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ADDRESS

OF

Sir GANGA RAM,

PRESIDENT,

April 1924.

YOUR EXCELLENCY AND GENTLEMEN,

It was no small surprise to me last year when I heard that I was elected President of the year, and, since it is the highest honour in a technical institution of this kind that can be conferred on a member, and I being so unworthy of it, I recognised all the more that you have treated me with a generous consideration which I highly appreciate. I cannot say that I entered on my office with deep responsibility, because, after all, it is a sinecure post, the brunt of the work falling upon the Secretary, and I was especially lucky in getting so able and hardworking a Secretary as Mr. Morris, to whom my thanks are due.

My first duty is to extend a hearty welcome to Your Excellency for keeping up your interest in Engineering, and as you are shortly retiring and this will be the last occasion on which we shall have the pleasure of seeing you in our midst in this Congress, it is my duty to voice the feelings of the members to bid you hearty farewell and God speed, particularly from the bulk of the members who come from Roorkee, the premier Engineering Institution in this country, which was started by your illustrious father as its first Principal. I also welcome on behalf of this Congress, Sir John Maynard, the Hon'ble Member for Finance, Mr. King, Financial Commissioner and other distinguished visitors present here.

Since our last annual meeting the cruel hand of death has removed from us an unusual number of members, some of them very distinguished persons, and therefore on behalf of the Congress I propose to send a vote of condolence to the mourning relatives of those who have passed away. The names of the Irrigation Engineers who have met such premature death, are as follows :—

(1) Elsden, (2) Gibb, (3) Harvey, (4) Stoddard, (5) Bur Singh, (6) Chestney, and (7) A. S. Nikai.

This axe of death, falling particularly on the Canal Engineers shows to what dangers and hardships the Irrigation Engineers are exposed and I hope members of the Legislative Council will bear this in mind when questions concerning hard-earned travelling allowances of these

officers come up for discussion. I would be excused, having the privilege of old age and ripe experience, if I make a little digression and advise the young blood of the Council to propose constructive schemes which are so necessary for the development of this vast country. There are plenty of natural resources and unexplored wealth in the land, of which India in general and this Province in particular may feel proud, and if the young *intelligentsia* only set about in earnest, they can develop these resources not only to produce food enough for its population, but also a surplus which can be exported for use in other countries.

Gentlemen, I am a living record of half a century of the Public Works in the Punjab, as I joined in 1873. I could never have imagined that I would live to see the day when a coolie, then getting two annas and six pies per day would be earning twelve annas to one rupee a day, and a mason or carpenter then getting six to eight annas a day, would be earning two rupees four annas to two rupees eight annas a day. This is seemingly an index of prosperity, yet the working classes are not getting proportionately richer, as the mode of their living has materially changed, prices of commodities have risen, and altogether there is a keener struggle for life, a necessary result of modern civilisation.

You will, I hope, pardon me if, before taking up my subject proper, I tax your patience by giving you a short review of the changes which have come over the Public Works Department during this period.

The Building and Roads Branch has, since my retirement twenty years back, to use the favourable phraseology of the day, been *reinforced* by four specialists, the Architect, the Sanitary Engineer, the Road Engineer, and last, though not least, the Drainage Engineer, leaving the remaining engineers a mere shell, or perhaps we may more appropriately call them builders and repairers. Further changes in the personnel of this Branch are impending due to the recommendations of the Public Works Re-Organisation Committee, of which I was a member and when I was not a little disliked for being a dissenting member.

The Irrigation Branch, however, has progressed by leaps and bounds, and has been the chief source of bringing about all the wealth and prosperity of the Punjab which is being harped upon in every direction, and I am glad that this Department does not appear to require any reinforcement, and every member thereof is keen on the details of his work and at the same time is studying how to increase the duty of water. The field for research before the canal engineer is unbounded, yet I must add that it can only be done if he takes earnest interest in, and pays special attention to the details of agriculture, showing more sympathy to, and harmony of purpose in poor zemindars.

Next comes the Railway Department which has expanded in the Punjab from 519 miles in 1873 to 4,067 miles in 1920. The scope for engineering is enormous in this department, as owing to the coming system of decentralisation it will have to pay special attention to economy, not only in initial cost of construction, but also in working expenses,

in order to reduce the cost of maintenance and yet increase the comfort of the people. It is not an easy task to reconcile these two seemingly conflicting desiderata.

