ART. XX.—*Kendal reservoirs.* By PAUL N. WILSON.

Read at Cambridge, September 8th, 1973.

THIS paper is not concerned with reservoirs for supplying Kendal with drinking water; it is about a scheme, put forward in 1844, resulting in an Act of Parliament which has not, in 1973, been repealed.

The Act is entitled:

> "An Act for making and Maintaining Reservoirs in the Parish of *Kendal* in the county of *Westmorland.*"

It was signed by Queen Victoria 21 July 1845.

If all the works envisaged by the Act had been carried out the effect on the valleys of Longsleddale and Bannisdale would have been profound, and it is even possible that Manchester Corporation might have made their first move into the Lake District by acquiring the "Kendal Reservoirs", leaving proposals to take water from Thirlmere, Haweswater and Ullswater until well on into this century.

The preamble to the Act reads:

Whereas it is expedient that Reservoirs should be constructed upon or across or at the Sources of certain Streams in the Parish of *Kendal* in the County of *Westmorland,* known respectively as the *Sprint* otherwise called *Sleddale Beck,* the *Mint* otherwise called *Bannesdale* [*sic*] *Beck,* and the *Kent,* for the Purpose of affording a better and more regular Supply of Water to the Mills and Manufactories upon the said Streams, and thereby promoting the Health of the Persons residing upon the Banks of such Streams. . . .

The Act then trails off into hundreds of words of legal jargon which are of no particular interest. The mill owners, formed into a body of "Commissioners" were now empowered to go ahead and build up to five

reservoirs to store water in wet periods and release it down the three rivers as the flow fell in dry times.

The background.

Kendal was — and, for that matter, still is — an industrial town. Up to the mid-18th century all the processes except fulling in the woollen industry were carried out by hand, and most of the mills on the three rivers with which we are concerned were country corn-mills. The Wakefields started their Gunpowder factory at Sedgwick on the Kent in 1764[1] using a converted corn mill, and as the inventions which were revolutionising the textile industry swept through the north west of England, the requirement for water power to drive the new mills became supremely important. Even after Boulton and Watt were successfully selling their steam engines for driving textile mills (starting about 1790), the "boom" in factory steam engines applied mainly to those areas where coal was cheap and close, and in the regions distant from the mines steam power was regarded as a very poor alternative to water power. By 1844 there were woollen, gunpowder, bobbin, logwood, dyewood, paper and marble mills on the three rivers, together with an iron foundry which used water power. Table 1 lists the mills on the three rivers as shown on the map, Fig. 1, which accompanied the Engineer's "Report"; the names of the owners are from John Somervell's *Water Power Mills of South Westmorland* (Kendal, 1930), and the "Fall" (for the river Kent mills only) is that recorded by the Commissioners of Kentmere Reservoir.

In Kendal the river fell 30 feet from the crest of the Dockray Hall Mill weir at Aikrigg End to the tail-race of Low Mills.[2] About 23 feet of this fall was utilised

[1] Paul N. Wilson, "The Gunpowder Mills of Westmorland and Furness", *Trans. Newcomen Soc.*, xxxvi (1963/4) 47-65.
[2] Now Somervell Bros. Ltd. Low Mills Works.

TABLE 1

MILLS on the rivers KENT, SPRINT and MINT

1844

(See also MAP Fig. 1)

River KENT

Name of Mill	Use	Owner	Fall
Low Bridge, Kentmere	Corn Mill	John Sharp?	
Ullthwaite, Kentmere	Corn Mill	Ed. & Jno. Philipson	
Goose How, [Fell Foot], Kentmere	Bobbin	Wm. Philipson	14 Ft.
Scroggs, Nr. Staveley	Bobbin	Geo. Suart & Bros.	12 ,,
Staveley (Old) or Barley Bridge [On east bank of river]	Corn Mill	Brian Robinson	
Staveley (Old) [On west side of river]	Woollen	Simpson and Ireland	16 ,,
Staveley	Bobbin	Ben. Turton	9 ,,
Cowan Head	Paper	Corn. Nicholson	21 ,,
Burneside	,,	,, ,,	15 ,,
Dockray Hall, Kendal	Woollen & Dyewood	Jno. Whitwell Gerard Gandy Jas. Gandy	7 ,,
Castle Mills, Kendal	Woollen	J. J. & W. Wilson	7 ,,
Low Mills, Kendal	Woollen & Iron Foundry	J. Winder & Son Caleb Metcalf & Co J. Ireland	9 ,,
Helsington [Laithes] Mill	Marble processing	Francis Webster	7 ,,
Sedgwick [Old]	Gunpowder	John Wakefield	10 ,,
Bassing Ghyll	,,	,, ,,	11 ,,

TABLE 1—continued

River SPRINT

Name of Mill	Use	Owner	Fall
Wilson Mill, Longsleddale	Bobbin	??	
Garnett Bridge [Upper]	Bobbin	Wm. Muncaster	
[Lower]	Corn Mill	Nathan Martindale	
Sprint Mill	Woollen	Geo. & Wm. Robinson	

River MINT

Patton Mill	Corn Mill	Wm. Chamley	
Meal Bank	Woollen [and Corn ?]	Geo. & Isaac Braithwaite	
Scar Foot	Woollen & Logwood	,, ,,	
Beck Mills [Upper]	Corn Mill	Thos Nicholson	
Beck Mills [Lower]	Worsted	Geo. & Wm. Robinson	

by three, large, modern (1800-1816) mills, mainly concerned with the woollen trade. Upstream the most important were probably Goose How Bobbin Mill (better known as Fell Foot Mill), Staveley Mill, Cornelius Nicholson's paper mills at Cowan Head and Burneside, with Wakefield's Gunpowder mills at Sedgwick, and Bassing Ghyll below the town. All of these made a very substantial contribution to the livelihood of the people of Kendal and the surrounding villages who looked to Kendal as their centre.

The factories probably ran for about 60 hours per week, with the paper and gunpowder mills running on shift for $5\frac{1}{2}$ days or more.[3]

[3] The importance of a continuous supply of water power to the gunpowder mills is reflected by a letter from John Wakefield to his friend W. Wager, agent for Mandale Mine in Derbyshire, July 1826:

"... as requested I have forwarded the above [12 half barrels of powder] to put you on for a while — our water is still very low and the rain we have has yet had no effect on the springs [at the source of the river]." Wilson, *Gunpowder Mills, op. cit.*

The amount of water power which can be developed at any mill is in direct proportion to the height of fall and the volume of water flowing. The height of fall depends entirely upon natural conditions aided by a certain amount of civil engineering. For example, Castle Mills at Kendal only had a "Fall" of 7 feet; more might have been obtained by raising the weirs, but this would have *reduced* the fall at Dockray Hall Mills and increased the danger of flooding near and above Stramongate Bridge to an unacceptable extent. Hence the only way to increase the *reliable* power at any mill was by increasing the flow of water in dry times. This the "Act" proposed, but the works had to be paid for, and it was decided that each mill which expected to gain from the building of the reservoirs should contribute to the capital and upkeep cost by paying a "Rate" of so much per foot of fall employed at the mill. This was reasonable, and was generally accepted as such. For instance, if, at dry times, 1,000 cubic feet of water per minute could be released to the mills from the reservoirs, this would represent about 9 horsepower at Castle Mills with 7 feet fall, but 27 horsepower at Cowan Head with 21 feet fall.[4]

The proposed Kentmere Head reservoir.

