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RAI BAHADUR WAZIR CHAND CHOPRA

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ADDRESS

OF

RAI BAHADUR WAZIR CHAND CHOPRA, M.I.C.E., M.I.E., (IND.) F.R.S.A.,

President.—

GENTLEMEN,

It is my privilege to welcome on behalf of the Punjab Engineering Congress to open this our twenty-first annual session, the Hon'ble Dr. Gokal Chand Narang, Minister, Local Self-Government, Punjab. We had hoped that His Excellency the Governor would be able to find time to honour us by his presence here to-day, but to our great regret he is unavoidably absent on account of more pressing engagements. We are beholden to the Hon'ble Doctor for accepting our invitation to perform the function this morning. We rejoice to think that he cannot claim to play the role of a layman amongst us, as he cannot deny his affinity to us on account of being closely associated with the latest and most modern phase of engineering development in the Province, as Minister in charge of the Hydro-Electric Branch.

It also gives us great pleasure to welcome our other distinguished guests, who as custodians of public weal in and around this progressive province of ours, have, by their presence here to-day, evinced their real interest in the activities of a body of men, who professedly direct the great sources of power in nature for the use and convenience of man.

Gentlemen, the cruel hand of death robbed us during the year of three members, namely, Col. B. C. Battye, D.S.O., R.E., first Chief Engineer, Hydro-Electric Branch, Mr. E. L. Crawford, who rose to be officiating Chief Engineer, Roads and Buildings Branch, and Lala Narsingh Das Kapur, Assistant Executive Engineer, Punjab Irrigation, a young officer of great promise. We deeply deplore this loss. Col. Battye's death is particularly sad as he died on the very eve of the completion of the great Hydro-Electric Scheme in Mandi, which owed so much to his energy and ability. The Punjab Government in a special Notification expressed their deepest regret at his death and eulogised his services to the Province. In deference to the wishes of those who knew and worked under him and with your permission, I read an extract from that Notification :—

"His Excellency the Governor of Punjab, acting with his Ministers has heard with the deepest regret that on the 16th of May last Colonel Basil Condon Battye lost his life as the result of an accident to his motor car while on a tour of inspection near Batala in the Gurdaspur District.....

"His connection with the Punjab Government began in 1910 when his services were requisitioned in connection with the Simla Hydro-Electric Scheme.....

"The Punjab Government again requisitioned his services to act as Superintendent of a Hydro-Electric Survey of the Province.....He prepared a project for a large hydro-electric scheme on the river Sutlej, and later a project for a hydro-electric undertaking in the Mandi State utilizing the waters of the Uhl river. The latter scheme was eventually adopted for execution by the Punjab Government and in December 1925 he was appointed by the Punjab Government to a special post of Chief Engineer created for the purpose of carrying out the Mandi Hydro-Electric Scheme. Colonel Battye brought great qualities of energy, initiative and resource to the execution of this difficult project. He was animated by an unbounded faith in the future of the Punjab and of the great industrial and other developments which might be expected to result in the Province from the provision of an abundant supply of electrical energy. Inspired by this confidence he pursued his task with boundless enthusiasm and untiring perseverance. Difficulties merely served as a stimulus to his ingenuity and resource, and dangers only evoked courageous expedients to surmount them. Inspite of indifferent health Colonel Battye never spared himself and throughout his connection with the project his keen devotion to duty and cheerful outlook in all circumstances provided an inspiring example both to the staff and labour on the work.....

"By this tragic accident Government have been deprived of the services of an officer of great capacity at a moment when the work, on the completion of which his heart was set, was within a few months of reaching its culminating stage. His loss is deeply deplored both by the Punjab Government and by all those who have been associated with him in his work in the Punjab."

Gentlemen, it has often been the custom to take in the Presidential address a stock of the engineering activities in the Province in the year that closes with the session of the Congress. On account of financial stringency and depression in trade, however, it has not been possible to make much headway in new engineering enterprise in recent years, the expenditure in the main being confined to the completion of works already in hand or to the upkeep of and essential improvements in existing works, and in ameliorating the condition of water-logged tracts. In the description given below, therefore, new works will find very little mention.

On the North-Western Railway, the principal event of importance is the opening of the two bridges which had been under construction for some years, namely, the De Montmorency bridge over the Jhelum at Khushab by His Excellency the Governor, and the Chiniot Bridge on the Chenab. As a result of the policy of gradual replacement of old locomotive engines by more modern and heavier ones, as mentioned in

Mr. Pavry's address, a programme of strengthening tracks and bridges has been evolved on this Railway. The most important portion of this programme in hand during the past year has been the strengthening of girders on Ludhiana-Saharanpur-Ghaziabad and Delhi-Panipat-Ambala Sections. The two large bridges dealt with are Indus bridge at Kotri where the work is approaching completion and the Jumna bridge at Delhi where satisfactory progress is being made. Of the projects the first to be taken up, when funds permit, is the Bombay-Sind connection. This scheme is over 50 years old, but due to irrigation developments on the Lloyd Barrage and on the Sutlej Valley Project, the need of it has become urgent. When carried out, it will result in shortening the rail connection between Bombay and Sind by over 200 miles and doing away with transhipment at break of gauge.

