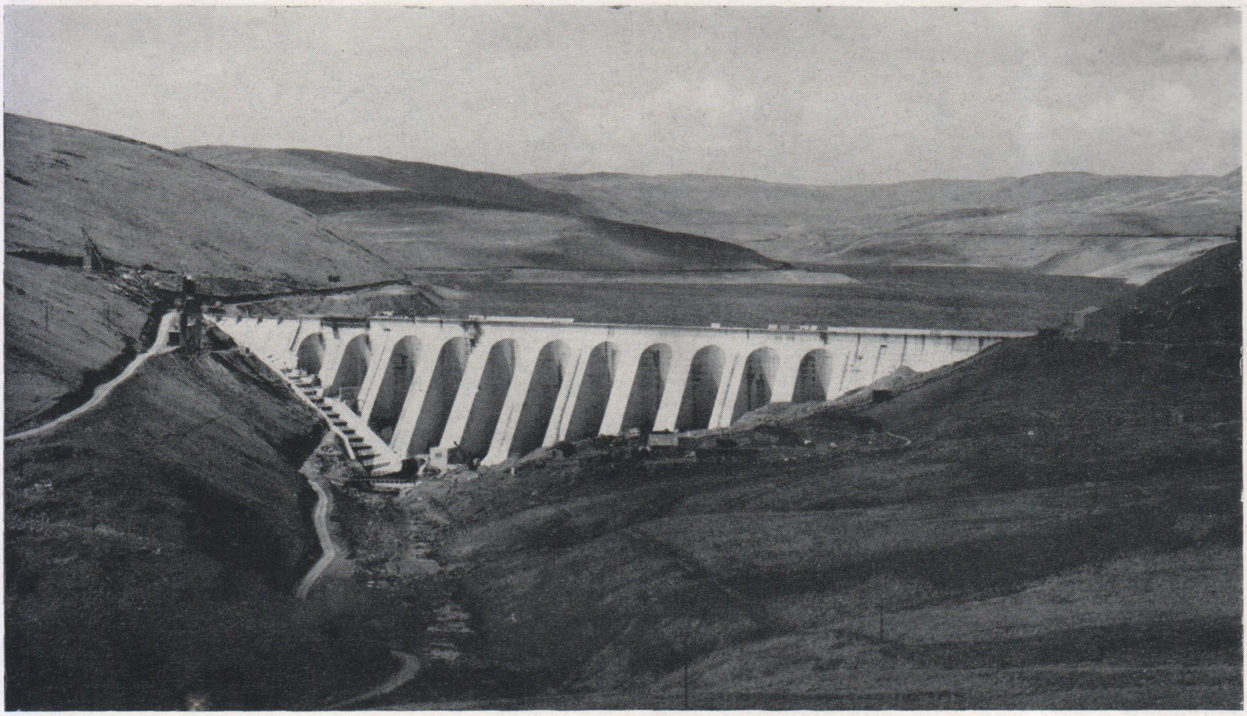

Fig. 1. Nant-y-Moch dam

The Rheidol Scheme

The upper stage of the 49MW Rheidol hydroelectric scheme in Wales is described in this first article. It comprises a seasonal storage reservoir, a pressure tunnel and a 12MW power station. The second article will describe the lower and regulating stages

PART ONE

THIS Welsh peak-load project, which has a load factor of about 20%, is situated on the Afon Rheidol, a stream that rises in the Plynlimmon range and flows into Cardigan Bay at Aberystwyth. The scheme utilises run-off from a 59 sq mile catchment area in the hills to generate electricity in two main stages followed by a small regulating stage.

In the upper stage, Nant-y-Moch reservoir, with a live storage capacity of more than 1,000 million ft^3, is used to regulate seasonal variations in rainfall on the 24 sq mile catchment area which it serves. Rainfall over the upper-stage catchment ranges from 90in at the highest altitudes to 80in per annum at the dam. Water from the reservoir, which has a top level of 1,118ft O.D., is taken through a tunnel to a 12MW generating station situated on the banks of the lower-stage reservoir at Dinas.

The lower-stage reservoir, which has a storage capacity of 33 million ft^3 at 841ft O.D., is also a regulating reservoir but its operating cycle is measured in days rather than months. In addition to the inflow from Nant-y-Moch via Dinas power station and the compensation flow in the stream, it collects run-off from a 14 sq mile catchment on which rainfall varies between 70 and 60in per annum according to the altitude. A tunnel from the reservoir supplies the main 36MW power station at Cwm Rheidol.

The regulating stage catchment has an area of 21 sq miles with much lower rainfall than the upper catchments, but the reservoir is primarily intended to regulate flow from Cwm Rheidol power station which, because of its peaking function, has a relatively large discharge for a few hours each day. Unrestricted flow from this station would have a detrimental effect on the regime of the Afon Rheidol on its course through the alluvial plain down to Aberystwyth and the dimensions of the reservoir are such that flow from it can be spread out evenly over each 24 hours with a corresponding fluctuation in level of about 5ft.

Flow recorders have been installed at various points along the river but they do not register above 1,500 cusecs. During construction a flood estimated at 7,000 cusecs was experienced at Cwm Rheidol and a minimum flow of about 40 cusecs has been recorded.