The idea of storing water in wet times to be released in dry weather began (and, for that matter, finished) with the building of a reservoir at Kentmere Head. There is a report in the *Westmorland Gazette* of 17 August 1844 giving notice of a proposal:

". . . to form a vast reservoir at Kentmere, so that the waters accumulated in winter may furnish a better supply in droughty seasons than has otherwise been enjoyed. . . .

The following week a meeting was held at the

[4] It is difficult for us in these days to realise how important a *little* power could be. The best way to look at it is in terms of man-power, the only alternative. It is doubtful if a man could exert, *continuously for 12 hours* as much as one-tenth of a horsepower, so that the extra 9 horsepower at Castle Mills was roughly equivalent to the work of 90 men.

Commercial (now Kendal) Hotel, Kendal, with James Gandy (Dockray Hall Mill) in the chair. The scheme was explained by that tireless supporter of new commercial ventures, Cornelius Nicholson, and after the meeting the *Gazette* was given a statement from which I quote extracts:

For several years, and especially during the past summer, great difficulty has been experienced by the mill owners on the Kent from the scarcity of water, so much so, that one manufacturer has estimated his loss of orders from this cause at £1,000 in one year alone.[5]

The statement goes on to blame the recent agricultural drainage for the more rapid run-off of the rivers, and several subsequent letters in the *Westmorland Gazette* castigate the landowners upon this score.

There can be no doubt that the major event about which the mill owners were complaining, although I cannot find it specifically mentioned, was the draining of the Kent Mere in an effort to obtain more agricultural land, most of which never became more than a reed-covered swamp. This shallow tarn, 1½ miles long and a fisherman's paradise, was drained about 1840.[6] Although the mere was not a controlled reservoir it would, by its boggy nature, have formed an excellent

[5] 1844 had an exceptionally dry May, with only 0.143 in. of rainfall compared with the average of the previous 32 years of 2.500. There was also a very cold dry wind, and although the June rainfall was 3.757 in. compared with an average of 3.550, this rain fell over a very short period, and just soaked in sufficiently to save the crops. It probably produced a flash flood, like that of 16 June 1954 when 3.050 in. of rain fell in 24 hours and did little to re-charge the "springs" referred to by John Wakefield. (See f.n. 3.) The July rainfall was barely half the average, and August only three-quarters. This supports the statement about the dry summer.

[6] My efforts to date the drainage of the Kent Mere from reference to the *Westmorland Gazette* proved fruitless, although map and guidebook references, not to be relied upon too much, indicated a date between 1830 and 1842. I was then lucky enough to get in touch with Mr J. A. Butterfield, M.Sc., F.G.S., of Morecambe, who has made a detailed (though not, I understand, published) survey of Kentmere. He told me that the first attempts to drain the Mere were carried out in 1840, but were unsuccessful. Later the job was completed [before 1844?] by blasting through the solid rock. The depth of the excavation, as seen from Waterfoot Bridge is most impressive.

"sponge" to hold up flood water and release it slowly.

The statement in the *Gazette* concluded:

The survey undertaken by Mr Bentley [*sic*][7] is not yet perfected, but it is estimated with a sufficient approach to exactness, that the cost of the undertaking will be about £2,000 . . . it appears that the embankment will be about 300 feet in length, and about 45 feet deep; that the reservoir will have a superficies of 30 acres and will contain one million to a million and a half cubic yards of water.

The following resolution was passed:

That it is considered desirable, for the benefit of this town and district, that reservoirs [note the plural] be formed in Kentmere and elsewhere, to render the supply of water in the river more constant and uniform.

A Provisional Committee of local mill owners, nearly all of whose names appear in Table 1, was formed to go further into the matter. They were:

James Gandy	J. Wakefield
John Ireland	J. H. Wilson
John Whitwell	Cornelius Nicholson
J. Philipson	B. Turton
George Suart	J. J. Wilson

The Mayor of Kendal for the time being[8]

The Provisional Committee must have moved fast. They called in the services of John Frederick La Trobe Bateman,[9] an eminent Consulting Engineer from

[7] Job Bintley, 1812?-1889, was appointed Borough Surveyor of Kendal at a salary of £100 per annum when the Local Board of Health was formed in 1849. He prepared a comprehensive Sewerage Scheme for the town which was submitted to the Council in 1850; not only did the Council take no action upon this scheme but they also reduced his salary to £50. He resigned in 1852. *Information from Miss Alice Palmer.*

He prepared the plans for Kendal Reservoirs for the Consulting Engineer, J. F. Bateman, set out the new Sedgwick Gunpowder Works *c.* 1858, and worked on sections of the Furness Railway.

[8] Kendal Corporation owned the leasehold and water rights — i.e. the "fall" — of Castle Mills, and the Mayor became a "Commissioner of Kentmere Reservoir" until J. J. & W. Wilson bought Castle Mills outright in 1853.

[9] Bateman, 1810-1886, was one of the more famous consulting engineers of the Victorian era, practising mainly in the north. He is best known as consultant to Manchester Corporation, and engineered their Longdendale Reservoir system with extreme competence. He was a strong advocate of the principle that water from sparsely populated regions of high rainfall should be taken, if necessary by very long aqueducts, to the rapidly developing and highly populated industrial areas. As early as 1876 he advocated the conveying of water from Thirlmere, Haweswater or Ullswater to the greater Manchester area. *Manchester Waterworks,* J. F. La Trobe Bateman, Spon., 1884, p. 215.

In 1836 he worked with [Sir] William Fairbairn to build a large reservoir at Lough Island Reavy, the source of the river Bann in Co. Down, to augment the flow of the river for the benefit of the mill owners, and was concerned with other similar schemes in east Lancashire.

Manchester to advise them, and he employed Job Bintley as surveyor.

Job Bintley's suggestion for a reservoir at Kentmere Head was now replaced by much more ambitious proposals, and probably the sight of Bintley and his team trudging up the valleys in September and October, armed with theodolites, poles and chains alerted the landowners to the comprehensive schemes which were being planned.

The case For and Against the reservoirs.

The opposition to the proposals was bitter, and is reflected in the correspondence columns of the *Westmorland Gazette* in November 1844.

"Correspondent" fired the first shot with a letter of 23 November 1844. His main points were:

(i) A reservoir at Kentmere would be enormously costly.

(ii) It would only benefit a few of the larger mill owners.

(iii) It would use up a lot of *valuable* [my italics] agricultural land.

(iv) Bursting of the dam would cause tremendous havoc and desolation, let alone loss of life. Who would compensate the landowners?

(v) Kendal Corporation, as owners of the leasehold of Castle Mills should oppose the Reservoir Act as strongly as possible.

The following week there are letters from "Monitor" opposing the scheme, mainly upon the score of the high cost which would be a perpetual burden on the mill owners, and from "Admonitor" defending it. These letters are too verbose and dull to quote verbatim, but the end of 'Admonitor's" letter states the case for the mill owners quite well:

To the inhabitants of Kendal and the district generally, as well

as to the Corporation, I would, in conclusion, address a few words, whether landlords or tenants, manufacturers, tradesmen or shopkeepers. How much are your interests and welfare identified with the prosperity of Kendal, which so much depends upon the prosperity of its manufacturers, and those deriving their livelihood thereby? How much has the manufacturing business declined within the last fifteen years in your town, and from what cause? Has it not been, as the mill owners and manufacturers know full well, to compete with their Yorkshire and Lancashire rivals, in consequence of the greater facilities afforded to the latter by the cheapness of coals and consequent application of steam power, coupled, I may say, with an inadequate supply of water in the Kent, Sprint and Mint, at seasons of the year when most wanted. Orders upon orders for goods might have been executed during the bygone summer, if the manufacturers only possessed a sufficient supply of water; which, when available, is always cheaper than steam power. As a natural consequence, those orders are given to manufacturers of other districts, a connexion is lost for ever to those of Kendal, and the trade of the town diminishes year after year. If something is not speedily done to obviate such a state of things, Kendal must soon hide her diminished head amongst manufacturing towns, and sink into a country village or little more.

