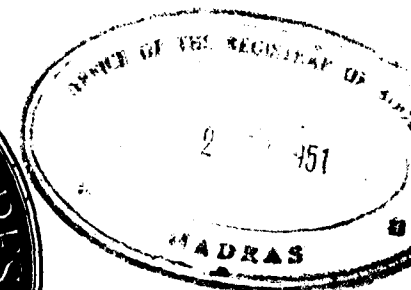


810 Transport-Communications

MONTHLY REVIEW

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No. 49

May 1951

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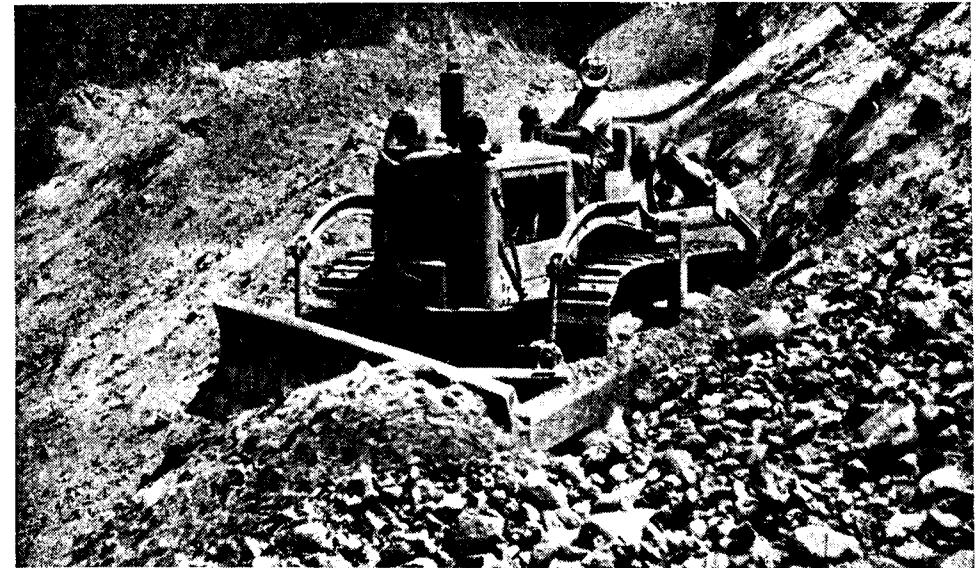
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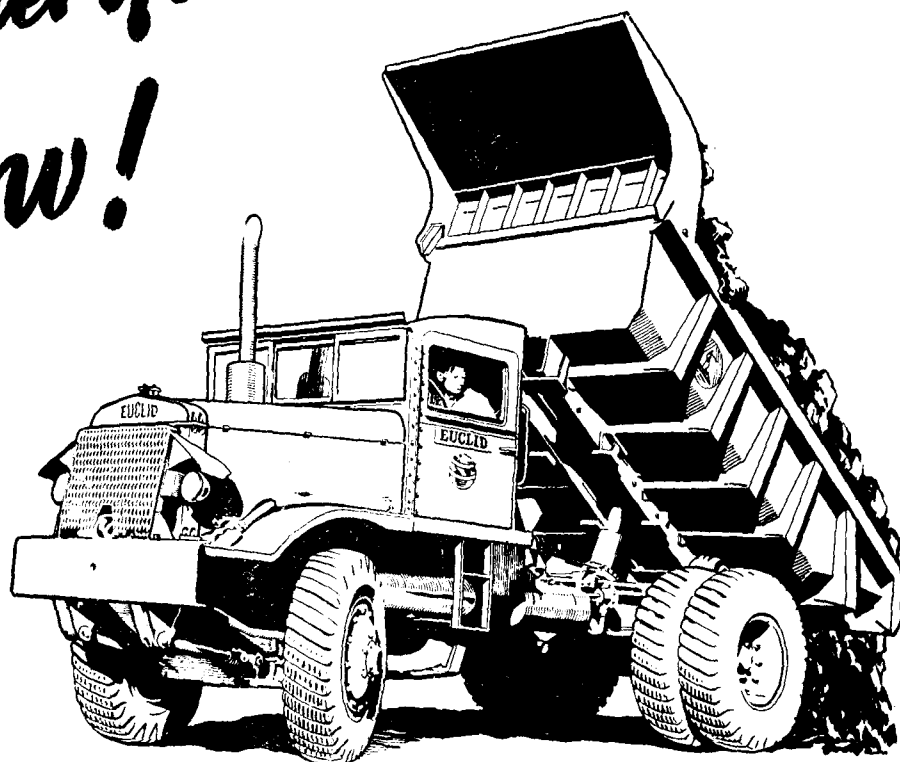
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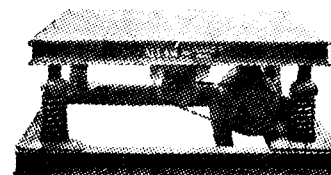
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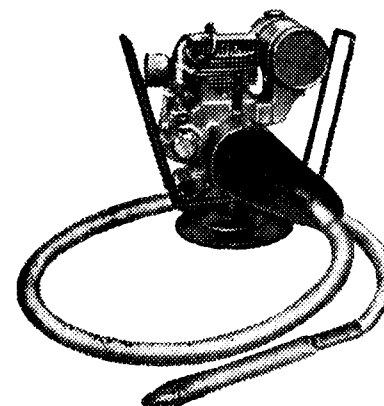
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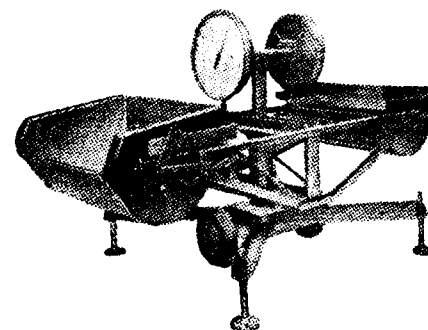
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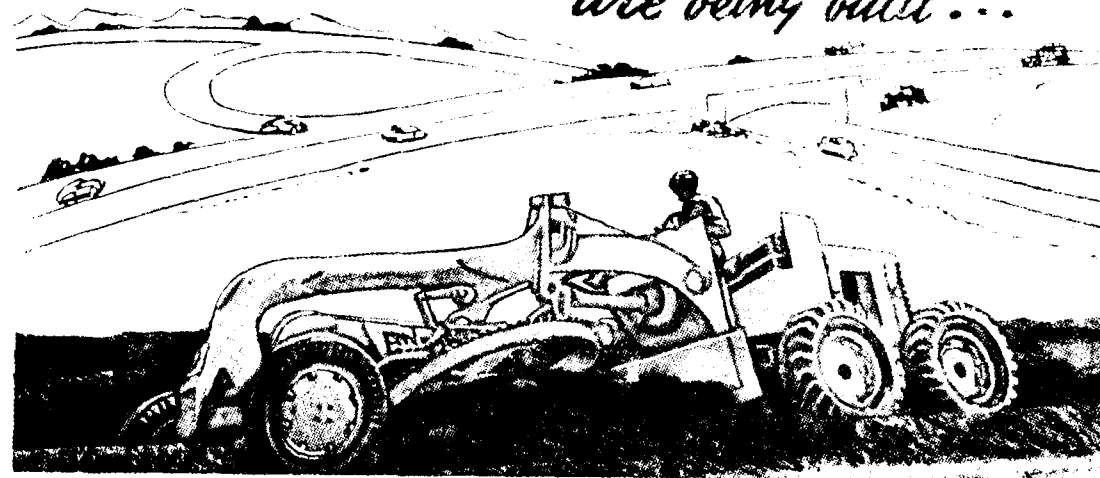
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THE CENTRAL ROAD DEVELOPMENT FUND

(Contributed)

Financing of ex-
penditure on
roads prior to
1927

PRIOR to 1927 expenditure on all provincial roads was financed exclusively from the general revenues of each province and on local roads from local revenues supplemented by provincial grants.

Appointment of
a Road Develop-
ment (Jayakar)
Committee in
1927-28

About the year 1926, the Bombay Government contemplated levying a horse-power tax on motor vehicles. The transport interests, represented mainly by the Indian Roads and Transport Development Association, opposed this form of taxation and proposed, as an alternative, the creation of an additional source of funds for road development in the form of an all-India surcharge on petrol. This proposal eventually received the support of the Bombay Government. Ultimately, the Government of India agreed to appoint a Road Development Committee to examine the desirability of accelerating the development of the road system of India and, in particular, the means by which such development could most suitably be financed.