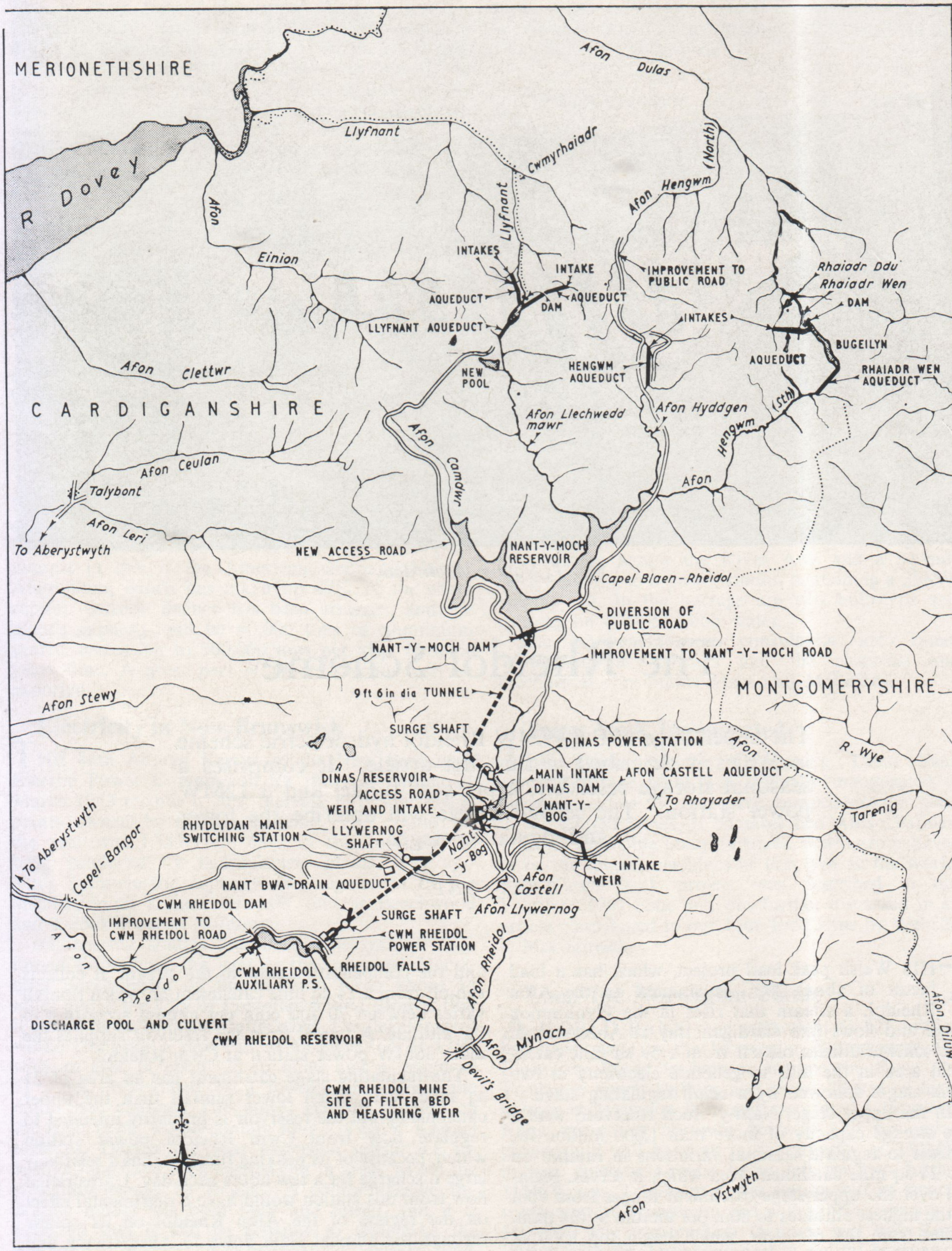

Fig. 2. Map showing general arrangement of Rheidol scheme

Geology

The area is made up of ancient sedimentary rocks belonging to the upper part of the Ordovician system and the lower part of the Silurian system. These include shales and mudstones, siltstones, greywackes and grits. No igneous rocks occur in the area. These strata are cut by several faults many of which are mineralised and contain lodes of lead and zinc which have been extensively worked. Uncertainty as to the exact position of old workings was the reason for

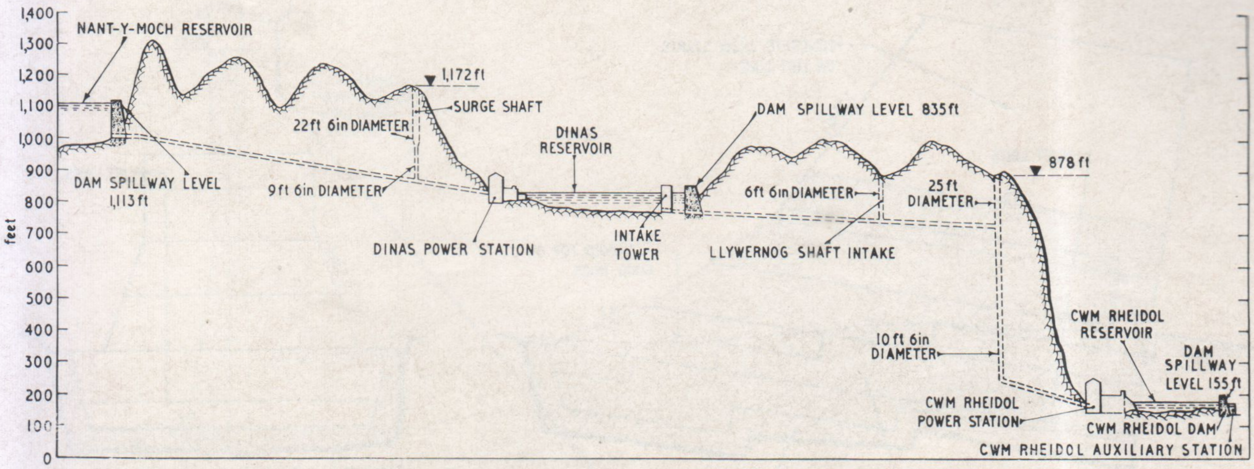

Fig. 3. Longitudinal profile of scheme

driving pilot shafts ahead of the main face in all tunnelling operations.

Upper Stage (Nant-y-Moch/Dinas)

The upper stage consists of Nant-y-Moch reservoir and Dinas power station, to which it is linked by a 2½-mile pressure tunnel.

Nant-y-Moch reservoir is impounded by a 172ft-high massive buttress dam constructed across the Afon Rheidol just downstream of its confluence with the Afon Camdwr. The maximum capacity of the reservoir is more than 1,150 million ft^3 at the top water level of 1,118ft O.D. The capacity at the maximum drawdown level of 1,040ft O.D. is approximately 120 million ft^3. The normal operating range is 1,063 to 1,110ft O.D., with a corresponding variation in volume of about 700 million ft^3.

The overall length of the dam is 1,150ft and the roadway along its crest stands approximately 172ft above the stream bed. There are gravity sections at each end of the structure, that at the west end accommodating an ungated spillway with a capacity of 6,000 cusecs. The buttress section comprises ten buttresses standing at 65ft centres with minimum and maximum stem thicknesses of about 23ft and 26ft respectively, but the buttress footings are splayed (Fig. 5) to reduce foundation rock pressures. The dam has a straight upstream face which slopes at 1 : 6, whereas the downstream faces of the buttresses and gravity sections slope at 1 : 1·25. The buttress heads have elliptical downstream faces, and theoretically each pair of buttresses forms a horizontal semi-ellipse with a semi-minor axis of 15·17ft.