In the same issue "Malagrowther" describes in blood-curdling terms what he knows, from experience, could happen to these reservoirs. In the depth of a severe winter Killington Reservoir [built in 1820 to feed the Kendal and Lancaster Canal] was thickly frozen over when there was a sudden thaw, accompanied by a change of wind from the south to the north [this, in itself, is remarkable] and heavy rain. The swollen streams poured into the already full reservoir, the ice broke up and was driven against the embankment which failed, and the resultant flood: ". . . committing fearful ravages" caused ". . . the terrified inhabitants in the valley of Old Hutton and Holmescales [to flee] for their lives, and take up their abode for a time in the outhouses that were beyond the reach of the foaming waters".

During the ensuing week protagonists for the reservoirs pointed out that Malagrowther's story was

remarkable in that the partial failure of Killington dam took place in July ! Malagrowther came back on 7 December without a word of apology for the pack of lies he had told, but pointing out how much more serious the affair would have been if it *had* occurred under the conditions he outlined ![10]

By the end of the year Bateman's Report was being considered by the Provisional Committee, and a Parliamentary Bill was promoted.

J. F. Bateman's Report.

I do not propose to go in detail into all Bateman's calculations and forecasts. His basic idea was that a number of reservoirs should be built, and I will only outline the scheme which was put before Parliament and approved.

Fig. 1[11] was prepared to show the scheme as a whole, and is much the most important of the maps I have included. It speaks for itself and calls for no explanation.

I will now deal with the reservoirs proposed. Realising how costly his scheme was becoming. Bateman indicated reductions for building lower dams with smaller reservoirs, but the maps and descriptions deal only with the full recommended scheme.[12]

[10] What, in fact, happened was that Killington Reservoir was built with too small a spillway. It would not carry the heavy rain on the night of Friday, 30 July 1836, and was in danger of overtopping the embankment. The reservoir keeper took a spade and opened up a channel at the south-west end of the *smaller* embankment which made up the full dam. Naturally the rush of water quickly widened this, causing a considerable flood which did quite a lot of damage and thoroughly scared the people in the farms bordering Peasey Beck. The breach in the dam was 15 yards wide, and it was repaired by 50 men in eight hours. *Gazette*, 6 August 1836.

[11] The "Map", now deposited in the Archives Office in Kendal, is beautifully drawn and lettered, but much of the lettering is so small that the Map could not have been reproduced and *reduced in size* to make it possible to include it in the *Transactions*. The only merit of my "utility" copy is that it is legible.

[12] Bateman's "Report" included a reservoir on Potter Fell, on the eastern slopes south of Skeggles Water. This proposal was ruled out in the very early stages and, as it was never seriously considered, I do not include it.

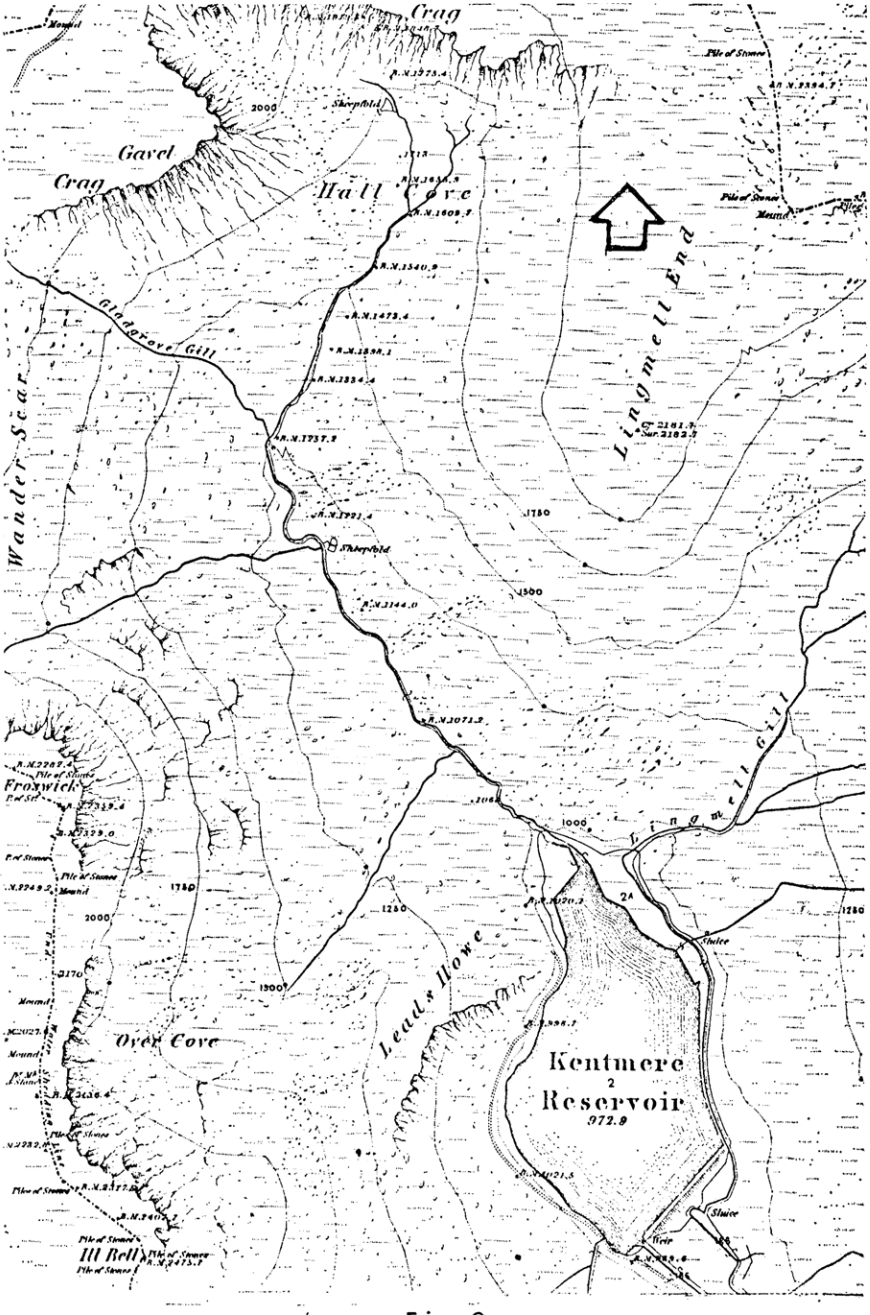

Fig 2

Kentmere Head Reservoir

0 500 1000 Yards

Kentmere Head (Fig. 2).

Height of dam	...	57 feet
Capacity	...	44 million cubic feet
Gathering ground	...	1,330 acres

As this reservoir *was* built, it is shown on the Ordnance Survey map, and I will have more to say about it later. It was the smallest of the reservoirs but had the advantage that it would help all the mills on the Kent from Low Bridge, Kentmere, to Bassing Ghyll below Sedgwick. The land was poor, it was far above the nearest habitation, and would not affect the only track out of the top end of the valley over Nan Bield Pass. Also there was a good supply of boulder clay and stone for building it. The gathering ground was small, but the rainfall very high.

