

machine, driven by two motors, one rated 15 h.p. and the other 40 h.p. The heat for the drier is supplied by steam from the power house conducted through steam coils in the drier and is controlled thermostatically. It requires approximately three hours for a wet skin to become thoroughly dried by this process.

The staking machines are group driven from a line shaft to which is connected a 15-h.p. motor. There are 33 such machines in all, arranged in groups of 11 each.

The glazing jacks are group driven by a 10-h.p. motor. Each group consists of ten jacks, there being six groups in all.

Measuring and Sorting Room

With the exception of the measuring machines, the labor in this room is manual since the sorting is best performed by hand. The measuring machines, eight in number, are belt-driven from a line shaft to which is connected a 2-h.p. motor. These machines will later be arranged for individual motor drive, each machine requiring a $\frac{1}{4}$ -h.p. motor.

Results of Electrification

The Ruby plant has now been electrically operated for ten months, but since operating

statistics are being compiled on an annual basis it is still too early to present figures covering the operation of the entire plant for such a period.

There is, however, a sharp line of demarcation between several of the manufacturing steps and it has been possible to determine accurately what the intelligent utilization of the electric motor has accomplished. In the new lime yard, for instance, statistics available at the end of nine months clearly indicate a saving of two-thirds the cost of the manually operated yard. In the shaving operation, with the same equipment, production has been increased 100 per cent. Moreover, the constant speed at which the shaving machines are now driven has resulted in a tremendous decrease in spoilage. The motor-driven continuous drier accomplishes in four hours the work for which the old steam-heated loft required two or three days.

That the results at the Ruby plant have exceeded expectations is best attested by the fact that the officials of the John R. Evans Co. some months ago decided to electrify their other plants: Peerless Leather and Jersey Kid. This work is now under way and is rapidly being pushed to completion.

Water Power Resources of Montana

By H. H. COCHRANE

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With her many developed and undeveloped natural resources Montana is fortunate in having such a wealth of water power. Montana uses more power per capita than any other state in the Union and the author shows how great are the possibilities for future hydro-electric power developments.—EDITOR.

The main range of the Rocky Mountains cuts across the western part of Montana, forming the Continental Divide, and gives the state two principal watersheds. The eastern slope is drained by the Missouri River and its tributary, the Yellowstone; the western slope by the Clark's Fork and Kootenai rivers, which combine to form the Columbia. Although the western watershed comprises only about 15 per cent of the area of the state, yet the runoff from this 15 per cent is greater than from the remaining 85 per cent. In fact, the Clark's Fork is the largest river in the state, followed in order by the Missouri, Kootenai and Yellowstone.

The most important developments which have been made up to the present time are those on the Missouri River, including the Madison, its principal tributary. This is

clearly indicated in the following list of developed water powers.

DEVELOPED WATER POWERS IN MONTANA

Name	River	Kilowatts
Madison	Madison	12,000
Big Hole	Big Hole	3,000
Canyon Ferry	Missouri	7,500
Hauser Lake	Missouri	18,000
Holter	Missouri	40,000
Black Eagle	Missouri	3,000
Rainbow	Missouri	35,000
Volta	Missouri	60,000
Livingston	Yellowstone	1,500
Billings	Yellowstone	1,000
Thompson Falls	Clark's Fork	30,000
Bonner	Missoula	2,400
Big Fork	Swan	1,600
Flint Creek	Flint Creek	1,200
Total		216,200

There is one important development on the Clark's Fork. This is at the town of Thompson Falls from which the plant takes its name. This plant, together with those on the Madison and Missouri rivers, are tied together with a high voltage network and form the system of The Montana Power Company.

Various estimates have been made, from time to time, by Government officials and others, of the total undeveloped water power of the state, some estimates running into millions of kilowatts. A very good summing up of possibilities was made by E. W. Kramer, Hydro-electric Engineer, United States Forest Service, in the *Electrical World* of July 16, 1921.

Estimates based on total river flow and total fall within any given region naturally lead to very large figures of possible power. Such figures are liable to be misleading, due to the fact that only in rare instances can the entire fall of a river be economically utilized. To develop head with a dam requires a reasonably narrow channel and high banks. To develop it with a pipe line or other conduit requires a river slope of about 50 feet or more to the mile. Where neither of these conditions exist a development will ordinarily be uneconomical. There are other things which may spoil an otherwise good power site, such, for example, as the existence of a town or railroad which would be flooded by back water from the dam.

The present estimate of possible power developments is therefore limited to really good sites which may be reasonably developed as soon as there is a market for the power.

The Mystic Lake site, on the West Rosebud River, is of importance on account of its location, being well toward the eastern part of the state, where the country is mostly flat and good power sites are scarce. Preliminary development work is now being done by The Montana Power Company on this site, with the idea of amplifying the amount of power available in the eastern end of its transmission system. The development will utilize a head of 1100 feet, which will be the highest head yet developed in Montana.