In the Buildings and Roads Branch, the principal achievements this year have been in collaboration with the North-Western Railway, as both the Khushab and Chiniot bridges are for rail and road traffic, the roadways being independent. The reconstruction of Kohala Bridge across the Jhelum on Rawalpindi-Kashmir Road, damaged during the floods of 1931, was completed with the help of the North-Western Railway and the Military Department and reopened to traffic on 1st August, 1932. The new Bhimber bridge on the Grand Trunk Road was also completed, replacing perhaps the last timber bridge of any pretensions in the Punjab plains. Another important work carried out is the widening of the Grand Trunk Road between Lahore and Attari, removing the dust nuisance to motorists between Lahore and Amritsar. The Maternity Hospital at Lahore, one of the most modern of its kind in India, has been completed during the year. Under Public Health the most important work under execution has been the Murree Waterworks Extension, involving the construction in two compartments of a large pressed steel reservoir of over three million gallons capacity, understood to be the largest of its kind in the world.

The Irrigation Branch, in the year under review, saw the opening of the Punjnad Main Canal in April, 1932. The Punjnad Barrage has, during the year, successfully withstood the onslaught of the combined waters of the five Punjab rivers, in carving for themselves a new channel on their way to join the Indus some forty miles beyond. This Barrage is the second longest in India, and its completion after twelve years' diligent labour on the part of the Punjab Engineers marks the conclusion of one of the greatest Irrigation projects undertaken either in India or in any other country in the world. Members might remember that the work of protecting the cliff foreshore, which forms the upstream left flank of the Mangla Head Regulator, Upper Jhelum Canal, against the action of whirlpools in the Jhelum River, which were eroding and threatened to undermine it, was described to them with the help of a film screen when they met last year for dinner at Nedou's Hotel. This work has been completed, and it is gratifying to record that the protection withstood the Monsoon floods well and has functioned satisfactorily during the year.

Mr. Haigh is presenting before this year's Congress a paper giving full details of this work. The Irrigation Research Institute at Lahore has continued to do useful work under the able and vigilant direction of Dr. McKenzie Taylor in its various sections, namely, Statistical, Reclamation, Chemical, Physical, Mathematical and Hydraulic.

In the Hydro-Electric Branch the most outstanding item on the Mandi Scheme was the holing of the Tunnel, which event took place on the 1st of March, 1932. It is most creditable to the engineers in charge of this tunnel that the closing error both vertically and horizontally did not exceed fraction of an inch. The tunnel was completed in all respects and water admitted on the 22nd September, 1932. The Headworks have also been completed with the exception of a few finishing touches to the Diurnal Reservoir. The pipeline underwent official pressure test in August 1932, and gave very satisfactory result. In the Power House all generators and plant have been erected and tested. The main step-up Station at Jogindarnagar has also been completed during the year. The transmission system as a whole has been brought practically to completion and full voltage of 1,32,000 has been applied for testing purposes as far as Lahore. The various sub-stations are nearing completion. Within a few weeks the construction staff of the Mandi Scheme will have been dispersed, and its place taken by the operating organisation. It is hoped that the commercial supply of energy will be given some time in April next. In the domain of non-Government enterprise in electrical undertakings, it may be mentioned that the Shahdara Supply Company is now equipped with three turbo-alternators each generating 3150 K.W. with proposals for further expansion, to cope with the increased demand for power, and that four more towns are being electrically equipped, namely, Sargodha, Montgomery, Campbellpur and Gujrat, bringing the total number of licenses up to seventeen.

Gentlemen, some of my predecessors have been rather partial to their own particular branch of engineering, in taking some aspect thereof as a theme for their address. I hope you will pardon me if I succumb to the same temptation, and speak at some length on the various phases of development of Canal Irrigation in the Punjab, the Branch of Engineering with which I have been connected for the last third of a century.

The British advanced in the Punjab from the south-east. Their engineers were not irrigation engineers by instinct and as yet the great Ganges Canal or the Delta works in the South had not been even thought of. But they felt the necessity of irrigation in this area of precarious rainfall, and the existing examples that came to their notice were the two derelict canals from the Jumna, which became the parents of the Western Jumna Canal in the Punjab and the Eastern Jumna Canal in the United Provinces. The next existing work that came to their notice was the Hasli Canal from the Ravi, the parent of the present Upper Bari Doab Canal. The Western Canal from the Jumna and the Hasli were meant more for the pleasure of kings or for taking water to the sacred Golden

Temple at Amritsar, than for irrigation, the latter service being only incidental. The irrigation works (many of them private-owned) were a series of Inundation Canals irrigating narrow belts on the fringes of the rivers. Although situate in more or less disturbed areas, they continued their existence on account of aridity of climate.

With the British, irrigation became a public work in the true sense of the term, the works being built mainly for the good of the cultivators. With this policy in view, the first phase of irrigation development in the Province was the restoration or improvement of the existing indigenous works.

The first work taken up was the re-opening of the Western Jumna Canal. Surveys were started in 1810, and work was completed by 1825, according to the needs and standards of the time. Famine raged in 1832-33, and more channels were added. We shall speak of the remodelling of this canal later, but it is useful for our purpose to state here, that on account of want of experience and scientific knowledge, old and faulty alignments were adopted and depressions were crossed on heavy earthen banks with no provision for intercepted drainages. The restored canal, however, was very remunerative and in early days gave satisfaction to every one. The remodelled canal with its extensions now has a capacity of about 6,500 cusecs, commands a gross area of 27½ lacs of acres and irrigates annually about 10 lacs of acres.