The main intake tower, which serves the pressure tunnel to Dinas power station, is situated against the upstream face of the dam in the vicinity of buttresses 4 and 5. A draw-off intake chamber, housing the inlets to the main discharge regulator and the 50kW compensation set is situated at the foot of buttress 7. The spillway consists of a 148ft long section divided into five 28ft bays by the four piers of the spillway bridge, the crest level being at 1,113ft O.D. A stepped side-spillway channel, the dimensions and shape of which were determined by means of tests on a small-scale hydraulic model at the consultant's offices in London and later on a larger open-air model near the site, terminates in a stilling pool near the foot of the dam. Dragon's teeth are provided on the spillway channel steps for energy dissipation purposes. The stilling pool, into which the discharge

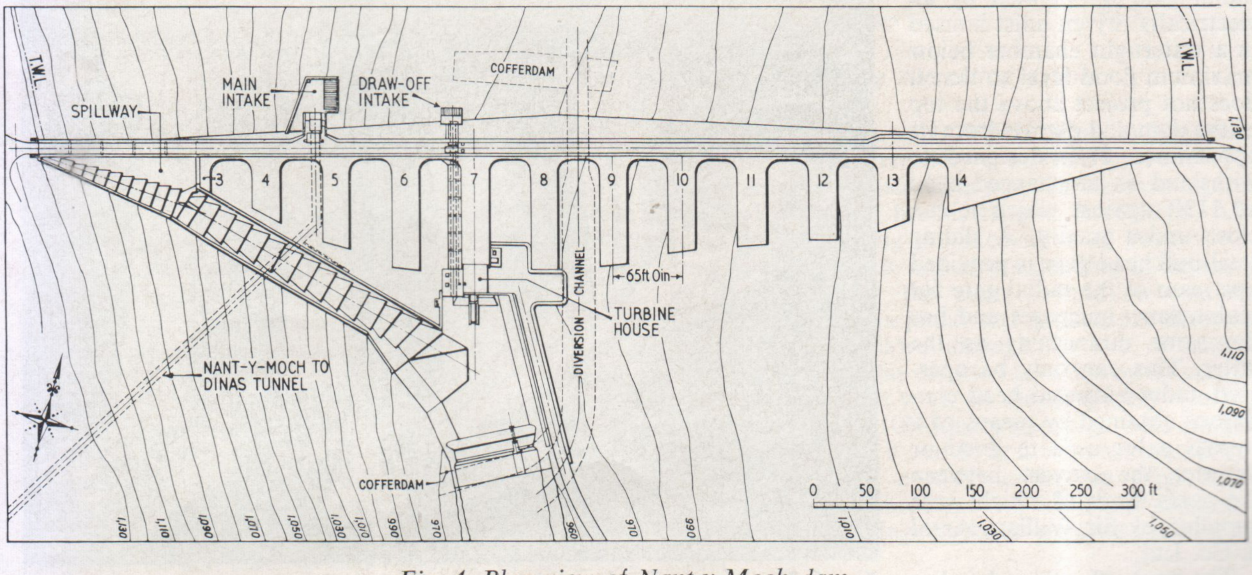

Fig. 4. Plan view of Nant-y-Moch dam

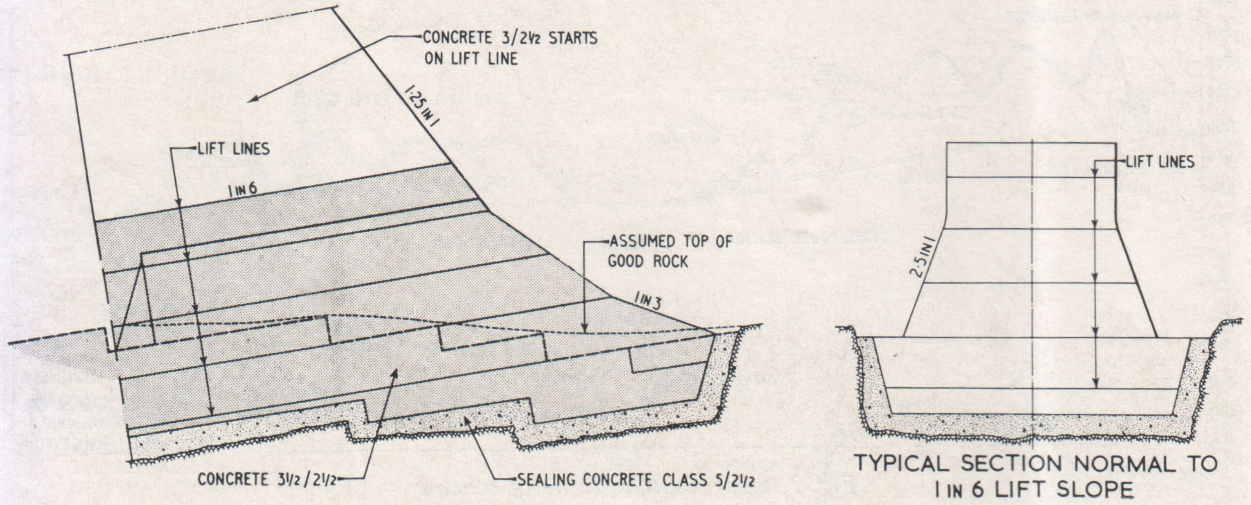

Fig. 5. Detail of splayed buttress footing

regulator and compensation-water outlets also discharge, was also designed on the basis of model tests. It is of trapezoidal section and has a weir at its downstream end. The spillway's capacity of 6,000 cusecs takes into account the fact that reservoir lag will retard an incoming flood and reduce the resultant discharge over the spillway by about 50%. Normally the reservoir level will be held to a maximum of 1,100ft O.D., to provide a 3ft flood-absorption reserve below the spillway crest.

The main intake tower is a reinforced-concrete structure monolithic with the upstream face of the dam. At the rear of the intake chamber there is a 9ft 6in by 9ft rectangular opening forming the inlet to Dinas power tunnel. Two inclined openings, each with a slant height of 29ft and a width of 14ft, are provided at the east side of the chamber and these are protected by trash screens supplied by Hughes & Ellison Limited. A 9ft by 9ft radial gate can be used to shut off full discharge very rapidly under emergency conditions and can be operated automatically from Cwm Rheidol power station. The radial gate is operated by an electrically driven hoist housed in a watertight chamber below maximum flood level so that it does not project above the top of the dam and detract from its appearance. It is designed to withstand an unbalanced head of 113ft against which it can close under gravity. A sliding steel bulkhead gate is provided upstream of the radial gate for maintenance purposes and has the same dimensions as the latter. This can only be operated under balanced head conditions obtained by means of a bypass valve used to flood or dewater the culvert between the gates, both of which were supplied by Sir William Arrol & Co. Ltd.

The draw-off intake chamber contains the inlet to the draw-off pipe and the turbine pipe. At the downstream end of the draw-off pipe there is an electrically operated 5ft-diameter hollow-jet valve used for dissipating the energy of the water that is released when the reservoir is being drawn down. This valve was supplied by Neyrpic through the Armfield Hydraulic Engineering Co. Ltd.