This Committee, which was presided over by Mr. M. R. Jayakar, was appointed in 1927 and it submitted its report in 1928. The Committee's finding was that, although roads were constitutionally the responsibility of provincial governments and local bodies, their development was of national importance and to that extent might be a proper charge on Central Revenues. Road development, they said, was getting beyond the capacity of provincial and local administrations and the Centre should therefore promote co-ordinated development by making annual block grants to (the then) Provinces from a Central Road Fund to be created by levying a special surcharge on motor spirit at a rate of 2 annas per gallon.

This recommendation, on acceptance by the Government of India, resulted in the creation of the Central Road Fund (Road Development Account) in March 1929, by increasing the customs and excise duty on motor spirit from 4 annas to 6 annas per gallon. The proceeds of the additional 2 annas duty was allotted as a "Block-Grant" for expenditure towards the development of India's Road system which was admittedly not then commensurate with the needs of the country.

The fund is administered by the Central Government on the advice of a special Standing Committee of the Central Legislature. Unexpended balance in the Fund, unlike ordinary budget grants, do not lapse at the end of each financial year. Twenty per cent of the total receipts in the Fund (it was 10 per cent upto 31-3-1934 and 15 per cent thereafter upto 31-3-1948) is set apart as a Central Reserve which is "applied first to defray the cost of administering the Road Fund and thereafter upon such schemes for research and intelligence and upon such special enquiries and grants-in-aid for objects connected with roads as the Central Government may approve". The balance, called for convenience the "States's allocation account", is allocated to the various States on the basis of the consumption of motor spirit, other than aviation spirit, within the respective areas for expenditure on road construction or improvement as distinct from ordinary road maintenance or repairs.

The object of creating the Central Road fund is to supplement and not to replace the normal provision for roads made from the States and Local revenues. Works proposed to be financed from a State's own allocation account in the Central Road Fund require the prior approval of the Central Government before they can be taken up.

The annual receipts in the Road Fund, which automatically expand with increases in petrol consumption, rose to Rs 172 lakhs in 1939-40 from Rs 98½ lakhs in 1929-30. Since then, petrol rationing and the consequent fluctuations in petrol consumption have resulted in like fluctuations in the annual receipts of the Road Fund. During the 18 years ending 1946-47 (1929-30 to 1946-47), however, the total revenue was Rs. 27.03 crores giving an annual average of nearly Rs 150 lakhs. The present revenue of the Fund is about Rs 300 lakhs a year. Although it was clear that no spectacular increase in road development could be expected from such a small Fund, it was confidently expected that, with this expanding source of revenue to supplement ordinary provincial expenditure on roads, progress in the field of road development would be **sure though slow**.

After setting apart the necessary amounts for the shares of the then Indian States and the Central Reserve, the then Governors' and Chief Commissioners' Provinces and Central Administered Areas received Rs 16.40 crores from the Road Fund as their ordinary shares up to March 1950 in respect of the revenue up to March 1947. The statement at the end of this note gives details of the cost of the schemes approved against the allocations from the Central Road Fund and the allocations made in respect of the various Provinces and Administrations as on March 31, 1950.

From 1929-30 till the end of September 1936, allotments from the Central Road Fund were made in full, i.e., the Government of India passed on the full share belonging to a Province as soon as the revenue from the additional duty on motor spirit was allotted to the various recipients. From October 1936, the Government of India, in consultation with the Transport Advisory Council, has made it a condition to avoid the accumulation of large balances of Road Fund money in the Provinces, that **Provincial Governments should receive their allocations only after they had utilised their previous unspent balances** and then only to the extent actually required for expenditure in any given year.

According to the present procedure, therefore, the portions allocated each year for expenditure in Part A and Part B States are retained by the Central Government to the credit of those States. From these credits, quarterly advances are made of 90 per cent of the estimated expenditure to be incurred in each quarter, the advance being adjusted at the end of the quarter against actual expenditure. Part C* and Part D States are not affected as they are administered by the Centre.

* A States are former Governors' Provinces, i.e. Assam, Bihar, Bombay, Madhya Pradesh, Madras, Orissa, Punjab, Uttar Pradesh, West Bengal.

B States are Hyderabad (Dn.), Madhya Bharat, Mysore, Pepsu, Rajasthan, Saurashtra, Travancore-Cochin. (Jammu and Kashmir does not participate in the C.R.F.)

C States are Ajmer, Bhopal, Bilaspur, Coorg, Delhi, Himachal Pradesh, Kutch, Manipur, Tripura, Vindhya Pradesh.

D States are Andaman and Nicobar Islands.

In 1931 there was an increase in the customs/excise duty on petrol from 6 annas—which was the rate after the levy of the 2 annas Road Fund surcharge—to ten annas per gallon and, from the first of March 1931, the share of the Road Fund was increased in the process to 2½ annas per gallon.

In the period 1918-19 to 1928-29 the average expenditure from provincial revenues on extra-municipal roads was about 437 lakhs annually, made up roughly of Rs 137 lakhs on road development and Rs 300 lakhs on maintenance as shown in the following Table :

Year	Road construction	Road maintenance	Remarks
1918-19	53.80	101.14	
1919-20	83.96	111.25	
1920-21	94.04	124.20	
1921-22	Figures not available		
1922-23	Figures not available		
1923-24	122.90	344.70	
1924-25	130.00	356.50	
1925-26	160.10	386.00	
1926-27	159.60	405.50	
1927-28	219.00	429.00	
1928-29	206.30	441.90	
Average	136.52	300.24	

The hopes built up on the Central Road Fund were not fulfilled for some years owing to the economic depression of the thirties which led most of the Provincial Governments to curtail their grant for roads.

The average expenditure on roads in the next eleven years rose only from Rs 437 lakhs to Rs 513 lakhs although the average Central Road Fund receipts in that period were Rs 113 lakhs as shown in the Table below :—

Year	Road construction	Road maintenance	Total	Central Road Fund
1929-30	181.0	451.3	632.3	98.4
1930-31	228.3	443.5	671.8	107.4
1931-32	165.5	392.2	557.7	102.0
1932-33	115.2	306.9	422.1	101.8
1933-34	98.2	373.9	472.1	108.5
1934-35	108.1	376.2	484.3	158.9
1935-36	148.3	417.3	565.6	128.8
1936-37	173.4	428.1	601.5	146.4
1937-38	189.1	424.5	613.6	143.2
1938-39	209.5	414.4	623.9	151.9
Average	146.5	366.2	512.7	113.4

It will be seen from the above Table that during the first decade or so after the Central Road Fund was created the major part of road development in India was due to the Fund. The advantage of the Fund, even in this period, showed itself from the influence it exerted on the kind of development that took place. Provinces were for the first time able to formulate their plans on a fairly long-term basis rather than in the spasmodic or piecemeal fashion of the past and to execute them systematically and economically. Works were actually brought to completion on a large scale instead of being left incomplete as so often happened in the past. Even then the expenditure on roads was always disproportionately low compared to the revenue derived from them as will be seen from what follows.

From 1938-39 onwards, the advantages of the Fund made themselves apparent in increased expenditure on road development, in spite of the war, as shown in the following Table.

Year	Expenditure on road development	Receipts in the Central Road Fund
1939-40	222.1	151.89
1940-41	236.2	172.10
1941-42	368.5	154.20
1942-43	307.8	202.65
1943-44	229.3	156.94
1944-45	231.1	143.32
1945-46	324.0	169.84
Average	274.2	164.41

The total income from road transport derived from the States and the Centre was Rs 965 lakhs and Rs 2,598 lakhs in 1938-39 and 1945-46 respectively, whereas the total expenses incurred on roads (construction and maintenance) was only Rs 783 lakhs and Rs 1,483 lakhs respectively. From this it is clear that only a part of the revenue from road transport was spent on the construction and maintenance of roads and the rest was credited to the general revenues.

In 1947-48 the average tax paid by a lorry doing 60,000 ton miles per year was 21.91 pies per ton mile whereas the average rate charged for carrying goods by rail in the same year was only 9.18 pies per ton mile. Though this burden of taxation on haulage by road is so crushing, still a major portion of the road revenue is spent on subjects other than roads. Out of a total road mileage of 3,13,342 in India only about one third is surfaced and so a road user gets rough roads and bad bumps for all the taxes he pays to the Government.

Within the first ten years (upto March 1939) 287 new bridges and causeways were built in the former Governors' Provinces and Centrally Administered areas at a cost of Rs 275 lakhs. In addition 2,269 miles of concrete or other modern surfaces, 999 miles of new metalled roads (including metalling of existing roads) and 1,459 miles of new fair-weather roads were built, and 1,870 miles of the existing metalled roads were improved.

