ther added between the mouth of the Pine and the site at Quinnesec Falls, making a total drainage area at this point of 2,432 square miles. It is still further added to below Quinnesec Falls by the Pike, Sturgeon and Little Cedar Rivers. The divides separating this from the adjoining basins vary in elevation from between 400 to 500 feet above Lake Michigan water levels in the southwest corner, to from 950 to 1,000 feet above the lake, in the entire northern section. The river descends about 950 feet through lands covered by large timber growths. In the 56 miles above the mouth of the Pine River the fall is 475 feet; from the Pine to the Sturgeon the river falls 225 feet in 18 miles; from the Sturgeon to Green Bay, 250 feet in 72 miles.

Topographically, this basin would not be considered mountainous, although many ranges, a few hundred feet in elevation, occur. The bulk of the timber is pine and spruce, although considerable hard wood is also found.

The average annual precipitation of the entire Menominee basin is 35 inches, while on the neighboring rivers in the south it is 32 inches.

In a report of the United States Engineers upon the power to be obtained on the Menominee River it has been estimated to be 0.34 cubic foot per second per square mile. The Wolf River low-water discharge has been gauged 0.43 cubic foot per second per square mile for the entire basin and 0.71 cubic foot per second per square mile for the Upper Wolf at Shewano Lake, both from an average rainfall of 31 inches. The low-water discharge of the entire Winnebago basin is rated at 0.413 cubic foot per second per square mile from an average rainfall of 31 inches.

The Upper Mississippi has been more carefully gauged than the rivers above mentioned, and it has been found that the average ratio of total discharge to total precipitation in all these streams is about fifty per cent.

In considering the distribution of flow to be expected at Quinnesec, it will be first estimated on the basis of the distribution of the Upper Mississippi, with the preface that the Menominee presents better conditions for conservation of flow than the Upper Mississippi. Were the percentage of discharge of the Upper Menominee like that of the Upper Mississippi, under a rainfall of 35 inches, we should have a precipitation of 2.576 cubic feet per second per square mile of drainage area, which, estimated at fifty per cent. discharge, should result in a average flow of 1.288 cubic feet per second per square mile of drainage area.

A United States Engineer's report for the entire Menominee River estimated a low-water discharge of 0.46 cubic foot per second per square mile of drainage area.

The entire basin of the Wolf is fed by an average annual rainfall of 31 inches, and has an average low-water discharge of 0.43 cubic foot per second per square mile. The Upper Wolf, however, for the same rainfall, has an estimated low-water discharge of 0.71 cubic foot per second per square mile. The minimum low-water discharge of the Fox River at Lake Winnebago, with a rainfall of 30 inches, is 0.38 cubic foot per second per square mile.

An examination and comparison of the foregoing data would seem to lead to the following conclusions:

First.—The average rainfall of the Upper Menominee being 35 inches, and basing the estimate on the low-water discharge of the Fox River and Lake Winnebago, we have 0.44 cubic foot per second per square mile, as the low-water discharge, even though the characteristics of the basins are identical, which, however, they are not, the Menominee having exceptional natural advantages.

Second.—From a comparison of the Upper Mississippi basin with the area in question, we judge the power of conservation to be in favor of the Upper Menominee, having regard to the first effect of reducing the flood flow and afterward increasing the low-water flow shown on the basin of the Upper Mississippi, which would seem to indicate that the low-water discharge would not be less than 0.50 cubic foot per second.

Third.—A comparison between the actual measurements during a portion of May and June, 1898, and the probable flow of the Upper Mississippi would indicate a reduced flood flow of the Upper Menominee and would tend to strengthen the above-stated conclusion.

Fourth.—By a comparison of the entire Menominee basin and that portion above Quinnesec Falls and an examination of the above in the hydrological and forest conditions, especially as regards rainfall and forest growths, which both increase as we go up the stream, it would apear that for the drainage area in question the low-water discharge would be in excess of 0.46 cubic foot per second per square mile drainage area.

Fifth.—Measurements taken on the Wolf River, both for the entire basin and for that portion above Shewano Lake, seem to approximate very closely the relative conditions obtaining on the entire and Upper Menominee basins respectively.

For a rainfall of 31 inches the low-water discharges on Wolf River are: Entire basin, 0.43 cubic foot per second per square mile; upper basin, 0.71 cubic foot; showing a ratio of 1 to 1.65 existing between the low-water discharge on the entire basin and the upper basins. Were this rainfall increased to 35 inches, the ratio remaining unchanged, these discharges would become: Entire basin, 0.49 cubic foot; upper basin, 0.80 cubic foot.

Under the conditions above stated, a conservative estimate would place the ratio of the low-water discharge for the Upper Menominee at Quinnesec Falls to that of the entire Menominee at 1.25 to 1. This, taken with 0.46 cubic foot per second as the lowest determination applicable, would give for the low-water discharge for the Upper Menominee 0.575 cubic foot per second per square mile of drainage area, equivalent to 10,154 horse-power gross or 8,125 horse-power net.