Skeggles Water (Fig. 3).[13]

Height of dam	...	26 feet
Capacity	...	85 million cubic feet
Gathering ground	...	1,260 acres

Skeggles Water would have been far the most extensive reservoir, with a water surface of 180 acres. (Kentmere Head was 40 acres.) Only those few readers who have visited Skeggles Water can have any idea of the acres of almost level boggy ground which surrounds it. Three long, low dams would have been required, and if the dam across Skeggleswater Dike had failed when it was spilling there would undoubtedly have been a disaster in Staveley and probably Burneside and Kendal as well. This was Bateman's first choice, as he estimated the cost as being *less* than that of Kentmere Head with nearly the same gathering ground and twice the capacity. However, his estimates were so wide of the mark, and the rainfall would have been so much less that I think that the Commissioners were wise to build Kentmere first.

[13] Figs. 2, 3, 4 and 5 are reproduced from the *original* 6-inch Ordnance Survey maps of 1861.

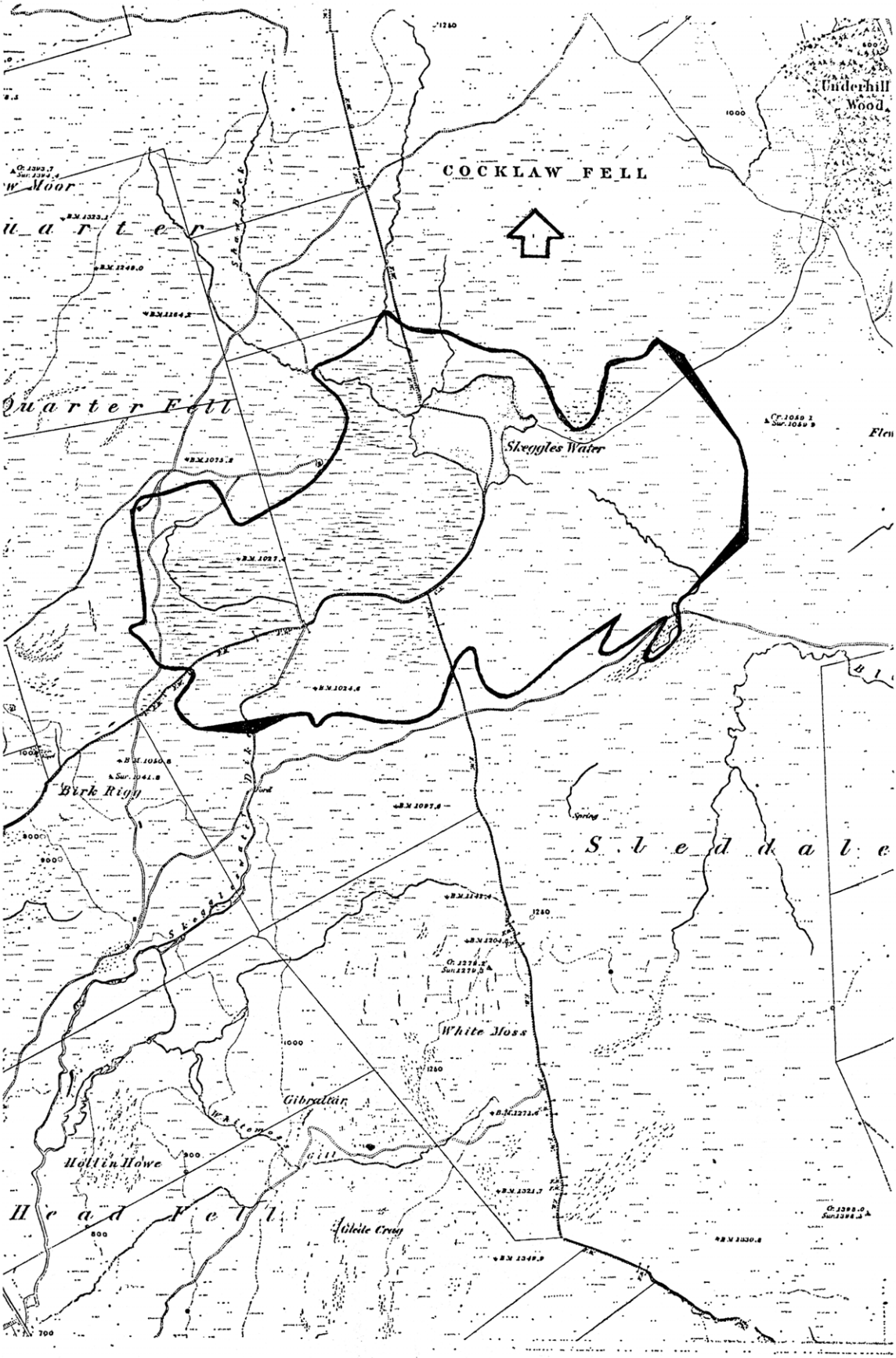

Fig 3

Skeggles Water Proposed Reservoir

0 500 1000 Yards

facing p. 336.

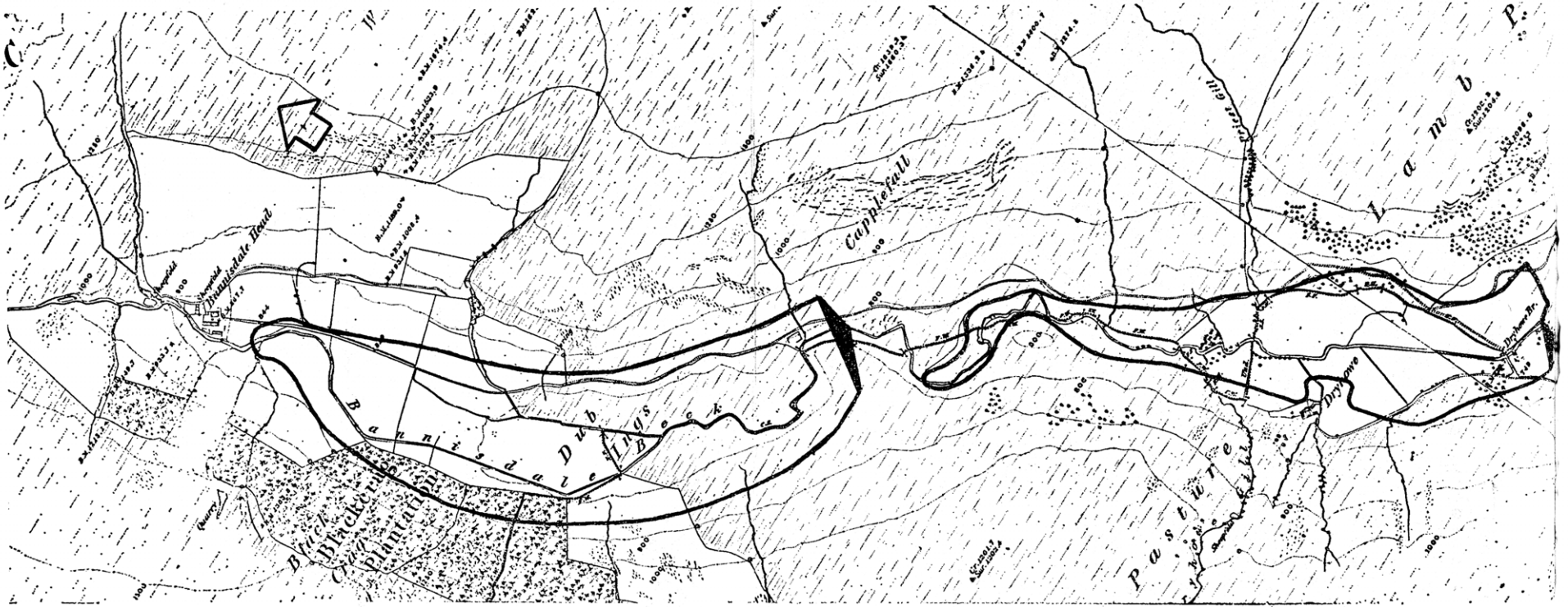

Fig. 4.