When the Nagpur Conference of Chief Engineers recommended in 1943 that the main arterial roads of the country should be classified as National Highways and become the financial responsibility of the Government of India, the Central Government thought of winding up the Road Fund. This proposal was vehemently opposed by the Provincial Governments and Public Associations such as the Indian Roads and Transport Development Association. Some of the Provinces went so far as to say they would rather not be relieved of financial responsibility for National Highways than forego benefits of the Road Fund and all Provinces complained that even after making allowance for the proposed Central contribution to National Highways, an unduly large share of taxes on motor transport would go into the Central exchequer.

The Government of India, in deference to the general wishes of Provincial Governments and others interested, ultimately decided not to disturb the Road Fund. They also agreed to proceed with their plan to take over financial responsibility for the National Highways with effect from April 1947 as their contribution towards the post-war development of roads in general and the co-ordinated development of land transport as a whole. The total mileage of National Highways, which ultimately came under the control of the Central Government, was 13,429 out of India's total road mileage of 3,13,342.

Though the Centre is financially responsible for the development and maintenance of National Highways, it is generally the States who, as agents of the Central Government, construct and maintain these roads. A proportionate share of the establishment charges of the States' Public Works Departments is borne by the Central Government.

Annual allotments for the maintenance of National Highways are determined on the basis of pre-war average maintenance costs, suitably weighted to allow for increases in the cost of labour and materials in the post-war period, due regard being paid to the rate of expenditure being incurred by States on their own roads. In addition, allotments for "special repairs" relating to flood damages and unforeseen charges are made by the Central Government, wherever necessary.

With the financial integration of all the former Indian States with the Union of India from the 1st April, 1950, the procedure for allotments from the Road Fund has also been made uniform for all the States by amending the Resolution on Road Development. A new addition has also been made to the Fund, viz., the "Special Reserve," to which contributions from sources outside the Fund are credited for financing particular road projects, e.g., road works of military importance financed from the Defence Services Estimate.

**Statement showing Allocations Made from the Central Road Fund
and Expenditure Incurred therefrom upto the end of 1949-1950**

Name of State or Administration	Cost of schemes approved upto 31-3-50	Allocations made upto 31-3-50 (in respect of the revenue to end of 31-3-47)
	Rs lakhs	Rs lakhs
STATES		
Madras	306.34	294.73
Bombay	383.57	388.60
West Bengal	260.01 (1)	317.02 (2)
Uttar Pradesh	135.62	136.43
Punjab (India)	176.25 (1)	175.94 (2)
Bihar	65.47	82.58
Madhya Pradesh	88.57	65.12
Assam	112.66 (1)	120.23 (2)
Orissa	7.63	7.96
Total States :	1536.12	1588.61
CENTRALLY ADMINISTERED AREAS		
Delhi	32.58	40.86
Ajmer	4.17	4.24
Coorg	2.54	2.00
Himachal Pradesh	—	0.13
Bhopal	3.00 (3)	3.85
Manipur	—	0.33
Vindhya Pradesh	—	0.26
Tripura	—	—
Andaman & Nicobar Islands	—	—
Cutch	—	—
Bilaspur	—	—
Total Centrally Administered areas :	42.29	51.67
GRAND TOTAL	1,578.41	1,640.28

Note: As the procedure relating to allocations to part B States was brought into line with that relating to Part A and Part C States with effect from April 1950 only, information regarding Part B States is not given in the above Statement.

- (1) The figures against West Bengal, Punjab (India) and Assam show the costs of the schemes sanctioned in the undivided provinces of Bengal, Punjab and Assam.
- (2) Represent the allotments to the Governments of the Undivided Provinces upto 14-8-47 plus the shares of the present States out of the balances held by the Old Central Government to the credit of the Undivided Provinces in respect of the revenue upto 1946-47.
- (3) Represents allotments made to the Bhopal State before 14-8-47 and treated as expended.

EXPENSIVE FALSEWORK ELIMINATED

[From the "Engineering News Record" Feb. 23, 1950.]

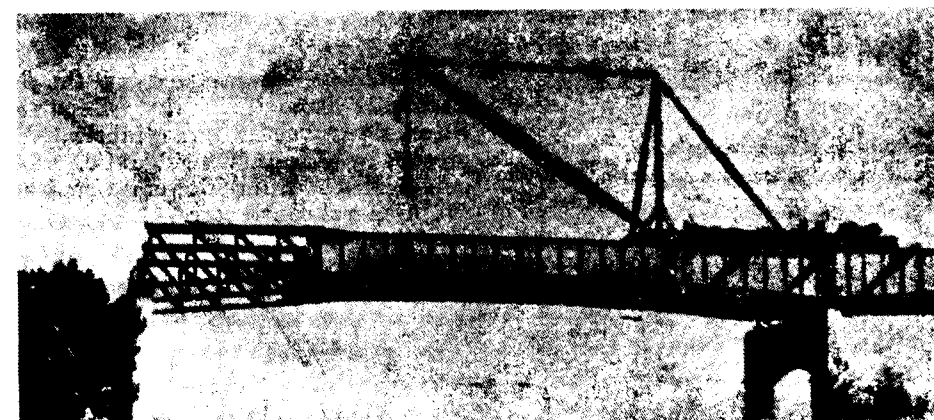
CONTINUOUS girder highway bridges with spans of 160 ft. and more are becoming increasingly popular with designers. And Virginia Bridge Company has a method of erecting them that is economical and fast. It utilizes temporary trusses to extend the length of the outer girder sections so that they can be erected without falsework.

A typical example is afforded by the bridge over French Broad River at Asheville, N. C., where three lines of continuous girders 1,080 ft. long, consisting of five 160 ft. spans and two 140 ft. end spans, cross 100 ft. above the boulder-strewn river bottom.

ween the trusses and connected. Field splices are located 37 ft. 6 in. from the piers.

In the erection operation, a 50-ton stiff-leg derrick traveller with 85 ft. boom was assembled on the bridge's concrete approach span. This traveller was assisted by a 20-ton crawler crane working on the ground in erecting the 140 ft. end span. Beyond that first steel span the stiff-leg derrick worked alone, taking girder sections from a push car that followed it from span to span with materials.

When girder sections were erected over the near pier on each span, the traveller



Temporary Trusses aid erection of continuous girder spans.

On this bridge—as on so many of its type—field splices are located so that the length of girder over the piers is about 45 per cent of the span, leaving the other 55 per cent to be filled in by the centre section of the girders.

Girder sections over the piers are 75 ft. long and weigh 21 tons each. Centre sections are 80 ft. long and weigh 20 tons. The extension trusses bolt in pairs to the centre section and are arranged so that girders over the piers can be threaded bet-

moved out to within 2½ ft. of their ends (where they were to be spliced to centre sections). Then, taking centre sections—with trusses attached—from the push car, the derrick held them with their truss-ends resting on the far pier while the field splice was made.

With this splice completed on each of the three girders, the traveller moved forward to place girders over the next pier. Truss-pairs bolted to mid-span girders were designed so that pier girders could be pro-

perly seated and spliced without any jacking. Floor-beams and bracing were

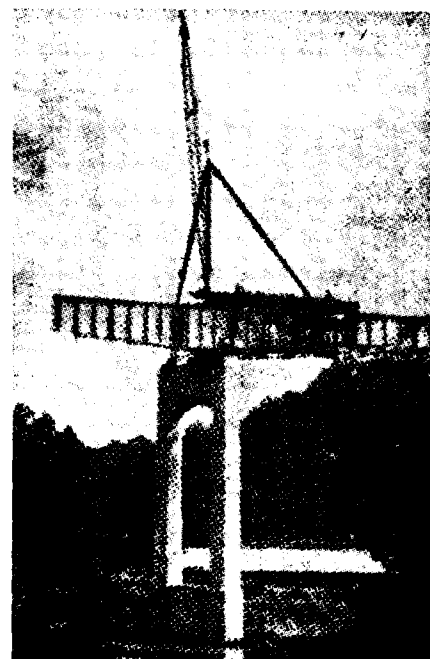
placed by the travelling derrick as the work progressed.

Rails mounted on the trusses attached to the outside girders match shoes on the traveller. Thus the traveller could move all the way out to the end of the truss to be in best position for placing pier girders. Then, backing off, the traveller removed the temporary trusses and transferred them to the yard for reuse in the next span.