The next work taken up was the building of the Upper Bari Doab Canal, the Hasli being its forerunner. The Punjab was annexed in 1849, and it was thought wise to settle the disbanded Sikh soldiery on their lands in the Manjah, and this led to the immediate construction of this canal. Surveys were started in 1850, and the canal opened in 1859. With further additions since, this canal now commands a gross area of 16½ lacs of acres and does annual irrigation of about 13 lacs, and has a Head Capacity of 6,750 cusecs.

While the above two canals, *viz.*, the Western Jumna and the Upper Bari Doab Canal, were developing, events were shaping themselves in distant Madras and Bengal leading to a sound policy about financing irrigation works in India, which had its repercussion in the Punjab. The two Jumna canals were paying handsomely and the famine of 1837-38 had brought the idea of the construction of the Ganges Canal to the front. In Madras 1832-41 were years of famine and scarcity, and this lead to the construction in turn of the three great Delta Works on the Cauvery, the Godavari and the Kistna. Col. Sir Arthur Cotton's signal success on these works made him put forth proposals for ambitious schemes in Madras and Bengal. As a result of previous successes there was an irrigation boom, and two English companies were launched, one in Bengal in 1858 called the 'East India Irrigation and Canal Co.' and the other in Madras in 1863 called the 'Madras Irrigation Co.' each with a capital of one million sterling. Time does not allow to relate the vicissitudes through which these companies passed, but it is enough for our purpose to state that both of them proved utter failures. This

experience led to the acceptance by the Secretary of State in 1866 of the policy, according to which irrigation works were to be built by the State, if necessary on loans raised in the open market, and not to be entrusted to private enterprise.

The first loan work in the Punjab was the Sirhind Canal, an entirely new British enterprise. The original schemes limited their scope to areas in Patiala State only, but in 1867 the Government of India issued orders that the only project they would entertain should be the best that could be devised irrespective of territorial boundaries. This wholesome principle of ' greatest good of the greatest number ' has been followed since, and has also led to great development of irrigation in the Province. The Sirhind Canal was built in the seventies and opened in 1882. It has a capacity of about 9,000 cusecs at Head, commands a gross area of 44 lacs and irrigates annually about 19 lacs of acres. It is important for our purpose to mention that the first eleven miles of this canal offered almost insuperable engineering difficulties, both as regards the excavation of the channel and the construction of masonry works, specially the large Superpassages of Budki and Siswan in the fifth and eighth miles respectively.

The opening of the Sirhind Canal marks the end of the early British period, during which experience led to definite lines of action in irrigation undertakings. Besides what is enumerated above, this period saw the improvement and extension of the Innundation Canals mentioned before. Thus the main features of this period are the restoration, improvement and extension of the pre-British works, building of the Sirhind Canal and introducing the policies of financing works by State funds and extending irrigation to the best possible limits of projects. This period also saw the introduction of permanent headworks. The Western Jumna and Upper Bari Doab Canals had originally temporary headworks, but were later given permanent headworks at Tajewala and Madhopur, and the Sirhind Canal had permanent headworks at Rupar from the very beginning.

The next and the most important phase of irrigation development was that of the colonization of Crown waste in the Province. This colonization has been, as we all know, a wonderfully successful enterprise in the Punjab; and when we find to-day that the eight Colony Districts pay in land revenue and water-rates somewhat more than all the other districts put together, the question arises why it took so long in coming, especially when these wild fertile plains with water running to waste to sea were not unobserved by administrators of the forties to sixties of the last century. The reason is three-fold. Firstly, the Punjab rivers were not well understood in the beginning, and large projects could not be taken up with confidence. Secondly, there were famines, and they occurred in tracts where normal rainfall was fairly good and where therefore, cultivation was possible and population large, but where rain failed in the particular year of famine. It was for this reason that the Government thought of dealing with cultivated and peopled districts

first. Thirdly, following the boom of the fifties and sixties there came a slump in the seventies on account of conditions both in the Punjab and the rest of India. In the Punjab, the Western Jumna Canal, though remunerative, was water-logging the country on account of obstructed drainages mentioned before and was impairing the health of the people, the Sirhind Canal in its construction was presenting difficulties, with which the engineers could not very well cope, and the Upper Bari Doab Canal was not working at a profit. In the United Provinces, the Ganges Canal was not working up to expectations. The Bengal schemes were financial failures and the two companies in that province and Madras had miserably failed. The Secretary of State had by 1875 lost faith in irrigation schemes, and it was because of this that a complete scheme of Chenab Canal Project submitted by Mr. Palmer was turned down, although subsequently the scheme adopted was of the same full scope and proved to be the most successful irrigation enterprise in the world.

