfill the conditions imposed in the contract. The sad death of 1st Lieut. Thomas E. Selfridge, the passenger, and the serious injury to Orville Wright, the pilot, as a result of a 75-foot fall during one of the trials, postponed further flights for that year and necessitated a nine months' extension of time. The death of Lieutenant Selfridge, whose monument may be seen at Arlington Cemetery, was the world's first airplane casualty.

While Orville was starting his flights in the Army airplane in September, 1908, Wilbur Wright was flying in France. On the last day of the year he made a record of 77 miles in 2 hours, 20 minutes, which stood until August, 1909.

After the delivery of the Army airplane on July 30th, 1909, Orville Wright went to Germany, where a company had been formed similar to those in France and England. Wilbur Wright remained to teach the United States' first Army fliers, 1st Lieutenants Frank P. Lahm and B. D. Foulois.

In addition to the formation of the world's first military aviation force, there are some other reasons why July, 1909, should be remembered in the flying world. Bleriot, the lamp manufacturer; the automobile racing driver, Henry Farman; Hubert Latham; Delagrangé; the airship mechanic Louis Paulhan, and Roger Sommer were daily making new individual records in France, though none yet equal to the achievements of the Wrights. Colonel F. S. Cody, an American of the British Isles, was making short hops in England as was A. V. Roe, originator of the now famous Avro training machine.

On July 25th, Bleriot made the first airplane crossing of the English Channel from Calais to Dover, in his own famous monoplane—31 miles in 40 minutes. Latham made his second attempt to cross the channel on July 27th and for the second time landed in the water, though within two miles of his goal.

Glenn H. Curtiss, on July 5th, was flying for the benefit of the citizens of New York at the world's first open air meet, at the world's first club aviation field, on the old

The self-centering lock-joint

A, Joist or stud. B, sill or plate. The tenons are oppositely faced at the ends of the joist or stud. This obviates any right or left so that either end will fit into the designed mortise.

Morris Park racetrack, which had been leased by the Aeronautical Society, organized to give embryo fliers a place where their machines could be built and tried.

Charles F. Willard, the airplane manufacturer, began his career in 1909 and it was at the Aeronautical Society's field that he built his first plane. It was unfortunate that this was too big to be got out of its shed on the day of the exhibition but that was the fault of the shed.

In this month Curtiss forever established his reputation as an airplane pilot when, on the 15th, he flew 52 minutes and covered 25 miles in the Aeronautical Society's airplane at Mineola, his longest flight to that date. The previous year on the 4th of July he had won the SCIENTIFIC AMERICAN trophy by making a flight of a little more than a mile in his biplane the "June Bug"

Model of a section of standardized construction consisting of elements of definite dimensions which can be assembled with one-third the usual number of nails. Only one tool is required—a hammer

and the 25-mile flight gave him the trophy for the second time. The next year by a flight of 74½ miles without stop he came into permanent possession of the cup. It might be appropriate to mention here that while the Wrights were delivering their first Army airplane to a world power, Curtiss was delivering the first commercial machine of record to the Aeronautical Society which had been contracted for the year before while Curtiss was experimenting in Hammondsport as a member of Dr. Alexander Graham Bell's Aerial Experiment Association.

After his 25-mile flight, Curtiss started on the instruction of Charles F. Willard, one of the society's members, who, under the terms of the purchase order, was one of the two selected to be taught the art of aerial locomotion. Thus was inaugurated the first flying school in the world.

All over the United States there was great activity. Every youth of mechanical trend of mind was reading the few aeronautical magazines of the world and building airplanes of his own or some one's else design. There was a demand for aviation motors which no one could supply, not even Curtiss.

Many old timers in aeronautics have dropped out and gone their unknown ways and some have died in traveling the new way. Others have continued, of whom many have achieved prominence. Lieutenant Foulois, now Brigadier General, was the first Chief of Air Service of the American Expeditionary Forces; Lieutenant Lahm, as Lieutenant-Colonel, was Chief of Air Service of the Third Army, A. E. F.; Major C. McK. Saltzman is now Brigadier General.

Colonel C. deF. Chandler, head of the Balloon Section of the A. E. F., was the first Army dirigible pilot and one of the very earliest officers to learn to fly the Wright airplane. Major George O. Squier, the second United States officer to have a flight in an airplane, is now Major-General and Chief Signal Officer. These men were on the aeronautical board which accepted the Army's first plane. Colonel T. D. Milling, Lieutenant Milling in 1911, when he was one of the army officers detailed to learn to fly the Wright, was Chief of Air Service of the First Army A. E. F., Colonel H. H. Arnold, also a member of the first group to learn to fly, was assistant Director of Military Aeronautics in Washington during the war.