In many cases it has ben found practicable to arrange for increasing the natural low-water supply by means of storage reservoirs, controlled by dams. The Menominee River, however, has very few lakes of any size and these have a limited drainage area. Lake Michigamme, the largest, is located far up the Michigamme River near the head-water of the basin. It has an area of only about 6½ square miles and a drainage area of 160 square miles. If, however, control should be obtained it is quite likely that an appreciable effect on the steadiness of the stream would be realized. The tributaries of the Menominee are generally rapid in flow, so that dams flood only a limited area.

It seemed quite desirable to make arrangements with the logging company for control of dams during that portion of the year when logs are not running, as it is during this time that the lowest water flows would occur.

It was decided that 8,000 horse-power could safely be depended upon during the entire year, with the exception of perhaps twenty to twenty-five days, and except when the natural flow of the stream is affected by artificial conditions, which may, perhaps, in the main be overcome by arrangement with the logging company.

(To be continued.)

THE FINANCIAL IMPORTANCE OF RAPID BUILDING.

Not the least interesting feature of the lofty office buildings which are erected in large cities at present is the remarkably short time required in their construction. The history of the building of such a structure, the Broadway Chambers, New York, is given by the architect, Mr. Cass Gilbert, in the "Record and Guide." The building is 50x95 feet in plan and eighteen stories high, and was finished from foundation to roof in less than four months. Mr. Gilbert's article is as follows:

"The contract for the construction of the Broadway Chambers was signed by the George A. Fuller Company, builders, March 1, 1899, with Mr. W. R. Andrews, principal owner and trustee of the property. Wreckage of the old building on the site began May 3. Excavation followed immediately after, when great difficulties were encountered in supporting neighboring buildings and streets, and the work in this stage necessarily proceeded slowly. New foundations were inserted under the buildings north and west, as it was necessary to go 12 feet or more below them. This was done without disturbing business in either of these buildings.

"Piles were sunk a short distance from the walls of the old buildings and cribbed with timber—the site being upon a bed of clear sand at least 50 feet deep. These pits were spaced about 10 feet apart, and a heavy post placed upright in the center of each, the same having been given a broad footing of heavy timber. After these posts were placed the pits were filled again as new pits were dug alongside of them. This system was continued along the length of each wall until a series of vertical posts, spaced 5 or 10 feet apart, had been inserted with footings at the level of the proposed foundations. Needles were then inserted through holes in the sub-basement walls of the adjacent buildings, and supported well within the lines of the old buildings, the outer ends being carried upon the posts before mentioned, and the wall meanwhile being shored from the outside. The sand was then removed from the pits and from around the posts and beneath the old walls, sheet piling being used to retain it where required, and the old buildings were thus found to be supported in the air some 12 feet above the proposed foundation. New foundation walls of brick with concrete footings were then put in, and when sufficiently set the shoring and timbers were removed, and the space was then clear for the insertion of the foundations and the erection of the columns and piers of the Broadway Chambers.

"Up to this point the work was necessarily slow, and consumed nearly half the time required for the completion of the whole contract. It was not until about September 1 that the actual foundation work of the Broadway Chambers was under way. The concrete and steel footings (grillage) were then rapidly put in place. About October 1, the steel columns in the basement were set, and by the 26th the columns were in place for a height of two stories above grade. On November 9 the columns were up to the seventh story, and from then on the work went rapidly, notwithstanding the difficulty of getting material, which everyone encountered last year. By December 7, seventeen stories of structural steel were in place, including the basement and ground story; three stories of granite had been erected, together with three stories of brick, and thirteen stories of terra cotta floor arches were in. On December 31, twenty stories of floor beams and the roof, twenty-one tiers of beams in all, were in place and the masonry was completed up to the twelfth floor. On January 4, 1900, the masonry was completed to the thirteenth story, and part of the fourteenth was in place, leaving thus the four upper stories open to the weather in the dead of winter, and when no heat was possible in the building, except such as could be supplied in the lower stories by "salamanders," and the window openings were protected only by screens of sheeting. On February 1, the masonry had been completed up to the cornice, the glass was in place for fifteen stories and the work practically housed in, so that heat could be turned on. There then remained three months in which to have the building ready for tenants on May 1. The work from that time on went with great rapidity, nothwithstanding the fact that the entire woodwork for the interior was burned up in a fire at the mills, where it was being gotten out; that another fire destroyed the engines, and a third the ornamental copper intended for use above the roof. The labor question constantly arose with the ever-present walking delegate, not only at the building, but at the shops and factories in various parts of the country that were preparing materials, etc., for the building. The enormous demand for building material in 1899 made it peculiarly difficult to obtain it promptly, and occasional delays were thereby caused. The work, however, was pushed forward with unremitting zeal by the contractors, whose well-organized force never for a moment lacked intelligent direction and skill in every department. On April 27, tenants began to move in, and on the first day of May the building was substantially completed, with the machinery in operation, and needing only the little touching-up and refinishing incident to all building operations.