However, the remodelling of the Western Jumna Canal on scientific lines and succcessful construction of the Sirhind Canal, removed the main discouraging features in the Punjab, and influenced by this and perhaps actuated by the famine of 1877-78, the Government of India made a strong representation about the necessity for irrigation as well as the need of money for it, to the Secretary of State, and the latter fell in with their views. Demand came on the Punjab for new irrigation schemes. The Punjab engineers had at first no idea of what exactly to do, but worrying around they eventually prepared in great haste the three projects of the 'Lower Sohag and Para,' the 'Sidhnai' and the 'Ramnagar' Canals, the last named ultimately developing into the present 'Lower Chenab Canal.' These schemes involved colonization and formed, therefore, a new departure and were really experimental. The 'Lower Sohag and Para' were a moderate success, but the 'Sidhnai' opened in 1886 being weir-controlled, proved a tremendous success, although the area commanded was only 4,17,000 acres of which about 2,32,000 acres were colonized. The success on the Sidhnai paved the way for the two well-known big schemes of the Lower Chenab Canal and the Lower Jhelum Canal. The Lower Chenab Canal was opened in 1892 and the Lower Jhelum Canal in 1901, and colonization on both of them went on briskly. The changes that have been brought about by these two canals are nothing short of a romance. In the words of Mr. Purves, one of our eminent Chief Engineers, as a result of this colonization "the order of things in the Bar with its vast stillness, its boundless growth of stunted vegetation of no economic value, its thirsty land and dry air, its scattered inhabitants of thieving junglies have passed away for ever, and in their place is to be found life, bustle and activity, an endless panorama of flourishing crops and vigorous plantations and invigorating atmosphere and streams of water, a great and growing population, a sturdy peasantry, expanding towns and flourishing industries." The Lower Chenab Colony of Sandal Bar, with headquarters at Lyallpur, is described as the richest tract in India and perhaps in the whole of Asia. The canal with head-works at Khanki has a capacity of over 11,000 cusecs at Head, commands

a gross area of about 34½ lacs of acres, and irrigates annually about 26 lacs of acres. Taken by itself it is the largest and for its size the richest single unit in the world, the net return being about fifty per cent. on the capital outlay. The Lower Jhelum Canal, with headworks at Rasul, has a head capacity of about 4,000 cusecs, commands a gross area of 13½ lacs of acres and irrigates annually about 9 lacs of acres.

The success of these two schemes restored confidence in the Punjab, and thereafter any project submitted by her engineers was accepted at even more than its face value. There was vast Crown waste land still available, but before any actual further work was begun, there sat at this time Lord Curzon's famous Irrigation Commission of 1901-03. This was an event of great significance and importance in the annals of Irrigation in India. Through its instrumentality, a new idea and therefore a new phase in irrigation development in the Punjab took place, *viz.*, the pooling of supplies of the various rivers to be used to the best advantage by levelling down inequalities of distribution.

On the completion of the Lower Chenab and Lower Jhelum Canals, the only river which remained untapped in the Punjab proper was the Beas, and there was corresponding Crown waste land lying in the lower part of the Bari Doab. A project was actually prepared for it on usual lines for a canal with its head at Harike below the confluence of the Beas and the Sutlej. But this method of utilising the Beas supplies was strongly opposed by two distinguished witnesses before the Commission, *viz.*, Sir James Wilson, then Settlement Commissioner, Punjab, and Col. S. L. Jacob of the Chenab Canal fame, then retired Chief Engineer. Their reasons were that the Jhelum carried more water than could be utilised in the Jech Doab and that Irrigation of the Lower Bari Doab represented the last possibility of using this surplus, and further that the Beas-*cum*-Sutlej supplies could be best used for the development of Irrigation on either side of the latter river. These views so impressed the Commission that they issued an *ad interim* report recommending a thorough examination of this aspect of the case before the project for a canal from Harike was sanctioned. The result of this examination was the famous Triple Canal Project consisting of three large canals, the Upper Jhelum, the Upper Chenab and the Lower Bari Doab. The Upper Jhelum takes off at Mangla and carries the Jhelum water into the Chenab a little above Khanki. The Chenab water thus freed is taken by means of the Upper Chenab Canal, the second link of the Triple Project, taking off at Marala 36 miles above Khanki, to the Ravi which it crosses on the level. Below this point it is called the Lower Bari Doab Canal, the next big Colony Canal that came into existence in the Ganji Bar. The Upper Chenab was opened in 1912, the Lower Bari Doab in 1913 and the Upper Jhelum in 1915. Their head discharges are about 14,400, 7,000 and 8,800 cusecs respectively, and between them they command an area of 39 lacs of acres of which they irrigate over 22 lacs of acres annually.

The conservation of the Sutlej supply in the manner described above, has been justified by the fact that it has been possible to bring into

existence the great Sutlej Valley System, which has just been completed. This gigantic scheme has a three-fold object of giving a weir-controlled supply in Kharif to the existing Innundation Canals from the Sutlej, to further extend controlled Kharif irrigation so as to embrace the whole of the low-lying area in the Valley, and to provide perennial irrigation for the large bangar tracts on either bank of the river, *viz.*, Nili Bar in the Punjab, and certain arid tracts in Bahawalpur and Bikaner States. The system of dividing the irrigation into the perennial and non-perennial, ensures the best use being made of the water available. For this it became necessary to build four weirs in the river, *viz.*, at Ferozepur, Suleimanke, Islam and Panjnad, and take off from above them no less than 11 canals of a total head capacity of about 47,000 cusecs, commanding an area of about nine millions of acres of which they will provide irrigation to over 5 millions of acres annually. Taken as a whole, it is perhaps the largest irrigation project in the world.