These trusses have been designed for reuse also on other jobs. Careful consideration of influence-line diagrams for several continuous girder bridges—to be built possibly in the future—went into the design of the erection trusses.

Because of the length of steelwork (1,080 ft.) on this French Broad River bridge, special care was taken in fabrication. When the last sections were erected, it was found that overall lengths of the three girders were within $\frac{1}{4}$ in. of one another and of the center-to-center distance between piers 1 and 8.

The bridge was designed by the North Carolina State Highway Department. Steel superstructure was fabricated and erected by Virginia Bridge Co. under a sub-contract from Bowers Construction Co., General contractor.



Traveller Derrick threads a pier section of one of the three girders into position, between trusses temporarily supporting the near girder.

A golfer in the duffer class drove his ball into an anthill where there were 475 ants. The first swing with his iron killed 470 of them. The next swing killed three more. Said one of the remaining two ants to the other: "It is plain to see that if we expect to stay alive we will have to get out on the ball."

ROADS IN INDIA

[From the Presidential address by Shri M. S. Thirumale Iyengar at the 28th Annual meeting of the South India Centre of the Institution of Engineers (India), Feb. 27, 1951.]

UNTIL the latter half of the nineteenth century, road communications in India were left in an extremely backward state. The impression then seems to have been that "made roads" were a superfluous luxury in India. It is said that when Lord Elphinstone, as Governor of Madras, proposed the construction on a comprehensive scale, of new roads, the idea appeared so ridiculous to men in authority that a certain member of the Council wrote to England thus: "The silly young Nobleman actually talks of making roads".

The incessant flow of travel back and forth, up and down as a result of the ever-increasing population has always out-distanced the development of highways in the State. The need for more adequate highways to meet the demands of traffic has been present throughout. Also, development and maintenance of these State highways traversing mountains, valleys and coast, present problems now of such variety as to challenge engineering ability and practice. By the average motorist, modern highways are taken for granted. Travel along Passes and over mountains is accomplished with little or no thought of obstacles overcome in their construction and maintenance. A few moments over a bridge that was many months in erection, a few hours and an entire mountain range is negotiated—the same range that perhaps took several weeks to cross by foot or on an elephant—all these are travelled with such ease and comfort that it seems to the road user, on first impressions, that their construction must have been quite simple. The highway era has been a progressive raising of standards of design for high speed heavier loads, multiple lanes, durability and safety—all for a mixed traffic flow. The traffic on our roads is a combination of the slow-moving ox-cart and the relatively very fast-moving motor vehicle. The road for this pattern of traffic has to be designed specially for durability and safety.

The Most Popular Form

The most popular form of road surface in our country, specially in Madras State, that held the field till recent years and even now in certain sections, is the age-old water-bound macadam, because of its comparative cheapness. But the complex type of traffic we are having in certain areas and along the through National and Provincial routes, is proving the water-bound macadam very costly to maintain in a satisfactory state. So long as the type of traffic was mainly the iron-tyred bullock-cart, the stability of the water-bound macadam was not disturbed fast enough for crumbling, as the only factor that then operated was the high pressure intensity transmitted through the narrow hard wheels, tending to disturb the mechanical interlock of the metal and loosen the gravel binder material filling up the interstices. Now the fast moving motor vehicles tend to suck away the binder material when it is dry and worked loose by the continuous impact of passing iron-tyred wheels. The failure of the water-bound macadam is thus hastened and maintenance is proving costly and frequent. The dust nuisance is also great and the motorist has no good word to the Road Engineer, however much he may spend to keep such surface in a satisfactory condition. The age-old water-bound macadam has to be given up in heavily mixed trafficked roads in favour of more durable, dust proof pavements. Amongst these, the bitumen-treated and the cement-concrete pavements hold the field. The bitumen-treated roads, though they can stand wear and tear from 2 to 5 years depending on the kind of treatment, are not under heavy traffic as economical as the cement-concrete roads in the long run. But Bitumen has its own use in lighter trafficked sections. In waterless and rainless tracts, it is specially useful. It is eminently suitable for making the roads passing through villages and towns dust-proof. Asphaltic concrete is handy

in heavily trafficked municipal and city areas where underground piping for water supply and sewage exist. There is also this fact that there may not always be facilities for the import of this stuff from abroad. During the war-time, all the asphalt roads except the roads used by the Military, suffered for want of bitumen for renewal and repairs, and many of them had to be dug out and water-bound macadam substituted.

The cement concrete pavement, therefore, though costly, is really the most economical and durable for heavily trafficked roads. Further, it is made entirely of indigenous materials. The initial high investment is put forward as the reason in the present financial stringency for not adopting this kind of pavement in a larger measure. In heavily trafficked sections of over 1,500 tons intensity with predominant iron-tired traffic, it costs about Rs 4,500/- a mile—annual maintenance to keep the water-bound macadam surface in a satisfactory state. If we capitalise a part of the annual maintenance allotment, we can at once improve all the heavily trafficked sections with cement-concrete pavements. A 12 ft wide, 4" thick cement-concrete pavement costs about Rs 75,000/- a mile on the average and would last at least 25 years with about Rs 750/- a mile for maintaining the berms.

Rolled concrete pavement, which is as good as the orthodox slab concrete, is cheaper by nearly Rs 10,000/- per mile. Deducting the small annual maintenance of Rs 750/- a mile on a 12 ft wide concrete road, the saving in maintenance of Rs 3,750/- a mile, if capitalised at 3%, would be equivalent to more than one lakh of rupees. But we would be spending only about Rs 75,000 a mile on the average. So, capitalising a part of the annual allotment and investing the sum on making concrete roads straightaway on all the heavily trafficked sections in our State Highways would be financially a sound and wise policy instead of spending large amounts on water-bound macadam renewals. We are spending enormous money now to maintain some sections of water-bound macadam that has to stand heavy traffic. This must be stopped straightaway and cement-concrete pavements substituted.

With segregation of iron-tired traffic to the sides, the problem of management of the mixed pattern traffic is much simpler but a conphalt road or a multiple lane cement-concrete road is so much more costly that we cannot think of such pavements at the present time. Let us start with the 12 ft wide single lane pavement.

Financing

Now where is the money to come from for such accelerated pace of improved surfacing? It must come largely from the people who are the beneficiaries. I do not, for a moment, suggest that there should be any fresh taxation. But the major beneficiaries like the private transportation organisations, Bus operators and public carrier companies, and individuals must come forward and loan money. The other road users should also come forward to loan a moiety of the cost. Why I say that the finance must come from the public, is on account of the fact that the few annas per gallon of gasoline taxes, the licence fees and other taxes levied on the motor vehicles in the State are not at all enough to meet the normal demands of highway finance. Take the case of Madras State Highways which is the largest transportation system in India. The Madras State derives from the Gasoline and Motor Vehicle taxes, 350 lakhs of rupees, while she spends 700 lakhs every year, excluding the National Highways grant given by the Centre.

There is, perhaps, one obstacle that has to be gradually overcome. It is the indifference or apathy of the people who are not seriously road-minded, and I exclude the luxury car riders who are really a small minority, though perhaps the noisiest in the criticism of the road system. This indifference in the people must go and it will go if they are made to realise the importance of the road. I am sure then they will come forward to loan money for improvements even as they have started doing so for Irrigation Projects.

Development of roads in any region must precede the development of the irrigation and power projects in that region in order that maximum benefit is derived by

the people when the power and food became available from these projects. If the people only realise this, and ere long I am sure they will, loans will be forthcoming from the people for road improvements and new formations. In what form the people will be associated with the works, is a matter of detail and can be solved. One form is the Transport Development Societies working on some co-operative basis.

Low Cost Roads

Next, I wish to mention about the great potentiality the stabilised soil has in the making of low-cost roads and its use as a base-course in black cotton soil areas and in water-logged conditions. Here, I cannot resist the temptation of giving you an interesting recorded anecdote on how the early road makers in India under the British rule made a road on Black Cotton Soil. The Roads Department was under the Quarter-Master-General. One of the Officers commanding the pioneers, employed on road construction drew up a memorandum on the best construction for a road on cotton soil. The plan which was deeply appreciated by the Quarter-Master-General as displaying a **remarkable talent**, was circulated by him to all officers for adoption and to the Chief Engineer of the Corps for circulation of the brilliant idea. The plan was this: "First, a complete layer of large stones about a foot to a foot and a half thick was to be laid over the whole surface to be occupied by the road, and over them was then to be laid *three feet* thick of the black cotton soil, to raise the road to a sufficient height and prevent its being flooded." Lieut.-Col. A. Cotton, in 1854, while mentioning the above, has recorded thus:

"By this admirable arrangement almost any amount of money might be spent, as in such a situation the stones would have to be brought several miles, and at the same time the surface of the road being formed of the natural soil, but thoroughly loosened by being dug and thrown up, would be ten times worse than the original surface of the country. Such was the state of knowledge of road-making, among those who conducted the undertakings, and who were en-

trusted without check or supervision, with the expenditure of many lakhs of rupees."

