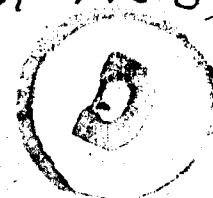


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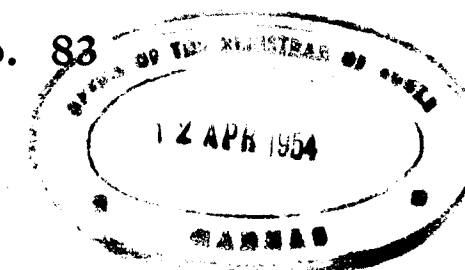
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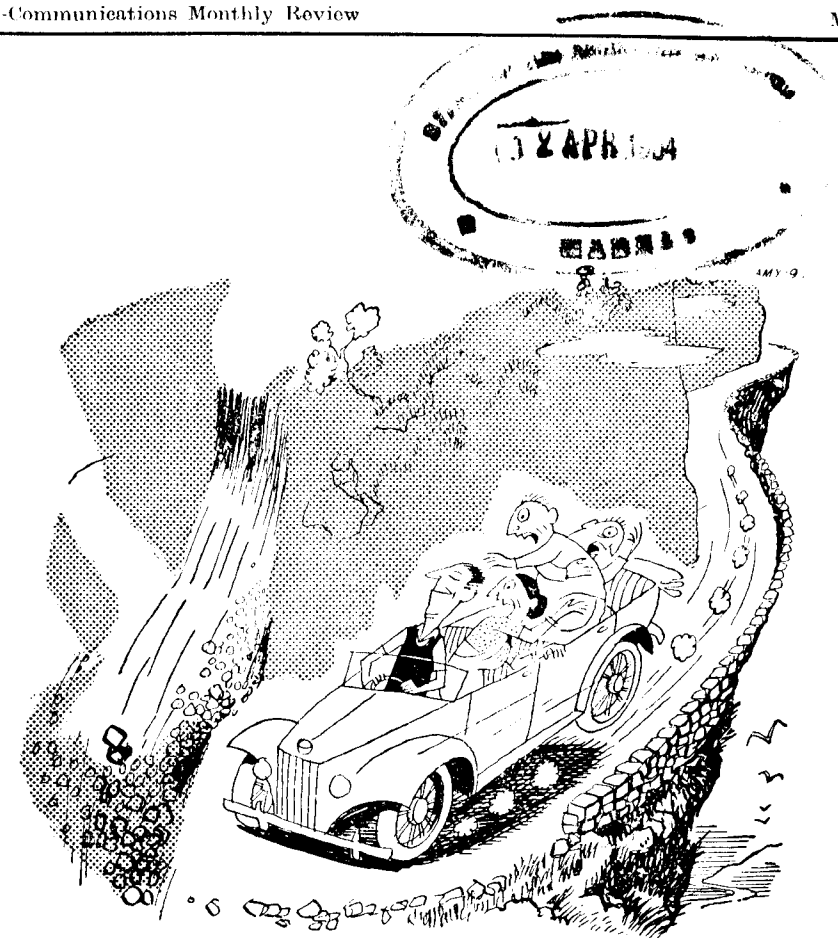


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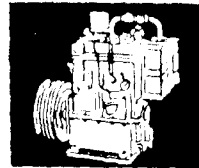
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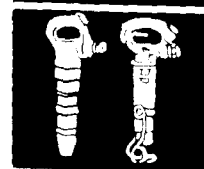
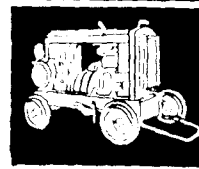
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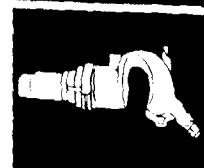
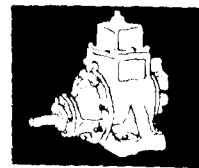
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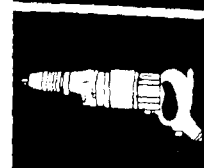
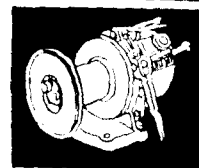
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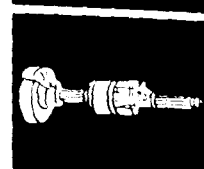
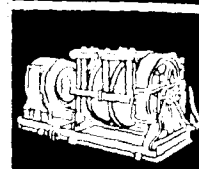
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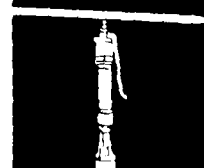
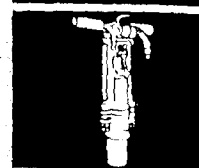
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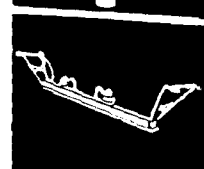
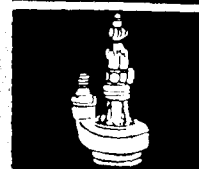
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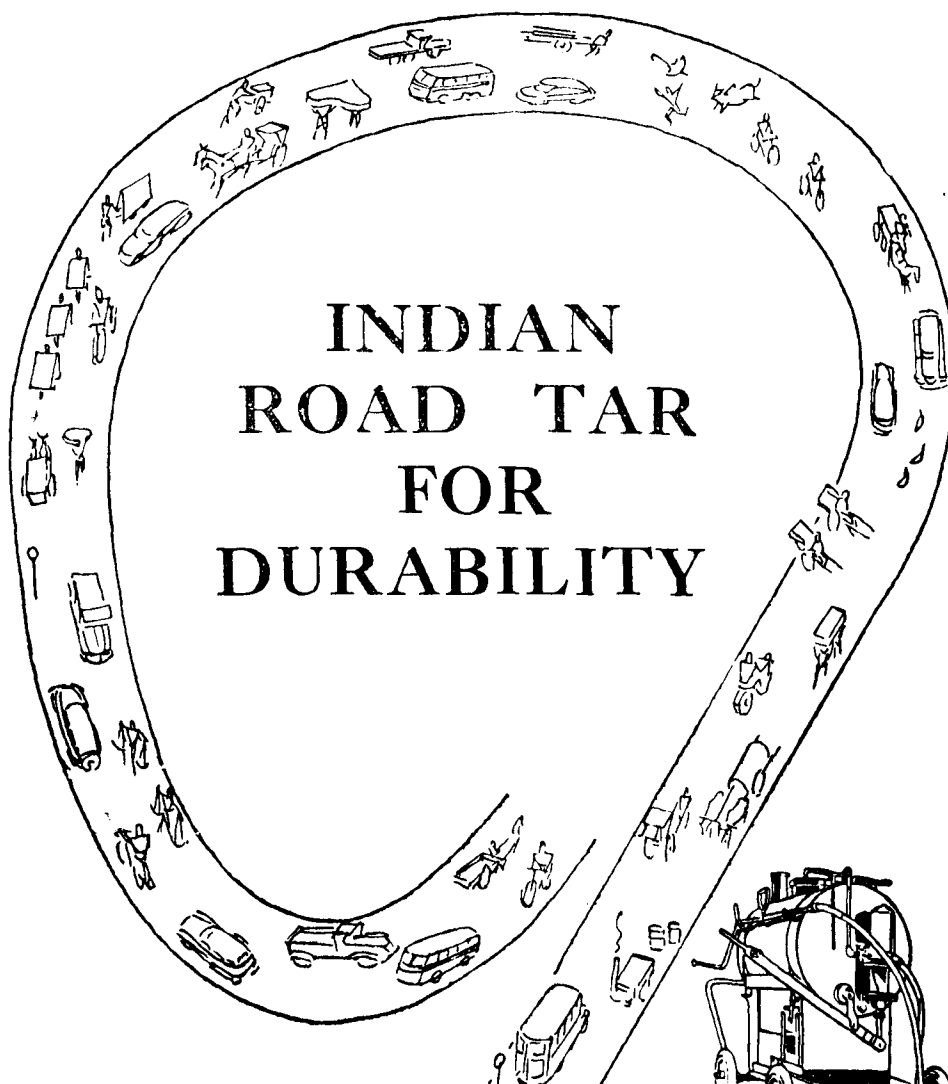


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TRANSPORT- COMMUNICATIONS

MONTHLY REVIEW

MARCH 1954—No. 83

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ALSO: Definitions of Highway Engineering Terms—Character—Deft Definitions of Criticism—Economist—National Highway Milage.

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This Review is sponsored by the Roads Organization, Ministry of Transport, but the Government of India accept no responsibility for any views or opinions expressed.

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TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

MARCH 1954

INDIAN ROADS CONGRESS 188 EIGHTEENTH SESSION - BHUBANESWAR

BHUBANESWAR, the picturesque new capital of Orissa, was the scene of the Eighteenth Session of the Indian Roads Congress which met between the 4th and 11th of February last. The delegates who were able to spare some time for visiting the innumerable temples scattered round about Bhubaneswar must be carrying with them the haunting memory of these beautiful shrines which exhibit a unique architectural style. The finest specimens are the Lingaraj, and Rajarani, and the Mukteswar temples. The Lingaraj, is Bhubaneswar's main shrine and is one of the best archaeological monuments in India. It stands in a courtyard 520 ft by 465 ft and towers up to a height of 127 ft from the ground.

The Session was inaugurated by Shri Naba Krushna Chowdhury, Chief Minister, Orissa, on the 5th February 1954. About 200 delegates from all parts of India attended the Session. This was the first meeting of the Congress in Orissa.

Shri R. K. Batra, Chief Engineer, Roads and Buildings, Madhya Pradesh, delivered the Presidential Address. The special point made out in his Address (published in full in this issue) was the creation of a non-lapsing fund for road development in order to ensure that road development is steady, balanced and continuous.

The President assigned first priority to the construction of village roads and, next, to bridges and culverts on rivers and waterways along main roads. He also urged the need of replacing on a programme, the weak or obsolescent and derelict structures which have outlived their normal life or are too narrow and unreliable for the heavy loads and their impact.

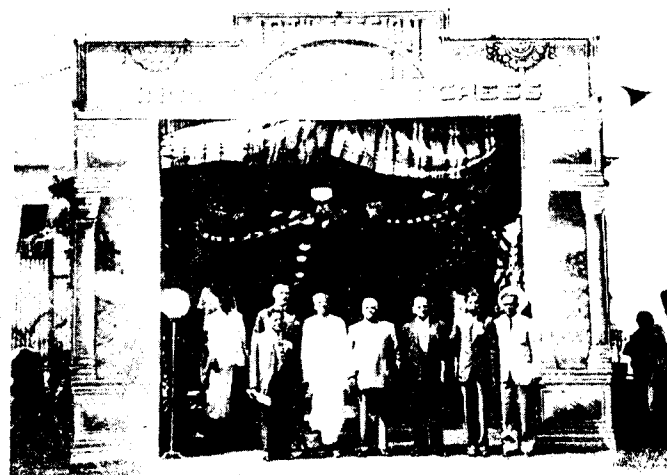
Other points touched upon by the President in his speech were the provision of adequate width of roadway and suitable horizontal and vertical curves—factors pertinent to the safety of modern high speed travel. He also referred to other aspects of road development such as aesthetics and avenue perspectives, segregation of traffic, railway over-bridges and sub-ways and improved level crossings.

The President advised the younger engineers to develop initiative and pride of profession, maintain an attitude of humility, sense of humour and proportion and be not discouraged by criticism.

To senior engineers, he appealed to take a keen and lively personal interest in guiding their assistants with helpful and positive advice and direction.

The Chief Minister in his inaugural address said that while every one desired the process of national reconstruction to be completed with the least possible delay, there were many limiting factors, particularly financial stringency and they had to exercise the utmost economy. He further referred to the shortage of suitable technical personnel for the execution of projects.

Shri Naba Krushna Chowdhury, Chief Minister, Orissa, is received by the President on arrival to inaugurate the Session.



The Chief Minister of Orissa, Shri Naba Krushna Chowdhury with office-bearer after inauguration of the Session.

He paid high tributes to engineers and advised young men not to be afraid of doing manual labour themselves.

The Indian Roads Congress medal was awarded to Shri K. K. Nambiar and Shri K. Namasivayam for their Paper "The Investigation, Design and Construction of the Cauvery Bridge at Pugalur."

Messages of goodwill were received from the Prime Minister, the Hon'ble the Speaker of the House of People, His Excellency the Governor of Orissa, His Excellency the Lieutenant Governor of Vindhya Pradesh, and several Ministers of the Centre and the States and professional institutions abroad.

There were five Papers and one Road Research Note open for discussion. About sixty speakers, took part in the discussions which will be published in the Journal of the Indian Roads Congress.



Shri K. K. Nambiar, receiving the I.R.C. Medal.