With the Sutlej Valley completed, our labours have not come to a close. We have now under contemplation the Haveli Project Canals from the Chenab below its confluence with the Jhelum, in order to afford the same relief to the Chenab Series of Innundation canals, that the Sutlej Valley Project has done to the Sutlej series, and for other stabilising purposes. This project will command about 11½ lacs of acres of which it will annually irrigate 7 lacs of acres. It will form an integral link of the Quintruple System of the Upper Jhelum, the Lower Jhelum, the Upper Chenab, the Lower Chenab and the Lower Bari Doab Canals and perhaps of the Sutlej Valley Project.

We are also casting our wistful eyes on the great Thal Project, the fate of which is hanging in the balance for reasons which need not be detailed here, but which, if brought to fruition, will command about 46 lacs of acres and add another 22 lacs of acres to annual irrigation of the Province.

With the completion of the above Projects our resources of natural and free supply from rivers shall have been practically exhausted and our further hope lies in storage works in the hills. One such scheme, *viz.*, the Bhakra Dam on the Sutlej is already under contemplation, and in course of time, more may be taken up. This Dam when built will add about 26 lacs acres of more irrigation to the Province.

Gentlemen, the above review will have shown to you what the efforts of our Punjab Engineers have done to turn to good account the set of physical circumstances that prevail in the Punjab plains, *viz.*, fertile flat land, scanty rainfall, deep watertable and a number of large snow-fed rivers. Without this effort most of the Province would have been a desert waste, and with it, it has turned into a panorama of smiling fields. The Punjab has in point of fact become the premier irrigation tract in the world. Taking the position just before development on Sutlej Valley Project began, the total area of artificial irrigation in the world from all sources, *viz.*, canals, wells, tanks and pumps, etc., stood at 125 millions acres of which India claimed 50 million acres, the United States coming

next with 20 million acres. Of the 50 millions in India, rather more than half, *viz.*, 26½ million acres was irrigated from state-owned works and the other moiety from wells, and private canals and tanks. And of this 26½ million acres about 10½ million, or 40 per cent., belonged to the Punjab, Madras coming next with 7¼ million or 27 per cent. The resulting economic gain is really marvellous. We have so far invested a capital of about 33 crores of rupees in our canals and derive from it a return of 12 to 20 per cent. per annum. The area irrigated from productive works alone stands to-day at the high figure of 12½ million acres. For sheer maintenance of population it is estimated that 0·4 acre of cropped area is needed per head, and at this rate these 12½ million acres can sustain all the population of the Province; and thus we have insured the Punjab against famine. By colonizing our new areas we have relieved the pressure of population on land in congested districts of central Punjab, thus giving them a fresh lease of life. The hot weather in the Province has become milder and dust-storms less frequent, and it is hoped that these dust-storms will become a thing of the past when the Sutlej Valley Canals in the Punjab and Lloyd Barrage Canals in Sindh are fully developed. The wholesome reaction that the extension of canal irrigation had had on the development of communications and trade and the resulting prosperity can best be appreciated by a study of economic statistics of the Province. To the Provincial Government, their irrigation works are the first asset, the Canal Receipts both direct and indirect less working expenses, being larger than any other Head of Revenue, even the Land Revenue which is taken to be the real mainstay of Governments in agricultural countries.

There is of course the other side of the picture, *viz.*, the evil of water-logging that our irrigation works have brought in their train. Every effort is being made to combat the evil, and I have no doubt that the Punjab engineers will prove imaginative and practical enough to devise, with the help of cheap hydro-electric power and economic forms of lining channels, a system of rotation of irrigation by flow from canals and by lift from underground water-table in different tracts of the Province, in such a manner as to establish a happy equilibrium between the conditions of surface irrigation and drainage and sub-soil flow, making water-logging as extinct as famines or dust storms.

I am also not unconscious of the slump that has come on irrigation enterprise on account of the general economic depression, but I am sanguine that when recovery comes the peak of success shall be even higher than in the past. I refuse to be a pessimist.

I also look forward to the time when Punjab should lead the world in the cognate engineering of storage dams coupled with hydro-electric works. The Bhakra Dam on the Sutlej as contemplated would have a height of five to six hundred feet which is higher than any dam that existed in the world when the idea was first taken up, and will be next to the 700 feet Hoover Dam on the Colorado river in America, now under construction. Reconnaissance surveys have been carried out for some years, the last one being by the Committee of 1927, consisting of one

American expert, two eminent geologists, and on behalf of the Punjab Irrigation, Mr. Nicholson, Superintending Engineer, who in the previous year had made an extensive tour of inspection of the principal dams in America, and to whose talent we owe so much. With further knowledge and experience we should expect our Himalayan heights and streams to yield us hydro-electric works of the first magnitude in the world, beating the largest one extant at Queenston-Chippawa on the Niagara river in Canada generating 5,50,000 H. P. which I have had the privilege of visiting, or the still larger one under construction on the Dnieper in Russia to generate 8,10,000 H.P.

Then there is a possibility of improving our great rivers for inland navigation—another branch of practical hydraulics. It is strange that nothing should have been done in this direction since the Indus Steam Flotilla, which plied its boats between Kotri and Multan, became extinct about 1880, while America and Central Europe which have more extensive and better organised Railway transport, are doing so much in the matter of inland navigation. In America the Mississippi is navigable from its mouth at New Orleans to Minneapolis, *i.e.*, for 1,944 miles out of a total length of 2,477 miles. Its large tributary the Ohio has only recently been made navigable from its outfall to Pitsburg, the work having been opened by President Hoover in October, 1929, while I was in America. The surveys of another large tributary, the Missouri, were also being carried out for the same purpose, and I cannot forget the fact of a railway running parallel to it as I travelled by it from the City of Kansas to its outfall at St. Louis to have an idea of the physique of the river prior to the contemplated improvement. Similarly in Central Europe there is considerable inland navigation observable on the Rhine, the Elbe and the Danube. There is no reason why we should not also develop this form of transport.