The use of stabilised soil of appropriate specifications and adoption of a special technique of construction with vigilant field controls, has been found, after considerable research in the Madras State Highways Laboratory, to provide a strong and durable foundation for the road structure. The cost in most cases is considerably cheaper than the old specifications using other hard bases. The saving in cost ranges from Rs 5,000/- to Rs 10,000/- per mile. Several miles of road are now under construction in the Madras State using stabilised soil for the base and for berms in Black Cotton Soil areas and under water-logged conditions. Research has shown that apart from savings in cost, the entire road width is usable for traffic even in wet weather due to the total elimination of the dangerous clay soil berms.

In the Madras State, we have over 3,000 miles of roads in the deltaic regions requiring urgent improvements to the base course and 2,000 miles of new roads to be formed, and the use of stabilised soil adopting the new technique of construction would save a few crores of rupees while giving a trouble-free 'all the year round' serviceable roads. The amount spent on research is nothing compared to the savings we get in applying the results of research on the field. Research on soils has also a direct bearing on Low Cost housing problem, as well as on the foundation problems in Black Cotton soil areas. Recently a laboratory was opened at Roorkee for research on low cost housing.

Such laboratories should be set up in all Provinces as the conditions that exist in one Province are not the same in the other in the matter of men, materials and soils. The soils of Bengal were tested in the Madras Highways Laboratories and suitable specifications were prescribed for conducting full-scale tests at the Government Test Track at Alipore. These tests have been going on since July 1950, and the stabilised soil has been standing up extremely well even with the sub-grade fully saturated due to water kept standing continuously on both sides of the Test

Track. While we have applied the results of our research on a large scale in the field here already, the Calcutta Test Track performance will give the fillip to Bengal, Bihar and other States where similar problems exist.

The attainment of successful results in the field is the only proof of the success of Applied Research. The whole set-up, i.e., the Departmental organisation must be geared to achieve practical results—the applications of the results for drawing out specifications, developing the technique of construction to suit local conditions and last but not the least, the training of personnel for the purpose. And, all the Road Engineers must have a basic knowledge of the research part as well as the operational part of the construction. Data and experience must be recorded and bulletins issued for the dissemination of the knowledge, and movie pictures taken of the process for visual education. And all this is done now by the Highways Department in this State.

Bridges

I must next say a word about bridges in our Highways system. While we must not lose sight of the feasibility that in certain locations, small culverts and bridges can, and should be constructed with the locally available materials, lime, stone and brick proving more economical than concrete and steel, we cannot deny the fact that for large bridging, concrete has advantages. Till recently, the use of concrete was restricted to works mostly where the principal stresses are wholly compressive such as in foundation work or in small culverts and arches. In spite of the facility to produce high strength concrete, its use is restricted due to the fact that in R. C. C. design the concrete gives heavy cracking on the tension side of the Neutral axis and thereby wasting that material.

No doubt, with the recent research on the working of the concrete together with the modern methods of analysis of indeterminate structures, we, in this State, have taken advantage of these in carrying out long span continuous T-Beams, and flanged T-Beams, Box-type girder to reduce the dead weight and some rigid frame structures to suit the various

site conditions. But most spectacular work involving the use of the whole concrete section in compression to avoid cracking and increased safety is the use of Prestressed concrete. In the use of pre-stressed concrete, apart from the greater factor of safety, there is a great economy of steel upto 80% and concrete 40%. Shortly we will be building the first prestressed concrete Highway bridge in India of a 90 ft spans.

Loading Standards

I must, however, state that the loading prescribed for designing purposes seems unduly heavy and not at all likely to be attained in actual practice. Scour depth calculations and various other assumptions to neglect the existence of favourable factors like skin friction in wells, all make the sub-structure heavy and go down to inconceivable depths. I consider it is necessary to re-examine the various factors that come into the designs picture and arrive at really practical, economical and reasonable data for adoption. Besides standardisation of designs for economy, we must devise ways and means of reducing costs of centerings in R. C. C. bridge structures. An analysis of cost would show that the cost of the centerings is as high as 20 to 25% of the total cost of R. C. C. work. This certainly can, and should, be reduced after some research into it. Collapsible steel centerings have been suggested. These have not been tried on any large scale to determine its efficiency. The regional planning of schemes and designing of bridge structures should be so regulated and adjusted as to ensure maximum possible repetition of centering use.

It is time the Engineering firms have research organisations attached to their designs section. Knowledge can then be pooled and will help considerably the efforts of the Government Departmental organisations in this respect.

Bridges should come first

Lastly, I must say just a word about the bridges on our village road systems. These village roads are used mostly by pedestrians and bullock-carts and occasionally by a motor vehicle. The bridges across these roads should be for light load only. It is not infrequently we find that a village

road cuts a fair-sized stream and the bridge over this designed to take loads that will never go over them, costs a good deal more than the road itself. Invariably, we postpone the bridge and build the road alone. This, is a very wrong policy to adopt.

In all new road projects, we must put the bridges, culverts and causeways first and then improve the road. The bridge definitely gives a facility much greater than the

road without the bridge. If the given allotment does not cover the cost of the road and the bridges, we must first put the bridges and culverts with the allotment made, and then do the road in stages. It is possible to travel over the old beaten tracks with a bridge that will give the full facility for use at all times. I am not really suggesting anything new. In Tanjore, the ancient roads are of earth surfacing, with culverts and bridges in place.

Mark Twain once told a story of his early lecturing days. Arriving in a town where he was to speak in the early afternoon and seeing that the evening lecture was poorly billed, he stopped in at the general store and addressed the proprietor:

"Good afternoon, friend, any entertainment here tonight to help a stranger while away his evening hours?"

The storekeeper straightened up, wiped his hands on his apron and said: "I expect there is going to be a lecture—I've been sellin' spoiled fruit and eggs all day."

The farmer was sitting on his front steps eating a sandwich when a hen zoomed by with a rooster in hot pursuit.

Suddenly, the rooster put on the brakes, slid to a halt, and began picking the crumbs from the sandwich.

"Dern," muttered the farmer in disgust, "hope I never get that hungry!"

THE PRESENTATION OF TECHNICAL INFORMATION

(Extracted from "Engineering" September, 15, 1950.)

(Continued from our last issue)

SO much for the written and spoken word as vehicles for technical information. They do not by any means cover the whole of the field of study that might be labelled "The Art of Exposition." The field has other corners as well; and the most basic of all the rules of technique, the rule that the good expositor must be vividly aware of other people, applies to all these corners. Let me review a few of them quite briefly.

Use Good Type and layout

Some of these corners are concerned with what might be called technicalities. Typography is one of them. Though not as important perhaps as words and ideas, it is an important enough subject to deserve careful study. Specialists can tell of a great number of different kinds of type. Some of them are easier to read than others; they produce less eye strain. So choice of the best kind is not irrelevant when the presentation of technical information is being considered. Neither is choice of the best length of line. If there are too many words in one line the eye has to travel too far back when it has followed one line to the end and starts on the next one. It may get lost on the way and reach the wrong line. The effort of avoiding or correcting this error tires the reader unnecessarily.

If there are too few words in each line the effort of having to bring the eye back too often is also tiring. So there is an optimum length of line. In scientific books and periodicals the lengths of line vary very much. They cannot all be the optimum. Here is a subject that deserves more attention than it always receives, though the matter is more the concern of editors and publishers than of authors.

So are such often neglected matters as the best spacing between lines, the best width of margin, the best position of page numbers, the most suitable forms for mathematical symbols.

Drawings, Sketches, and Photographs

Of more immediate concern to scientific authors is the choice of method for conveying technical information pictorially. Many such methods are available. As vehicles of technical information there are photographs, line drawings, diagrams of electrical connections, flow diagrams, curves, nomograms, conventional semi-representational pictures, such as isotypes; and outside the field of published literature, but still within the field of the expositor's art, are lantern slides, lecture demonstrations, display stands in show rooms, exhibitions, museums.

There are also scientific films. Many problems arise in connection with each of these means of presenting technical information. Some of these problems are specific to one of the means only, and some of the problems are common to all; these are among the basic problems that arise in presenting technical information.

