Mokshagundam Visvesvaraya

Engineer, Statesman and Planner

A V Shankara Rao

A V Shankara Rao is currently the Chairman, Cauvery Technical Committee. He retired as Chief Engineer, Water Resources Development Organisation, Government of Karnataka, in 1978. Throughout his career, he was associated with planning and construction of several major and minor irrigation projects in Karnataka State.

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P Kodanda Rao

Introduction

MV – as Sir M Visvesvaraya was familiarly known played an important role in many technical projects across undivided India. Great leaders like Mahatma Gandhi and Nehru wanted MV to be associated with certain projects of great importance like the Orissa floods and bridge across the Ganga. In many of these projects, MV used innovations ahead of his time. For the water supply project at Sukkur in Sind, for example, he implemented the concept of 'collector wells' rarely used in those days but found in textbooks on ground water hydrology today. Another example is his automatic flood gate for dams (which he patented) which permits the passage of a flood through a reservoir without the water level exceeding the full reservoir level with the ordinary spillway used at that time, the flood discharge raised the water level above the full reservoir level, submerging additional surrounding land. This gate thus was a forerunner to the present day radial gates, which, however, are not automatic. He foresaw the importance of using a reservoir for flood control considered till then only for irrigation and power generation. His recommendations later resulted in the Hirakud dam being built, taming the Mahanadi river and reducing flood havoc in Orissa. Similarly, the twin cities of Hyderabad and Secundarabad are protected from floods due to plans drawn up by MV.

Keywords
Irrigation dams, flood control, iron and steel industry.

As with many great men, MV's creativity was not confined to his chosen professional discipline of civil engineering. He estab-

lished the Sri Jayachamaraja Silver Jubilee Technological Institute at Bangalore, Mysore Iron and Steel Works Ltd., at Bhadravathi (now named as Visvesvaraya Iron & Steel Ltd.,) Bank of Mysore (now State Bank of Mysore) and even wrote a book on Planned Economy for India and Reconstruction of Rural India long before the First Five Year Plan hit the drawing boards.

MV gave the clarion call to the country "industrialise or perish". He established many industries in Mysore State such as sugar factory, soap factory, wood distillation, ferro-silicon and soon he provided a list of 36 industries to be established in the country in industrial engineering and applied chemistry.

In the social sphere, he founded the Deccan Club in Poona and the Century Club and the Public Library in Bangalore. As Dewan of Mysore he fought against great odds and succeeded in founding the Mysore University in 1916.

After retirement from Government service, MV participated as Chairman or Member of numerous committees on a variety of subjects such as Bombay Technical and Industrial Education Committee (1921-22), Bombay University Committee for promoting chemical industries, Irrigation Enquiry Committee, Bombay (1938), New Capital Enquiry Committee of Government of India (1922), The Indian Economic Enquiry Committee (1925), Back Bay Enquiry (1926), Bangalore Political Disturbances Enquiry (1929), Sukkur Barrage Works Committee (1929) and Cauvery Canal Committee (1924) and the Committee for New Bangalore Water Supply.

MV presided over the Indian Science Congress at its annual session in 1923 and the Indian Economic Conference in 1924. Members of the newly constituted Court of the Indian Institute of Science in Bangalore elected MV as the President year after year for nine years commencing from 1938.

MV took part in two political conferences: The Bombay All-Parties Political Conference (1922) to bring about a Round

"One common slogan of the West, the importance of which the Indian Citizen has not yet sufficiently grasped, is:

"If you do not work,
Neither shall you eat".

It is by his work that an individual is enabled to earn a living."

Sir MV

> Work performed with higher knowledge or skill, capacity or ambition, usually brings a correspondingly higher reward.
>
> *Sir MV*

Table Conference to discuss and settle the questions agitating the Indian public and the South India States People's Conference (1929) for constitutional reforms.

Montague, the Secretary of State for India offered MV a seat in his Council. MV politely declined the offer.

To gain first hand knowledge MV travelled abroad several times, each trip extending several months to Japan, Europe, Africa and USA. He travelled most of the time at his own expense.

The Mysore Iron and Steel Works at Bhadravathi (1918-1929)

Bhadravathi on the banks of the river Bhadra in Shimoga District of Mysore State was originally known as Benkipura or the 'Fire Town' – due to the existence of country-made furnaces for processing high grade iron ore found in the Bababudan hills. To convert the ore to iron on a large scale, coal was required which was not available anywhere nearby. Transporting coal from long distances proved uneconomical. It occurred to MV that wood available in plenty from nearby forest could be converted into charcoal and used for smelting of iron ore as was being done in America, Sweden and Germany.