The panel discussions on "Practices prevalent in India regarding the construction of Cement Concrete Roads" which had not been completed at the last Session were continued at this Session and completed. The discussions, after suitable editing, will be published by the Indian Roads Congress.

There was the usual round of Committees and Council meetings.

The specifications and Standards Committee discussed the Standards to be adopted for Road-Rail Level Crossings. The Research Organization Division considered the reports of the research work done in various research laboratories. The test Track Division considered the report of the work done at the Road Test Track, Calcutta. Other Subcommittees which met during the Session were the Papers Subcommittee, the Education Subcommittee, the Road Transport Subcommittee, the Subcommittee dealing with the question of



The newly elected President
Shri H. P. Mathrani,
Consulting Engineer (Road
Development) Government
of India addressing the
43rd Council on 9-2-54.

the Provincialization of Local Bodies Engineering Services. The Education Subcommittee discussed the draft syllabus for Refresher Courses for engineers already employed and draft model syllabus for Highway Engineering in Civil Engineering Degree Course.

Demonstration of the actual working of Motor-Grader and Asphaltic Concrete Mixer were also arranged for the benefit of delegates.

The delegates were accommodated in the M.L.A.'s Hostels and Quarters—all in one place, and this helped the delegates to come into close contact with each other throughout their stay at Bhubaneswar during the Session. In the evenings, all delegates assembled in the meeting hall to see interesting technical films on the use of latest road making machinery.

The Technical Exhibition was opened by Shri Bahirab Chandra Mahanti, Deputy Minister for Works, Orissa. The coloured and flood lights of the



Shri Bahirab Chandra
Mahanti, Deputy Minister
for Works, Govt. of
Orissa, declaring the
exhibition open.

exhibition gave a festive appearance and the public, too, visited the exhibition in large numbers.



One of the Stalls in the Technical Exhibition.

On the 9th, the delegates visited the old Sun-god Temple of Konarak which is nearly forty miles from Bhubaneswar. On the 10th, the delegates paid a visit to the famous Jagannath Temple at Puri. The last day was devoted to the inspection of Kathjuri, Kuakhai and Taldanga Canal bridges and the layout of the new capital at Bhubaneswar.

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

- CROSS SECTION :** A vertical section at right angles to the centre lines.
- FORMATION LEVEL :** (a) The reduced level to which the earth-works, excavation or embankment, are to be or have been executed.
- (b) The new surface level obtained on completion of earth works on which material and construction are superimposed.

CHARACTER

"Character is the capacity to conduct one's self with restraint in time of prosperity and with courage and tenacity when things do not go well".

—James V. Forrestal.

"We must write over and over again the old copy-book maxims. Honesty is the best policy. There is no substitute for work. Folly brings its own penalty. Right living brings its own reward. The market place is mightier than any legislative hall".

—W. Alton Jones.

PRESIDENTIAL ADDRESS TO THE EIGHTEENTH SESSION OF THE INDIAN ROADS CONGRESS

By

SHRI R. K. BATRA

Bhubaneswar, February the 5th, 1954.

Hon'ble Sir, Ladies and Gentlemen,

IT is my proud privilege to welcome you, Sir, on behalf of the Indian Roads Congress and to voice our feelings of gratitude for the honour you have done us, in coming into our midst today, to bless and open this Eighteenth General Session of our Society. I also extend our hearty welcome to our lay guests, who as representatives of the public and trustees of the common man's interests, have graced this occasion with their presence in evidence of their interest in our activities. We want to take you into our confidence and cultivate your goodwill and support in our endeavour to add to and improve upon the road map of India. We need the sympathetic and helpful understanding of all road users in respect of the magnitude of our problems and the odds against us. To Members and Delegates, I offer my cordial greetings on this happy occasion of our annual re-union to discuss and compare notes of our past year's work and experience.



Shri R. K. Batra, President delivered the Presidential Address.

We also express our grateful thanks to the Orissa Government for the courtesy extended to us in inviting the Congress to their new Capital at Bhubaneswar. We are meeting here for the first time in the 20 years' history of our Institution. Bhubaneswar

has historical, cultural, and religious associations going back to the early centuries. The town as you see it today, is recent construction and has been planned and laid out according to a Master Plan based on what is described as "neighbourhood units" and there will be plenty of opportunities for all as they go round the place to observe and study the utilities and amenities of such an arrangement. Unfortunately, due to financial stringency, only the first phase of the programme has been taken up in hand so far. Quite apart from the attractive and novel features of this town, there are many ancient and beautiful temples scattered all round among which is the famous Lingaraj temple. These temples are noted for their distinctive architecture which is unique and striking in its pattern and are well worth a visit. The famous age-old temple of Puri frequented by pilgrims from all over India, is very near from here and those who are interested will be enabled to go and worship at this sacred shrine. The temple at Konarak dedicated to the Sun God, though in ruins, is a marvel in architecture and you will be interested to see it. The caves of Khandagiri and Udaigiri are another attraction in the neighbourhood.

We should also express our indebtedness to the Orissa State Officers for the excellent arrangements made both for holding the sessions here and for our boarding and lodging arrangements in spite of the various handicaps under which they must have laboured.

Orissa is still a young State created within the last three decades by welding together the most remote and outlying districts of the other contiguous old States and with a number of Princely States added on after the attainment of Independence. No wonder, therefore, if it has to work against the backlog of progress in its still unopened areas and a chronic and deficit economy. Its heroic struggle to come up and rise to its due stature on par with other States is worthy of our admiration. We wish the State the best of luck and success in its efforts. May the Grace of Lord Jagannath of Puri in conjunction with the bounty of nature activated by the construction of Hirakud Dam leaven in quick time the economy of the State and contribute to its ever-increasing prosperity.

The past Presidents of this Congress have, in their successive Addresses at the annual sessions, fully traced the history of its birth and achievements during the last two decades, and I need not traverse the same ground or enlarge upon it much further. The very fact, that the membership of this Congress has swelled from the 73 first fathers of this Association, who appeared on the scene in 1934, to a family of 1,315 in number within two decades is a measure of its vitality, popularity, and usefulness. Most of the road Engineers of the country, both in Government service and outside, are there either as members or as associate members.

Our primary objective and function is to see to the advancement of the technique of road construction so as to make for better strength and more enduring life of our structures and towards the utilization of local materials to best advantage and for maximum service, thereby reducing costs to the minimum possible. Towards this end, we are engaged in the creation and maintenance of a central pool of ideas by drawing upon past experience and up-to-date knowledge on the subject and are acting as clearing house for such of the ideas as have been proved in practice not only in this country but also in other parts of the world which have similar problems. It is a threshing ground for all the plentiful and varied lore on the subject, where the chaff is winnowed out and the hard core of grain is isolated. The officers working in the Roads Wing of the Ministry of Transport, which is mothering and nursing this Institution, pass on the results of their studies both on the theoretical and practical aspects. The field knowledge comes in through the many Papers, and notes and comments on them contributed by the engineers working in the States and from the estimates of major projects. All such grist is passed through the mills of the technical staff and the sub-committees working on behalf of the Roads Congress and the matter is churned, sifted, and presented finally to the Members in the form of condensed specifications and

standards and codes of practice. The comprehensive Bridge Code prepared under its auspices is an outstanding document and is today the Bible of the Bridge Engineer. Prior to the advent of this body, we had to rely solely on the British Standards Specifications which did not take into account our local conditions and material resources. Hence, on this score alone, the Indian Roads Congress fills up the void which has long existed in the technical armoury of our highway departments. Besides this, we are enabled to compare the various approaches to and the methods adopted towards the solution of the several problems met with in the different parts of this country. Similar Societies of advanced foreign countries exchange their literature with ours.

The Roads Congress has recently started a new service of publishing extracts and excerpts from the technical journals in the Transport-Communications Monthly Review for the benefit of the executive staff who, owing to their whole-time preoccupation with the organization and accomplishment of their day-to-day work, are not able to keep abreast of the latest advances in the science of road engineering, which is growing fast by rapid strides. They simply do not have the time and energy to read systematically and discursively. So, whatever is worthwhile as throwing more light on the different facets of road engineering is purveyed to them in concentrated essence for easy assimilation and guidance or as a pointer to the proper quarry for further information.

By encouraging the Members to contribute Papers or original articles based on their independent studies of particular subjects or experience on specific works and by bringing them up for discussion at the annual sessions, the Congress is providing a platform for crystallizing the various amorphous ideas which the different Members would have at one time or other imbibed in the course of their work. Engineers are generally silent workers, always in communion with nature for extracting its secrets, and if they talk at all about their work, they do so more in the language of sketches and drawings and terse specifications, not often intelligible to the lay public. It is, however, necessary for engineers in these democratic days to carry conviction to the public and to this end to be able to explain to them, in layman's language, the pros and cons of their projects. These faculties could be developed more and more by constant exercise and attempt at marshalling our facts, arranging them in their logical sequence, and indicating the inferences therefrom.

Annual prizes, medals, or honoraria are being awarded by the Congress for Papers of special merit. The aim and ambition of the Congress in this direction is to keep beaming the searchlights of the Congress over the whole of our fraternity and its area of operation and kindle every spark of talent therein and rouse it into flame so as to illumine the several yet hazy, twilight and dark corners in the field of our science. With this objective in view, the venue of the sessions is being changed from year to year so as to enable all States, all men, and all problems to be canvassed and covered in its sweep.

In fulfilment of its educational objective the Congress is maintaining an up-to-date library and it lends books to members who are constantly kept informed of the list of new books added from time to time. It has a small museum not sufficiently large yet for want of accommodation. There is an Education Subcommittee which is working on the proper syllabus and curriculum of Highway Engineering studies.

Of late, along with our annual sessions, we have been organizing technical and film exhibitions of road practice, machinery, tools, etc., for the benefit of engineers. As a matter of fact, these exhibitions have been drawing a considerable number of visitors from among the public as well.

Road construction and maintenance till the other day, even within the memory of the senior Engineers, was largely craftsmanship based on intuition and empiricism. But motor vehicles with their high speeds and heavy loads have brought in their train

a multitude of complex problems, for the solution of which we have to adopt a scientific and rationalised approach. Soil, which was being classified by appearance and feel, has now to be classified by the qualitative and quantitative content and behaviour of its several ingredients. The potentialities of using stabilized soil for the construction of the base courses of road pavements, where stone and other hard materials do not exist within economical leads, are enormous and impressive advances have already been made in devising specifications for the proper use of local soils. From the simple water-bound macadam and stone-sett pavements of pre-motor era, we have since advanced to pavements of concrete and bitumen mixtures, and from masonry arches we have passed on to Reinforced and Prestressed concrete. The strength and performance of the different materials going into these new types of construction have to be investigated for different conditions and proper specifications and processes have to be evolved by conducting large-scale laboratory experiments. Hence the construction of road research laboratories has become an imperative necessity. The institution of the Test Tracks at Alipore, Calcutta, and at Okhla near Delhi, and the building up of Road Research Laboratories both by the Central Government and the States owe their inspiration to the impetus and fillip given by the Congress during the last several years.

The Roads Congress has also got subcommittees to advise on road machinery, tools and plant, and on the problems of transport as a whole. It has another Subcommittee commending to the State Governments the advantages of constituting specialised highway departments working directly under their wings. Now to those who are still lagging behind in giving full effect to this suggestion, we wish to point out the considerable achievement of Madras, West Bengal and Bombay, which have so far followed our lead. The question of forming an All-India Service of Engineers, on the analogy of I. A. S. and I. P., has also been mooted and is worthy of serious consideration.

The Highway Chief Engineers of State having met at the instance of the Roads Congress in the year 1943 drew up the well-known Nagpur Plan suggesting an *ad hoc* 10-year road development programme for the country as a whole so as to provide an integrated and closely knit grid of roads, and presented it to the several Governments. Though for various reasons this programme has had a chequered career in its implementation during the last ten years, it is satisfactory to note that our efforts have at last borne fruit in that a fairly large provision has been made in the Five-Year Plan under this head as a result of the general appreciation of the need for roads. Though it may not be as large as it should have been in view of the prevailing backwardness in the matter of adequate communications in this vast spread out country, we have to accept it gracefully as it is said that no more could be provided on account of the competing demands on available finances.

In this connection, I can do no better than quote the recent pronouncement of our Prime Minister whose instinctive flair for striking the right emphasis is indisputable.

"I have come to the conclusion that one thing to which we must give topmost priority is roads—roads of all kinds, not only very up-to-date bitumenized or cement roads, but roads of any kind, to open out vast areas of this country which are closed up today and which you cannot reach unless you walk or ride.....I give roads first priority."

Any tardiness in this direction will be to the peril of the Welfare State. This is also the considered opinion of the Roads Congress and the Nagpur Report is specific on this issue of balanced development.