Sometimes one has to make a choice between some of the above-mentioned alternatives. Shall one use a photograph or a line drawing, a family of curves or a nomograph, a table of statistics or a set of stereotyped little pictures? In our present state of knowledge of the rules of good exposition the choice has generally to be governed by intuitive judgment, but many of us would like to have a more positive basis. We should welcome rules for our guidance.

The same applies to each particular kind of vehicle for technical information. There is a real need for criteria by which to distinguish between good and bad methods, for rules that would, for instance, provide guidance with the preparation of diagrams of connections.

Good illustrative material, it should be remembered, is a very effective vehicle for technical information. It does its work more quickly and surely than words can,

but if such material is not good or if it is not used on a suitable occasion and on a suitable subject, it is ineffective: it wastes people's time, it diverts attention from the subject under discussion, it may even be misleading. So there is here, as well as in the part of our field that is concerned with the written and spoken word, much that should prove rewarding if subjected to scientific method, if made the subject of research. It is worthwhile to consider in what direction research is likely to prove most profitable. What are the most important aspects of the expositor's work?

Language, Logic, and Psychology

I venture to suggest that there are three such aspects: linguistic, logic and psychology. The first of these is the one most often referred to. It is said that a course in English ought to be given to everyone who will be writing scientific books, papers and reports; but in my opinion mastery of the English language is less important than either logic or awareness of the person addressed. A knowledge of school English will, at best, help the expositor to turn out grammatical and elegant sentences, and sentences are no more than the expositor's raw material.

A research worker requires good materials if he is to do his best; but many do, nevertheless, obtain excellent results with makeshift materials and apparatus, with what one might almost describe as string and sealing wax. Similarly, an uneducated docker may surpass an English scholar in his ability as an expositor. With the help of phrases, that, from their lack of grammar might be compared to string and sealing wax, the docker will yet be able to convey his meaning with the utmost precision. So a good knowledge of school English is not essential.

Logic Essential

Logic is, however, essential. Facts and arguments have to be presented in the order in which they can be most easily received; and this is the most logical order. The person addressed must be saved the trouble of having what is irrelevant inflicted on him; and only by logic can one distinguish between what is relevant and what is not.

Then again, the good expositor must complete one theme before he proceeds to the next; and it takes a logical mind to be sufficiently cognisant of the theme discussed at each moment. The expositor who would express himself with precision must, in other words, think clearly. If he would convey what he is expressing to another mind he needs something more; he needs, not only to think clearly but also to think about the person to whom the information is being conveyed.

Psychology

The art of exposition demands, more than anything else, an understanding of the work done by a person to whom technical information is being presented. Those who would study this art must also study some aspects of psychology. They must seek to discover the factors on which receptivity depends, the laws that govern the association of ideas, the way memory works, to mention only a few of the aspects of psychology with a bearing on exposition.

Here surely is a rewarding field of study. Few have, so far, attempted to cultivate it. Is this because all of those now engaged on some piece of research have something better to do? Hardly, I think. One could not honestly claim that everyone of the thousand research subjects that are now being tackled is so valuable that no time ought to be spared for research in the art of exposition. I think that the reason for the present neglect of this field is simply that its existence has not been noticed.

Importance of good Technical writing

It is true enough that the importance of good technical writing has been mentioned quite frequently during recent years. Most of the recommendations on post-war training that have been prepared by sundry learned societies mention the need for a better knowledge of the English language; and some institutions have published valuable advice on the writing of papers, but the emphasis is placed on linguistics rather than on logic and psychology, and those who render lip service to the importance of higher standards of presentation are many, while

those who are prepared to do something about it are, I fear, but few.

This is unfortunate. Diagnosis should be followed by curative measures, an appreciation of the situation by appropriate action. So we are led to consider: what is appropriate action? What should be done in order to ensure a higher standard in the presentation of technical information?

Three Steps to take to obtain good Technical exposition

How is one to set about the task of discovering and formulating the rules of good exposition? Three things, I think. They are always done after a door has been opened to a new intellectual discipline. The first is to teach that discipline in our universities and

technical schools. The second is to provide a forum on which its problems can be discussed, such as is provided by each specialist institution or learned society. The third is to provide a specialist literature in the subject of the new discipline. Activity has already begun in each of these three directions, though it has not gone very far in any of them.

Systematic instruction in the art of exposition is available in a few, but only in a few, of our teaching institutions. The only forum of which I am aware is provided by a small, though admittedly active, discussion group. The only literature on the art of exposition consists of a rather small number of books; there is no periodical. May I suggest in conclusion, therefore, that the time has now arrived when more could and should be done in each of these three directions.

A HARD LIFE

An experienced engineer said to us the other day, "I would never go to a young doctor for advice."

We asked why and pointed out that young doctors had their living to earn.

He said "When I think what I knew about engineering when I left college (and I got a double first), I cannot but feel that the young doctor must know the same about medicine and surgery—practically nothing."

We pointed out that the young doctor generally worked in partnership with some older man and so had available to him the wisdom that comes from experience. We also suggested that for most human ailments (except those that were really serious, when an expert would naturally be consulted), any one of a dozen or two "cures" would be equally successful or perhaps a rest in bed with no medicine would do the trick. The human body was very resilient and could generally manage to cure itself and that medical help (even if not very skilled) merely assisted the natural processes.

The old fellow shook his head and said, "The doctor's failures are buried or sent to the funeral pyre and few could say whether they were really failures or not. The engineer's failures are there for all to see."

KEEP LEFT—KEEP RIGHT

(Extracted from 'LIFE' February 27, 1950).

These countries drive

LEFT

Aden	Kenya
Anglo-Egyptian Sudan	Malaya
Australia	Malta
Bahamas	Maritius
Barbados	Mozambique
Basutoland	New Guinea
Bechuanaland	New Zealand
Bermudos	Nigeria
British Cameroons	Norfolk Island
British Guiana	Northern Ireland
British Honduras	Nyasaland
British Somaliland	Pakistan
British West Indies	Republic of Ireland
Burma	Rhodesia
Ceylon	Sarawak
Channel Island	Scotland
Cyprus	Seychelles
England	Siam
Ethiopia	Sierra Leone
Fiji	Somalia
Gambia	South Africa
Gold Coast	Sweden
Hong Kong	Tanganyika
Iceland	Tasmania
India	Trinidad
Indonesia	Uganda
Jamaica	Wales
Japan	Zanzibar

These countries drive

RIGHT

Angola	Hungary
Argentina	Italy
	Iraq
Austria	Israel
Belgium	Jugoslavia
Belgian Congo	Lebanon
Bolivia	Luxembourg
Brazil	Mexico
Canada	Netherland West
Canary Islands	Indies
Chile	Newfoundland
China	Nicaragua
Colombia	Norway
Costa Rica	Paraguay
Cuba	Panama
Czechoslovakia	Persia
Denmark	Peru
Dominican Republic	Phillippines
Ecuador	Poland
Egypt	Portugal
El Salvador	Saudi-Arabia
Eritrea	Spain
Finland	Switzerland
France	Syria
French Colonies	Transjordan
Germany	Tripolitania
Gibraltar	Turkey
Greece	Uruguay
Guatemala	U. S. A.
Haiti	U. S. S. R.
Holland	Venezuela
Honduras Republic	

ROADS IN THE PARLIAMENT

7th February, 1951

Starred Question No. 1259 by

Shri J. N. Hazarika

Will the Minister of Transport be pleased to state:

- Whether a proposal from the Government of Assam has been received for the construction of a highway from Kohima to Mukachang of Naga Hills in the tribal areas of Assam for the purpose of Defence; and
- if so, whether it is under the consideration of Government and when will it be implemented?

Reply by The Honourable Shri
K. Santhanam

- The answer is in the negative
- Does not arise.

5th March, 1951

Starred Question No. 1924 by

Shri J. N. Hazarika

Will the Minister of Transport be pleased to state:

- the progress of the construction of the Shillong-Agartala Road;
- when it would be completed?
- the percentage of expenditure to be borne by the Government of Assam.

Reply by The Honourable Shri
K. Santhanam

- The Honourable Member presumably refers to the Shillong-Jowai-Badarpur-Lowairpowa-Churaibari-Agartala road. This road is motorable upto Passi, a little beyond Jowai and from near Badarpur along existing roads to the Tripura border. About 30 miles within Tripura are also motorable with difficulty but there are large gaps between the motorable sections. Construction from Passi to the

Lubha river on the Passi-Badarpur section is expected to commence shortly. Work on the Churaibari-Agartala road is in progress and it is hoped this portion of the road will be ready for fair-weather light traffic before the rains.