A compensation flow of 5·5 cusecs has to be provided downstream of the dam and this is normally passed through a small turbine at the toe of buttress 7. The compensation set of 50kW nominal capacity is therefore rated at 5·5 cusecs over the normal working range of the reservoir. At full head its output is 56kW. It comprises a 1,525rpm vertical-shaft Francis turbine built by Gilbert Gilkes & Gordon Limited. It is without a governor or automatic shutdown device and the guide vanes are hand controlled. The set is designed to withstand continuous runaway at 2,500rpm. The turbine runner is overhung on the

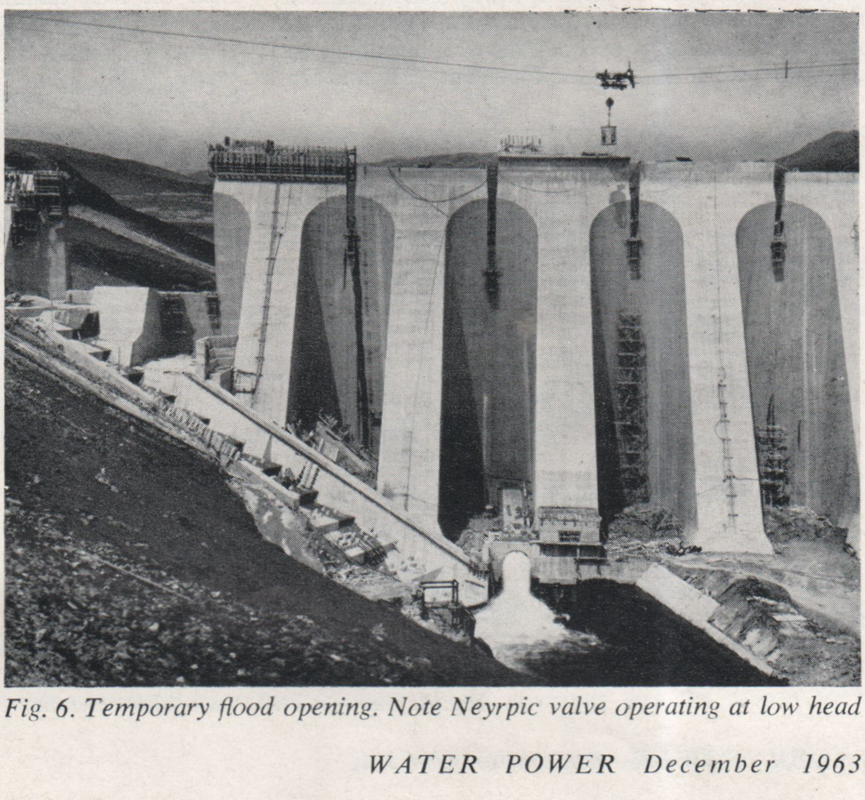

Fig. 6. Temporary flood opening. Note Neyrpic valve operating at low head

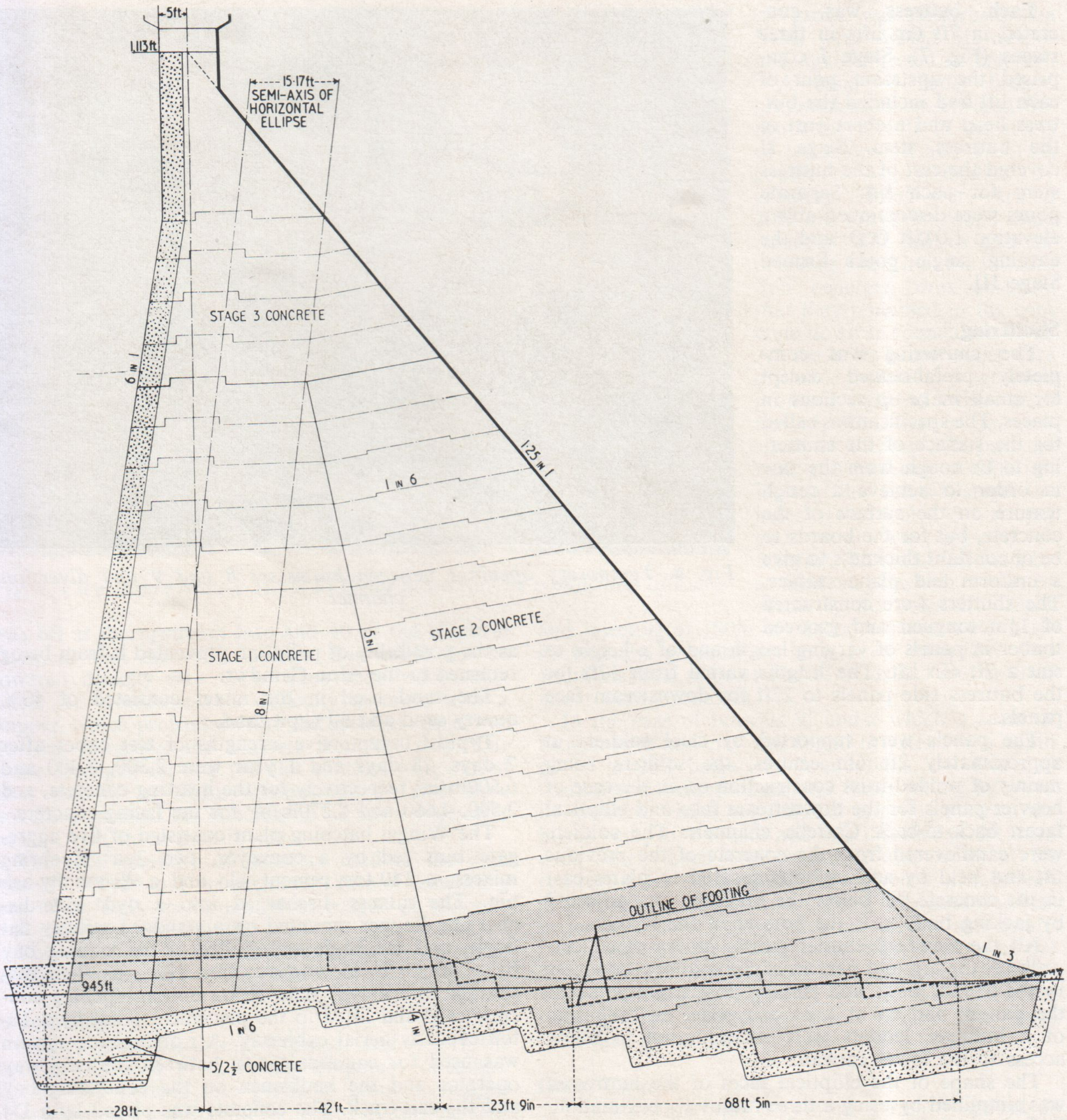

Fig. 7. Section of typical buttress at Nant-y-Moch showing concreting details

generator shaft, and the generator, which was manufactured by Bruce Peebles & Co. Ltd., is a squirrel cage wound for 415V and has a roller bearing.

A sharp-edged weir and a float-operated level transmitter, supplied by the Lea Recorder Co. Ltd., are installed downstream of the turbine to measure the compensation flow. Similar equipment supplied by the same company is installed below each dam in the scheme, and transmits level data to Cwm Rheidol power station.

Construction

Nant-y-Moch dam was constructed by The Cementation Co. Ltd., who also constructed the Nant-y-Moch to Dinas tunnel, and Dinas power station.