Whatever is the use of exhorting people to move out to the villages without creating conditions which would attract them. Young men who have been having

their education in urban surroundings fight shy of leaving the towns for want of even the minimum amenities in the countryside. Today, there is such a well-defined water-shed separating the sophisticated urban and the simple rural communities who live two different standards of life both materially and culturally. There is a big lag between the two standards and it is necessary to help develop an intermediate standard incorporating the best features of each. The ocean of buoyant life is all to one side of the ridge and the tides and waves of technical, cultural, and social progress lap up only to the levels of the urban areas and break thereafter. It is necessary to cut channels through the ridge for inducing direct and open flow through this barrier by equalising the levels as far as possible between the village and town life. Again, the common man who lives largely in the village as the producer of the basic wealth of the country and the elementary necessities in food and raw materials can no longer be ignored. He has been till recently approaching the Government with applications in a supplicant mood for his release from the land-locked interior. But the last war and its repercussions which precipitated a new era in the affairs of men and changed all fundamental values accepted hitherto, have exalted this common man to his rightful place in the democratic way of life. He insists to be brought on to the broad stage of life to establish direct contacts with the virile modern civilisation. Social justice has to be done to him and he should be relieved from his joyless, drab, monotonous and uneventful existence. It should also be the concern of the Government not to let him languish and waste his energy in the desultory and factious life now ruling in the villages.

It is necessary to build new village roads first before our other economic plans could be put on wheels. Unless we criss-cross the whole country with village roads of at least minimum specifications, village communities will be a drag on our progress and will not be in a position to contribute their mite to the building up of the country's economy. At least those villages should be linked up first which lie within a few miles on either side of the existing roads. A low type village road at small cost as first stage development can be provided to give the villager access on to the main roads which lead to towns and markets. With the construction of these links, the several amenities of life under different categories can be brought within his easy reach. Such roads will also help in the dispersal of ancillary and of even main industries towards the countryside where labourers could live a cheaper, healthier, and more spacious and effective life, and thus reduce the cost of production and increase the output. They would further facilitate the exploitation of the unexplored resources lying in the interior. In short, the effect will be to create such a congenial environment to rural existence as to tempt men of the stamp of Lloyd George who, after retiring from the Prime Ministership of England, found the growing and marketing of potatoes from rural England a sufficiently profitable and exhilarating occupation in his latter life. Good transport facilities in the interior would help towards the desirable exodus of educated people, young and old, to the countryside where they can live useful lives far from the madding crowd and enliven the countryside with their gifts and experience.

It is a welcome trend that the Community Project and National Extension Service Administrations are intensely seized of this issue in their programmes and are concentrating on village road construction by enlisting public co-operation. The Government of India, have also offered token grants to State Governments for encouraging construction of village roads on co-operative basis by the villagers offering free labour, gifts of land, money or idling transport. Such a procedure while reducing the incidence of cost to the Government to the minimum is also the best way of enhancing the dignity of labour and practically demonstrating the equality of man and man. The energies of local scout and other youth organizations could be harnessed purposefully to creative work instead of being limited to or frittered away on spectacular ceremonial. We shall thus be working with the community and not merely for it and there seems to be no better way of converting the prevailing frustration into enthusiasm and the insurgent masses into a resurgent and self-respecting community with faith and confidence in itself.

The Government in the past had been acting on our recommendations without definitely committing themselves to any firm policy. But to-day, by the pressure of public opinion or may be as a result of the persistent labours of the Roads Congress and other road promotion associations like the I. R. T. D. A., it is extremely gratifying to see on the horizon the dawn of a new road era and prospects of a sure and steady advance towards the fulfilment of our dreams. The recent statement of the Hon'ble Minister for Transport at the Silver Jubilee meeting of the I. R. T. D. A. is a charter for road development and indicates go-ahead policy. Let me quote the relevant portions of his statement made on behalf of himself as well as of the Government.

Policy. Our policy is to encourage the development of an integrated system of transport in which.....road transport will play an appropriate and useful role in its own sphere of effective service. Government's plans are further based on a full recognition of the fact that road transportation facilities still lag behind the actual requirements for proper economic progress. There is less than one-fifth mile of road per sq. mile in India against 2 miles in the U. K. and one mile in the U. S. A. On a population basis, India has only 6 furlongs of road per 1,000 persons against 36 miles in the U. K. and 12 miles in the U. S. A.....Governments in India are quite conscious of the large leeway still to be made and the community projects do include the construction of rural roads as an important part of their programmes. I may say that I am personally very keen on the development of proper roads connecting different villages to the main roads. A small amount of Rs 20 lakhs has been provided in the current year's budget for this purpose, but I shall be glad to provide more if there is an increase in village road building on a voluntary basis."

The overall money provision for capital road construction and improvements under the Five-Year Plan is of the order of Rs 145 crores inclusive of Rs 25 crores from the Central Road Fund and Rs 10 crores recently added under the head of relieving unemployment for constructing inter-State roads or roads of economic importance to rural areas. Physically, the plan covers the construction of about a hundred large bridges and construction or improvement of 24,000 miles of roads in the several States of the Union. Some of the largest bridges over the Ganges, Sone, Godavari, Kistna, Torsa, Damodar, Rupnarain, Cossye, to mention only some of them, find place therein. Add to this, the provision made under Community Projects and National Extension Service Administrations for more than 20,000 miles of new village roads and the expenditure likely to be incurred on road improvement and construction by Municipalities and other administrations like those of Forest and River Valley projects. Now with the steady progress of these schemes by easy rises and treads, we shall have arrived by the middle of 1956 at the first landing on the stairs of progress from which we can easier aspire further.

Now we can take it that the Government is fully convinced of the deficiency in our road system and the urgency of making up the same. If more money has not been provided, it is due to want of resources and not for want of will on the part of the Government as we have been assured. Let us, therefore, for the time being reconcile ourselves to this position; for, it may also not be possible to get more work done in a satisfactory manner under the limitations of the present organizations and within the remaining two years of the 5-year period. We may look forward to provision on a larger scale under the next Five-Year Plan. Meanwhile, we can settle down to hard practical and technical work in the execution of all the projects to strict schedule and with the utmost economy. Towards such a consummation, on a solemn occasion like this, let us dedicate ourselves heart, soul and body to play our part in accelerating the progress of the country.

There next remains the important issue of the creation of a non-lapsing fund for road development which has been for long the prime plank in the platform of the

Roads Congress. The latest advance registered in the progress of this idea is that the Planning Commission has accepted it in principle and in spirit by enunciating the proportion that road development "should be steady, balanced, and continuous and that for this purpose a certain continuity in the supply of funds is essential if wasteful expenditure is to be avoided and programmes are to be pursued without interruption." In implementation of this idea they have fixed the money provision for development works over a 5-year period and have further permitted works to be taken up (in the Central sector at least) of a 100 per cent more value so as to provide for continuity and overflow into the successor plan. Such elasticity conceded towards the natural extension of the programme into future years is a guarantee for the smooth flow of the requisite funds required not only for this Plan, but also for the subsequent ones. We hope, on realization of the advantages of this policy during the present 5-year period, the same will be continued and we would have ultimately a separate non-lapsing fund constituted by statute before long. The States also meanwhile, must be taking steps towards the constitution of their own non-lapsing funds for road development from motor vehicle user taxes and by credit of the due share of road cesses under the approach made to them separately in terms of the Motor Vehicles Taxation Enquiry Committee's findings.

Let me next proceed to an appraisal of the existing road system and its deficiencies. From a study of the road map one can see that the required quantum of arterial road mileage (of National and State Highways) is fairly existing as it is, except in the Part C and some of the Part B States, and except for missing links in various reaches and missing bridges particularly over big rivers. These roads are the responsibility of the Centre and the State Governments and have been built up over years to tolerable standards. We have however to provide the missing links and bridges and to improve the roads for the quality and efficiency of service demanded by the higher stresses and strains of modern traffic. The main deficiency lies in the want of Feeder roads to and from the villages.

How to go about remedying the defects in both these systems in an economical manner in relation to the poor resources of this country and in what sequence, we should consider. We may suppress the likely temptation of importing costly ideas and methods and the dazzling standards of American Highways as there is a vast difference between the developed hinterland of American prosperity and our stagnant backland which has still to be explored for throwing up the wealth which only could sustain a higher grade and more commodious road system. The stream of arterial travel characteristic of America stems from their advanced mechanization and the prevailing high standards of life there. Our standards should be modulated to lesser scale and hitched to nearer stars. We have to resort to stage construction and stagger improvement so as to spread our moneys over as large an area as possible, and not until definite traffic load trends, offering the prospect of a continuity, are established, should any big commitment on expansion be made.

The main desideratum which reduces the all-weather utility of our road system is the bridging of the many perennial rivers and creeks on the lengthy coastline of the Peninsula and of the several major and minor rivers in the plains. Construction of bridges and culverts over smaller channels therefore, should be an early charge on available resources. Another frequent sight along the roads which could not have escaped the most casual road traveller is the Notice Board warning about the weak and narrow bridge ahead and enjoining speed or load limit. There are heaps of such obsolescent and derelict structures which have outlived their normal life or are too narrow and unreliable for the heavy loads and their impacts. Considerable reconstruction and replacement is called for and they have to be tackled one by one giving priority to those which are demonstrably unsound and have visibly deteriorated.

There is next the width of roadway and its geometric alignment—factors pertinent to the safety of modern high speed travel. In this ancient land of intense settle-

ment over centuries and roads laid afterwards of slow evolution, and for slow traffic, individuals and communities lived and cultivated haphazard and hence roads through them have had to be narrow and winding. These now need widening and straightening to cater to fast traffic. Again, even where wise men in the past, in exercise of their elementary instincts, laid wide roads with broad margins, pushful and avaricious owners of properties by the roadside have gradually encroached and closed in upon the traffic width so that in and around inhabited areas we have what is called Ribbon Development, which detracts seriously from the traffic capacity of such roads. These grabbings have to be reclaimed by stern and sustained executive action. Curves, both horizontal and vertical, have to be eased and superelevated and amplified by acquiring at corners for increasing sight distances, the worst bottlenecks and death traps being taken up first.

There is again the question of bye-passing along through routes that pass through bazars of intermediate towns, where the local urban traffic resists and holds up through traffic. Where the volume of the latter is sizeable, ring roads on the outer periphery of the towns with limited access service roads or in the alternative, accommodation or distribution routes within the town will have to be provided.

Yet another aspect of road development is its aesthetics and avenue perspectives. New avenues, have to be planted and reared while the existing ones have to be protected against the vandalism practised by the villagers. There is also the need to maintain all the rest houses along the main roads in efficient condition so as to afford reasonable comfort to tourists and travellers.

Road interests adversely affected or insufficiently conserved due to laxity and want of vigilance hitherto have to be safeguarded in future by enacting a statutory Highway Law which will regulate access to roadside land and prescribe the limits of building, set back and control lines.

Segregation of traffic according to the different speeds of vehicles has to be kept in view in the design of pavements for heavy mixed traffic.

Railway over-bridges and subways and improved level crossings are also required on a large-scale but may perhaps be deferred to the next stage of development.

Road Maintenance.—Physically, roads are a piece of the social, industrial, and agricultural equipment of the country which must be maintained. The State, as the owner of these roads, is no more free than an industrialist is—not to maintain his tools and plant. If we do not maintain the roads adequately, certain unpleasant consequences follow and we actually waste money. Though our arterial roads can be said to be maintained at present to some standard, it is not adequate. The maintenance of secondary roads, i.e., the minor district and village roads, is very poor and almost in name only although such roads are of great importance in the day-to-day life of the masses as coming close to the skin of the large number of villagers living thereon. Not having the means to maintain them in the way they like highway authorities have been compelled to resort to makeshift methods of patchwork, often with the result that the repaired surface is at least as dangerous as the one it replaces. Water-bound macadam which has been the mainstay of our road surfaces can no longer survive under present conditions of traffic. It has ceased to be an economical proposition except where traffic is light and pneumatic tyre borne and stone is available in plenty just by the roadside, and even then it is sisyphian labour and terribly wasteful of human effort as having to be repeated on a cycle of too frequent renewals. The only answer is to go in for rigid or flexible pavements of concrete or black top of high grade specifications related to the traffic intensities on the main arteries. Concrete roads cost Rs 75,000 and high specification black top Rs 40,000 on the average per mile and unless capital construction at these high costs is undertaken, the maintenance

of these roads will be an unmitigated headache to the engineer and their unsatisfactory condition will continue to give room for complaint by the public. Hence, until we have a plentitude of funds to construct surfaces suited to the traffic in each case we may not be able to show satisfactory results. Smooth and dustless surfaces yield handsome dividends in the shape of better health of the people living alongside it, of conservation of the energy of man, animal and machine, and of considerable national savings in spare parts and replacements of motor vehicles most of which are at present imported from outside. It has been roughly estimated that the loss to motor transport on account of bad roads is of the order of Rs 38 crores per annum. This aspect has come to the forefront of late and a Committee of the Roads Congress recently constituted at the instance of the Transport Advisory Council is now engaged in studies of the comparative costs of operation of motor vehicles on different types of pavements and of the economy in transport costs resulting from improvement of road surfaces.