A scheme was prepared for transporting the ore from the hill-top by a 5 km long ropeway to the foot of the hills, from where the ore could be transported to Bhadravathi at a distance of 40 miles by tramway.

The scheme, drawn up with the help of C P Perin, expert metallurgist from America envisaged converting 76000 tons of wood into charcoal in retorts with apparatus for recovering the by-products of destructive distillation and utilise the charcoal in smelting 30,000 tons of iron ore. The part of charcoal which was too fine for the furnace was used in the manufacture of calcium carbide with the power generated from the waste gases of the furnace.

This scheme was sanctioned by the Mysore Government during 1917-18 and executed during 1918-1922. It was one of the most ambitious schemes adopted in India at that time. It was the first plant in Asia excluding Japan to undertake manufacture of pig-iron using charcoal.

Due to general economic depression consequent on the war, food scarcity and influenza epidemic, very little progress could be achieved. There was talk of closing down the Works, especially when the price of pig-iron in the old markets fell steeply and the Works became a losing concern. At this point MV was persuaded to take over charge as Chairman of the Board of Management in which office he functioned for six and a half years.

In 1925, MV toured at his own cost Sweden, England, America and Germany to get first hand knowledge of manufacturing iron by charcoal and with this knowledge he modernised the Works and reorganised the departments, the heads of which were made accountable for the progress. The Works then started a new chapter of progress, production and profit. The price of the Bhadravathi iron was cheaper than the American pig-iron, even after accounting for transportation from India to America. The Works could export 5,000 tonnes of pig-iron to the east-coast districts of America. Manufacture of cast iron pipes was started in 1925 with the help of a German Firm. When the Second World War broke out, the importance of these works was realised by the British Government and its products proved a great help in the war efforts. The accumulated losses of previous years were wiped out and the Works then became a valuable national asset.

MV had to face not only very difficult situations in organising and running the Works but also bitter criticism of his schemes when they were in a nascent stage.

The Mysore Iron & Steel Works had the unique distinction of being the biggest State-owned concern in South India. It was the first in India to establish a ferro-silicon plant and electric pig-iron furnaces. Bhadravathi came to be called the Birmingham of South India.

"Work, Work hard; hard work does not kill; it is worry that kills." With these stirring words to the then somewhat lethargic officialdom of Mysore, Sir M Visvesvaraya began his eventful tenure of office a Dewan of the State in November 1912. Setting an example of what he preached, he accomplished in six years what might oridinarily have taken twenty four.

– *S Hiriannaiya*

Sir MV's penchant for cleanliness and good deportment is another trait of his. He dinned into his subordinates the value of personal deportment. He always said that a well-dressed person does things in a much better way than a slovenly one. He was himself an example in this respect. He often said that a person who did not look after himself by keeping his dress neat could not be expected to be efficient in his duties. I have found this to be only too true in my later experience.

To come back to Sir MV's Khandala visit, he gave me a piece of advice which I reverentialy follow even today. We were discussing the collapse of a dam built by the Tata Power Co., and he remarked, "Nature never excuses lapses".

– M R Varadarajan

Block System of Irrigation (1899)

Whenever an irrigation facility is opened, the beneficiaries usually use water indiscriminately leading to irregular, wasteful use of water resulting in lower crop yields and damage to lands due to water-logging and salinity. To control the misuse of water, MV first introduced a 10 day rotation system – called block system – in the Deccan Canals by way of rationing of water.

The objective of the Block System is to distribute the benefits of an irrigation work over a larger number of villages and to concentrate irrigation in each village within blocks of specified units and in selected soils and situations. The total area of the blocks in each village should be large enough to enable everyone who is able to grow an irrigated crop to have a share, but not too large a share to constitute a surfeit or lead cultivators to neglect the advantages of water-supply in good seasons as was being done.

Only one-third of the area in each block could have sugarcane or another perennial crop; the remaining two-thirds could either have rabi or monsoon crop or vegetables grown till the end of February. After February and till monsoon, water will be supplied only to one-third of the area in which the perennial crop is grown. There would thus be a sort of triennial crop rotation in each block. This system has stood the test of time and is still followed in Deccan Canals.

Controlling Flood Havoc in Orissa (1938)

The deltaic area of Orissa is subject to heavy floods caused by the river Mahanadi due to cloud-bursts. At the instance of Mahatma Gandhi in 1937, MV was approached by Orissa Government to render advice in the matter of controlling the floods in the Mahanadi delta.