Reverting to Irrigation Works in the Punjab, it should be noted that the talent for their development grew in the Province itself; for, except for some little help we may have derived from the Ganges Canal in the case of the Upper Bari Doab Canal, we have developed our own ideas and details of construction, and learnt our lessons from the experience gained in the Province itself. The term 'cusec' itself I believe (I am open to correction) was coined in the Punjab on the Upper Bari Doab. The theory of silt equilibrium was also discovered on the same canal by the great Kennedy, in whose grateful memory, we of the Punjab Irrigation have endowed a medal, and I feel proud that I happened to be the Organising Secretary for establishing the same. In the matter of headworks we have come from practically no headworks at all to the most up-to-date headworks on the Sutlej Valley, our gates starting with spans of 10 to 20 ft. having gone up to 60 ft., the largest in the world. The uncertainty that prevailed about design of river weirs in plains on sand foundations—a great feature of irrigation work in India—is vanishing before our research. In recent years Rai Bahadur Lala Ajudhia Nath Khosla, Executive Engineer, has taken great pains on the subject, and

he is presenting a third paper to the Congress this afternoon, *viz.*, the one on ' Pressure pipe observations at Panjnad Weir.' I am confident that his recent tour of inspection in America and Europe will prove of inestimable value to the Province. Our canals and distributaries are designed on most up-to-date and scientific lines. We have devised a very efficient system of distribution, and in this again Mr. Kennedy led in ideas and design of the module. He and Gibb dealt with the rigid module, and Harvey and Stoddard, and more recently Crump, with the flexible one. Our system of irrigation in colonies is ideal, the sizes of Chaks, the alignment of watercourses and the location of village sites being guided solely by level contours. We meet our problems with confidence now and no work appears to us as too large, and no effort as too great. For their sizes we possess some of the most remarkable irrigation canals in the world, the main line of the Upper Bari Doab Canal being perhaps the most picturesque, the Upper Jhelum Canals the most difficult of construction, the Lower Chenab Canal the richest in results and the Sutlej Valley system the largest in magnitude, its one unit the Gang Canal being the longest lined channel in the world. I have had the good fortune of being in charge of the first three for long and being connected with the last one now.

There is no reason why our efforts in further development of the Province should not be crowned with an equal or even greater success. And this not only in the domain of irrigation, but in all other branches of engineering, for our progress in the development of roads, railways and electric works has been very phenomenal. The future will be in the hands of the coming generation, and here I address a few words to our younger members. Your predecessors in the Punjab have left you a very good legacy and tradition. Follow their examples and carry forward their torch even livelier and brighter. Yours is a profession which is essentially one of applying the truths of science and laws of nature to the use and convenience of man, and yours is, therefore, a profession whose pursuit is truth and aim service, and if you search your hearts you will find that real happiness lies in these two. It follows naturally that without truthful character you cannot achieve much. What are the prizes of life ; come they not unoften by fluke? But the habit of imbibing truth from nature and applying it to the problems of life and needs of the profession in a spirit of duty, like all virtue carries its own reward. Never, therefore, scamp your work but design and build true and square. Be true to what is before you, be true to your profession, be true to your employer, and, above all, in the words of Shakespeare :—

"To thine own self be true,
And it must follow, as the night the day,
Thou canst not then be false to any man."

I now ask the Hon'ble Dr. Gokal Chand Narang to declare the Congress open.

SPEECH

By

THE HON'BLE Dr. GOKAL CHAND NARANG, M.A., Ph.D.,

Minister for Local Self-Government, Punjab.

Mr. President and Gentlemen,

I thank you very much for the great honour you have done me in inviting me to open this Congress. I have many times acted as a stop-gap but I assure you never with a greater diffidence than on this occasion. It is a pity that His Excellency the Governor was unable to be present and you had to cast about for a substitute and had to put up with a substitute of no particular attainments. The only association, if it can be called one, that I had with engineering till lately was that at one time of my life I had entertained an intention of joining the Thomason College at Roorkee, but I do not think that Mr. Hadow, even if he had known of it, would have considered it a sufficient ground for approaching me to open this Congress. Nor do I think that my short association with the Hydro-Electric Branch of the Public Works Department of the Punjab would qualify me for this honour. The truth is that I accepted Mr. Hadow's request not because I considered myself qualified for the task but because considering the great regard I have for him I did not have the courage to say "no" to him. It is, however, not only an honour to be associated with this function and to act as an understudy to His Excellency the Governor but I assure you it gives me great pleasure to be here to-day as it would give me an opportunity to pay my tribute to a class of experts who have done so much for our Province. The pleasure is all the greater because your Congress is a fraternity of art and science whose watchword is unity and progress and no caucus, clique or communalism affects your deliberations to mar its harmonious working. I have glanced at the list of papers read at your various sessions and though most of them relate to irrigation, they cover a fairly wide range of important subjects of practical utility. Your Congress has fully justified its existence and has proved not only a strong tie of union for yourselves but its activities have been of considerable help to the public services as a whole.