Curtiss, Willard, Wright, Burgess, Seely, Kirkham, Leo Stevens, Glenn Martin, Spencer Heath and other old-timers have all done big things in the recent tremendous development of aviation. They and their successors may be counted upon to stick by the ship until commercial aviation becomes profitable, regardless of what Congress may or may not do.

Fabricated Lumber and the Housing Problem

By Robert G. Skerret

THE housing problem is countrywide in its reach. If the estimates of the various authorities be correct, there are several hundred thousand families in this land of ours who cannot find the accommodations they desire or to which they are accustomed. This seriously menaces our whole social fabric, because it makes for unrest and unquestionably cuts down the efficiency of our citizenry.

To make matters worse, the price of labor has recently been raised a substantial percentage. Similarly the cost of structural materials is mounting more or less in proportion. How, then, can the situation be met without imposing a needlessly heavy tax upon all concerned? Has American ingenuity anything to offer in the way of immediate relief? Is there anything distinctly novel in house building which will help measurably to meet the present need and also offset hereafter the higher prices which we are informed are likely to prevail for years to come?

The structural steel worker—and this incidentally includes the designer or architect—has been achieving many of his amazing results in the last decade or so by reason of the standardized materials turned out at the steel mills. Going a step farther, these plants have cut and prepared their plates, angles, beams, etc., so that only a minimum of labor would be required to assemble these units at the building site. In a kindred way the fabricated ship has come into being. Why, then, should standardized lumber parts not find a corresponding and helpful field of usefulness? Native genius has answered this question in a thoroughly practical fashion.

Engineering cunning and practical experience have come to the rescue in the shape of cut-to-length lumber which is so cleverly machined at the economically-located saw mill that the finished products can be assembled with a marked saving in time and outlay. Not only that, but, within some limits, the house builders can be recruited from the very commonest of laborers. The significance of this becomes clearer when it is borne in mind that the first-class carpenter, so the experts say, can cut, trim, and nail or

(Continued on page 117)

A Terminal on the Jersey Flats

(Continued from page 103)

will likewise be ample. The present pier-head and bulkhead lines, as established by the New Jersey and the Federal authorities, are, respectively, roughly at the out-shore three-quarters and at the mid-section. Because of the physical nature of the harbor bottom and the contour, it would not be feasible to develop the property without a modification of pierhead and bulkhead lines. In the absence of such changes, it would naturally devolve upon the Federal government to dredge the entire area from the present channel back to the existing pierhead line. Since this would involve an expenditure of some millions of dollars, while the space in question can be more effectively utilized by bulkheading and filling, the space for actual navigation allowed by the project is ample.

In the plan therefore the coal bunkers are located on rock along the proposed bulkhead line, outshore of the present pierhead line. The ship-repair plant is located at the northerly edge of the property, adjacent to the oil works and the National Docks, not only because it will lead to less congestion of traffic in the dock slips, but also in order to make use of existing rock foundations for the graving dock. The piers and slips on the southerly edge of the property were designed adjacent to a wide channel and also with reference to the sub-surface rock so as to minimize the cost of excavation. However, the presence of this rock makes it possible to erect multi-story pier sheds, specially designed, for expediting the loading of outgoing vessels. The inshore slip is to be used for lighterage and barge-canal business requiring less depth of navigable water.

In the drawing herewith, a perspective view of the completed development is given. Commencing at the upper left-hand (southwest) corner are seen the railroad roundhouses, with space for a minimum of 50 locomotives. Next, coming east, are the barge and lighter docks, consisting of two piers with landings on both sides and bearing large warehouses. Dredging to a depth of 30 feet would be practicable here if necessary. The regular steamship piers are next, eastward toward the open bay; of these there are three of 1,500 feet each, with six to eight-story superstructures, and two open piers. All these have slips on both sides.

Coming on to the northeast corner is the fuel-oil supply station, containing three tanks, each with capacity of several million gallons, connected by circulating pipes to ship berths over a large wharf frontage; also heating and lubricating oil plants. The all-important coal equipment occupies the east frontage, with 2,400 lineal feet of pockets. The system here is an elaboration of that at Newport News, which has already been described in these columns.

Next along the east frontage, to the northward, is the carfloat terminal, which connects directly with the great freight car classification yards extending backward the entire two miles of the tract. There are five double slips for the car floats, a new feature being trackage on long piers between the slips to permit of storage of cars to prevent delays. Next come the truck ferries and transfer sheds for accommodation of teamsters, so that goods received direct via dray can be transferred to all parts of the harbor. Direct connection will be established between trucks and cars, with roadways, ramps and overhead bridges provided for all vehicles, and grade-crossings wholly eliminated.