The maintenance of the secondary roads for all-weather traffic is a much more difficult problem so long as bullock-cart again remains the principal means of rural transport. Low cost roads with stabilized soil surfaces are not the solution in spite of the lighter traffic on them as they are incapable of standing up the cutting action of the iron tyres of the cart. The only possible way of keeping up these roads in traffickable condition for the greater part of the year is for the villagers to take up this work themselves to be done at frequent intervals by reforming the surface after each rainfall and just before the moisture in the roads dries up and by the addition of locally available stabilizing materials of gravel, sand, or clay, as may be required. It is on account of the difficulty of maintaining these roads that quite often the construction of new village roads is sought to be postponed until such time as money could be found for initially providing a stable crust capable of standing up to the needs of the particular traffic.

It must be quite relevant on this occasion to make a brief mention of the highlights of the road development programme of Orissa State in particular. Quite a number of missing links on the Calcutta-Madras and Calcutta-Bombay National Highways are being forged at present and the construction of many of these stretches is already complete. Bridges over the Kathjuri and Kuakhai rivers and the Taldanga Canal on the former route and over the Mahanadhi on the latter have already been constructed and are in use, while bridges across the Subernarekha, Brahmini and Baitarni are in course of construction. In this context it may be pointed out that the first three bridges are of daring design and of types attempted only recently in this country.

Now, I wish to refer to a question which has been agitating the minds of many senior engineers in Government service for a considerable time. In connection with our country's developments in the several sectors, a great responsibility rests upon their shoulders. To come up to the nation's expectations, they have got to work willingly, courageously and unflinchingly. You must have however noticed from speeches made by senior engineers all over India during the last few years that there is a sense of frustration among them. India needs good engineers very badly and she cannot advance unless a conscious effort is made to diagnose and remove the causes which are frustrating them. There is a dignity in the profession which must be fostered. If the engineer has to deliver the goods on a hundred fronts to-day, he must have the proper environment to do so. It is not correct to smother him with censure all round. It is generally overlooked that the engineer has to play an important part in the life of the community not only as a technician but also as a planner and administrator. One of the major causes of his despondency, I venture to say, is that many of his plans are often spoiled because they have to pass through hands which lack the training and experience required for a proper appreciation of them. I am convinced that the nation is not getting the best out of her engineers in the present arrangement, which has come to stay due to the innate reticence of engineers. May I in this connection remind them of what Dr. John Matthai, the then

Minister-in-charge of Transport, said in 1948 in a message to the Indian Roads Congress.

“Too often Engineers appear to play the role of big silent men. I have always felt that, with their education and their experience as men of affairs, they should achieve much more, if they would emerge from their shell.”

Ladies and Gentlemen, your over-worked patience must be at the end of its tether, so let me close after doing a little introspection and loud thinking on the human side. It is necessary as all progress is conditioned by the nature of the human agency working at it. My exhortation to you, the young assistant engineer is that you should develop initiative and pride of profession as well as possession in your works. You should quickly, after emerging from college, learn all about the practical side of your work lest you be outwitted by the engineering trade with whom you have to deal all the time and without whose cooperation you cannot show results. Maintain an attitude of humility and sense of humour and proportion and be not dismayed by criticism. Where it is unbiassed and correct, own up and benefit therefrom. If it is ill-informed, the opportunity afforded to clear yourself will enhance your reputation. Work up by the hard way and do not buckle under stresses. Whatever be your station at the time in the official hierarchy, shed your lustre on the job and do not consider the job as your ornament. Guard against getting cynical as a cynic is an enemy of himself and of society. Train yourself to take responsibility for whatever you do. Your future will then be assured as Society and the State are bound to look after your interests. You have very big opportunities in the offing for bringing out your best and advancing your knowledge in the many-sided works coming under the Five-Year Plan, especially in the construction of bridges over the major rivers. Let economy be your watchword. Be on the scent for new quarries and newer and better techniques. Be loyal to the Congress and reduce the gap between its well thought out specifications and your actual working standards.

To the senior engineers my appeal is that you should take a keen and lively personal interest in guiding your assistants on the right path, not only by putting up warning signs at all the likely pitfalls by the way but also by giving helpful and positive advice and direction. Train him to be a worthy successor to you in due time. You are fortunate that your early career was cast in the good old pre-war days when engineers worked under easier conditions. The lot of today's entrant into service is certainly more difficult and he needs sympathetic handling.

To you, our guests, let me address myself finally. Pray, be gentle in future while you swear at a road for, from what has just been explained, it must be apparent to you by now why roads are often bad and that good roads mean high costs. A road like a billiard table has to be paid for. All the economics we try, do not carry us far. In this connection it is pointed out, paradoxical as it may seem, that you are all paying even now without being conscious of it, extras in the shape of your vehicle and health repair bills arising out of the jolts and dust nuisance on bad and rough roads. I request you therefore to throw in your weight on the side of getting more funds for road maintenance. There is no use indulging in cavilment of the engineer-in-charge. These engineers are of your choice. They were trained by selection, strained in examination and tested and stamped by the Public Service Commission, and must therefore be the best men the country could yield. You have no go except to manage with them. So if they are good, encourage them to be better. If they are lame, give them crutches and set them on feet; and if they are bad, diagnose the disease and nurse them to health and vigour by going to the root causes. Then only can progress be registered. I now request you, Sir, to inaugurate this Session.

JAI HIND!

INAUGURAL ADDRESS

Delivered by Shri Naba Krushna Chowdhury,
Chief Minister, Orissa at the 18th Session of the
Indian Roads Congress

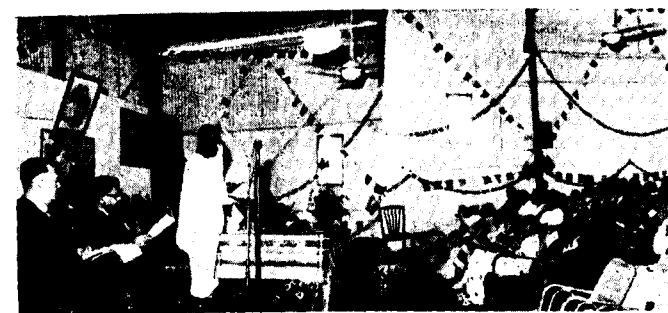
AT BHUBANESWAR

on the 5th February, 1954.

Mr. President, Ladies and Gentlemen,

IT is a matter of great happiness for us in Orissa to have had this opportunity of providing our new Capital as the venue for the 18th Annual Session of the Indian Roads Congress and of welcoming in our midst eminent Engineers from all parts of the country. I extend to you all a most cordial welcome on behalf of myself and the Government and people of Orissa. I have no doubt that in these surroundings where the relics of the glorious ancient past mingle with a growing modern township, you will find a congenial atmosphere for your serious deliberations. I understand that the present session includes visits to Hirakud, Konarak and Puri—places which will give you an idea of the present achievement as also the achievements of by-gone days.

2. We have all listened to your very interesting and may I venture to say, Mr. President, highly instructive address. To me, it is very gratifying indeed to note that you attach great importance to the building of village roads and adopting economical methods. I have been particularly delighted to hear you impressing upon our Engineers the desirability of making a practical approach to the problems before them by taking into account local conditions and not being dogmatically wedded to the superior American or European standards. This is a very sound and timely advice.



Shri Naba Krushna
Chowdhury inaugurated
the Session on 5-2-54.

3. It would be presumptuous of me to speak before this distinguished gathering of Road Engineers of such commonplace things as the importance of easy communications for a programme of all round development. It is true that in the first Five-Year Plan, it has not been possible to accord the development of road communications as high a priority as it deserves because the primary problem of food had unavoidably to receive our immediate attention. We are now happily turning the corner so far as the food problem is concerned and I have every hope that development of communications will hereafter receive its due place in our plans of development. The Indian Roads Congress will deliberate on many technical problems regarding the development of road science. You will, no doubt, apply all the resources of your technical knowledge and experience to devise economical, as opposed to cheap specifications which are the crying need of the hour. With the establishment of a Central Road Research Institute, new opportunities have been provided to the Road Engineers to develop their science and technique.

4. With the dawn of Independence, the expectations of the people have naturally gone very high. Both quick and lasting results are expected. We have

a great leeway to make up in our national reconstruction. While we are all desirous that this process of national reconstruction should be completed as early as possible, there are many limiting factors particularly that of financial resources; and we have to exercise the utmost economy. Fortunately for us economy is not merely a dire necessity but by its very nature, engenders all the virtues that foster progress or growth of a nation. It is the tight hand of economy which builds and indicates strength. Our own history and the history of other great nations teaches us that extravagance is a sign of decadence. Closely allied to this question of economy is the larger and more important question of integrity. In the context of the changed condition in our country with the advent of Independence, this concept of integrity has acquired a new force. In every sphere of activity for the development and reconstruction of the country we have to be moved by the patriotic urge, to dedicate ourselves to the service of the country, work for its advancement and for the betterment of the conditions of the masses. Integrity, about which we used to talk in the past, as a virtue, has now become a necessary concomitant of this patriotism. It has to come now from within and not as a result of checks and controls from above. Amongst our Engineers and other technical personnel particularly, it should be the twin forces of patriotism and pride of profession that should give rise to this virtue in the rank and file.

5. I may be permitted the liberty of drawing your attention to an unfortunate tendency noticeable generally amongst educated young men in our country. This is the growing disinclination on their part to work with their hands. Manual labour is looked down upon. It is considered dignified to live on the labour of others. This is a serious matter because the country needs more and more workers in the field. Unless, therefore, this tendency is counteracted, most of our dreams of a great and glorious future may be shattered. This is really a relic of our feudal caste ridden past and our faulty and deficient educational system. I am certain Roads Congress would give this matter the serious consideration it deserves. Engineers with their excellent training, both at home and abroad, should set a healthy example to the rest of the educated community. It will be a tragedy if instead of doing that they succumb to the prevailing vice and go after Whitecollar positions. You have not only to build big bridges and broad highways, great dams and aqueducts, but you will also have to take a leading part in clearing the debris of feudalism and building the solid edifice of a democratic society by bridging the gulf that separates the workers and peasants from the class of Babus and gentlemen who have to soil their hands.

6. With the growing tempo of development work in our country, we are requiring increasing numbers of qualified Engineers. We are, in fact, experiencing a very great shortage of Engineers in many spheres and at all levels. In view of this, it is felt that our Engineers should not be overburdened with administrative responsibilities and work in spheres which do not call for play of their technical skill and knowledge. I would request the Roads Congress to give their earnest consideration to this matter also.

7. Before I conclude, I would like to pay my warm tributes to the Engineers of our country who, in the post-Independence period, have taken up execution of gigantic projects requiring the highest skill, experience and professional ability. The Hirakud Project in this State, with which I am intimately concerned and of which I have first-hand knowledge, is being entirely executed by our own Engineers at all stages. The Project, when completed, will be a matter of pride to the whole nation. It would be an achievement of which our Engineers could be justly proud. Even in the construction of smaller projects, roads, bridges, etc., the Engineers are distinguishing themselves and have won admiration here and abroad. I am confident that what our Engineers achieve in future will be even more worthy of admiration and wider recognition.

8. I need hardly say how much interested I am in the deliberations of your Congress and how sincerely I wish them all success. I again thank you for asking me to inaugurate this, the 18th Annual Session of the INDIAN ROADS CONGRESS and I have great pleasure in doing so.

MESSAGES

to

the Eighteenth Session of

THE INDIAN ROADS CONGRESS

held at Bhubaneswar from 4th to 11th February, 1954

SHRI JAWAHARLAL NEHRU, PRIME MINISTER, INDIA

"The Prime Minister sends his good wishes for the 18th Session of the Indian Roads Congress."

SHRI O. V. ALAGESAN,

DEPUTY MINISTER FOR TRANSPORT & RAILWAYS, GOVERNMENT OF INDIA

I HAVE great pleasure in sending my best wishes for the success of this Eighteenth Session of the Indian Roads Congress.

Of all transport facilities, road communication comes nearest to man. It functions from his front gate and from portal to portal.

We are today right in the middle of the execution of the current Five-Year Plan and have got into our stride. Road development forms a part of the plan. Although the public purse is not so large vis-a-vis the many urgent needs of the country, yet enough has been provided for a very good beginning. Now it is up to our engineers to use their ingenuity and skill to produce maximum results out of these funds. Here is at once a serious challenge to and a glorious opportunity for them.

May your deliberations be directed purposefully towards this end.

—o—

*If everyone could meet the wife and children left behind,
And step into the darkened home where once the sunlight shined,
And look upon the vacant chair where Daddy used to sit,
I'm sure each reckless driver would be forced to think a bit.*

DEFT DEFINITION OF CRITICISM

Criticism is something you can avoid by saying nothing, doing nothing and being nothing.