Proposed Upper and Lower Bannisdale Reservoirs

0 500 1000 2000 Yards

Bannisdale (Fig. 4).

		Bannisdale	
		Upper	Lower
Height of dam	...	60	64 feet
Capacity	...	140	84 million cubic feet
TOTAL capacity	...	224 million cubic feet	
,, gathering ground	...	2,380 acres	

The Bannisdale Lower Reservoir dam would have been just below Dryhowe Bridge, with the upper dam half-way up the gently sloping bed of the valley, with its headwaters almost lapping Bannisdale Head farm.

This would have been by far the largest reservoir complex, and it is not surprising that a hundred years later Manchester Corporation turned their eyes on this unfrequented valley containing only one homestead and little to attract the average tourist. Bateman proposed two dams instead of one, as in 1844 he would certainly have been taking a chance in building a single dam at Dryhowe Bridge about 130 feet high.

Meal Bank and Scar Foot mills (later combined into one) were important, and here again the scheme would have been an excellent one for the Kendal and Sedgwick mills.

When I was a boy I remember hearing Mr Brocklebank, the keeper of Kentmere Reservoir, refer to it as: "Nobbut a porridge bowl." The Bannisdale reservoirs would at least have been a soup tureen.

Longsleddale (*Sadgill*) (Fig. 5).

Height of dam	...	74 feet
Capacity	...	67 million cubic feet
Gathering ground	...	1,730 acres

The dam would have been just above Sadgill farm, with a water level of about 750 feet A.O.D. It would have flooded the whole of the top end of the valley, and the road leading to the quarries, Gatescarth Pass and Mosedale would have had to be diverted. This diversion is shown on the original map.

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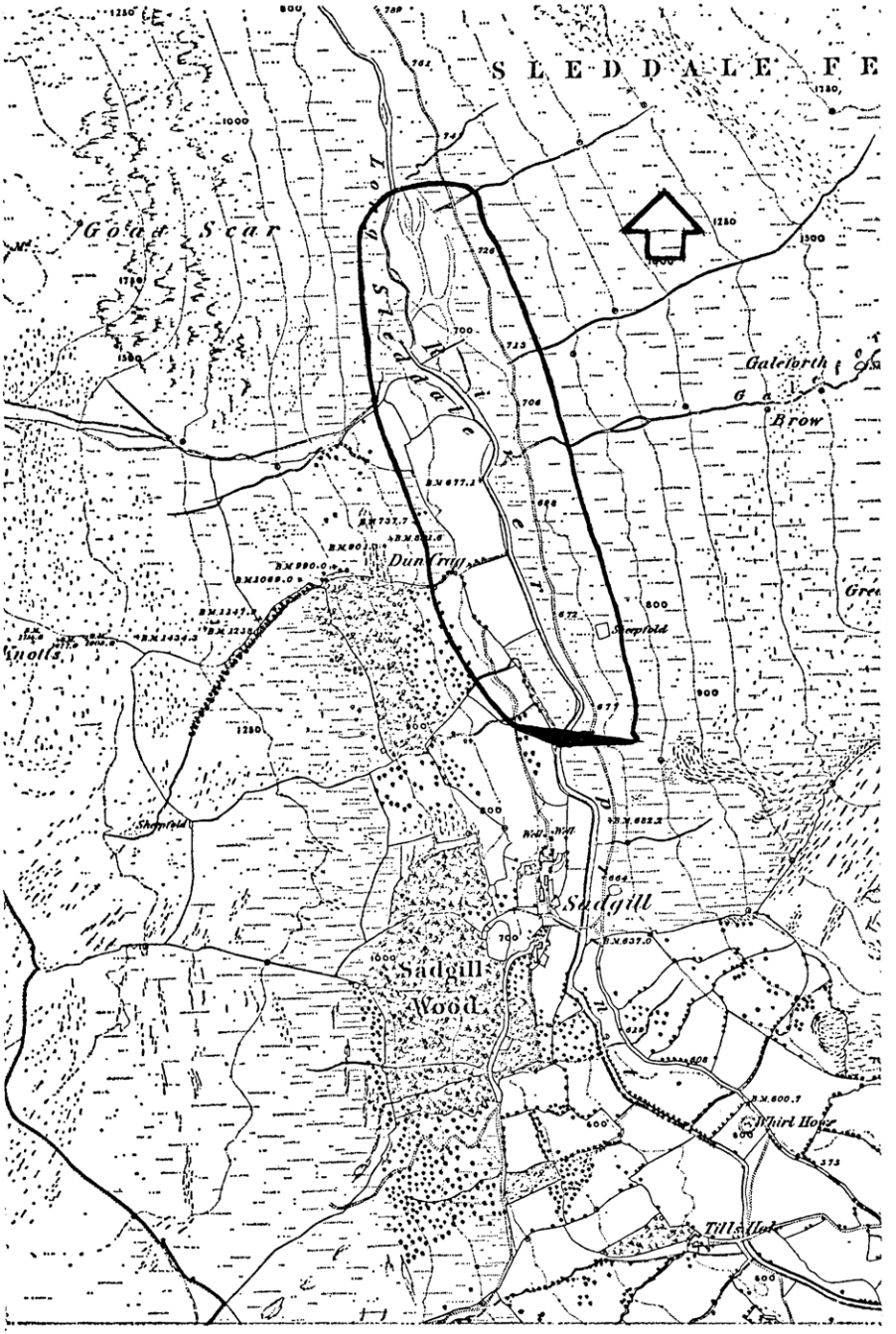


Fig. 5.

It would have been no help to the Staveley and Burneside mills, and the five mills on the Sprint do not appear to have been very much interested. However, the Kendal mills from Dockray Hall downwards would have benefited.

The Act of Parliament.

I am greatly indebted to Mr James Cropper, Chairman, and Mr J. F. Hill, Engineer of Messrs James Cropper & Co. Ltd. of Burneside for nearly all the information contained in the latter part of this paper. Mr Hill has been particularly helpful in providing me with extracts from the records of The Commissioners of Kentmere Reservoir, a task which has involved him in a lot of extra work.