Excavation for the dam involved the removal of 54,000yd³ of soft material and 78,000yd³ of rock. The plant used for this work, which began in November 1958 and was substantially completed by June 1960, comprised two Ruston-Bucyrus 38 excavators, one Ruston-Bucyrus 22 backacter, and three 10yd³ AEC dump trucks. During the excavation of buttress 4, a seam of broken rock and clay extending to depths of 10 to 25ft below the stem foundation was encountered. This was jetted and grouted. A diversion channel was excavated through the site of buttress 6, and the stream was diverted into this by an earthfill cofferdam to permit work on the temporary openings in the dam. These 10ft-square openings were situated between buttresses 8 and 9, and were separated by a 3ft-thick wall. An earthfill cofferdam (Fig. 8) rediverted the water through them when they were completed, thus allowing work to proceed on the left bank.

DO

Each buttress was concreted in 7ft 6in lifts in three stages (Fig. 7). Stage I comprised the upstream pour of each lift and included the buttress head and a short part of the buttress stem. Stage II covered the rest of the buttress stem for each lift. Separate pours were discontinued above elevation 1,045ft O.D. and the ensuing single pours formed Stage III.

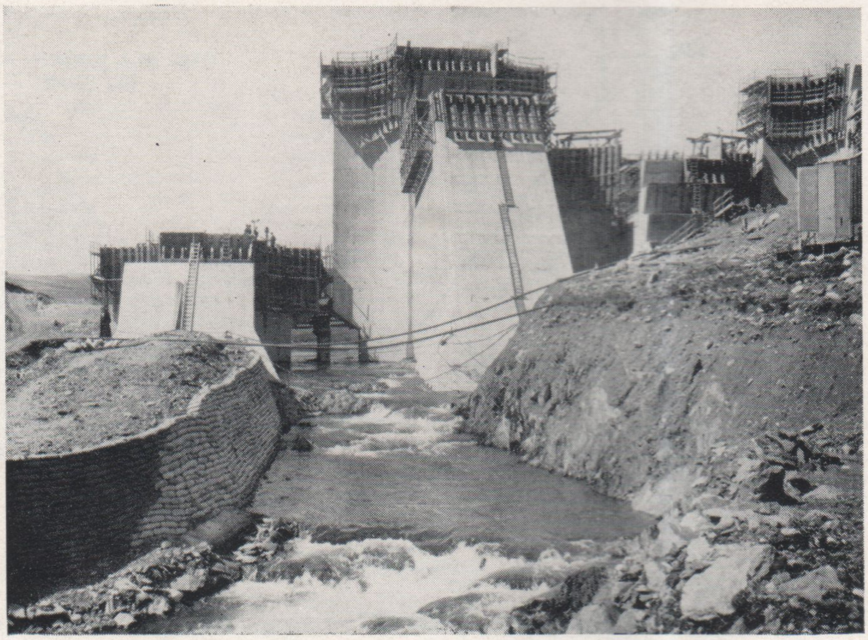

Fig. 8. Temporary openings between buttresses 8 and 9 and diversion channel

Shuttering

The shuttering was completely prefabricated except for small make-up sections in places. The specifications called for the surface of the shuttering to be rough from the saw in order to achieve a rough texture on the surface of the concrete, but for the boards to be of constant thickness to give a uniform and plane surface. The shutters were constructed of $1\frac{3}{8}$in tongued and grooved timber in panels of varying length and of a height to suit a 7ft 6in lift. The lengths varied from 12ft for the buttress side panels to 22ft for downstream face panels.

The panels were supported by steel soldiers at approximately 2ft 6in centres, the soldiers being mainly of welded-truss construction or, in the case of heavier panels for the downstream face and elliptical faces, back-to-back Castella channels. The soldiers were cantilevered from the concrete of the previous lift and held by anchor bolts secured to plates cast in the concrete 9in below the lift level, and adjusted by jacking bolts near the bottom of the soldiers.

All the standard shutter panels incorporated catwalks at the top and bottom of the soldiers for access to the anchor bolts and jacking points. On some of the panels, and on at least one panel on each side of a buttress, ladders were incorporated to allow access to the lower catwalk.

The shape of the elliptical faces of the buttresses was simplified by using a three-radius approximation. Different panels were used for each radius.

The shutters were designed to be lifted by means of frames incorporating lifting tackles at various points but after a time these were found not to be fully satisfactory, particularly in the somewhat smaller bays at the higher levels, and they were abandoned. Subsequently the overhead cableway was used to lift the shutters.

Concrete Plant and Mixes

Typical compositions of the concrete used in the dam are given in Table I.

The coarse aggregates consisted of crushed greywacke ($\frac{3}{16}$in–$2\frac{1}{2}$in) from Carn Owen quarry, which is located about four miles above the dam and was opened specially for the project. Plant at the quarry consisted of a hammer mill, a gyrosphere and a secondary crusher. A notable feature of the quarry operation was the recirculation of aggregate washing water through a hydro-cyclone and settling ponds, as the possibility of pollution prevented it from being returned to the Afon Camdwr.

The sand used in the mixes consisted of 40% quarry sand and 60% pit sand.

Typical compressive strengths of test cubes after 7 days, 28 days and 1 year were 2,300, 3,400 and 6,500lb/in^2 respectively for the hearting concrete, and 2,500, 4,660 and 8,270lb/in^2 for the facing concrete.

The Winget batching plant consisted of five aggregate bins fed by a conveyor, two 2yd^3 Koehring mixers, a 140-ton cement silo and a 40-ton fly-ash bin. The mixers discharged into a 4yd^3 side-discharging hopper mounted on a standard railway flat bogie, and the bogie was pulled to the loading bay by a 40 DLU locomotive. Concrete was then discharged into a 4yd^3 Blaw-Knox bottom-opening concrete skip and lifted to the placement point by a 10-ton capacity aerial cableway. A Loudaphone system was used for communication between the cableway operator and the banksmen on the concreting bay and the rail track. The concrete was placed by a D4 Caterpillar dozer and vibrated by 4in Sinex vibrators.

Concrete Placement

The pours in Stage II were not placed until the corresponding pours in Stage I were at least four weeks old, a minimum of seven days being allowed between successive lifts. Vertical contraction slots were left between each pair of buttresses. These accommodate keychecks and 9in rubber sealing strips, which extend from the bottom of the cut-off trench to the top of the dam. The width of the slots

TABLE I

	Facing ($5/2\frac{1}{2}$) kg/m^3	Hearting ($3/2\frac{1}{2}$) kg/m^3
Cement	285	189
Sand	497	675
Aggregate	1,490	1,440
Fly Ash	95	63

Fig. 9. View inside Nant-y-Moch to Dinas tunnel before completion of lining

was 6ft at the upstream face and 4ft at the elliptical faces, so that the 4yd^3 concrete skip could not be lowered directly into them when they were being filled. To overcome this difficulty a chute with a hopper, which protruded from the upstream face, was devised to receive the concrete from the skip. The chute arrangement and the slot shutters were raised after each lift by Tirfor winches and the slots were not filled in until the concrete in adjacent buttresses was at least three months old.