DEPARTMENTAL EXECUTION OF HIGHWAY PROJECTS

(Contributed)

HIGHWAY engineers believe that highway projects should be executed departmentally whenever it is in the interests of the tax-payer to do so. In many States, the construction and maintenance of road pavements (metalling and black-topping etc.) is done departmentally as a rule. The supply of heavy materials like stone, gravel, etc., is generally done by contractors who are specially equipped with transport vehicles. But as regards the actual fixing of those materials into road beds, there is no doubt that doing it departmentally is the soundest practice. Precisely for these reasons, Highway Departments keep a complete plant of road rollers, tar boilers, mixers, etc.

There can be no doubt that departmental work provides very valuable opportunities for training young engineers in organization for works. The engineer must not only excel in producing accurate and safe designs but also be capable of executing them economically. He must, therefore, acquire the art of collecting and organizing labour, planning piece jobs, measuring progress and keeping cost accounts. Opportunity is afforded for all such training by departmental execution of works.

It is sound policy to create and equip some permanent units in each State for departmental work and keep them in trim with the object of using them when some contractor does not perform his contract properly or attempts to dictate impossible terms.

There are thus many advantages of doing work departmentally. But we

must not rush to the conclusion that that is always the most economical way of executing road works. Contractors are an essential part of the industry of public works. They specialise in their own line. A contractor has the natural aptitude and a life-time of experience in his trade and can successfully compete with departmental execution in many a type of work. It would be wrong to eliminate him altogether. That would annihilate a valuable industry and would be economically unwholesome.

What the contractor does has to be done by somebody and since no body works for nothing the project has to pay for this part of the job and it is not illogical to suppose that the project may have to pay more if that some body is in Government employ with assured salary rather than a contractor whose gain is directly proportional to the results produced by him.

In letting works on the basis of competitive tenders it is essential to ensure that contractors do not form "rings" in an attempt to subvert competition. This ensured, a good contractor is certainly worth the reasonable profit he aspires to. In the ultimate analysis, it would be against the interests of the tax-payer indiscriminately to employ salaried men on all jobs that are now done through the private enterprise of contractors. It devolves on the Engineer-in-charge to exercise judgment in deciding whether to employ a contractor or execute a work departmentally so that the public funds are wisely spent.

THE NEED TO BREAK WITH TRADITION

(Extracted from the 'Proceedings of American Society of Civil Engineers,
Vol. 79, Separate No. 339'—November, 1953)

TRADITION may be both a benefit and a detriment. Undoubtedly, the tradition of high quality in performance, material, service or workmanship is one that should be followed or cultivated. The mention of Toledo or Damascus steel bespeaks a goal in quality that is truly traditional. On the other hand, following traditional practices with little thought of their background or basic concepts leads one into an ever deepening rut or trench whose unshored sides eventually collapse and engulf him. The blind following of tradition or "worship of sacred cows" as L. L. Hedgepeth has so aptly phrased it, has been a great hindrance to progress in all lines of endeavour. There is a strong human tendency to follow or be bound by tradition and to ridicule or slander those who would vary or stray from the well-worn path. Columbus, Copernicus, Galileo, and countless others were all persecuted and suffered because of their efforts to break with tradition. This inertia to depart from the well-beaten road that follows precedent without rhyme or reason has too often delayed for years many urgently needed reforms and the use of new inventions. To quote Max Planck in his autobiography: "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."

Those who oppose departure from traditional practices often point triumphantly to the failures of those who have taken the "wayward" step. It is most certainly true that there have been many failures—sometimes disastrous—because of varying from tradition. It is equally true that any action will ultimately rise or fail solely upon its own merit. If ideas, procedures, designs, or action are based upon sound logical principles, they will last and out-ride any storm of criticism or abuse heaped upon them.

The handicap of tradition may only be overcome by a clear analysis of the entire problem following a thorough study of all basic factors involved. This thorough study and clear understanding of such basic factors is absolutely essential before departing from conventional practices. As has already been stated, only too often engineers failing to make such analysis or lacking understanding of the basic factors have met disaster by either unwarrantedly following the tradition or unjustifiably departing therefrom. Is then this tendency to blindly follow tradition due to a lack of understanding of basic principles, or is it indifference and a desire to take the easy way to save expense of time and effort necessary to give the problem the thought and planning it requires? In either case, engineering definitely has no place for such attitudes.

A few examples might be cited to better illustrate the problem. The art of war is often so spoken of since one is dealing with biological factors represented by troops where such intangibles as their morale, physical condition, training, leadership, etc., must be taken into consideration, and rigid formulas cannot be used as with mathematical or chemical problems. Every military commander makes an "estimate of the situation" for each campaign or encounter with the enemy. This estimate may be a very brief and simple one when small units are concerned, or it may be quite involved when dealing with an army or a group of armies. It basically covers, first the commander's own and the enemy's mission; then such factors as training, equipment, morale, numbers of opposing troops, supply, terrain, and plans available, and finally, the most desirable action to accomplish the mission after considering all factors involved. A successful and outstanding commander is one whose understanding of all basic factors is thorough and who will vary from tradition without

violating these basic concepts. Consider the collapse of France in World War II. According to the French, the Germans were traditionally bound to make a direct frontal attack on the heavily fortified Maginot Line as had been done at Verdun in World War I. Hitler, departing from tradition, by-passed the Maginot Line, used the Stuka plane as his artillery in the dense Ardennes Forest, and the results are history.

There are many engineers whose contributions to the profession have produced long strides toward the goal of human betterment. Many are the instances where tradition has been defied and bold steps taken to depart from customary practices to affect economies and increased efficiencies in design and operation. It is unfortunate, however, that our human tendencies are such that we often long remember the failures and soon forget the successes. It has been said, "When a doctor makes a mistake, he buries it; when an engineer makes a mistake, it buries him." This tendency to brand one as incompetent because of but one failure often acts as a deterrent to departing from tried practice. If,

however, one has a clear concept of basic principles and follows them out logically, he need not be apprehensive of failure.

In each of our problems let us ask: "Why are we acting so? Is it just because it is the line of least resistance?—or is it because it is the logical well thought-out step? Are we cutting the cloth to fit the person?—or is it going to be a ready-made suit with no alterations because it is the easiest and cheapest to do? Most of us, because we are engineers, give the problem the study it deserves. There are those, however, who follow the easy way. The former succeed; the latter fall by the wayside. If, however, the latter become the majority, then our profession goes down with them and other allied groups take over. Let us then continually take stock of ourselves and see that each of us is in the progressive group following tradition where necessary, boldly making breaks wherever warranted, but with our actions always firmly based on sound principles. In that way and that way only can our profession grow and advance and maintain the respect that is due.

ECONOMISTS

An economist is a guy with a Phi Beta Kappa key on one end of a watch chain, and no watch on the other.

* *

In one of her exotic moments a famous dancer wrote to the late George Bernard Shaw and suggested that they favour humanity with an incomparable offspring, say:

"What a contribution to the human race we could make with a child who possessed your brain and my body."

To which Shaw replied:

"Have you ever thought of the catastrophe should that child happen to have your brain and my body."

* *

HISTORY OF THE THEORY OF FRAMED STRUCTURES

(Extracted from 'The Structural Engineer' — May, 1938)

THE parallelogram of forces was used by Daniel Bernouilli in the 18th century and doubtless led to the discovery of the triangle and polygon and the funicular polygon.

Rankine—It appears to be Rankine to whom we are indebted for the commencement of graphic statics. In 1856 the preparation of his courses of lectures in Civil Engineering and Mechanics at Glasgow University led him to the discovery of reciprocal diagrams of frames and forces. The stress diagram for a simple roof principal is given in Rankine's "Manual of Applied Mechanics" in 1858.

August Ritter

In 1863 Professor August Ritter in Germany published his method of sections for finding the stress in a member of a framed structure by taking a section cutting that member and others and applying forces at the cut ends equal to the stresses in the members.

Clerk Maxwell

James Clerk Maxwell at the age of 25 was Professor of Natural Philosophy at Aberdeen. Four years later he held a similar position at King's College, London, and later was Professor of Experimental Physics at Cambridge.

Most of his work deals with researches in physics on colour and light, electricity and magnetism but between 1864 and 1876 he contributed four papers to various scientific societies dealing with framed structures. In these he simplified and

extended Rankine's reciprocal diagrams and gave the Theorem of Reciprocal Deflections which has led to the method of solving problems on statically indeterminate structures by means of measured deformations of elastic models.

Robert Bow

Robert Bow, who like Maxwell, was an Edinburgh man, published a treatise in 1850 dealing with stresses in structures and in 1873 gave his method of lettering the spaces instead of the joints or the members—the method known as Bow's Notation.

Williot

The next important development in the study of statically determinate framed structures was the displacement diagram devised by the French Engineer Williot in 1877 and later extended by Professor Mohr so that it is frequently known as the Williot-Mohr Diagram.

The Williot Diagram can be constructed to give the deflection of all panel points of a braced girder under a given fixed system of loads since the vertical displacement of any panel point in relation to a support is the deflection of the point.

With the development of influence lines and the use of Maxwell's Theorem of reciprocal deflections the Williot Diagram is useful to give a construction for influence lines for deflection of braced girders.

RECENT TRENDS IN DEVELOPMENT OF ROAD TRANSPORT IN INDIA

(Contributed)

THE Five-Year Plan visualises an expenditure of Rs 8.97 crores during the year 1951-56 on Road Transport Development in various States of the Indian Union. The break-up of this sum is as follows:

Part A States.....	Rs 5.62 crores.
„ B States.....	Rs 0.96 crores.
„ C States.....	Rs 2.39 crores.
Total	Rs 8.97 crores.

The Plan, in addition, provides for other means of transport such as the Railways, Shipping and Ports, etc.

The question whether the enlargement of various forms of transport facilities envisaged under the Plan would ensure that the development programmes in the various fields would not be hampered or delayed through bottlenecks or difficulties in the movement of essential commodities or finished products has been brought to the forefront in view of the transport difficulties during the course of last few months. It, therefore, appears desirable to create the necessary climate or conditions to bring about a better and wholesome balance between the demand and the available transport facilities.

Road transport has an important and vital role to play during the next three to four years as a supplement to railway transport, since the Railways single-handedly might find it extremely difficult or almost impossible to handle or cope with the additional, and pressing demands for transport facilities arising from the actual execution of various development schemes included in the Five-Year Plan. The atmosphere created for extensive development of the system of public carriers will, to a considerable degree, depend on the licensing policies adopted by the State Governments with regard to road transport. For an adequate

and proper appreciation of the developments in this field, it is essential to collect data and information in respect of the following.

- (i) the policy and future programme for passenger transport in the States;
- (ii) the extent to which nationalisation of passenger transport would be achieved by the plan period i.e., by 1955-56;
- (iii) the extent and nature in which private operators would be permitted to function in the non-nationalised sectors and whether long-term licences would be offered to instill in them a feeling of security and stability;
- (iv) whether the Government contemplates State operation and management of freight transport and the areas selected for this purpose;
- (v) the licensing policy in respect of public carriers in the field of freight transport and whether any relaxation is proposed to encourage freight transport by roadways;
- (vi) the principle of controlling points between which freight transport services would be introduced to render a helping hand to the role of Railways in the movement of commodities within the State. Should the services be operated by State Government or by some sort of a joint undertaking of several parties like a collectively represented Corporation;
- (vii) whether the programmes for road development have been properly and adequately phased or

synchronised with the extension of road transport services in the State, i.e., whether the roads, bridges, etc., could stand the expected additional traffic or load; and

- (viii) the part played by air transport of freight in the past and future possibilities in this direction.

In the present context of unemployment situation now obtaining in the country, development of road transport constitutes an important and growing source of employment for educated persons. Nationalisation of road transport has not been assigned a high priority in the Five-Year Plan. It appears, however that many State Governments have adopted licensing policies which tend strongly to discourage or retard the growth of private road transport. The expansion of production that is taking place in the agricultural and other sectors calls for increased transport facilities for passenger and goods. Therefore, there seems to be need to relax the present policies in this field. It would be supported by the fact that during recent years the growth in the number of vehicles in use has not been commensurate with the increase or expansion in the country's road mileage. That is not all. The Central and State Governments, District Boards and Municipalities have formulated ambitious programmes for Road Development in the years to come. Again, motor vehicles and motor traffic have had to bear the burden of increased or heavy taxation which hampers further and rapid development in this direction.

With this background of general and overall policy and development, a review of the recent trends in the development of road transport in various States is given below. Trends in the Development of Road Transport.