Remembering the contemplated construction of flood storage reservoirs on such enormous rivers like Missisippi and Ohio in

USA, MV was emboldened to recommend an innovative design of flood control reservoirs on Mahanadi and tributaries that would hold up the floods temporarily and release them gradually and harness the storage for hydro power and irrigation of commercial crops thus rendering large flood storage schemes economically viable.

Another suggestion was that the deep cuttings could be avoided by constructing a weir or a dam combined with the overflow channel leading into the valley and mechanical excavators and dredgers could be used in river training. MV advised that such measures might prove of incalculable value as a protection against both flood and drought. MV's careful calculation of hydrologic data can be seen from the extract gathered from his report.

"Taking the maximum flood in each of the three big rivers, the combined flood volume will come to about 27,00,000 cubic feet per second. If this discharge is spread over the surface in a flood of 5 ft depth and 4 ft per second average velocity, the width of the space required for pursuing it through the delta will be about 25 miles. Assuming average length of rivers to be 50 miles, this will mean that more than one-quarter of the total deltaic area should be normally reserved to provide the necessary water-way.

'The tendency of the deltaic rivers is to gradually raise their beds and banks above the level of surrounding country. Even protected areas in the neighbourhood may one day become unprotected and be subjected to catastrophic inundations.' He cautioned, 'because there is such a tendency, efforts at flood control should not be relaxed.' "

MV's advice bore fruit in the actual construction of Hirakud Dam on the Mahanadi under the Five Year Plans in independent India.

Water Supply to Sukkur in Sind on the Banks of River Indus (1895)

In MV's own words from his Memoirs, the Sukkur Water Works

From his early years Sir MV always looked frail and fragile. One of his Sanskrit Pandits while talking about life and longevity in the class pointed his finger to Sir MV and said "This Visvesvaraya looks so thin; he will pop off at thirty". How we wish the Pandit was living today to see his student reaching the 100th Milestone!

–Shakuntala Krishnamurthy

It will be relevant to quote here the resolution passed by the Court of the Institute at its meeting held on 28th June 1947 in appreciation of the services tendered by Sir M Visvesvaraya:

"RESOLUTION – This meeting of the Court of the Indian Institute of Science places on record its very high appreciation of the distinguished services rendered by Sir M Visvesvaraya as President of the Court from its very inception under the new Regulations. Since the establishment of the Institute, he has always taken, in various capacities, a very keen and personal interest in its welfare and in the programmes of development and expansion. The Institute therefore owes him a deep debt of gratitude and the Court hopes that he will continue to take the same interest and give the Institute the benefit of his wide experience and wise counsel as in the past."

– S Bhagavantam

can be described best thus:

"Water, which had to be supplied from the river Indus into the town water-works system, had to be pumped into a reservoir on top of a hill close to the river bank, locally known as "Edinburgh Castle Hill." The water of the Indus River, always muddy and discoloured, had to be filtered and purified before distribution to the city. At that time the City Municipality of Sukkur was not in sufficiently affluent circumstances to spend money on filter-beds. As an alternative, I decided to excavate a circular well in the river-bed itself close to the river bank to obtain spring water by percolation. The supply from this well was found insufficient, so a tunnel had to be driven from the bottom of the well for some distance under the flowing river. This tunnel brought a sufficient supply of pure water which was conveyed by a pipe into the engine sump well of the pumping station on the river bank. The water was then pumped into the pure water reservoir constructed on top of the 'Edinburgh Castle Hill.'

The circular well-tunnel combination used by MV is known as 'collector well' in modern textbooks.

Flood Protective Dams and Embankments for Hyderabad (1909)

River Musi runs through the city of Hyderabad dividing it into two parts. Most destructive cyclonic floods occurred on 28th September 1908. MV studied the problem and found that 221 tanks had breached. Maximum flood had risen to 4,25,000 cubic feet per second. There was no record of a run-off of 3/4 inch per hour from any other catchment of this size in the world. The maximum flood in the River Krishna that occurred was 10,41,670 cusecs in 1903 from a catchment of one lakh sq miles which is 13 times larger than Musi catchment. From available hydrologic data MV noted that equivalent run-off, in inches per hour, was 0.045 in Pennar, and 0.81 in Koyna and a value close to that found in Musi catchment.

When the Hyderabad Government approached MV for advice he suggested construction of two reservoirs to contain the

floods and to provide irrigation: one on the main River Musi and another on Esi, a tributary, and both dams to be located 20 to 25 km upstream of the city. The reservoirs were designed to store 8500 million cubic feet and 12,000 million cubic feet, respectively. Embankments were advised along the banks of the river in the city; with some portions of it converted into walks and gardens. After translating MV's advice, Hyderabad city has been practically free from floods.