The Big Horn Canyon site is also in eastern Montana and apparently offers an opportunity to develop a large amount of power economically. The canyon is deep, narrow and long, and power can be developed either in small units with a number of low dams or in larger units with high dams. The total available head is about 450 feet, which must all be developed by dams.

The Madison No. 3 site is located at the lower end of the Lower Madison Canyon, about four miles from the present Madison No. 2 plant of The Montana Power Company; 175 feet head is available, which can probably be developed most advantageously by means of a low dam and tunnel. The Giant Spring, Great Falls and Sheep Creek sites on the



Fig. 1. Hauser Lake Development of the Montana Power Company, on Missouri River, 18,000 kw., 65-ft. head

UNDEVELOPED WATER POWER SITES IN MONTANA

Name	River	Kilowatts
Mystic Lake	West Rosebud . .	10,000
Stillwater No. 1	Stillwater	5,000
Yankee Jim Canyon	Yellowstone	5,000
Buffalo Rapids	Yellowstone	5,000
Big Horn Canyon	Big Horn	75,000
Madison No. 3	Madison	20,000
Black Eagle	Missouri	10,000
Giant Spring	Missouri	10,000
Great Falls C	Missouri	28,000
Sheep Creek	Missouri	28,000
Missouri No. 8	Missouri	50,000
Missouri No. 9	Missouri	50,000
North Fork	Flathead	25,000
Coram	Flathead	9,000
Polson	Flathead	100,000
Flathead No. 2	Flathead	50,000
Fish Creek	Missoula	13,000
Donlan	Clark's Fork	40,000
Rock Island	Clark's Fork	50,000
Cabinet Gorge	Clark's Fork	65,000
Kootenai Falls	Kootenai	15,000
Total		663,000

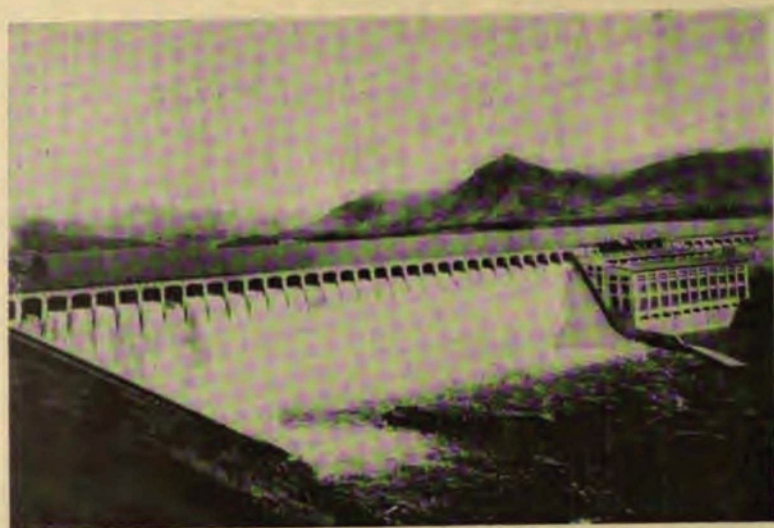


Fig. 2. Holter Plant of the Montana Power Company, on Missouri River, 40,000 kw., 105-ft. head



Fig. 3. Dam at Thompson Falls, on the Clark's Fork River



Fig. 4. The Montana Power Company's Dam on Yellowstone River, at Billings

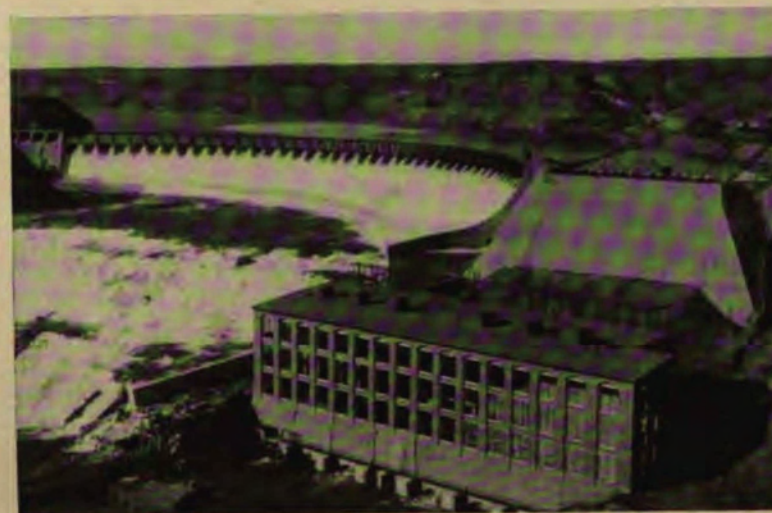


Fig. 5. Volta Plant of Great Falls Power Company, at Great Falls, 60,000 kw., 150-ft. head