The total quantity of concrete used in the dam was 197,000yd^3 and the maximum rate of concreting was 80yd^3/h. A maximum of 12,100yd^3 of concrete was placed in one month.

Two coats of black bituminous paint were applied to the upstream face of the dam.

Impounding

Stoplog gates consisting of timber and steel joists were finally used to close the temporary openings. These were lowered into prepared grooves, wedged in position and held down by means of turnbuckles. Rubber sealing strips were used between the stoplogs and the concrete, and a mixture of sand, fly ash and $\frac{3}{4}$in aggregate was deposited on the upstream side to stop some slight leaks. Concreting of the openings was carried out in three stages using a concrete pump.

Buttress 4 was kept at a lower level than the others so that any flood water could flow down a prepared route into the lower half of the spillway channel (Fig. 6).

Impounding started in March 1962 and the water level was raised in successive stages as construction of the dam progressed.

Foundation Treatment

Wherever poor or fissured rock was encountered during the foundation excavations 3in diameter pipes were left in the first lift of concrete to permit easy access to the faulty zone for subsequent grouting. The treatment usually consisted of drilling 5ft into the rock and injecting at 25lb/in^2. Where more than 5cwt of grout was absorbed, the holes were drilled 5ft deeper and again injected at 25lb/in^2.

A band of badly broken greywacke was discovered beneath the middle of the stems of buttresses 12 and 13. This condition was remedied by grouting. Holes were drilled 20ft into the rock around these stems at 20ft centres and inclined at 1 in 4 into the foundation concrete, thus ensuring that they remained in the concrete down to foundation level. All the holes in any stage were drilled before progressive grouting around the stem started. The first stage consisted of drilling 20ft into the rock and injecting at 25lb/in^2. During the second stage the holes were drilled 3ft deeper and grout was injected at 50lb/in^2. This was followed by a third stage which consisted of taking the holes 5ft deeper and injecting at 100lb/in^2. In both cases, water tests showed the grouting to have been ineffective, and additional sets of holes had to be drilled and grouted under both buttresses.

In the case of buttress 4, under which a seam of broken rock and clay was found to extend to a depth of 10 to 25ft below the foundations, the remedial treatment consisted of air and water jetting followed by grouting. Holes were drilled in a box pattern, the boxes being 10ft square and at a distance of 2ft from each other. Each box contained nine holes at 5ft centres. After all the holes in a given box had been drilled, the standpipes were capped. The next step was to jet in a given hole until a connection was established with another, which was then jetted after the first hole had been capped. This continued until the whole box had been flushed and all the holes were running clean without any traces of clay. The boxes were then grouted at 50lb/in^2.

Grout Curtain

The grout curtain holes were normally spaced at 7ft 6in intervals along the upstream face of the dam but this spacing was reduced to 5ft in certain areas of poor rock. The depth of a primary hole below the foundation level of the cut-off trench was roughly the same as the height of the dam at that point, up to a maximum depth of 90ft. The maximum depth of secondary holes was therefore 45ft since they were generally half the corresponding primary depth. All holes at Nant-y-Moch were raked at 1 in 4 in a westward direction as far as buttress 9, to 1 in 4 in an east-

TABLE II

Hole Depth ft	Injection Pressure lb/in^2
15	50
30	75
45	100
60	125
75	150
90	175

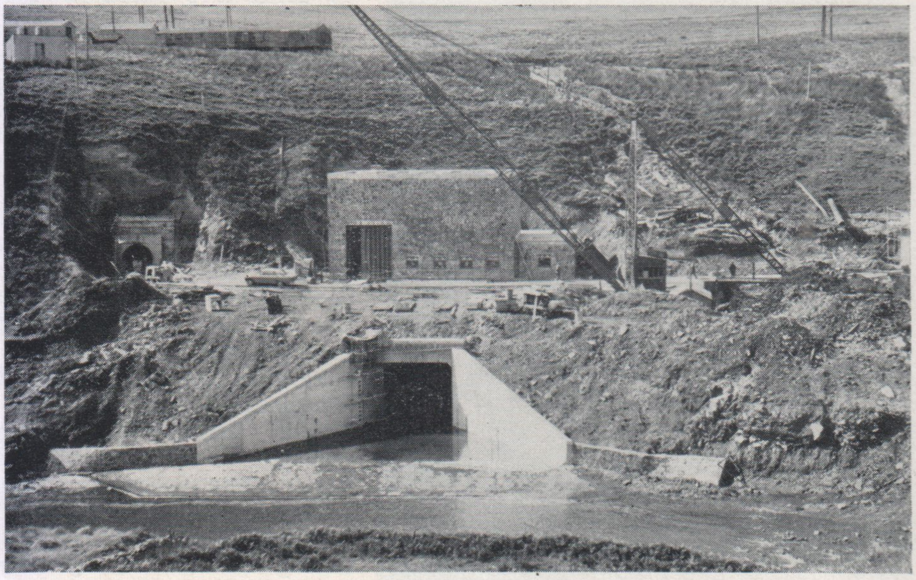

Fig. 10. Dinas power station showing tunnel adit and unsubmerged tailrace culvert

is one reading per day and it is expected that one reading will be taken each month in the future.

Nant-y-Moch/Dinas Tunnel

This tunnel comprises a 9ft 6in diameter concrete and steel-lined section covering a distance of 11,275ft from the intake at Nant-y-Moch to the surge shaft above Dinas at a maximum gradient of 1 in 56. This is followed by a 9ft 6in diameter steel-lined section which descends to Dinas power station at a gradient of 1 in 7. The surge shaft is 300ft deep and concrete lined, the diameter of the upper 200ft being 22ft 6in and that of the remaining 100ft, 9ft 6in. The steel linings of this tunnel and all other tunnels of the scheme were coated by E. & F. Richardson Limited with Adcora Pervon.

Dinas Power Station

The steel penstock which emerges from the tunnel

ward direction after a gradual transition between buttresses 9 and 10.

Drilling and grouting proceeded in 15ft stages. After drilling each stage the grouting was performed slowly, raising the injection pressure to the maximum given in Table II and continuing until refusal at each stage.

Test holes showed that the rock was not sufficiently watertight in several areas so tertiary holes were introduced. These were generally drilled between the original holes where more than 5lb of cement had been absorbed per foot run of rock. They were drilled in one stage to the secondary depth and then injected and reinjected to 100lb/in^2 before being water tested.

Drilling footages and cement quantities for the foundation treatment work and the grout curtain are given in Table III.