- The total work will be completed so as to be fit for light traffic by 1954 if sufficient funds can be provided.
- As at present estimated, only 1½ per cent of the expenditure.

21st, March 1951

Starred Question No. 2441 by

Shri S. V. Naik.

- How many miles of road in Hyderabad State have been declared as National Highways?
- what is the annual cost of maintenance of these roads? and
- whether any part of this is also borne by the Government of Hyderabad?

Reply by The Honourable Shri
K. Santhanam

- 581 miles as designated at present.
- about Rs 6 lakhs at present.
- none from 1950-51.

12th April, 1951

Starred Question No. 3069 by

Dr. M. M. Das.

Will the Minister of Transport be pleased to state:

- how far the construction of the Assam-Tripura Road has been completed;
- the length of the road and the estimated expenditure for the construction;
- the average number of labourers working per day in the construction work; and
- the number of East Bengal displaced persons employed in the construction work, if any?

Reply by The Honourable Shri
K. Santhanam

- The Honourable Member presumably refers to the Agartala-Assam border road. Formation of the road has been completed in about half the length. Work is in progress in the remaining half and it is hoped to provide a jeepable fair-weather road from Assam border to Agartala before the next rains.
- the length of the road is about 134 miles, including an approach road of about 5 miles to Dharmanagar, a divisional headquarters of the State, from the main road. The total estimated expenditure is Rs 2.98 crores.
- 4,000.
- 400 per day on an average.

1st May, 1951

Starred Question No. 3874 by

Shri. A. C. Guha

Will the Minister of Transport be pleased to state:

- the work so far done to improve the road transport in Tripura and Manipur;
- whether the Government of India have got any plan for a certain number of years;
- if so, what the plan is;
- whether there has been any attempt to enlist local co-operation in the work of constructing the roads; and
- whether there has been any offer of local help either from the Congress Committee or from any other organisation?

Reply by the Honourable
Shri. K. Santhanam

A statement containing the information required is laid on the table of the House.

Statement

(a) Presumably the Honourable Member desires information about what has been done to improve road communications in Tripura and Manipur. This information is given below.

(i) Tripura

The construction of the Agartala-Assam Road (134 miles) is in progress. It has been decided to construct three more important roads (totalling 86 miles) namely, the Udaipur-Sabroom, Belonia-Bogafa and Khowai-Teliamura Roads. These roads have been surveyed and construction of the first road is in progress. The other two will be taken up shortly. Surveys for six other roads (totalling about 122 miles) are also in progress. In addition, the improvement of 22½ miles of cart tracks leading to colonies of displaced persons has been undertaken as an essential measure of rehabilitation. All these works are, at present, estimated to cost about Rs. 3.1 crores.

(ii) Manipur

Special repairs have been carried out on the Palel-Moreh (Burma border) Road which had fallen into disuse after the end of the war. A girder bridge has been constructed at Moirangkampu on the Tinseed Road. Nearly 112 miles of hill roads in the Tribal areas have been improved and a diversion road from Litan to Ukhrul (25 miles) on the Ukhrul-Imphal road has been constructed. Survey of a proposed motor road connecting Tamenglong (a tribal administrative headquarters) with the Dimapur-Imphal road is nearing completion and construction work will be started this year. These works are at present estimated to cost about Rs 10 lakhs.

(b) and (c)

(i) Tripura. A five-year plan envisaging the construction of the nine roads referred to in my reply to part (a) and also of 100 miles of village roads, estimated roughly to cost Rs 1.5 crores, has been proposed, but these proposals have yet to be examined by the Planning Commission.

In addition it is proposed to construct the Jowai-Badarpur road through Assam at a rough estimated cost of Rs 1.0 crore to provide a direct link between Tripura and Shillong.

(ii) **Manipur.** Similarly a five-year plan envisaging the improvement of four roads and a few bridges, estimated to cost about Rs 28½ lakhs in all is under examination. This too has to be considered by the Planning Commission.

(d) This has been done in Tripura where local labour is employed, as far as possible, on road works and the advice

of local Sardars is sought in matters of alignment of roads and mobilisation of labour.

No such attempt has so far been made in Manipur, but it is proposed to do so, particularly in the tribal areas.

(e) The Tripura State Congress Committee have made suggestions for mobilising local tribesmen for construction of roads. These are under consideration.

No offer of help has been received from any Committee or Organisation in respect of Manipur.

SOUGHT AFTER

The type of man qualified to act as a county or borough engineer and surveyor is now sought for by large commercial and industrial undertakings, in whose service his labours might be, and generally would be, highly remunerated. Directors of great manufacturing and trading concerns, which are a salient characteristic of this age, seek the sort of mind that can plan the public works of large communities and carry their plans into execution. Such men are thinkers and also men of action; and since they combine those dual powers, as a general rule separated and distinct in ordinary folk, their real worth in this modern community rises day by day.

(Extracted from 'The Surveyor' - June 16, 1950)

(Continued from page 26)

While Engineering is our vocation, we must cultivate an interest in literature and humanities, so that we may have a hobby or intellectual pastime other than that relating to our profession, and to which we may turn to in times of worry. When you are too worried with any Engineering problem, turn to *Valmiki, Kalidasa or Shakespeare*. Remember the ultimate proper study of mankind is man. Study of Elemental Forces must be correlated with the study of man. Success in life depends as much on the man as in the Engineer in you. This is what, I believe, Rajaji intended to bring out in his address at the inauguration of the International Engineering Conferences in Delhi last month when he enumerated the attributes that an Engineer should possess.*

That makes me wonder how Carlyle

missed to write a chapter on the Engineer in his *Hero and Hero-worship*. While one can never be that in full, one can strive to approach it in some measure by maintaining a 'high morale' in the profession as a whole and in the individual in particular. Our goal is the attainment of a Welfare State in the most comprehensive sense of the term. It behoves us, Engineers, on whom the brunt of the responsibility naturally, falls to gird up our loins and equip ourselves, to fulfil the task and attain that goal of economic freedom as speedily as possible.

May God aid us in our united endeavours.

[From the Presidential Address by Sri M. S. Thirumale Iyengar, to the 28th Annual Meeting of the South India Centre of the Institution of Engineers, India.]

HERE AND THERE

1. TRAMS

INADEQUATE in number, old and rickety with the passage of years, the trams in Madras, comparable only to similar vehicles in old Delhi in point of age and decrepitude, drag on a noisy existence. The most merciful end for a mode of transport which has outlived its utility is to take it off the road at the earliest possible moment. The Finance Minister disclosed in his Budget speech that the tramways have been offered for sale to the Government. We have no doubt the Government will do nothing in a hurry but carefully examine the question whether it would be worth while spending money on acquiring the tramways in their present condition.

Nerve Shattering

We have urged in the past that the trams should be replaced by trolley buses and are glad to note that the Transport Commissioner takes the same view. He has stated that trolley buses might be introduced "if and when the trams have to be replaced". The harassed travelling public and those who work in places near tram-

lines and have to put up with the shattering screams of trams in agony would fervently wish that the replacement were effected soon.

The Alternative

Trolley buses would be quicker—Madras trams are exasperatingly slow—and could be made to run at the edges of the road instead of filling the centre as the present tramlines do. And there would be no small advantage in the saving of the roads from being periodically ripped open for repairs to the lines. While in the present state of acute shortage of transport in the city the sudden withdrawal of all trams may worsen matters, there is no reason why the Government should not insist on the removal of the more noisy vehicles and their replacement and the maintenance of the others in good repair. The Government must see that so long as we have to keep trams, they are run properly and do not give cause for being regarded as a public nuisance.

(Extracted from 'Hindu'—Madras, 17-3-1951)

2. INTENTIONS AND ACHIEVEMENTS

NO country can become economically self-sufficient unless she has a network of good roads. Whether it be for easy access to the sources of our raw materials or for the spread of education to the 90 per cent of our illiterate brethren in the rural areas or for quick marketing of the produce of our farms, the "creation of new and better roads is a first logical step" towards the accomplishment of these objects. Realising that roads are the hand maidens of the country, the Government of India at the instance of the Indian Roads Congress, convened a conference of the Chief Engineers of the Provinces and States at Nagpur as far back as December, 1943. As a result of the deliberations that took place, the Nagpur Plan was evolved, with the admirable object of criss-crossing the country with a system of national highways, provincial or state highways, district and village roads. Although the Nagpur Plan was conceived

on a ten year basis and should have been implemented forthwith in order to yield maximum results as early as possible, it was not till the partition of India that it was taken down from the dust-laden shelves of our Development Departments. Four years have now elapsed since the road development scheme was taken up by the present Central and State Governments and it will be interesting to examine what progress has been made in equipping the country with a scientific network of good roads. For our facts and figures we turn to Part II of the 1950-51 Report just published by the Ministry of Transport. The story it contains is one that will leave the reader with no doubt that road development instead of being given the highest priority among the social services has been turned into a cinderella.