The Act, in effect, accepted Bateman's recommendations, and gave power to build all or any of the reservoirs. Its working was placed in the hands of Commissioners who were to be the occupiers of the "Falls" on the rivers concerned of an annual value of at least £50. The original Commissioners named in the Act were:

The Mayor of Kendal, for the time being (so long as the Corporation of Kendal were	owners of a fall of water)
John Wakefield	of Sedgwick Mills
John Gandy, James Gandy	
John Edward Whitwell, Isaac Whitwell	of Dockray Hall Mills
John Jowitt Wilson, William Wilson, John Hewetson Wilson	of Castle Mills
John Ireland	of Low Mills
Cornelius Nicholson	of Cowan Head and Burneside Mills
Benjamin Turton	of Staveley Bobbin Mill

The Commissioners were empowered to borrow money to carry out their works, and to levy a Rate to meet the expenses, based upon each foot of fall used

by individual mills. It was also laid down that *only* the Commissioners had powers to build reservoirs in these valleys, a fact completely overlooked by Manchester Corporation when they planned to build a reservoir in Bannisdale in 1962.

Cornmills with less than six pairs of stones were exempt from paying a Rate, and the corn mill at Barley Bridge, Staveley, was always free. A mill which claimed that the supply of water was sufficient for its purposes without the construction of the reservoirs might be granted exemption, and special Rates could be fixed where it was agreed that the full rate was not justified.

Kentmere Head Reservoir.

The Commissioners decided to start their work by building Kentmere Head Reservoir as originally proposed by Job Bintley and discussed at the promotion meeting in Kendal in August 1844.

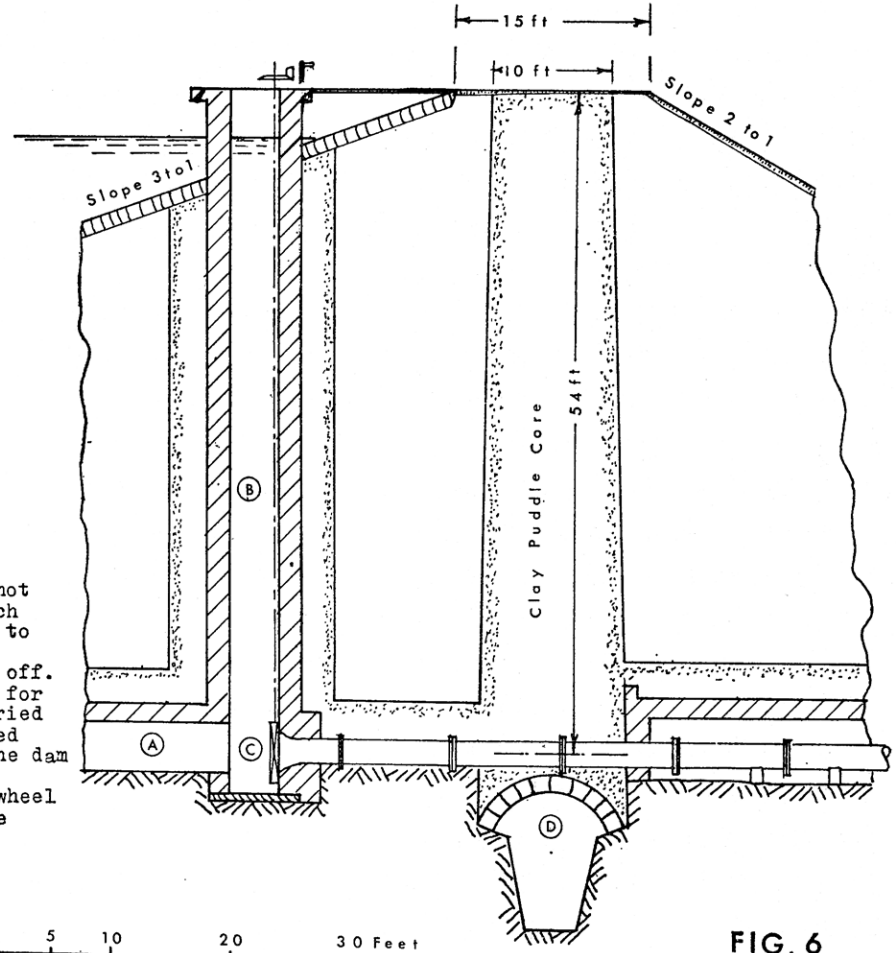
Compared with the speed with which the Act was rushed through, the reservoir took an unconscionable time a-building. The Commissioners met on 9 October 1845 and accepted a tender from Messrs Shuttleworth and Dobson for building a dam at Kentmere Head for £6,150; 48 acres of land cost £960, and the cost of the reservoir keeper's cottage was not to be more than £45. Already, before a sod had been turned, the works were going to exceed Bateman's estimate by 60% and that of Job Bintley by 350%.

The work was completed during the summer of 1848, and water was drawn from the reservoir in July or August, three years after the passing of the Act. The total cost was in the order of £13,435. The byewash channel was partially washed away during a flood, and had to be extended downstream to its present form for an extra £686.

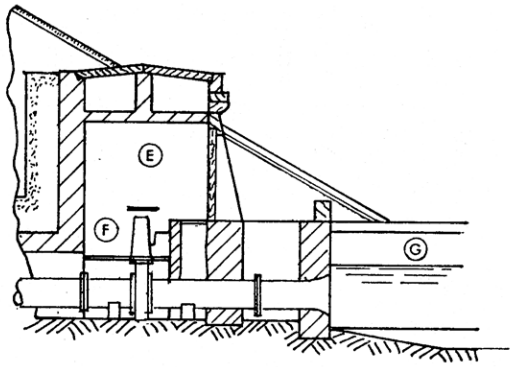
NOTE: In the Appendix I give some information about the construction and history of the dam itself which may be of interest to a few readers.

KENTMERE HEAD RESERVOIR

Part Section of the Dam, from Bateman's design, modified during construction



A Inner Culvert
B Valve Well
C Valve
D Core Supporting Arch
E Valve House
F Control Valve (Now removed)
G Gauge Basin



NOTE !

This drawing does not show the valve which was fitted in 1936 to enable the Inner Culvert to be shut off. The operating rods for this valve are carried up the stone-pitched upstream face of the dam and the valve is operated by a handwheel near the top of the valve well.

0 5 10 20 30 Feet

FIG. 6

Paul N Wilson
Kendal 1972

The outcome of the Scheme.

Why were the other reservoirs not built?

I think that the answer lies mainly in the high cost of Kentmere Head compared with the estimates, the three years taken to complete it, and the fact that coal could now be brought directly from the Wigan coalfields to Kendal, Burneside and Staveley. Mill chimneys began to appear at the factories, and in 1850 a 100 horsepower steam engine was installed to help the water power at Castle Mills in Kendal. In the same year Wakefields moved their main gunpowder mill from Sedgwick to Gatebeck on the Peasey Beck where they had a better fall and a reasonable supply of Compensation Water from Killington Reservoir.[14]

There was no enthusiasm on the part of the smaller mill owners to pay their Rate, let alone help to finance new schemes involving many thousands of pounds of capital expenditure. Probably before any stored water flowed from Kentmere Reservoir the Commissioners had decided not to proceed with any other major works, and the "Commissioners of Kendal Reservoirs" automatically became "The Commissioners of Kentmere Reservoir"; they still retain this title *and* the powers which were vested in the Commissioners under the Act.

The reservoir and the decline of the water power.

