

EUROPEAN HYDRO-ELECTRIC DEVELOPMENT

French Plants in the Vicinity of Grenoble.

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The city of Grenoble lies in the heart of the French Alps. Its 70,000 people are engaged almost entirely in the manufacture of gloves and kindred leather industries, hats, buttons and clasps, linen and silk weaving, wood-working, paper, cement and miscellaneous iron manufactures. In earlier days, many of these industries were operated by small

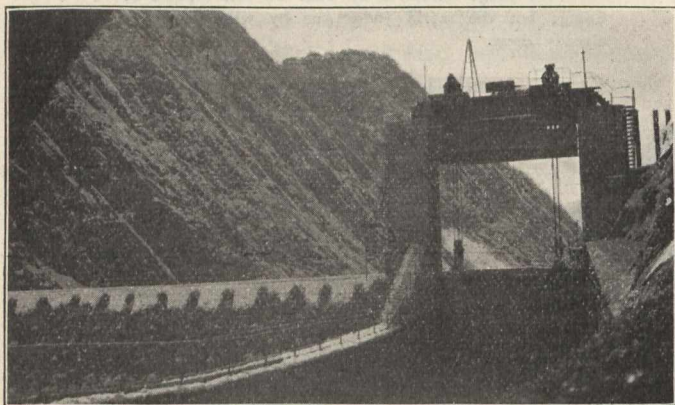


Fig. 1.—Avignonet Dam and Head Sluice.

steam power units, and in the case of paper and cement, by direct water-power, at the waterfalls in the vicinity of the city.

Since the advent of electrical transmission, however, the conditions have changed; now the numerous waterfalls are more advantageously developed and their power transmitted to the city and adjoining towns. Grenoble is situated at the junction of two small rivers, the Drac and its tributary the Isere, both rich in natural power. A few miles above the city, on the Drac, another tributary the Romanche enters, and this, notwithstanding its small size, is the most efficiently worked of the three. On these rivers and within thirty miles of Grenoble are now installed some sixteen hydro-electric and direct hydraulic plants, varying in capacity under normal conditions, from 1,000 to 8,000 horse-power, and having an aggregate power of some 60,000 horse-power.

Under these circumstances, it is not surprising, that when a few years ago the French Government and the people took up the question of investigation of the water-

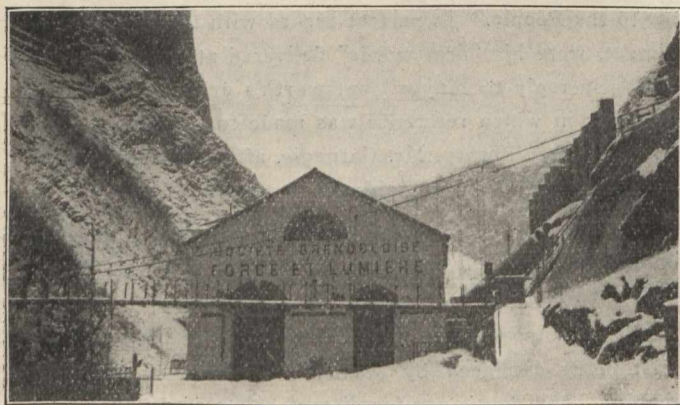


Fig. 2.—Avignonet Generating Station.

powers and hydro-electric resources in the Alps, Grenoble was chosen as the headquarters and centre of operations of the Congress. The work of this body, known as the "Congress de la Hoville Blanche," ("White Coal") has now become world famous and its proceedings, bound in two large octavo volumes, form a most valuable engineering record, describing as they do in detail, the many plants then (1902) in operation and under construction.

The moving spirit of this Congress was M. Berges, of Lancey, a small town in the valley of the Isere, about 10 miles north of Grenoble. He owned several mills utilizing water-power from mountain streams tributary to the Isere, aggregating about 6,000 horse-power; used mainly for pulp and paper manufacture, saw mills, etc., as well as lighting and traction purposes. That he is a pioneer is evident from the fact that as early as 1868, he built the first conduit down the mountain and established a plant at Lancey, under a head of some 600 ft. A few years later, he increased this to 1,600 ft. head, using about 18 cubic ft. of water per second. This plant has continued in operation to the present time with but little trouble from the high head. A second installation here of about 2,000 ft. head remained until a few years ago the highest operated head in the world.

It is, of course, impossible in this article to adequately describe the many plants in the vicinity of Grenoble, all that one can do is to select several of the more interesting as typical of the districts in which they are located.

Avignonet Station, Drac River.

The Drac River drains a large area in the higher Alps and flows to the Rhone. Its dry weather flow in midwinter is fed only by springs, and above its junction with the Romanche does not exceed 800 cubic ft. per second. At times of freshet, however, this discharge runs up to the

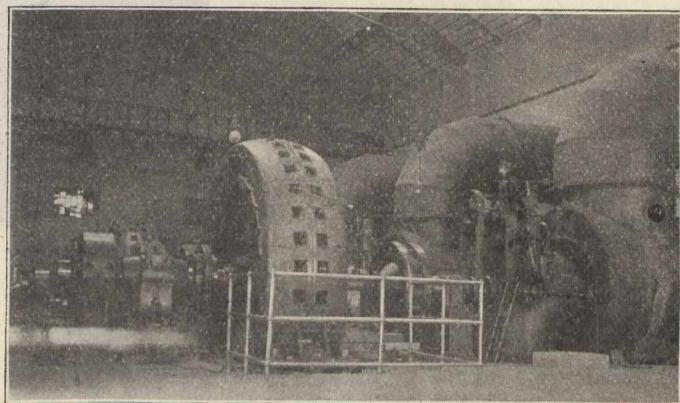


Fig. 3.—Interior of Avignonet Station.

enormous flood of 40,000 cubic feet, a ratio of 1:50, which is most unusual.

The uppermost plant on this river at present is that of Avignonet, situated in a deep and narrow gorge about 25 miles above Grenoble. It is one of three plants owned by "La Societe Grenobloise de Force et Lumiere," and has an output under normal conditions of about 6,000 horse-power. The power is used in Grenoble for street railways and miscellaneous industries; for mines at La Mure, 8 miles away, and for factories at Bourgoin, 60 miles distant.

The general scheme of the plant is that of a dam in the gorge about 3,000 ft. above the station; a tunnel in rock, a forebay cut in the rocky cliff; and penstocks to a generating station in the bed of the gorge; the hydraulic units operating under about 80 ft. head.

The dam is a heavy concrete structure of the over-face type, with a total height of about 65 ft., having exposed faces lined with masonry. On one side is a sluice way closed by a stony gate, about 25 ft. wide by 20 ft. deep. (See Fig. 1.) The dam is seldom over-tapped by floods, the regulation being effected by the stony gate. In front and shoreward of the sluice is the intake, with screens and headgates opening to head face, and being a tunnel, is protected from rock slides, and has a carrying capacity of about 1,400 cubic ft. per second. This tunnel has an overflow regulating weir which discharges into the river at about 200 yards above the station.