Part 'A' States

Assam

The Government of Assam decided in 1948 to nationalise transport on 692 miles of roads and is now running the services in most of these routes on a monopoly basis. Only on the Shillong-Gauhati-Pandu route, the State Transport carries both passenger and goods traffic. On the

remaining routes only passengers are carried. The State Transport is run by a Board of Control. The target for nationalisation is expected to be reached soon and nationalisation of any further routes is not contemplated at this stage. Licences are given to private operators for three years.

Bihar

State operation of freight transport in the foreseeable future is not visualised. Such services can, perhaps, be best organised. The Bihar Government's policy in respect of passenger road transport appears to be progressive nationalisation by stages. So far, the services in Patna and its suburbs, in Seraikella and Jamshedpur have been nationalised. In the current year, 1953-54, it is proposed to put another 100 vehicles on the roads in the district of Gaya. In the remaining two years of the plan period, another 200 vehicles are expected to be added by the State Government.

A liberal policy in regard to the grant of public carrier permits has been adopted. The permits have increased from 842 in 1950 to over 2,000 at present. As soon as a final decision on the areas which should be earmarked for State passenger services is taken, it would be possible to grant long-term permits in the rest of the State in the next 12 months. It is visualised that there would be an increase of 1,000 (additional) vehicles which would provide employment for 5,000 persons in the private sector of passenger and freight transport. Nationalised transport has provided employment to 900 persons of whom 350 are educated. There appears no proper co-ordination between road development programmes and extension of road transport services, particularly in North Bihar. The question of strengthening bridges and culverts needs urgent attention.

Bombay

There is not much scope for immediate extension of road transport in selected areas in Bombay. In the case of goods transport, the policy is to grant licences for vehicles liberally. The State Government appears to be inclined towards a more liberal policy towards road transport and is committed to nationalisation of

passenger road transport, the programme of which is expected to be completed in about a year. Steps have already been taken to ensure that the existing regions operated by the Bombay State Road Transport Corporation get adequate passenger vehicles before others are nationalised. The policy of nationalisation is stated to have brightened the prospects of employment in view of improvements in the organisation of workshops and other ancillary establishments and well-regulated conditions of work.

The Bombay State Road Organisation has already started the operation of goods vehicles without, however, monopolising the traffic on any specified routes. There would, in all likelihood, be no further expansion in the scope of this Corporation owing primarily to lack of funds. Meanwhile, the State Government has given ample assurance to private operators that at least, six months' notice will be given to them before the introduction of a monopoly in any zone or any route. As far as practicable, existing goods vehicles will be taken over and existing employees considered for employment under the State Transport Road Organisation in the event of the nationalisation of goods transport.

Madhya Pradesh

In Madhya Pradesh there are at present two Government sponsored companies. Additional road mileage which these companies can and ought to take up for operating on a permanent basis is under consideration. The rest of the road transport would be made available to private operators on the basis of three-year permit.

There is no proposal for State operation of freight transport. Licences for freight transport are granted to private operators for a compact block of four districts and, in addition, a route of about 200 miles. The State-sponsored companies are reported to be employing 7 to 7.2 persons per bus as against 4 by private employers.

Madras

Except in Madras City where road passenger traffic is nationalised both goods and passenger transport are expected to remain entirely in the hands of private operators for the entire period of the Plan.

The present form of individual enterprise without emphasis on other forms appears to be the best form of operation of goods vehicles in Madras.

The Madras State collects the heaviest tax from motor vehicle operators. It is estimated that, in the coming years, the number of lorries would be increased by 1,000 and the number of buses by, at least, 500 in the next three years. This is expected to create additional employment for 6,000 people consisting of 1,750 drivers, 750 conductors and 3,500 other skilled and semi-skilled mechanical workers.

Orissa

Freight transport, except an experimental service between Berhampore and Russelkonda, is left entirely to private operators. In Orissa, there exists nationalised transport passenger service operated through a tripartite joint stock company with the Central Government, Railways and the public sector as participants. The constitution of a Road Transport Corporation in place of the existing tripartite company is under consideration. As regards private road transport, the Government give preference to co-operative enterprises over individual operators while granting permits.

The State-sponsored joint stock company is operating a freight transport service between Berhampore and Russelkonda as an experimental measure in competition with the private service. The principal points between which freight transport service should be created to supplement the role of the Railways in the movement of commodities in the State are stated to be:

- (a) Berhampore-Russelkonda-Phulbani
- (b) Bolangir-Titilgargarh
- (c) Sambalpur-Bargarh
- (d) Rayagada-Jeyapore-Koraput
- (e) Jaipur-Keonjhar Road

A large number of illiterate personnel are employed in private road transport services. The State Transport Service has also employed a large number of skilled and semi-skilled people. Further extension of passenger transport as visualised by the State Government is expected

to absorb about 1,000 additional persons of which 500 will be educated persons.

Uttar Pradesh

The U. P. Government aims at nationalisation of passenger transport in gradual stages. The State Road Transport services operate at present over 4,700 miles of road and it is hoped that by the end of 1955-56, 6,500 miles will have been covered with a fleet of 1,500 buses. The service provides employment to about 6,800 persons and with the extension of the programme, it is expected to absorb another 1,000 persons.

Goods Transport is in the hands of private operators. The grouping of small operators is being encouraged. Lifting of the existing restrictions of the limit of 75 miles for applying public carriers in order to facilitate development of goods by road appears necessary.

West Bengal

The State Government have not formulated any scheme so far for nationalisation of Road Transport. The Government do not run any transport service except in Calcutta and in Cooch-Bihar and in these areas also private transport operators have not been ousted. With the development of new roads, permits for over 300 buses and a large number of public carriers had been issued since 1951 and recently the Road Transport Authority has been instructed by the Government to grant permits for another 213 buses, 248 taxis and 716 goods vehicles. It is expected that it will give employment to 7,000 to 8,000 persons. The Government have no intention of nationalising any transport services in the districts. In Calcutta, the Government have decided to have a transport fleet of 400 vehicles, out of which about 275 vehicles have already been acquired.

Two types of the most up-to-date and well-equipped workshops which have been opened for training apprentices from the educated unemployed youth in the most modern and advanced practice of engineering have been set up.

The State Government has no intention of starting any freight transport services. Permits for public carriers are freely issued by the State Government. There are about 6,000 public carriers in Calcutta.

Part 'B' States

Hyderabad

The State Government is committed to a policy of complete nationalisation of passenger transport by gradual elimination of private operators. Except in Parbhani District, passenger transport services in the west have been nationalised. Private operators are allowed to function on fair weather and kacha roads which still constitute non-nationalised sector.

The Government do not envisage nationalisation of freight transport. A permit is, as a rule, granted by a Regional Transport Authority valid for the whole of that region. On application to the State Transport Authority, this permit is extended to an area of 150 miles including operation on routes which run parallel to the Railway beyond a distance of 75 miles). And even on routes parallel to railway, temporary permits are freely granted in order to hamper the movement of essential goods.

Mysore

The policy of the Government of Mysore has been to nationalise the essential aspects of transport activities. This has been achieved in definite stages with a view to slowly replacing private enterprise by State monopoly. The State Government have under consideration the operation of road transport activities on scheduled routes and to provide ancillary services on scheduled routes in this connection.

Under existing rules, quarterly licences to private operators are being issued. No restrictions are being imposed on the development of the system of public carriers and in the matter of issuing permits, a liberal policy is being followed. However, private operators are permitted to ply buses on routes not taken over by Government on a monopoly basis. Private operators, in fact, are serving as feeders to Government buses.

The State Government are not envisaging any State-wise operation of freight transport in the immediate future and have been following a liberal licensing policy in respect of public carriers.

(To be continued)

GEOPHYSICAL EXPLORATION Resistivity and Seismic Methods

(*Extracted from 'Highways and Bridges, December 16th, 53'*)

GEOPHYSICAL exploration provides a technique of sub-surface exploration which has become and will become increasingly useful to the engineer. It does not eliminate boring, which is often used for a check, but rather supplements bore hole findings.

There are four general approaches to geophysical surveying. These are, firstly one employing the differing gravitational pulls of the earth, secondly magnetic, thirdly the resistivity method and finally the seismic method. It is with the latter two methods that this article will deal. The first two methods utilise the natural forces of the earth, the latter two apply forces to the earth and note the varying reactions of the ground.

Resistivity Methods

In general the electrical resistivity method is employed where the strata whose characteristics are to be discovered are not deeply buried. The principle of the method is that an electrical current is passed through the ground. At two points along the path of the current the potential fall is measured to obtain the resistivity of the ground.

Resistance to the flow of the electrical current is measured by a standard known as the resistivity of the material. It is measured by the metreohm. This is the resistance in ohms of a cube with a side measurement of one metre.

To measure the resistivity electrodes are placed in the ground a certain distance apart and an electrical current is passed between them at a potential of about a hundred volts. Spaced equally between these electrodes are a further two between which the potential fall is measured. The depth to which the resistivity is measured is controlled by the electrode spacing, the further apart the electrodes, the deeper the ground penetrated. By increasing the electrode spacing about a fixed centre point the investigator is able to determine

the varying resistivity of the ground at varying depths.

By the differing resistivity it is possible to differentiate between the types of underlying material. Rock formations have resistivities which vary considerably. As it is the contained moisture which acts as a conductor the least porous rocks have the highest resistivities. These are the igneous and metamorphic rocks. Sedimentary layers, including sandstone and limestone, have lower resistivities. At the bottom of the scale are alluvial deposits which have low resistivities especially if they are uncompacted and have a high water content.

Basic equipment for this type of survey is usually contained in two travelling cases. The Potentiometer to determine the voltage drop between two of the electrodes and the milliammeter to ascertain the current flowing in the circuit are contained in one compartment. In the second case is the battery to apply the electromotive force. Electrodes and cable are carried separately. Care is needed during field work to ensure a firm base for the potentiometer and the milliammeter as any slight vibration will introduce errors into the readings.....

The accuracy of an electrical resistivity survey was demonstrated during the construction of the Pennsylvania Turnpike. As part of the survey for this road the method was used to determine the amount of excavation in rock. In the first one hundred and four cut sections it was found after checking with cored drillings, that the average error was just less than two feet.

Seismic Method

With the seismic method the engineer is able to detect particular strata which will respond to the shock waves set up. If the material he is looking for does not possess good reflecting or refracting properties it is often possible to detect another layer of material which will respond to the

shock wave set up. By a general knowledge of the geological characteristics of the area the two layers may then be co-related.

Sound waves from the explosion act in a similar manner to light waves. They are reflected and refracted when they come into contact with a material of differing density. The equipment used is composed of a detonating apparatus to fire the explosive charge and create the shock wave. Small geophones pick up this sound wave after its travel through the ground and relay the impulse they receive back to a control unit. This control unit produces a photographic record of the time the shock wave is fired and when the sound impulse reaches each of the geophones.

These geophones are composed of a coil suspended in a magnetic field. Upon the arrival of the shock wave the coil is vibrated resulting in an electro-motive force being set up.

This current is amplified and transmitted back to the master control unit. Inside the control unit are a number of galvanometers, one for each detector. A ray of light is reflected by a small mirror set in the galvanometer. This ray of light is recorded upon the photographic record. As soon as the electrical current from the detector reaches the galvanometer the mirror is moved and the ray of light is caused to show a deflection on the photographic record. The break caused measures the time of arrival of the shock wave at each detector and the instant of finding is also marked.

The geophones spread in a line through a distance of two hundred feet over the terrain where it is desired to investigate the strata. The explosion takes place either at the centre of the geophone spacing or at either end, it is caused by detonating up to a pound of dynamite at a depth of about three feet below the surface. Sound waves sent out from the explosion travel outward through the ground until it reaches a differing medium where they are partially reflected and partially refracted. Velocities through each of the media can then be calculated by comparing the travel time and the instant of firing from the record on the master controller.

Time-Distance Graph

From this information a graph may be drawn of time against distance. Time values are obtainable from the developed film record produced by the master controller whilst distance is measured on the ground. In the simplest case this curve will resolve into two intersecting straight lines. The first line represents the path of the sound wave through the overburden. This sound wave has travelled the direct path from the shot point to the geophones spaced out over the ground. The second line indicates the shock wave which has been refracted back to the surface from the underlying bedrock. Where these two lines intersect is the distance from the shot point where the refracted waves have overtaken those travelling directly. Once this distance D has determined, the depth to bedrock at the shot point may be calculated from the formula.

Where H is the depth to bedrock.

V is the velocity of the sound wave in the overburden.

V is the velocity of the sound wave in the bedrock.

Faulted Strata

Should the formation of the strata be faulted or otherwise complicated reverse shooting is often employed. By this means, too, it is possible to obviate the too high velocity obtained when the sound wave is defracted along an upward bedrock slope, or a too low velocity when the sound wave is refracted downwards. Naturally those conditions result in a good deal of judgment being required and it is always considered advisable to check the results obtained by an occasional bore hole.