As I have never been a railway engineer, I cannot further dilate on this subject beyond drawing attention to the necessity of introducing more light and shade and sense of proportion in the openings, mouldings, cornices and arches of railway buildings, also to introducing flat roofs with reinforced slabs, a specimen of which you will see at Renala, instead of using hideous corrugated iron; and, from the details I will give at Renala, you will observe that all this can be achieved without appreciably enhancing the cost.

During the War period when I was acting as Honorary Chief Engineer, Benares University, we could not obtain rolled steel beams, hence we gave our earnest attention to reinforced brickwork, and through the exertions of my executive staff and the direct efforts of the Assistant Engineer, Mr. Datta, this type of construction was brought almost to perfection, and if ever you visit the Benares University Works, you will find that all lintels, beams, girders and staircases have been constructed of reinforced brickwork. The total area of reinforced brickwork in slabs, roofs and floors, exceeds in those buildings, six lakhs of square feet. These floors and roofs have been standing all these years without any sign of crack or failure. There are a number of rooms of very large size (particularly one special class room 30 feet × 50 feet) which have been covered with beams and slabs of reinforced brickwork. The biggest room is the hall of the Arts College (64 feet × 36 feet) with side aisles 36 feet × 27 feet. The beam in its central portion has been designed for a special load of 153 tons, equivalent in strength to seven beams of rolled steel joists 24″ × 7½,″ which is the biggest section available in the market.

The biggest span covered by a simple slab is in the hall of the Chemical Laboratory 52 feet × 73 feet. There is only one beam in the centre, over which a continuous reinforced brickwork slab is placed.

All the water reservoirs of the University, of a capacity of 6,000 to 7,000 gallons each have been made with reinforced brickwork. There are several such reservoirs. All roofs of the Physical and Chemical Laboratories in the Central Block have been covered with reinforced brickwork slabs resting on the bottom flanges of encased and strengthened rolled steel joists.

Mr. Datta, whom I shall introduce to you at Renala, has developed new systems of reinforced brickwork construction by combining reinforced brickwork with cement concrete, lime concrete and lime brickwork.

All roofs of the quarters at Renala Khurd have been constructed with reinforced brickwork, lime brickwork slabs. These slabs consist

of alternate ribs of reinforced brickwork in cement and ribs of brickwork in lime. 16,000 square feet of roofs were constructed last year at a cost of eight annas per square foot.

The roof of the power house at Renala has been constructed with reinforced brickwork slabs which consist of alternate ribs of brickwork in cement and cement concrete, and all reinforcing rods are embedded in ribs of cement concrete, two inches or so, wide.

Now, Sir, for my address, I choose my pet subject, agriculture, to which mere need drove me, as, on retirement, I found my financial position seriously on the debit side, and it was this fact which compelled me to take up service in Patiala.

I know that most of the young men present here would like to know how they could, if placed in the same predicament, extricate themselves. All I can say is, that there is no royal road to wealth, but, as a great writer has said, opportunity comes to every man, and this is what I usually called luck ; the question is whether and when a person grasps that opportunity. My opportunity was the advent of the Irrigation Commission, and the tendency of irrigation engineers to under-rate the value of crops, and to over-estimate the cost of pumping, especially the duration of pumping, practically required.

Judging from the figures I collected and relying on mathematics, I thought that irrigation engineers were rather pessimistic. The following remarks of the Commission encouraged me to pursue this course :—

" In Egypt many thousand acres are irrigated by steam pumps but in India steam lift irrigation is almost unknown, although a few instances have come to our notice, in which by private enterprise, efforts in this direction have recently been made on a small scale with oil engines. It appears to us that this is a matter in which Government might usefully lead the way, and that well devised pumping schemes should on this account alone receive favourable consideration."

Having strengthened my conviction that my knowledge of engineering ought to help me, I came into the field, and offered to solve the problem in right earnest. This led to a grant of 50 squares, which later on expanded to 100 and so on and so on. Opportunities after opportunities came in my way till " pumps," " cusecs," " lift," " power " became my household terms, and I deduced simple formulæ for solving in the jungle any factor outof the four I have indicated, and if you, gentlemen will, take pencil and paper and jot down a few simple rules, you wi ll find that you will be able to solve mentally several problems of lift irrigation for agriculture :—

(a). For centrifugal pumps,

$$\text{Discharge in cusecs} = \frac{d^2}{18},$$

for instance, a 12-inches pump will give $\frac{12^2}{18}$, $=8$ cusecs.