TABLE III

	Footage Drilled ft	Cement Used tons
Grout curtain	22,031	143·7
Buttress stems	4,374	68·5
Jetting under Buttress 4	8,969	53·2
Totals	35,374	265·4

Instrumentation

A total of 35 vibrating-wire strain transmitters and five temperature transmitters, supplied by H. Maihak A.G. of Hamburg, were built into one of the taller buttresses at the lowest level compatible with freedom from the effects of foundation discontinuity. Surface strain is also measured and compared with that deduced from the electrical measurements. The transmitters were embedded in September 1960 and since then only three have ceased to function. In the first eleven weeks after the instruments were installed, 160 sets of readings were obtained. The present rate

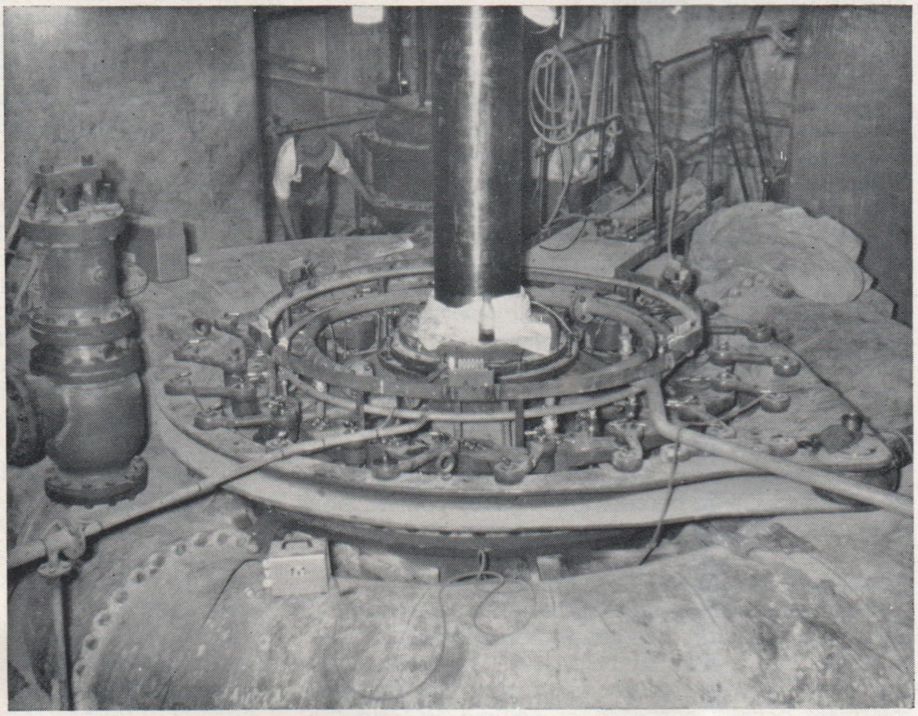

Fig. 11. Boving 16,700hp Francis turbine under erection

into the station reduces in diameter from 9ft 6in to 7ft and is set in a post-tensioned anchor block. Space restrictions at the site made it impossible to construct an anchor block large enough to withstand the total thrust exerted at that point so a design was adopted which embodied prestressed cables for the purpose of transferring a large proportion of the load to the rock.

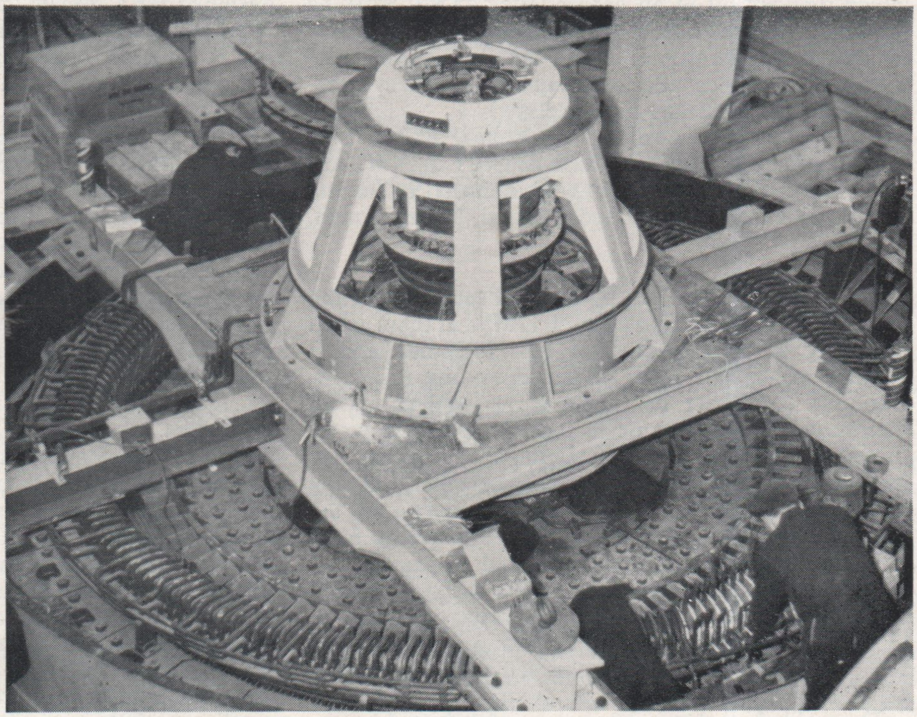

Fig. 12. Bruce Peebles 12MW generator under erection

Inlet Valve

The turbine inlet valve is a 7ft diameter Boving butterfly valve of fabricated construction with bronze journal bearings and an inflatable seal which seals against a special seating in the valve body. A needle-type bypass valve provides balanced pressure conditions upstream and downstream of the inlet valve prior to its opening. The valve is operated by pressure water from the penstock, and a dismantling joint is provided between the valve and the spiral casing.

Turbine

The Boving turbine is of the Francis type and is rated at 16,700hp or 12MW under 206ft net head and has a capacity of 13MW at full reservoir level and 9MW at the minimum operating level. Its speed is 333rpm. The spiral casing, set at 828ft O.D., is fabricated from mild steel plate and was shipped to site in two halves because of its size. The cast-steel guide vanes are mounted in bronze bushes in the top and bottom covers of the machine. The 1,625mm diameter runner is of stainless steel ground and polished to profile from a casting supplied by George Fischer Limited. It is keyed and bolted to a 400mm diameter shaft which is coupled to the generator rotor at 839ft O.D. A Huhn carbon gland is mounted on the top cover to prevent leakage up the shaft, and above this the self-lubricated guide bearing is mounted on a special support. The weight of all the rotating parts of the set together with the hydraulic thrust is absorbed by the generator thrust bearing.

The turbine has a vertical-axis relief valve which is held closed by a piston under pressure from the penstock. This valve is controlled by the guide vanes through a dashpot mechanism which ensures that a sudden closure of the turbine results in a corresponding opening of the relief valve. Slower motions are absorbed by the dashpot and the relief valve is not actuated.