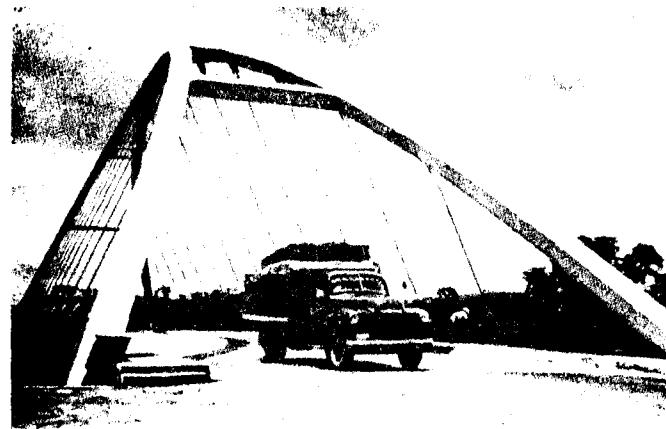
Apparatus including the control unit, amplifier, detectors and cable may be obtained with a total weight of approximately one hundred pounds. For work in urban areas where electrical interference may occur a special interference suppressor may be fitted.

The geophones are so sensitive that footsteps may upset the galvanometers. To eliminate faulty records due to this, a viewing screen is often incorporated allowing the explosion to take place when outside influences are at a minimum.

HERE AND THERE

1. A NOVEL BRIDGE DESIGN

A novel bridge erected over the Blanco River, near Vera Cruz, in Mexico, is illustrated below. The bridge is of all-welded steel design, with a span of 250 ft



the Lincoln Arc Welding Foundation for a welded highway bridge. The bridge accommodates three lanes of traffic, and the originality of its design will be apparent from the illustration. One refinement not shown in the illustration may be mentioned, however: the floor beams are placed diagonally to form structurally a highly redundant grid, which, although complicated in analysis, permits an appreciable economy of materials. The novelty of the bridge has been enhanced by its colouring; the arched ribs have been painted orange and the tie girders cherry red.

and is based on the winning design, by Dr. T. C. Kavanagh, of New York University, of the 1951 competition organised by

(Extracted from the *The Engineer*, London, January 22, 1954)

2. THE TECHNICAL WORLD KNOWS NO LONG-TERM BLUFF

"TECHNICAL effort.....which created and ceaselessly improves our civilization, is imposed by it on a greater and greater number of men.....Its power is due on the one hand to the passions which it causes in those who accept its discipline and to the joys with which it repays them; passion for research and invention, the joy of creation, the joy of living on a level where fraud does not hold sway over

probity; due on the other hand to the merciless retribution which overtakes those who seek to cheat, for in this domain sincerity alone pays. The technical world knows nothing of that long-term bluff, those false glories, which, in other worlds, may delude for generations."

(E. Freyssinet in his foreword to Guyon's *Prestressed Concrete*.)

3. WORLD'S LONGEST SPANS

Bridge	Span	Year Completed
George Washington	3,500	1931
Golden Gate	4,200	1937
The Narrows, New York	4,620	(Proposed)
Strait of Messina	5,000	(Proposed)

From *Civil Engineering*, December 1953.

4. BENEFICENT RESULTS OF SCIENTIFIC CONFERENCES

"THE most beneficent results may be achieved by an instructive interchange of ideas between scientific men; they may, however, not only mutually communicate their ideas, they may also state the advance made in their own respective spheres of action, and indicate to each other special departments which may be most profitably cultivated or the outstanding problems which may be attacked with the greatest utility. But personal association amongst scientific men may be pregnant with important consequences, not merely by a fruitful

exchange of ideas: cultivators of science, by periodical meetings and discussions, may bring their aims and views prominently into public notice, and may also, whenever necessary, press them upon the attention of the Government—a contingency by no means remote, for as experience has shown even the most enlightened Governments occasionally require to be reminded of the full extent of the paramount claims of Science upon the Public Funds."

—Asutosh Mookerjee

5. TRANS-CANADA HIGHWAY

THE first coast highway across the Dominion will be the Trans-Canada Highway, now in the process of construction across nine out of the ten Provinces. The tenth Province, that of Quebec, has not yet joined the other Provinces in signing an agreement with the Federal Government.

20 tons plus a single axle semi-trailer with a gross load of 10 tons. For shorter bridges, the width is to be equal to the width of pavement and shoulders and for bridges over 100 feet long the curb to curb dimensions are to be 24 feet. Overhead clearance is to be 14 ft 6 in.

The road, when completed, will be a through route of some 5,000 miles from St. John's, Newfoundland in the east to Vancouver and Nanaimo in British Columbia on the west coast.

Finance

The Trans-Canada Highway Act of December, 1949, was passed following a special conference a year earlier. By the terms of the Act, capital costs are shared equally by the Federal Government and by the Provincial Governments actually carrying out the construction. This is one of the largest undertakings in which the Federal Government and individual Provincial Governments are involved.

Standards

Each of the nine provinces has agreed to construct a hard surfaced two lane highway of high standard. As a general rule, the right of way is 100 feet with a minimum of 66 feet through urban areas. The minimum width of road is 32 ft including 5 ft shoulders and 22 ft wide pavement. The maximum road width has a pavement of 24 ft plus a 10 ft shoulder on each side. The finished pavement has to carry an 18,000 lb repeating axle load.

Horizontal curves do not exceed 6 deg. and are preferably less. The maximum gradient is 6 per cent and sight distances are 600 feet from the driver's eye to the road surface. Bridges are designed to carry 2 axle tractor trucks with a load of

Each Province decides which route the highway will take within its own borders, with the obvious stipulation that the route it chooses meets the routes chosen by adjacent Provinces and borders. The Trans-Canada Highway Division of the Engineering and Water Resources Branch of the Department of Resources and Development looks after the Federal angle of the work. It deals with the routes chosen by the Provinces, with the plans, specifications, and with details of grading, drainage, paving, bridging and structures. Prior to construction the Division also

inspects in order to determine the Federal Government's contribution.

Costs

The cost per mile of road constructed, varies substantially according to the type of terrain crossed. The lowest cost per mile, recorded so far is \$ 75,000 in Saskatchewan, while the highest is \$ million in British Columbia. These prices are, of course, a reflection of the difficul-

ties encountered. In some cases roads are built over Muskeg about 20 feet deep. Clay gumbo occurs in Manitoba and rock in Ontario and British Columbia. The Chief engineer of the overall project has stated that the ideal road is one with a concrete base and an asphalt wearing coat.

(Extracted from the *Civil Engineering, and Public Works Review*, December, 1953, Vol. 48, No. 570).

6. WOMEN MAKE CAUTIOUS DRIVERS

ARE women bad drivers? An American Insurance company, which has recently carried out a survey among 1,500,000 motorists, does not think so. Their investigation was undertaken to determine the relative safety records of 64 occupations. It revealed that the housewife has a better-than-average accident record. She is definitely safer behind the wheels than the lorry driver, lawyer, entertainer or commercial traveller. The safest drivers according to the survey, are bankers, farmers, pilots, clerks and school teachers. Men appear to have more driving skill than women, but over a given

milage, women between the ages of 17 and 28 have only one quarter of the number of accidents than men of the same group have. From the actuarial point of view men between the ages of 20 and 24 are the worst offenders. According to the Centre for Safety Education of New York University, blonde motorists are more susceptible to the effects of headlight glare than other types of drivers. No one quite knows why this should be so.

—From 'State Transport Review'. April 1953.

7. HIGHWAY TECHNOLOGY

SO far our scientific development has been completely lopsided and we now resemble a man who is trying to build a house by putting the roof in place before he has constructed the foundations. Of late years scientific research has been mainly devoted to finding more effective methods of destroying our fellow men, or of preventing our fellow men from destroying us. The basic needs of life-food and transport—have been pushed into the background.

There are millions of sterile acres for example, which could be made productive if science were applied to their develop-

ment and if they were rendered more accessible.

Collaboration between the agricultural scientist and the road builder could turn these wastes into corn fields, orchards, and market gardens and who shall say that this achievement would be less useful to the community than hydrogen bombs, radar, television, or air travel at supersonic speeds? Yet these things are hailed as outstanding examples of human progress, while wasted acres stand as mute evidence of our sloth and folly.

(Extracted from *Highways and Bridges and Engineering Works*, December 30th, 1953).

CURRENT LITERATURE

ABSTRACTS

625.739 "DIRECTIONAL CHANNELIZATION AND DETERMINATION OF PAVEMENT WIDTH"—Bulletin No. 72 of the Highway Research Board, Washington, D. C., 1953.

The bulletin contains the following two Papers:

- (1) Directional Channelization Design by W. R. Bellis.
- (2) Determining Widths of Pavements in Channelized Intersections by L. F. Heuperman.

Directional channelization is a device to localise the points of traffic conflict between cross movements by providing separate paths for turning movements. The Paper illustrates by more than a dozen examples of traffic improvement in New Jersey State as to how channelization could be used for orderly movement of traffic.

The second Paper describes experiments with models of different kinds of vehicles to find out the width of pavement required at a channelized intersection. A 50-ft semi-trailer, a 60-ft full trailer, a 35-ft long bus, and a 19-ft passenger car, made to a scale of 1 in. equal to 10 ft, were made to follow channelized intersections drawn to a scale of 1 in. equal to 10 ft. In the Appendix to the Paper are given the full details of the radius of the circular curve, width of the wheel path, the radius of steering, the front overhang, etc. Formulae for determining the widths of pavement from the track widths are developed for (1) single lane, and (2) two-lane channels. Illustrations of the vehicles, photographs of the principal models, and examples of application of the method of design are also given.

624.131 "DESIGN OF FRAMES BY RELAXATION OF YIELD HINGES" By J. Moreley English.

(Separate No. 322 of the American Society of Civil Engineers—November 1953).

A method is herein developed for determining the loading condition that causes the collapse of a rigid frame structure. It is shown that the location of the "yield-hinges," when the structure is on the verge of collapse, is independent of the stiffness of the individual members. The method consists of (1) the arbitrary distribution of moment to the joints of the structure; and (2) the adjustment of this distribution by the trial-and-error method until the highest ratio of actual moment to limit moment—at any point in the structure reaches a minimum. The location of the yield-hinges are the points at which these minima occur.

The procedure is extended to account for the order in which the yield-hinges develop. This order is dependent on the stiffnesses of the members and, therefore, the initial moment distribution must be consistent with the actual elastic properties of the structure. Similarly, the subsequent redistribution of moment—to minimize the highest values—is made in accordance with the elastic properties of the structure.

625.5 "A METHOD OF ESTIMATING SPEED AND FLOW OF TRAFFIC FROM A MOVING VEHICLE" by John Glen Wardrop and George Charlesworth. Journal of the Institution of Civil Engineers, London, Part II, Vol. III, No. 1, February 1954.

A method is given for measuring traffic speeds and flows by observations made from a moving vehicle. Observers in test cars driven in the traffic record their journey times, count opposing traffic, and

keep a tally of overtaking and overtaken vehicles. From these observations, the mean speeds and numbers of vehicles passing along a street can be obtained for all classes of vehicle selected.

The practical application of the method is described and the errors occurring in practice are discussed. It is concluded

that the method is efficient and practical, and is particularly suitable when a general picture of traffic conditions on a network of streets is required.

If the tally of overtaking and overtaken vehicles is not kept, a systematic error appears, but for many purposes this error is not serious.

BOOK REVIEW

INTRODUCTORY SOIL MECHANICS AND FOUNDATIONS, by George B. Sowers and George F. Sowers. (New York: McMillan, 1951), 284 pp., 9½ in. x 6 in. Price 22s.

After dealing in the first three chapters with the nature, physical properties and geological aspects of soils, the authors proceed to describe the various engineering problems to which Soil Mechanics can be applied with advantage.

Site exploration and testing are described in sufficient detail for those who are not specialists, and who do not want to become involved in higher mathematics. It is rightly assumed that the practical engineer will leave such matters to the specialist.

The nature, properties and geology of soil are dealt with thoroughly and with such exceptional clarity that they are worth a study by all; be they students, practical engineers or specialists. The same observations can be made about the chapters dealing with the application of Soil Mechanics. These not only describe

how Soil Mechanics is applied but also provide the reader with most of the basic knowledge of civil engineering works which have any connection with the natural ground.

Particular mention should be made of Chapter 6, dealing with deep foundation and piling. The latter is a subject of which most writers on Soil Mechanics seem to have fought shy in the past. Admittedly, the design of piled foundations is still surrounded with a certain amount of uncertainty, but the authors have however made a real effort at tackling the problem in a scientific and practical manner.

The authors are to be congratulated not only on packing in an extraordinary amount of useful knowledge in a comparatively small book, but also upon presenting it in such a lucid and interesting manner. This book should appeal alike to the student, the specialist and the experienced engineer.