Some further particulars about the maintenance of Kentmere Reservoir are given in Appendix 1. When, in 1930, the *Reservoir (Safety Provisions) Act* was passed, the Commissioners appointed Mr E. C. Oakes, M.I.C.E., Water Engineer of Preston Corporation, to

[14] Confusion often arises between Wakefield's *original* Sedgwick Gunpowder Mill which was *below* the present suspension footbridge and on the *east* side of the river, and the mill of the "Sedgwick Gun Powder Company" which was opened in 1858 and was situated on the *west* bank of the Kent *above* the bridge. Wakefield's mill had a fall of 10 feet, but the new mill had 21 feet and so would get twice the power from a given flow of water. When the new company started they must have known that no additional reservoirs would be built.

inspect and report upon the state of the dam. Some subsidence had taken place, there were minor leaks in the clay core, and at least one of the 24-inch pipes through the dam was broken. These defects were made good, and as the valve in the valve chamber at the toe of the dam had been out of use for many years a new valve was fitted at the *upstream* end of the stone culvert leading to the central shaft. This, and subsequent routine maintenance has kept it in excellent condition.

Unfortunately the story of the water power driving the mills, and of many of the mills themselves is less happy. Table 2 should be compared with Table 1, and shows briefly what has happened to them between the summer of 1844 and that of 1972.

James Cropper & Co. Ltd. soon became the greatest contributors to the funds of the Commissioners of Kentmere Reservoir; when their mill at Bowston was opened in 1880 they owned a total fall of 51 feet, far higher than that of any other individual mill owner. As the other mills closed down or stopped using their water power they became *de facto* the owners of the reservoir, and the bulk of the cost of repairs and maintenance has fallen upon them.

The charge made for *abstracting* water at Burneside to generate electric power by their turbines (the water is, of course, returned to the river a short distance from the point of *abstraction*) was so high that they have been shut down.

Croppers do, however, use river water in their mills, and in dry times the additional flow which can be obtained from the reservoir is very useful to them.[15] Anglers on the Kent who complain bitterly about the increasingly "flashy" nature of the river, as did the mill owners in 1844, are convinced of the value of the

[15] At a recent Public Inquiry in Kendal the Lancashire River Authority stated that the contribution made by the reservoir to the flow of the Kent was insignificant. Croppers, with over 120 years of experience to draw upon, strongly dispute this view.

TABLE 2. MILLS on the river KENT 1972.

Name of Mill		Remarks
Low Bridge,	Kentmere	Closed *c.* 1860
Ulthwaite Corn Mill,	,,	Closed *c.* 1870
Fell Foot (Goose How)	,,	Closed 1902
Scroggs Mill,	Staveley	Closed 1936
Barley Bridge Mill, (Kentmere Ltd.)	,,	Stopped using water power 1971*
Barley Bridge Corn Mill	,,	,, ,, ,,
Staveley Mill, (Staveley Wood Turning Co. Ltd)	,,	Still using water power 1972
Cowan Head	Mills	Burneside	Stopped ,, 1971
Bowston	Mills	Burneside	Stopped ,, 1964
Burneside	Mills	Burneside	Stopped ,, 1972*
(James Cropper & Co. Ltd.)		
Dockray Hall Mills,	Kendal	Closed 1922
Castle Mills (Wm. Goodacre & Co. Ltd.)	,, ,,	Stopped using water power 1940
Low Mills (Somervell Bros. Ltd.)	,,	Stopped ,, 1923
Helsington Mill,	,,	Gawith Hoggarth's Snuff Grinding Mill. Still using a water-wheel; the last on the Kent, and the last water-driven snuff-grinding mill in Great Britain.
Sedgwick Gunpowder Mill	Sedgwick	Closed & demolished 1936
Sedgwick (Original Wakefield) Gunpowder Mill	,,	Closed & demolished *c.* 1850–4 New Mill built at Gatebeck.
Basing Ghyll (Wakefield's) Incorporating Mill	,,	Closed & demolished 1936

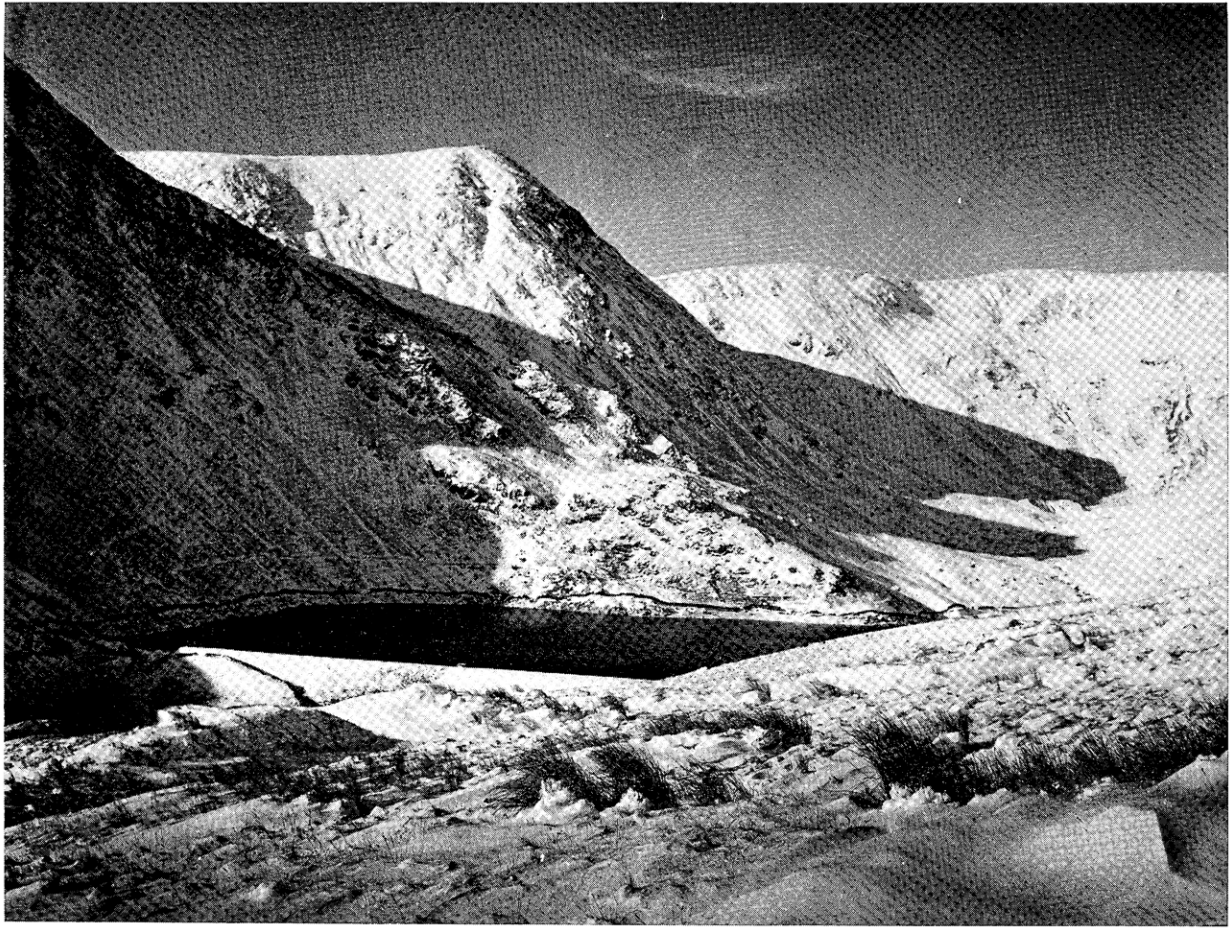
* These mills were forced, or largely influenced to stop using their water power because of the provisions of Section 58 of The Water Resources Act, 1963. This Act gives powers to river authorities (in this case the Lancashire River Authority) to charge mills a sum per thousand gallons of water *abstracted* (my, and every mill owners' italics) for the generation of water power. One can only assume that this section of an otherwise sensible Act was drafted to make it difficult or impossibly costly for users of water power on the rivers of England and Wales to carry on, and in this it has been very successful. The weirs and water races will now disappear even faster than they have done during the past fifty years.

extra flow it can provide, and it certainly improves the appearance of the river in Kendal during times of exceptional drought.