At the northeast corner are the grain elevators, with special provision for handling barge traffic and extensive pier sheds and warehouses for use of craft from the up-state canals. Next on the northerly side is the ship repair plant, extending to the oil works on the mainland.

Adjoining the railroad tracks near the outer extremity of the track at the north-

west corner is the free zone, where raw materials may be brought in and manufactured products taken out free of duty. As far as the shipper is concerned, the status of this zone is the same as that of a barren rock in mid-ocean over which no power claims jurisdiction. He can transship goods here to his heart's content without any annoyance from the United States Customs. Adjoining the free zone to the west is a million square feet of ground set aside for general factories of all kinds.

It will be noted that the plans provide quite generally for oblique piers to permit ships to berth themselves without the aid of tugs, and to back out to the open bay under their own power.

The full operation of the various industries of the tract, it is estimated, will employ about 50,000 persons.

Fabricated Lumber and the Housing Problem

(Continued from page 107)

screw in place about 1,000 feet of lumber a day, and for this service his compensation averages in the neighborhood of \$10 per diem.

The man that has achieved this extremely promising revolution in the lumber industry and, reflexively, in the building trade, is E. A. Laughlin of Port Arthur, Texas. He has made a dream come true. For some years back he was inspired by the belief that somewhere or somehow there would develop a method of producing the ideal home or dwelling from lumber in a machine-made, finished form, accurately cut to fit, and ready to use substantially without the employment of the carpenter's saw, chisel, or plane. The task of accomplishing this fell to him. The materials now produced by his method lend themselves to the construction of widely different looking homes, although fabricated out of standardized parts.

Substantially no restrictions are placed upon the architect or the prospective owner. The house can have either a hip or a gable roof, the only limitation being acceptance of a common pitch. Again, the supports for floors or joists, the vertical frames or studs, the rafters, and the dimensions of windows must harmonize with two or three standards from which a choice can be made. Otherwise, like a well-known mechanical toy, the building units admit of an extremely varied arrangement. That is to say, the architect is no more hampered in the designing of a pleasing and individual frame house with these new materials than he would be in employing bricks, which are of fixed proportions.

Starting at the saw-mill, where special machinery is installed and where thin saws are used which cut so close and cleanly that the surface is well-nigh as smooth as if planed, the standardized sills, joists, plates, studs, rafters, etc., are turned out at the desired lengths and accurately mortised and tenoned, so that they will make perfect fits and can be joined securely together with about one-third the number of nails commonly required. By this process of manufacture, short-length pieces of lumber can be worked up into a higher grade of material at the mill; and transportation charges and wastage at destination are greatly reduced because the shipping weight is cut to a minimum and the structural elements are dimensioned to a nicety.

As most of us know, the best of antique furniture owes its strength fundamentally to the skilful fashion in which its parts were joined together by dovetailing. The ready-to-assemble, standardized lumber is in the main similarly united, to just that extent cutting down labor costs in erecting and the outlay for nails. The machines that do this preparatory work have a daily capacity of 10,000 feet of finished product as against 650 to 700 feet—the work of the ordinary carpenter during an average day. The lock joint employed is of a special design consisting of a tapered tenon which enters a dovetailed, tapered dado.

(Continued on page 119)

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Fabricated Lumber and the Housing Problem

(Continued from page 117)

These tenons are on the opposite faces at the ends of the studding, joists, etc., and, therefore, there is no right or left to be considered—either end will fit the designed mortise. Because of this feature, assembling becomes foolproof.

Probably no better evidence of this is needed than the fact that very large quantities of this standardized lumber have been shipped to Mexico, where the laborers were unskilled and could neither read nor write. The different parts were painted a distinctive color on one end, and similar colors were marked on the blueprints which designated the locations for the pieces. In this simple fashion the peons were guided, and the structures were reared correctly and with creditable speed. As a matter of test, buildings of this lumber have been erected in this country by blindfolded mechanics; and recently a string of houses seven miles long was put up of this novel, standardized material.