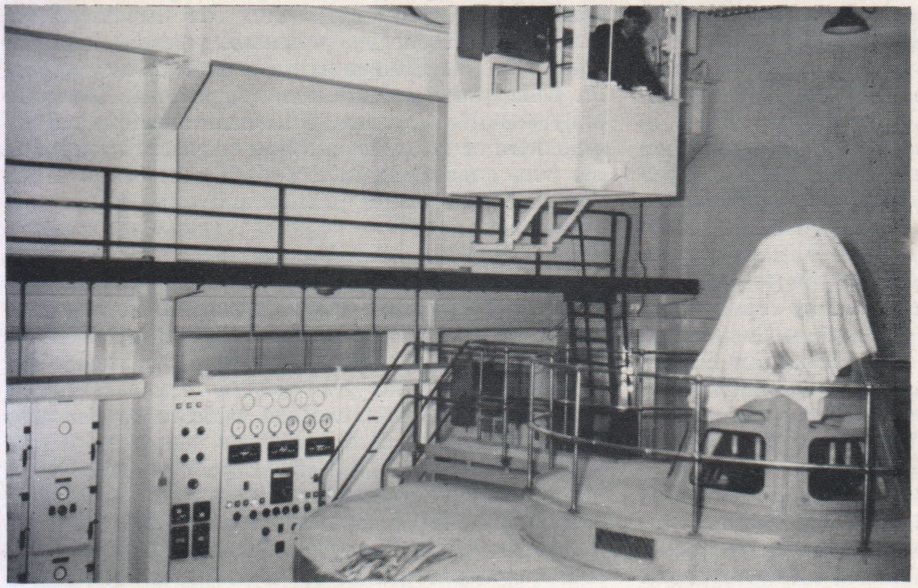

Fig. 13. Inside Dinas power station showing local control and instrument panels

The draft tube is fitted with a removable section immediately under the runner to enable the latter to be dismantled for servicing without disturbing the turbine or generator.

Speed control of the unit is provided by a Boving F10 Mark II actuator which controls the servomotor by means of a regulating valve; and the servomotor actuates the guide vanes through the usual arrangement of levers, breaking links and a regulating ring.

Pressure oil for the governor system is provided by a self-contained pumping set comprising an electrically driven pump which delivers oil to an accumulator at full working pressure. Pressure failures are catered for by a stand-by Pelton-turbine-driven pump which automatically comes into service and maintains the correct pressure until the fault has been rectified.

The turbine was designed by Boving & Co. Ltd. and manufactured by Markham & Co. Ltd., Chesterfield. The butterfly valve was manufactured to Boving designs by Peter Brotherhood Limited, Peterborough.

Generator

The machine, supplied by Bruce Peebles, is of the salient-pole type with a rating of 12MW at 0·8pf when operating as a generator. It has 18 poles and a nominal voltage of 11kV. When operating as a synchronous condenser its rating is 11·3MVAr at full excitation. The generator is closed-air-circuit water cooled by means of six air/water heat exchangers mounted at intervals around the periphery of the stator frame. The main and pilot exciters and the permanent-magnet generator are directly driven from the generator shaft and are mounted on top of the generator. A self-resetting overspeed device, situated above the permanent-magnet generator, operates at 135% synchronous speed and braking is initiated at 50% synchronous speed by a self-resetting under-speed device.

The welded-steel stator frame was fabricated in two sections for transport to site. The core laminations are segmental and the stator winding is of the two-layer open-slot diamond-lap type.

The fabricated-steel rotor spider has a laminated rim into which the heavy steel end plates of the laminated poles are T-slotted and secured by taper keys. The field winding is of the fabricated strip-on-edge type with cooling fins and there is a pole-face damping winding. A flywheel effect of 1,900,000lb-ft^2 is provided by the rotor and the machine is designed for a maximum runaway speed of 595rpm.

A single Michell combined thrust and guide bearing is situated below the rotor and is designed to sustain a load of 94 tons, which is the weight of the rotating parts together with hydraulic thrust. The bearing is self-contained, self-lubricated and has water cooling in the oil reservoir.

Bruce Peebles also supplied the panels which accommodate the turbine-control equipment, the unit auxiliaries starters, and the field suppression equipment. The voltage regulator is an automatic electro-mechanical model manufactured by AEI.

Connection to the system is through a 13·3MVA 11/33kV naturally cooled three-phase Bruce Peebles transformer.

Operation

The set is normally started automatically from the Rheidol control room as the station is unattended, but local manual operation is available. Synchronising and loading must be effected from the Rheidol control room. Both the Dinas set and the Cwm Rheidol sets in the lower stage are designed for operation as synchronous condensers. When it is required to change over to synchronous condenser operation, the load is reduced to zero but with the unit still on the line. The guide vanes are then locked into the closed position and the main inlet valve closes. A solenoid-operated pilot valve opens the valve from the 200lb/in^2 air compressor to blow the water clear of the runner. At this point the 5lb/in^2 compressor becomes available to maintain the water level and to make up the air volume as water drains from the casing. Level controllers and pressure switches are used to ensure that the water level does not rise above a certain point.

(To be concluded)

Motor-Columbus Report

After discussing hydroelectric conditions in Switzerland during 1962/63, the annual report of Motor-Columbus of Baden, the Swiss consulting engineers, goes on to consider the future of electricity supply in Switzerland. It is likely that between 1967 and 1972 imports of electricity will begin to exceed exports very greatly and that the country's hydro-electric resources will have been fully developed in the near future. Since it is cheaper to transport fuel than power, thermal power stations will be constructed, especially as they will reduce Switzerland's dependence on other countries by enabling her to accumulate stocks of coal and oil. Nuclear power, which requires the use of 300MW sets for it to be competitive with electricity generated by conventional thermal means, cannot yet be used in Switzerland because of the effect on the Swiss system of the unavailability of a 300MW set, which represents about 10% of the country's capacity. Thus, the present tendency is to install 150MW conventional thermal sets.

The report then relates the company's activities during the year under review. The Valle-di-Lei-Hinterrhein development was substantially completed and the Luzzone station of the Blenio development was commissioned. It was decided to go ahead with the Engadine scheme and work began in the autumn of 1962 on the access roads and tunnel for Livigno dam and on the Sampuoir adit of the Ova-Spin-Pradella pressure tunnel. Motor-Columbus are co-ordinating the activities of the group of consultants which is designing and supervising the scheme. Design and preliminary work on Emosson, the Franco-Swiss scheme, progressed, as did also the studies for the Flumenthal (Aar and Tessin) station, for which bulb sets are being considered. The company was also working on the modernisation and enlargement of the Aletsch-Mörel (Aletsch) station and has been commissioned to continue the design of the Guimaglio (Sopracina) station and supervise its construction.

Abroad, work progressed at the Peruvian station of Huinco where the intake was completed and the pressure tunnel lined. The lining of the sloping pressure shaft was being installed and excavation of the underground power station had been completed. The foundations for the four 60MW sets were being poured, and the first two sets were to be delivered this autumn. On completion the station will have an annual output of about 1,000GWh. Other work in Peru included preliminary design work for a station at Pativilca, 150km north of Lima. In Italy, construction of the Gaver-Rimas development has been postponed as a consequence of the partial nationalisation of generating stations in that country.