(*b*). Power required in lifting water =

Discharge x height of lift x $\frac{2}{9}$.

This is based on an efficiency of 50 per cent.

(*c*). $\frac{\text{Cusecs x height}}{15}$ =Horse power obtainable.

The denomination 15 is a safe practical figure ; in theory it is 8 and Mear's figure was 11, but the cautious figure is 15.

Thus I was able to solve the lift irrigation problem, and the success of that solution has led people to look eagerly for uncommanded lands.

Roughly speaking, the cost of lift irrigation works out to one rupee per acre per foot of lift subject to a minimum depending on the area and local circumstances. Gentlemen, as you will see on your visit to Renala, the great hydro-electrical works there will give a solution of the problem how to lift water from canals by steam or electric power.

Next, I draw your attention to power obtainable from canal falls. For fifty years the only use the Irrigation Department could make of canal falls was to set up corn grinding " panchakkis " over them and then to put the leases to auction. This gave them a very fair return, and in some places the bid for these " panchakkis " has been very high, not because people appreciated this kind of power, as power, but for the following two reasons.

Ist, that they have not to spend any money on the initial cost, and 2nd, because they are situated in villages where they can buy grain at comparatively cheaper rates. This, however, could not be a solution of utilising millions of horse power going to waste.

The first attempt to use this power on a large industrial concern was made at Dhariwal, but owing to the intermittent nature of the power obtainable, they had to put up a steam installation as a stand bye. Some years afterwards, Sir Thomas Higham thought of using the power of falls on the Upper Bari Doab Canal for industrial purposes by electrical transmission, for which he obtained a concession and engaged a representative who went canvassing, but did not get a favourable response from people engaged in industrial pursuits. I think I can claim to be the first to hit upon the idea that owing to the interrupted character of power available, the only economically sound use that can be made of this enormous potential energy is for agricultural purposes. I obtained, through the enlightened policy of Sir John Maynard and the support of His Excellency the Governor, concession of lease of a large plot of land and undertook to establish that one great use of the power would be to pump up water for irrigation from canals. This will, I hope, be achieved by next October, and when you will visit Renala on the 13th, you will see all the works under construction there.

In this connection I may be permitted to mention the use of low falls for the purpose of irrigating lands as well as for developing mechanical power to start small industries. A new idea, for which I have obtained a patent, was suggested to my mind by an ordinary incident which must have occurred to several of you. Standing near one of the " panchakkis," which are so numerous on hill streams, I found that the wooden turbine was actually made by the local carpenter, and on this vertical spindle was placed a stone which revolved. On the top of this stone was fixed a heavy stone, and this served the purpose of grinding corn. It occurred to me that if we replace the stone by a pump, it should be able to lift water to any height we like, there being no scientific limit to the height of lift, the discharge, of course, varying inversely as the lift. A picture showing how this could be done is exhibited on the board. Since then, I have been in communication with Major Ashford as well as with the representative of Messrs. Boving and Co., the leading turbine makers, and on asking the latter whether my system could apply to mechanical energy on a low fall, even as low as two feet, I am glad to say that the response was very encouraging. I exhibit the drawing of a small turbine, in which there is a wheel on the vertical spindle, and by a system of bevel-wheels or gearing, the shaft could be made to work, which would supply power for the lifting of water, or for working other industries. Now this is an idea which opens a large field of research for industrial purposes, and if the Canal Department could be persuaded to put up such machinery at an applicant's cost, they could institute any number of such works to foster industries, and I do not see any reason why the Canal Department should not offer this without any charge, because they lose no water, and, after all, the fall is, in the words of Mr. Mears, God's gravity. I propose to develop this idea later on when I get an opportunity to do so.

My next attempt will be to show how this power can be used for pumping water from wells, and perhaps my last attempt will be to show how to combine a series of wells and pump the water out from one central power unit, be it steam, oil, electricity, or compressed air.

This will be a great source of material advancement to the country and the Financial Commissioner will find ample opportunities to satiate his craving to swell the revenues.

Gentlemen, I shall close my address with a little sermon to my countrymen that yours is a noble profession of material progress, and it is lucky for you and your Country that you have chosen it for your careers. Please remember that it is the only profession which saves you from becoming a dullard after retirement.