Yours is a profession which has done more for the material progress of the world than any other profession. Law and medicine deal with only preservation and maintenance. Yours is the work of creation. There was a time when the profession of engineers was practically confined to military operations, to the construction of fortifications for defence and, perhaps, to the making of catapults and other devices for attack. They were for centuries considered as a unit of the army and as the use of

gunpowder and other explosives developed they took charge of the artillery as well. They had a corps of their own consisting at one time of a miscellaneous crew including masons, carpenters, smiths, tent-makers, miners, gunners and artillery men under a Chief Engineer who was subsequently, early in the 15th century, designated as Master of the King's Works, Guns and Ordnance, with his headquarters in that prison of princes, the Tower of London. By the middle of the 16th century engineers found fresh employment in the construction of coast defences but till the first decade or so of the 18th century continued to command artillery in the army of British generals. It was towards the end of the 18th century that engineers received the designation of Royal.

In India the East India Company followed a mixed system for some time having only one cadre of engineers employing them in civil works and transferring them to the army whenever required by the Military authorities. The Indian engineers also became "Royal" when the East India Company ceased to exist and the administration of India passed into the hands of Queen Victoria.

Military engineers are certainly indispensable and as might be read in Major-General Porter's *History of Royal Engineers* they have great achievements to their credit. It is, however, engineers other than the Military as such who have made the world what it is to-day. About the middle of the 18th Century there began to arise a new class of engineers who concerned themselves with works which were neither exclusively military in purpose nor executed by soldiers and they came to be called Civil Engineers. The Institution of Civil Engineers, London, received its Charter in 1828 and the aims and functions of Civil Engineers as defined in the Charter include "Art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states, both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters and lighthouses and in the art of navigation by artificial power for the purpose of commerce and in the construction and adaptation of machinery and in the drainage of cities and towns." This is a fairly comprehensive definition and would include most classes of engineering as there is hardly any class of engineers whose function is not the prevention of waste, economising of labour, facilitating operation or the promotion of convenience and comfort. If I had defined the functions of engineers as mentioned in the Charter, I would have added the creation of beauty as well. When I look at a beautiful building it strikes me as a work of art, in fact, a piece of poetry writ in brick and mortar, stone and cement, its arches, curves, cupolas and turrets, its architrave, friezes, cornices and other entablature representing, as it were, the letters of an artist's alphabet, its majesty of design vieing with the majestic flow of the mighty lines of Marlowe and Milton and its symmetry of structure reminding one of the balance of the many storeyed Spenserian stanza.

In ancient times, with few exceptions, Engineers' art found its expression in religious or semi-religious works or works designed for pleasure and show. Modern engineering stands distinguished from ancient engineering in as much as it has for its aim utility rather than pleasure, it being left to the super accomplishments of engineering to combine pleasure and beauty with utility and comfort. The pyramids of Egypt and the Suez Canal aptly illustrate the difference. Another feature in which modern engineering stands distinguished is its great specialization. Howsoever costly Specialisation may be, it is, to my mind, the essence of efficiency and it is in fact this specialisation which has led to great discoveries with the changed point of view and the more intensive method of procedure. The great discoveries in Physics, particularly in Electricity, and in Statics, Hydrostatics, Dynamics and other branches of mathematics and in Chemistry have made specialisation possible, profitable and a pleasure.

Modern engineering has achieved successes which could hardly be dreamt of in ancient times. An easy way of duly appreciating the value of the Engineers' contribution to the civilization, convenience and comfort of the world would be to visualise what life would have been without the engineers. There would be no roads, no bridges, no cars, no railways, no telephones, no telegraphs, no steamers, no aircraft, no air mail and, in fact, no factories, practically, no lights and fans and not even decent houses. One seems to shudder at the very thought of such a world.

Then again, who has done more for the removal of unemployment than our engineers. Could the Secretariates of the greatest sovereigns afford to employ a fraction of the men and women now employed on railways, telegraphs, telephones, factories, etc., which the discovery and exploitation of steam and electricity by engineers have made possible? Even now it will be a Scientist-engineer who will one day solve the problem of unemployment by discovering some new power.

Coming nearer home it is with a great pride and pleasure that I find myself able to pay a high and sincere compliment to the engineers of our own Province. They have achieved many great things but their great success in irrigation stands out most distinguished of all these achievements. As the President has pointed out the Punjab Government has already spent about 33 crores of rupees on its canal systems and the result achieved is certainly unique and would stand comparison with the best systems in other parts of the world. The massive waters of the mighty rivers of the Punjab had been running to waste for thousands of years, in fact, sometimes bringing devastation in their wake. The Punjab engineers curbed these restive steeds and harnessed them to the service of the Province, and the result is that the Punjab has been covered with a network of canals which have made the Punjab peasant comparatively the most prosperous cultivator in India, and have proved a source of considerable income to the administration. Of the total canal irrigated area in India the Punjab canals irrigate about 40 per cent. and

directly bring nearly 40 per cent. of net revenue to the Punjab Government. It is a work of which any government and any class of experts might well be proud. It has been said that one who can make two blades grow where one grew before is a benefactor of mankind. What about our Punjab engineers who have made millions grow where none of any use grew before and have converted the arid wastes of Sandal, Nili and Ganjibars into garden lands and granaries of India? I may also refer to another great engineering achievement of the Punjab and that is, the Hydro-Electric Project which has just been completed. It is a matter of great regret that Colonel Battye who had set his heart on this scheme and had done so much to make it a success is not in our midst to-day. I join the President in the expression of regret over his loss and the loss of Mr. Crawford and Mr. Kapur during the last year and in conveying our heart-felt sympathy to their families and friends.