The Lakes & Lune Water Board are not prepared to take the reservoir over for water supply purposes, and should costly repairs become necessary its future will be a matter of grave concern to the Commissioners. The possibility that the dam might have to be breached and the reservoir abandoned fills me with gloom. However, there may be others who would be happy to see the head of Kentmere returned *almost* to its 1844 condition, a boggy basin behind a broken, grass-covered embankment.

Acknowledgements.

I must repeat my thanks to Mr James Cropper and to the members of his staff who have helped me, also to Mr Gillman of Rhodes & Gillman, Clerk to the Commissioners of Kentmere Reservoir. Miss MacPherson, Archivist-in-Charge, Record Office, Kendal, has produced plans and information before I have finished asking for them, and Miss Alice Palmer gave up valuable time to pursue facts about Job Bintley. Mr G. V. Berry has produced an excellent photograph to add some visual charm to an otherwise pedestrian paper.



Photograph by G. V. Berry.

PLATE I.—KENTMERE HEAD RESERVOIR.

Photograph by Mrs. P. B. Andrews, Kendal.

PLATE II.—WALNOE HOUSE and GAUGING BASIN
at the toe of Kentmere Reservoir Embankment.

APPENDIX.

TECHNICAL INFORMATION.

The Dam.

Particulars of the dam are as follows:

Length of crest 832 ft.
Height from lowest point to crest 58 ft.
Spillway sill below crest 4 ft.
Spillway width 57 ft.
Discharge pipe diameter 24 in.
*Maximum discharge with reservoir full and valve full open 150 cu. ft. of water per sec. (cusecs).

The Clerk to the Commissioners of Kentmere Reservoir has a drawing showing a cross-section of the dam at the outlet pipe and sections over the length. Fig. 6 is a part section of the dam at the point of outlet based partly upon this drawing and partly upon my knowledge of the dam.

The central clay puddle core is 10 ft. wide at the crest of the dam and 12 ft. wide at the base where it is bonded into solid rock. The supporting arch, 'D', Fig. 6, is shown on Bateman's drawing but there is no indication as to what method of filling was proposed, i.e. whether it was to be puddle clay, boulders or a mixture of the two.

The drawing shows two valve wells approximately at the centre of the dam, the upstream well being fitted with a valve so that it could be shut off from the main well which also had a valve. When the upper valve was closed the main valve well would be "dry". In fact, only one valve well was provided which is some way upstream of the central core and is reached by means of a plank bridge. This well was always "wet" and access to the control valve could only be obtained by draining the reservoir.

It was intended that the flow of water should be controlled by means of the valve 'F' in the valve house 'E' but I understand

* One of the myths which has been perpetuated in Kendal for many years is usually quoted every time there is a serious flood in the town, this is that "... the man at the Kentmere Reservoir lost his head and opened the sluices thereby causing the flood". The figure of a discharge of 150 cusecs through the 24-inch pipes is the absolute maximum which they can pass and only represents a very tiny fraction of the total flow of water through Kendal if there is a flood comparable to that of 3 December 1954. It is safe to say that if there has been some continuous rain before a severe flood, the reservoir is nearly always full and has no effect at all upon the water level in Kendal.

There is a similar and even more popular myth to the effect that flooding in Kendal is affected by the height of the tide at Arnside. The level of the highest possible tide in the Kent Estuary is considerably more than 100 ft. below the waterside in Kendal.

that this valve became so worn as to be useless many years ago and control was carried out by the valve 'C'.

The water discharges into a gauging basin and is measured by the flow over an iron plate which is not shown.

There was no ladder in the valve well and when the reservoir was drained it was an uncomfortable climb down a rope ladder, as the masonry of the valve well is extremely rough and there are many sharp and projecting stones.

In 1926 a careful examination of the reservoir was carried out and it was found that there had been some subsidence on the crest which was filled up and levelled. In order to increase the capacity of the reservoir a series of "flashboards" were arranged along the crest of the spillway, each board being pivoted near the end and held in position by the tail end of the adjacent board. At one end of the spillway a locking pin was provided which could be operated by hand or by a float. When the reservoir level was above the spillway and the water was pressing on the flashboards they would swing, one after another, parallel to the line of flow when the locking pin was released. The sudden rush of water down the stepped spillway was most impressive.

When the dam was examined by Mr E. C. Oakes in 1933 there was evidence to show that the puddle core was leaking and this was repaired by grouting with cement. It was then found that at least one of the pipes through the dam was broken and all the pipes were renewed. Mr Oakes would not sanction the use of a valve in the valve chamber to control the outflow and a new valve was fitted (not shown in Fig. 6) which closed off the end of the inner culvert. This culvert was water-tight by reason of the puddle clay packed around it. The operating rods for this valve are carried up the stone pitched slope to a large handwheel on the crest of the dam. When this valve is closed the valve well can be drained and a permanent access ladder has been provided. Mr Oakes would not agree to the use of the flashboards which were removed.

A certain amount of maintenance work has since been required but there is no doubt that the dam was soundly constructed and is now in excellent condition.

The Jumb Falls Hydro-Electric Proposals.

In 1928 Kendal Corporation Electricity Department decided to change from direct to alternating current and had in mind taking a bulk supply when the national grid reached the area. Several proposals were made for generating electricity in the town. One proposal put forward was that a small hydro-electric

station should be built at Low Bridge, Kentmere, taking its water from a new reservoir which would be constructed immediately above the Jumb Falls. The head would have been approximately 180 ft. At that time agricultural land in the valley was relatively cheap and the farmers were having a difficult time.

A possibility of reviving this scheme and supplying electricity to Messrs J. W. Cropper & Sons Ltd. for their paper mills was again considered during the 1930s but no action was taken. In each case the electricity would have been transmitted either to Kendal or to Burneside.

Skeggles Water proposed Pumped Storage Scheme.

Another scheme was considered during the 1930s which also would have called for collaboration and agreement with the Reservoir Commissioners. This was put forward by the late Mr Eric Crewdson, A.M.I.C.E., Managing Director, and later Chairman, of Gilbert Gilkes & Gordon Ltd. This was the provision of a pumped storage power station in Longsleddale using an enlarged Skeggles Water as the upper basin and a new reservoir in Longsleddale as the lower basin.

Pumped storage on a large scale had not, at that time, been considered in the U.K., but stations had been constructed in France and Germany, the principle being that at night when the load on the steam power stations was low water would be pumped into the upper basin and at times of peak load it would be discharged through turbines and would be collected in the lower basin where it would be stored until pumped back. In effect, a pumped storage scheme is a very large accumulator and Mr Crewdson envisaged a station with two sets each generating about 50 MW. which would have represented very large turbines and pumps for that period

The electricity generating authority showed no interest in the scheme although the power station would have been reasonably close to their high voltage trunk line, and it was admitted later that such a station could have proved invaluable if main transmission lines had been seriously damaged during the war.

No action was taken and any such scheme is unlikely to be revived due to the opposition which it would now receive upon amenity grounds and also because the site is not suitable for the very large pumped storage plant which is now being installed in Scotland and North Wales.