Automatic Gates Patented by MV (1903)

All reservoirs should have a device to pass excess inflows safely. Open spillways do this at the cost of a rise in water level. MV invented automatic gates which do this job without a rise in the water level.

Such 48 automatic gates in six sets of 8 gates each are installed in the Krishnaraja Sagar (KRS) Dam which consist of (a) gates, (b) cill, lintel and side grooves and plates, (c) balance weight, (d) float, (e) chains and pulleys, and (f) inlet and outlet pipes.

Each set of 8 gates are connected by means of chains and pulleys to a dead weight, which in turn is connected to a float working inside a masonry well both situated on the rear of the dam. The float and the dead weight called the balance weight, are located one in front of the other so as to have 4 gates on each side of it. When all the 8 gates are closing the sluice vents, the balance weight will be at the top of its run and the float at the bottom of the well. The well has an inlet pipe (1ft dia) from the reservoir to allow water into the well at full reservoir level. The well has also an outlet pipe. When the water level in the lake reaches the maximum permissible level, water rushes into the well and the float rises up. The balance weight descends down and all the 8 gates are pulled up. The sluice vents then begin to discharge. When the reservoir level falls, the well gets emptied. The balance weight then comes up and the gates descend and discharge is stopped. (See the arrangements shown in *Figures* 1a and 1b).

Visvesvaraya felt that, while agriculture was the basic industry of Mysore, industries contributed to the prosperity of the people.

Economic development through industrialisation on a planned basis has all along been the principal objective of Visvesvaraya. It has been the constant refrain of all his speeches and addresses, particularly when he was Chief Engineer and Dewan of Mysore. He drove his theme home with an imposing array of the best comparative statistics from all countries that he could gather at the time, and capped it with the slogan: "Industrialise or Perish".

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– H Rangachar and P Kodanda Rao

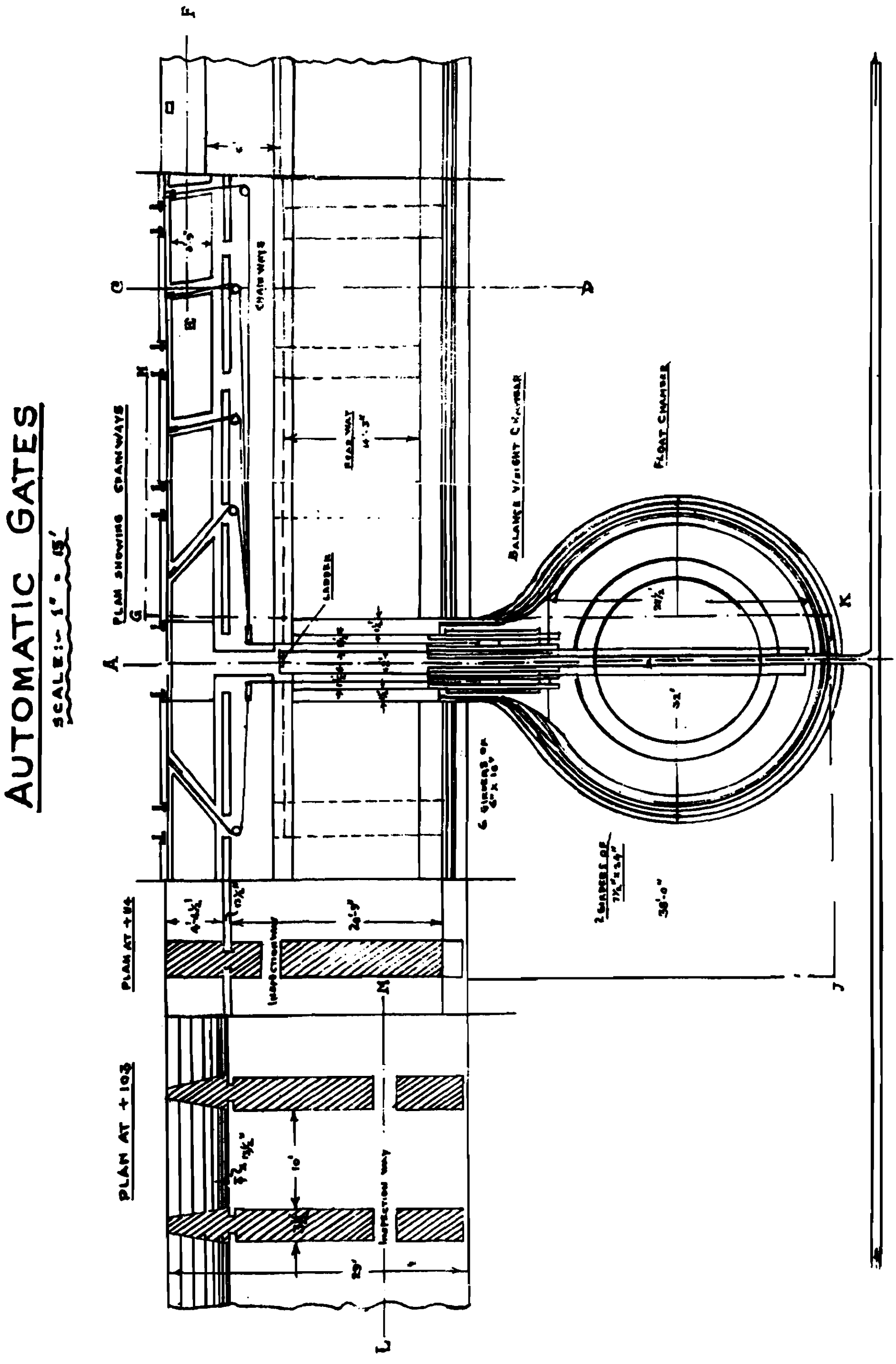
AUTOMATIC GATES
PLAN SHOWING SPANWAYS
PLAN AT +84
PLAN AT +103
LADDER
ROAD WAY
BALANCE WEIGHT CHAMBER
FLOAT CHAMBER
INSPECTION WAY