It was a bold conception to rouse the creeping, almost sleeping, waters of the Uhl into action, pierce the Dhaula Dhar at a height of 6000 feet and bring them down, disciplined and trained, to set the turbines in motion and galvanise almost equally sleepy country-side of the Eastern and Central Punjab. This scheme, as you know, has cost the Government well over six crores and with the completion of the first stage we expect to electrify 22 important towns of the Province situated in 9 districts which represent about $\frac{1}{3}$rd of the whole Province and economically and politically the most important part of it. It is, perhaps, seldom realized that such schemes when successfully carried out not only add to the material resources of the country but also serve a great political purpose. The comparative contentment of the Punjab peasant may in no small measure be traced to the magnificent irrigation schemes of the Punjab Government, and it may well be hoped that when the hydro-electric scheme has been thrown open to the public and becomes fully loaded it will bring peace and prosperity to another class of people who might then think it more advantageous to turn their attention to the economic and industrial development of the Province than to communal and political wrangles.

Your President, towards the end of his speech, made a reference to some of the other achievements of the Punjab engineers made in the domain of technical knowledge and, I assure him, we are all justly proud of the distinction achieved by them. I need hardly say, however, that though much has been done a great deal still remains to be done. Nature has let out only a part of its secrets and, to employ the language of a great philosopher, we are still like children picking pebbles on the sea-beach without having any access to the great treasures hidden in the vast and heaving deeps of the ocean. Many new sources of power may and must still be discovered, many new appliances must be invented to economise energy and labour, many devices must still be made available for saving time and cost of manufacture.

I am a mere layman but I have often looked forward to a time when modern railways would be considered an anachronism, the modern

telegraph system a clumsy and dilatory design, the modern cars a nuisance and modern aircraft too primitive. I have tried to visualise a time when we shall be able to see from our drawing rooms the great sights of London, New York, Cape Town and Yokohama without moving an inch from our seats, when we shall hear the music of the music halls of Europe and America with as much clearness as if it was going on in our own room, a time when we shall take up just a small apparatus and without troubling any exchange, talk to our friends in Peking or Peru. A time may come when even hydro-electric and thermal plants may become out-of-date and useless and devices may be discovered for taking out electricity whenever required in our houses or on our farms perhaps, with the same ease as we can have water by digging a few feet in the ground. A time may come when we may be able to shift our houses with the same ease as our cars and plant them on hills or seaccasts as it may suit our pleasure.

Long ago I read Professor Tyndal's work on Heat as a form of energy. I do not know if his theories still hold the field but I have often felt how primitive science and engineering still must be to allow millions and billions of horse-power to run to comparative waste in the shape of solar energy. An Engineer may arise one day who may invent receivers and accumulators to receive and store up solar energy particularly during the hot weather and like electricity from accumulators or water from the water works reservoirs may distribute it wherever and whenever it is required. What a great field for a seeker after knowledge with an inventive and romantic mind ! Our houses would be lighted and heated, our meals cooked, our water lifted, our factories run, our motors, railways and aeroplanes propelled without dependence on coal, petrol or other power at a cost which would be negligible as compared with the present cost. Many things which not long ago might have been looked upon as purely Utopian have become accomplished facts and many a romance of science has become a reality of life.

At the other extreme of this Utopian lies a pre-eminently practical problem which is facing the whilom votaries of mass production. With the industrial development in other countries the outlets for mass production of industrially advanced countries which alone could make it productive are being closed and the master-spirit in the fable whom they had enslaved is threatening to devour them. Here is a fruitful field for the exercise of inventive brains. They can find out means to aid manual labour within limits so as to stimulate production and yet keep it within safe limits.

Before I close, I must say a word of sympathy to those engineers who without much fault of theirs, have fallen a victim to the axe of retrenchment and some of whom may not even be present here. They should not lose heart. Government service is not the only avocation in life and there is a world elsewhere as well. Men of ability and grit will not starve. It is for them to combine and join their heads to discover some avenue

of useful pursuit. Private practice in engineering may be a novelty in the Punjab but it is not so in other parts of the world and what is possible elsewhere can and ought to be made possible in this Province. Then there is the great and yet almost untrodden field of industry. India is at a primitive stage of industrial development and engineers with initiative, grit and energy can pool their resources and set up moderate-sized foundries and other engineering works and induce capitalists to start factories and mills of every kind which will not only solve the problem of their unemployment but would also render a real service to their country.

Gentlemen, I have nothing more to say. It would be presumptuous on my part to try to express any opinion on the technical side of your activities or to anticipate your deliberations. I have full faith in the brain as well as the brawn of the Punjabi, and I have no doubt that once the Punjabis set their heart to achieve anything, nothing can stand in their way. We are proud of your achievements in the past and wish you greater success in the future.

With these words and thanking you once more for the honour you have done me I declare this Cnogress open and wish you all success in your deliberations.