During our participation in the European conflict, the United States Government employed this lumber extensively for war construction work both here and abroad because of its time-saving, freight-reducing characteristics. Today, the Federal authorities have released their exclusive claim upon the system, and the home builder, face to face with the problem of making his dollars go as far as possible, can now have recourse to this fruit of native cunning. Further, this new order of standardized product makes it possible, thanks to the conservation effected at the saw mill, to utilize much lumber which would be counted largely a loss at the building site if delivered there in the usual lengths and marred by natural defects. Therefore, we have in this example of efficiency, brought to a climax through stress of conflict, a commodity which will do much to solve the nationwide housing problem and, incidentally, lead to many material economies and enduring benefits. Every log will henceforth give a fuller measure of satisfactory, usable lumber.

Disposing of Ashes with Steam

(Continued from page 111)

half of the pipe sections. After the pipe line has been in service for the removal of several thousand tons of ashes it may be turned over so as to present a new wearing surface, and at the same time the liners are renewed. At the point where the steam is injected special provisions are made to take care of the wear, which at such points is a maximum because the stream of ashes must make a sharp turn to the vertical direction. The same is true of the elbow at the top of the vertical portion of the pipe. Here special liners are provided of wear-resisting material and the parts are so arranged that they may be readily renewed. Each plant has its own peculiarities that one standard installation will not fit all cases. Special joints and steam units are provided, in some of which the elbow instead of making a short turn consists of a long sweep.

One of the important advantages of this system of disposing of ashes lies in the fact that boiler rooms are kept clean. In fact dust-free boiler rooms prove a considerable inducement when hiring new men.

The Craters of the Moon

(Continued from page 114)

groups, under the names walled-plains, mountain-rings, ring-plains, crater-plains, craters, craterlets, and crater-pits.

Whether or not all of these various forms have been produced in the same way is a question. At present there is no consensus of opinion as to their origin. Many theories have been advanced, several of which in brief outline follow.

The ice theory, suggested perhaps by the resemblance of some portions of the moon to an ice surface seen from a distance,

supposes that formerly the moon was covered with pools of water kept in the liquid condition by heat from within. The water evaporated, but, on account of the low temperature of the surrounding atmosphere, was quickly deposited as snow, forming a crater wall.

This theory has little to commend it. It does not account for the central peaks, so often found within craters, nor for the steepness of the crater walls. If composed of ice, the walls would have flattened out long ago in the process of glacial flow.

A second theory is based upon tidal action. Just as the moon causes tides upon the earth, so the earth produces an ebb and flow in all parts of the moon which are not perfectly rigid. At some stage in its history the moon is supposed to have been in a molten condition. According to the tidal theory, as the moon cooled, a crust began to form on its surface, and, while there were still holes in it here and there, tidal forces caused an ebb and flow of the magma. At each high tide the lava rose through the opening and spread for some distance over the crust and then receded as the tide ebbed, but, as a result of cooling and hardening, some of the magma remained on the surface in the form of a ring around the opening. At each subsequent tide more material was deposited, until a typical circular crater wall was formed. As the opening became smaller, and the magma cooler and thicker, a central peak may have been built up.

It is quite possible that some of the craters may have been formed by this process, but it is difficult to see how such a complex system of overlapping and intersecting formations—as are shown in our third figure—can be accounted for in this way.

A third theory is based upon the marked resemblance between the lunar craters and the pits formed by dropping balls into soft mud or mortar. This may be called the meteorite theory, or, in its modified form, the satellite theory. The earth in its journey through space encounters thousands of fragments of matter. Many of these, as they dash into our atmosphere, are burned up by friction, and we see them as shooting stars, but many are large enough to pass completely through the atmosphere, and actually strike the earth. Of those which have been seen to fall, the largest weighs between six and seven hundred pounds.

The moon also must be struck by meteoric matter, and, according to this theory, what we see on the moon is the effect of such a bombardment at the time when the moon's surface was just beginning to solidify. If the craters were really formed in this way, the masses which produced them must have been much larger than any meteorites with which we are familiar. Judging from the size of the craters, several of the masses must have been somewhere about one hundred miles in diameter, that is about the order of size of the largest of the asteroids, and there must have been at least 50,000 with a diameter greater than half a mile.

The meteors which strike the earth are moving, singly or in swarms, around the sun and have an average velocity of 26 miles a second. Now meteors large enough to produce such effects as we see upon the moon, and moving with a velocity of even four or five miles a second would generate so much heat that not the slightest trace of the impact could possibly remain. Not only would the meteor itself be completely melted, but also any crater walls that it might form. Moreover, meteors moving in this way would strike the surface at all angles and if craters could be formed, the greater number of them would be elliptical, or rather oval in outline.

To overcome these two objections to this theory, it has been suggested that formerly the earth may have been surrounded by a swarm of small satellites, similar to those which form the rings around Saturn. The moon would be in the midst of the particles or masses of this swarm and moving at approximately the

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