Figure 1a

Figure 1b

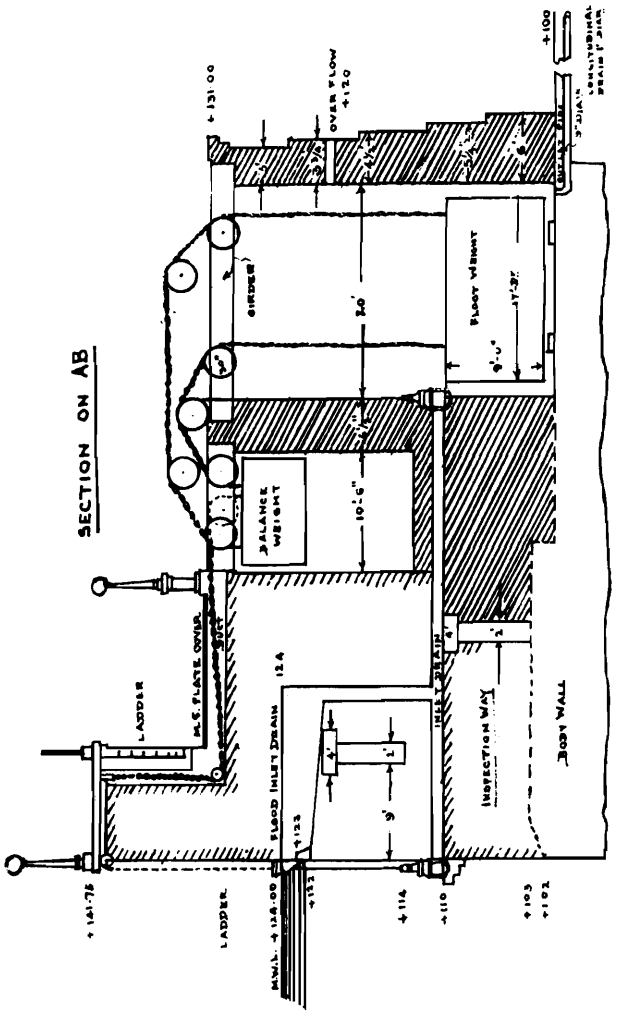

Figure 1 a, b.
Reproduced from – M C Sampatiengar, Krishnarajsagar Dam Sluices, 1952.

Each gate has the capacity to discharge at Full Reservoir Level, about 1000 cusecs. (cusec is a unit of measurement used to indicate the flow of one cubic foot per second of water.) These gates are called 'Automatic Gates' because they open and close at the rise and fall of water in the reservoir. The gates are made of cast iron and all the 48 gates were manufactured at the Mysore Iron & Steel Works, Bhadravathi.

Address for Correspondence
A V Shankara Rao
170, Atignal 3rd Main
43rd Cross
8th Block, Jayanagar,
Bangalore 560 082, India.