(Extracted from *The Structural Engineer*, December, 1953)

NATIONAL HIGHWAY MILEAGE

There are 13,477 miles of national highways in India. The State of Bombay tops the list with 1,546 miles, Uttar Pradesh and Madhya Pradesh standing next with 1,390 miles and 1,199 miles, respectively.

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BUDGETS AND ADMINISTRATION REPORTS

Administration Report of the Buildings and Roads Branch, P.W.D., Govt. of Madhya Pradesh for the year 1950-51.

The main features of the Report are summed up below:

I. Expenditure from the Road Development Fund			
(In lakhs of Rupees)			
	Madhya Pradesh Share.	Govt. of India Reserve.	Total
1949-50	0.21	0.82	1.03
1950-51	0.48	0.29	0.77

II. Expenditure from sources other than the Road Fund

(1) Expenditure on Central Works

Expenditure on Central works during the year under report under the heads 'buildings', 'communications', 'archaeology etc.' was Rs 20.62 lakhs out of which a sum of Rs 20.42 lakhs was spent on communications alone. The expenditure was distributed between original works and repairs as follows:

(In lakhs of Rupees)			
	Original Works	Repairs	Total
Communications	7.09	13.33	20.42
Others	0.06	0.14	0.20
Total	7.15	13.47	20.62

(2) Expenditure on Provincial Works

Provincial expenditure on buildings and communications during 1950-51 was as follows:

	Original works	Repairs	Total
Buildings	49.46	13.79	63.25
Communications	53.07	40.78	93.85

Of the total expenditure of Rs 53.07 lakhs incurred on communications—original works, a sum of Rs 26.25 lakhs was met from Provincial Revenues, Rs 0.48 lakhs from the Road Development Fund, Rs 0.29 lakhs from the Central Road Fund Reserve and Rs 26.05 lakhs from funds for Post-War Development Schemes.

III. Road Milage

Comparative figures of road milage maintained from Provincial Funds as at the end of 1950-51 and 1949-50 are as follows:—

	As on 31.3.51	As on 31.3.50
Class I Roads	6,038	5,872
Class II & III Roads	3,793	3,892
Total	9,831	9,764

According to the Report, the increase and decrease in the length of Class I roads and class II and III roads, respectively, is due to construction of a few new roads, and improvement of some of the existing Class II and III roads to Class I roads. The above figures do not include the roads maintained by Janapada Sabhas from their own funds.

IV. Provincial Works executed through the Agency of Local Bodies during the year.

(In lakhs of Rupees)				
	Original works	Repairs	Total	
Buildings	0.08	0.75	0.83	
Communications	0.01	6.15	6.16	
Total	0.09	6.90	6.99	

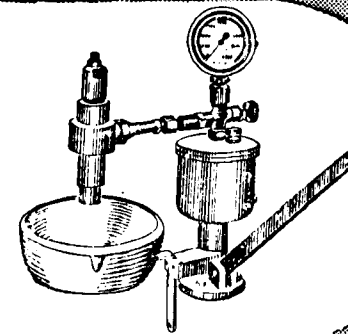
In addition, a sum of Rs 1,515, was provided for repairs to Tools and Plant. The total expenditure of Rs 7.01 lakhs on these works includes a sum of Rs 0.94 lakhs on account of supervision charges at 15½ per cent (establishment 14 per cent and tools and plant 1½ per cent) paid to the local bodies.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of Work	Amount (Rs in Lakhs)
SAURASHTRA			
1.	828 SR 8-B	Reconstructing Varjangjalia-Kutiyana Road, Section I from Varjangjalia to Madhya Saurashtra limit-Surfacing.	1.06
2.	829 SR 8-B	Reconstructing Varjangjalia-Kutiyana Road, Section II, from Madhya Saurashtra limit to Saradia Road crossing-Surfacing.	0.84
3.	830 SR 8-B	Improvements to the Bamanbore-Rajkot-Porbandar National Highway No. 8-B. Improving curve in mile 7 of Gondal-Jetpur Section from Gondal.	0.23
PUNJAB			
4.	831 PB 1	Construction of a bye-pass on G. T. Road (N. H. No. 1) at Jullundur.	11.32
5.	833 PB 10	Straightening sharp curves in mile 34/4 to 34/7 of Delhi-Hissar-Sulemanki Road in Rohtak District. (N. H. No. 10).	0.19
6.	834 PB 1	Construction of high level bridge over gap in mile 162/3 of G. T. Road (N. H. No. 1) in Ludhiana District.	0.23
BOMBAY			
7.	832 BM 8	Construction of a bridge over the Gulzari Nalla in mile 1/7 of the Tawa-Talasari section of the Bombay-Ahmedabad National Highway No. 8.	1.04

S. No.	Job No.	Name of Work	Amount Rs. in (Lakhs)
8.	837 BM 4	Strengthening the existing bridge across the Panchganga river in mile 143 of the Poona-Bangalore Road, National Highway No. 4 and approaches.	4.09
9.	840 BM 6	Construction of the bridge over the Waghur river near Sukegaon in mile 206 of the Dhulia-Etllabad-Nagpur Road, National Highway No. 6.	7.60
DELHI			
10.	835 DLH 10	Remodelling culverts from mile 6/0 to 16/0 of Rohtak Road (N. H. No. 10) in Delhi State.	0.65
ORISSA			
11.	836 RS 5	Straightening the curve near Boisinga on the 24th mile 2nd and 3rd quarters of Baripada-Balasore road N. H. No. 5.	0.11
12.	839 RS 5	Construction of a road overbridge on National Highway No. 5 near Bhubaneswar.	1.33
WEST BENGAL			
13.	838 BG 6	Construction of a bridge with approaches over the Dulong river on N. H. No. 6 in Midnapore District.	13.68
MADHYA PRADESH			
14.	841 CP 7	Construction of a bridge across the Penganga river on N. H. No. 7.	8.97
15.	842 CP 43	Construction of a bridge over the Dudh River in mile 87 of N. H. No. 43.	3.85
UTTAR PRADESH			
16.	845 UP 24	Painting miles 231-238 of N. H. No. 24 (Miles 68-75 of Lucknow-Bareilly road).	3.19

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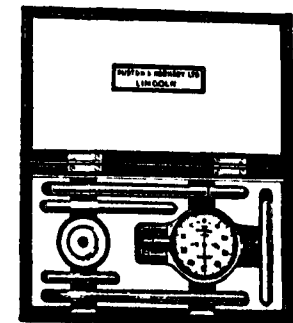
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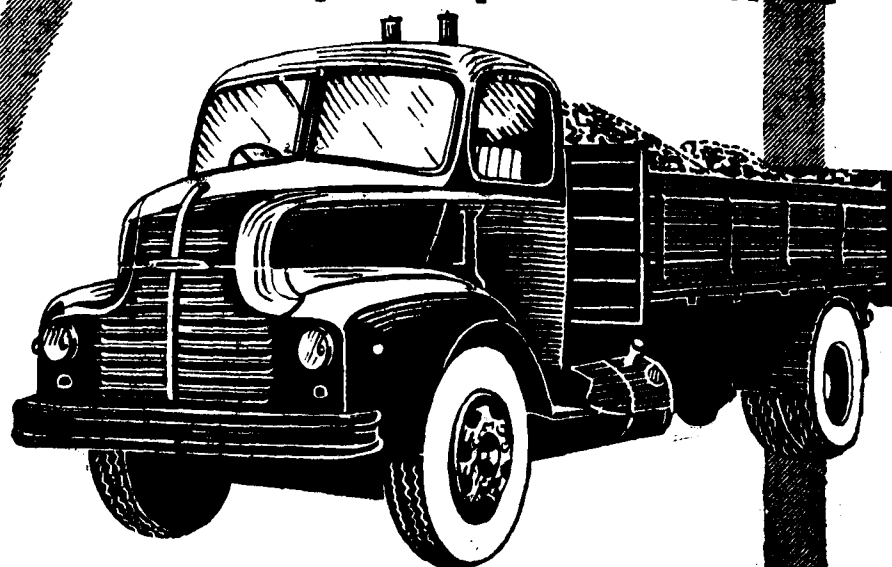
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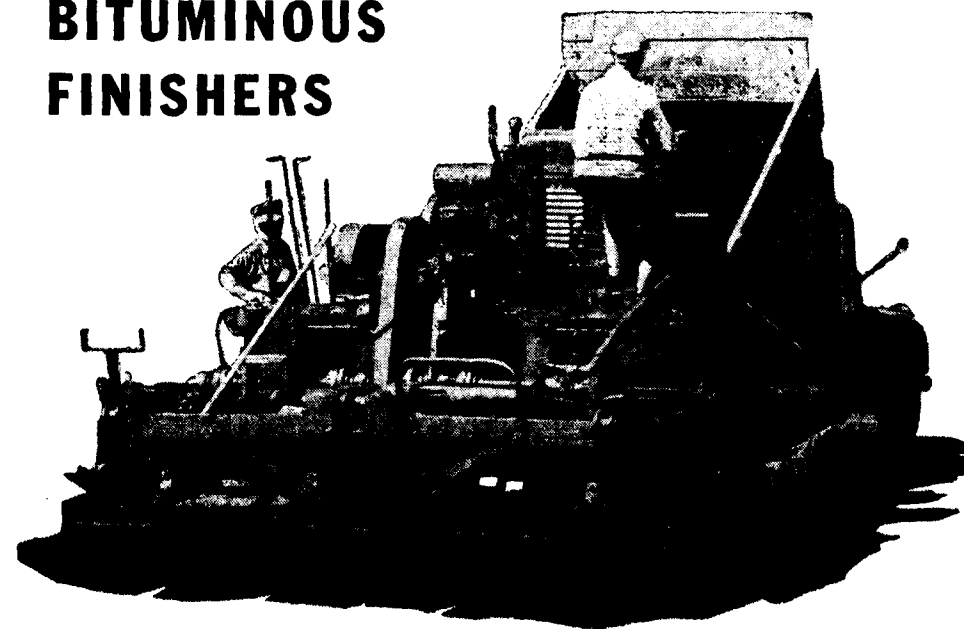
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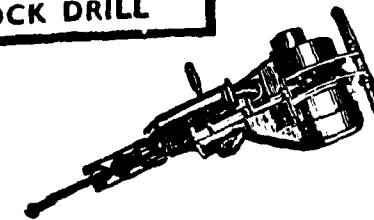
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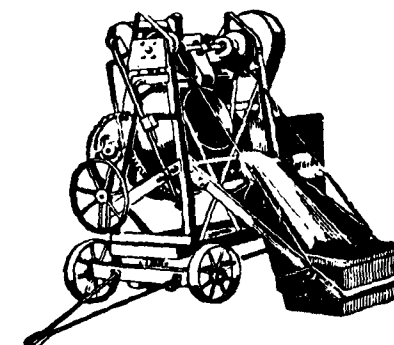
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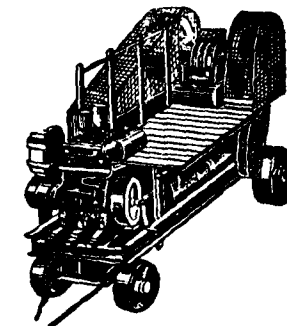
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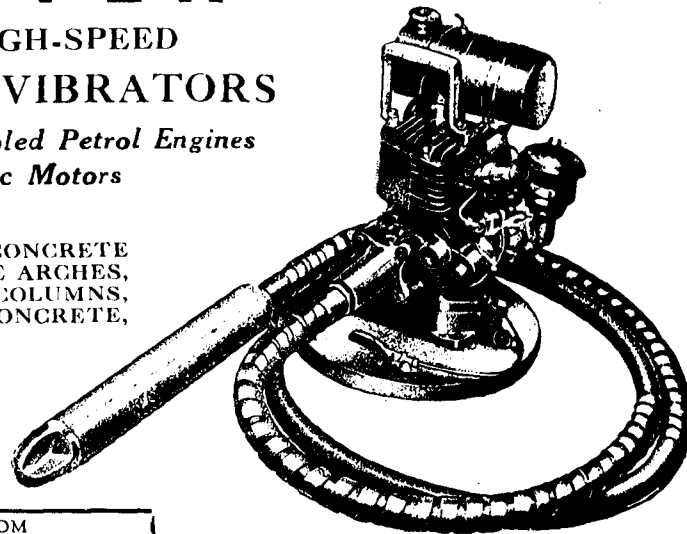
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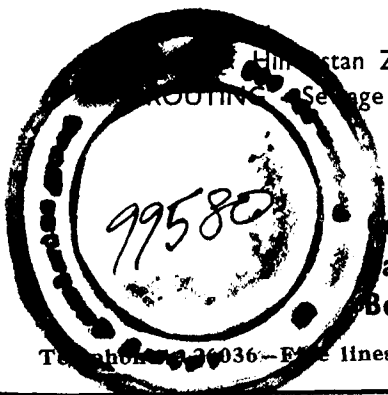
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