"Such is the brief story of the building of the Broadway Chambers. The result obtained would not have been possible except under experienced management and an intimate knowledge of the requirements of this type of construction. The handling of such a work, I may say, is not without strain upon the architect, builder and the various chiefs of departments in charge of the various portions of the work. Every detail must be arranged in advance; every contingency provided for. There is no time to wait for decisions on fine points when the work is under way. The questions arising must be decided immediately. Steel gotten out at Pittsburg must fit when erected in New York; terra cotta from Perth Amboy, and granite from Connecticut, specially-moulded brick from Ohio, and the thousand other materials used in construction must come into place as they reach the ground with absolute accuracy and without refitting.

"Rapid construction is not undertaken merely for the puropse of making a record. It is a necessity arising from economic conditions. The value of land is an important item in construction. Many an owner hesitates to tear down an old building and encounter the expense of a new one, when he realizes that in the process of the change he will, probably, lose from one to two years' rent, thus losing the interest on the money already invested in the land. To minimize this loss, then, becomes a most important factor in the financial scheme of the enterprise. Assuming, for instance, that the value of the land upon which the building is to be erected is placed at $1,500,000, the interest thereon, at 4 per cent., is $60,000 per annum. If two years are consumed in construction of the new building, it will have cost in interest $120,000, to say nothing of the loss of rental on the old building. Moreover, if interest is charged on the cost of building from time to time as payments are made to the contractor in the course of its erection, this account is greatly increased. Presuming the cost of the building to be $1,000,000, and paid in, say, ten payments of $100,000 each, at intervals during the two years, this interest account would be made up somewhat in this way:

Interest, two years, on $1,500,000 at 4%	$120,000
Interest on installments of $1,000,000 at 4%	30,000
Total	$150,000

or 15 per cent. on the cost of the new building. I have used the 4 per cent. rate in this illustration because that is the common rate of interest on first-class mortgages, but I have known some important instances where the money was obtained at 3½ per cent., or even less. It is obvious, whatever tne rate, that the new building should be constructed as rapidly as possible as is consistent with good workmanship to save as large a proportion of this interest as possible, and to make the enterprise begin to earn as soon as possible. For these reasons, then, and not for the purpose of merely making a record in rapid construction, such a building should, if practicable, be erected within a year. It is of comparatively small advantage to finish it within fourteen or sixteen months; for, assuming that rents are negotiated from May 1, the building must be completed before the first of next May, or carried over into the autumn. In order to accomplish such rapid construction drawings must be prepared considerably in advance, and the contracts should be let at least two months before the work is to be begun. This gives the contractor an opportunity to get the structural steel and other material under way in the shops, and have it ready when needed, and two months are the very least that should be allowed for this.

"Speaking of such enterprises from the financial aspect, it is a rule that holds almost invariably, that where the building costs less than the land, if properly managed, it is a success, and where its costs more than the land it is usually a failure. The land value is established by its location, and desirability from a renter's standpoint; hence high rentals make high land values and conversely. The building is merely the machine that makes the land pay. The more economical the machine both in construction and operation, provided it fulfills the needs, the more profitable the land. At the same time, one must not lose sight of the fact that the machine is none the less a useful one because it has a measure of beauty, and that architectural beauty, judged even from the economic standpoint, has an income-bearing value. In my judgment, the best equation of building and land is that the building should represent about two-thirds of the land value under normal conditions."

A NEW TYPE OF ELECTRIC PROPELLER FAN.

The B. F. Sturtevant Company, of Boston, has during the past year, remodeled its enclosed motors designed for direct connection to propeller fans and is now building a line of these machines, from 18 inches to 120 inches in diameter, with capacities of from 2,000 to 175,000 cubic feet of air per minute. The motor is of the bi-polar type, entirely enclosed, and thereby protected from dust, a most important element in a machine used under these conditions. In order to avoid the excessive temperature incident to operation, this type has been very carefully designed, so that a low temperature rise can be maintained without greatly increasing the size and weight above that of the ordinary open-type machine. It is considered capable of continuous operation for ten hours, with a maximum temperature rise not exceeding 60 degrees Fahrenheit.

Yokes extending out from the field ring support the armature shaft. The end casings are entirely independent and can readily be removed to give access to the entire interior. The bearings and brushes can be reached by removing the caps in the centre of the casings. The brushes are of hard carbon, in holders of a modified reaction type, to allow of easy adjustment when it becomes necessary to reverse the direction of rotation. The bearings are self-oiling and self-aligning and fitted with composition sleeves, removable from the outer ends of the boxes.

A NEW TYPE OF ELECTRIC PROPELLER FAN.

The design of the propeller wheel is the result of an extended series of comparative experiments with different types. The delivery edge is helical, and the form is designed so that the air is picked up at the inlet edge of the blade at low velocity, and when well under the influence of the blade is accelerated to its maximum velocity with the least amount of slip. As a result, the efficiency is said to be extremely high. The wheel is partially enclosed within a conoidal inlet ring, to decrease the frictional resistance to the entering air. The motor is accurately centered by means of a tripod support, and the entire apparatus may be bolted directly to the wall through which the air is to be discharged. The illustration serves to make clear the general features of the design.