Although four years have already passed 90 per cent of the work still remains to be

completed before the 5-year period ends on 31st March, 1952. The other half of the Nagpur Plan which was entrusted to the State Governments has met with no better fate. Except in the case of Uttar Pradesh which had a year's lead over the other States, all the other States are far behind the programme chalked out. After all our grandiose planning we find that on our National Highways and other roads we have registered only 10 per cent and 5 per cent progress respectively. These percentages speak for themselves and are a testimony to the "zeal" with which the Nagpur Plan is being implemented by Central and State Governments. It is not possible to examine in detail each of these reasons

and to assess how far they are genuine or not. But the fact remains, as Mr. P. Reid aptly put it almost a year ago, that "India does not yet realise that she pays for her roads whether she has them or not, and she pays more when she does not have them". It all boils down to a question of priorities. It is our belief that in the matter of implementation of the otherwise excellent Nagpur Plan, Governments at the Centre and in the States, are setting greater store on will-o-the-wisp schemes and neglecting one which is of paramount importance to the prosperity of India.

(From the 'Hitavada' Nagpur, 17-3-51)

3. ROADS TO AVERT FAMINE

MADRAS, March 16. The creation of a Central Road Board for carrying out a co-ordinated plan of National Road Development was urged by Mr. P. Reid at the annual general meeting held at Burmah-Shell House, this evening. Mr. Reid also urged the earmarking of a percentage of both Central and Provincial revenues to ensure adequate funds for the successful working of the Road Board.

At the outset, a condolence resolution on the death of Sardar Patel was passed.

In his address, Mr. P. Reid, Chairman of the Indian Roads and Transport Development Association, Madras referred to the report of the Motor Vehicles Taxation Enquiry Committee and said:

"Not all of the report can be pleasing to all who have interests in India's roads and transport but there can be no gainsaying the fact that the report has revealed in a vivid manner many Taxation and other inequalities and has put forth recommendations which should go far to helping the Union Government in their endeavour to establish a scientific basis of motor vehicle taxation".

Increasing need of Roads

Proceeding, Mr. Reid said:

"Unfortunately, the overall picture of road development in India is not

nearly so happy, and seems to me to be completely divorced from the ambitious Nagpur Plan of 1943 which set out to provide India with an additional 100,000 miles of roads. The first five-year plan which started in April 1947 was to cost Rs 150 crores. As at March 1950, Rs 30 crores had been spent or only about one-third of what should have been spent in the period. If the need to implement the Nagpur Plan was great in 1947, it is much greater today. We are spending vast sums of the Nation's revenues purchasing expensive food-grains from abroad, so that the people of India may be saved from starvation. I cannot help feeling that India's food problem is largely bound up with the development of roads".

"I feel strongly that no co-ordinated plan of National Road Development can be accomplished with reasonable progress or in a reasonable time until the Central Government places such development and plans in the charge of a Central Road Board".

Before such a Board could function satisfactorily, he added, it would be necessary to ensure that adequate funds were placed at its disposal, perhaps by earmarking a percentage of both Central and Provincial revenues for this purpose. Such grants as may be allocated from the Central and Provincial

budgets should be of a non-lapsing nature. Any National Road Development Plan could succeed only if the finance necessary to carry it through was assured.

Import of Automobile spare parts

Mr. Reid suggested that in the light of the present difficult spare parts supply position, the Central Government might reasonably consider placing the import of automotive spare parts under Open General Licence for the period of the present emergency. He added, "India's industrialists who are concerned with the development of the Motor Transport Industry in this country continue to

give a very creditable account of themselves in their endeavours to help Government to implement their policy of self-sufficiency in transport. The road to self-sufficiency can be both long and difficult, but I am convinced the journey can be shortened and the road made less difficult if Government would evolve means of permitting the import of capital goods to a pre-determined value for approved schemes without the encumbrance of the present time-absorbing procedure. There is every need to make this and every other nation-building task as easy for the builders as possible".

(From the "Hindu"—Madras, 17-3-51)

4. ROAD IMPROVEMENTS NEEDED

International Outlook

AT the annual meeting of the International Road Federation (European and Eastern Zone), held in London in November 1950, representatives of national road organisations discussed the need for more and better roads in various countries of the world.

* * *

Recommendations

Some of the more important recommendations made by delegates were:

- that in order to ensure a balanced economic progress an equitable proportion of every country's capital resources should be devoted to the development of roads and road transport;
- that the proceeds of taxation levied on road users should be spent on roads and not diverted to other purposes;

(c) that every country should, in its own interest, draw up a national plan for road development, co-ordinating this plan with those of neighbouring countries, and ensure that adequate funds will be forthcoming every year to finance it;

(d) that no artificial restrictions should be imposed on this form of transport which held out so much promise;

(e) that serious consideration should be given to the replacement of unremunerative branch railway services by road services;

(f) that it was an urgent necessity that the public in all countries should be educated to appreciate the many advantages, economic and strategic, social and cultural, of a road system adequate to their country's need.

* * *

(Extracted from 'Modern Transport'—November 18, 1950).

5. ROADS IN THE U. K.

THE services provided by road transport cost the country about a thousand million pounds a year, and according to official statistics about one and a quarter million persons were engaged

in making, repairing, servicing, and driving the vehicles used in maintaining the road system. It was probable that road transport absorbed about 8 to 10 per cent of the industrial potential,

as against about 3 per cent by the railways.

The total number of vehicles on the roads had risen by 1949 to about 4,000,000 vehicles, with a total horse-power potential roughly ten times that produced by the British Electricity Authority. Excluding any allowance for drivers' time, and one or two minor items, the cost per vehicle-mile of operating the nation's road vehicles was roughly made up as follows:—

	per cent
Road construction and maintenance	11
Fuel (1949 prices, excluding tax)	13
Accidents	13
Vehicle maintenance and depreciation	63

These figures showed that the proportion spent on road construction and maintenance which works out at one half-penny per vehicle-mile, was even lower than the cost of accidents or the cost of fuel. It was about one penny a day per head of population and for that sum the individual had the use of the vast network of the roads of the country. It could hardly be disputed that the civil engineer was providing amazing value for the limited money that he was allowed to spend.

(Extracted from 'Civil Engineering'—November, 1950).

6. MOTOR VEHICLES BILL—WEST BENGAL

THE House* then proceeded with the consideration of the Bengal Motor Vehicles Tax (West Bengal Amendment) Bill 1951, sponsored by the Chief Minister, Dr. B. C. Roy, and passed it with certain minor amendments.

The Bill proposed to enhance the rate of taxation on the ground that the increased yield of revenue would be utilised for the

implementation of various road development projects.

Dr. Roy said that the net yield from the tax would be about 1.47 crores a year. Dr. Roy mentioned the bad condition of roads in the rural area of West Bengal and stressed the urgency for repairing these roads.

(From 'A.B. Patrika'—Calcutta, 30-3-51.)

7. TOP PRIORITY

“WHEN one examines the manifold plans of Government which are designed to make this country prosperous, I am bound to say that enough appreciation does not seem to have been shown of the vital role that roads must play in increasing the productive capacity of the land,” declared Mr. E. A. Nadirshah, President of the Western India Automobile Association, at its 31st annual general meeting on the 25th April, 1951.

He added: “Every kind of production, whether industrial or agricultural, postulates easy facilities for the movement of men and materials, production centres and consuming areas. Thus a road system, as a tool of production is more vital in many cases than machinery or implements.”

Importance

Mr. Nadirshah pointed out that a good road system was equally vital for the provision of medical facilities in villages or for attracting the village children to schools. It was only by the development of a vast network of roads that the many schemes of harnessing rivers, electrification of the countryside, expansion of food cultivation, development of industries, and improvement of health could succeed.

Appealing to the State Governments to improve the conditions of travelling, he suggested the provision of road travel amenities like the modernisation of roads, the erection of road direction and warning signs and the elimination of travel restrictions. He urged the removal of

impediments which stood in the way of touring by car such as inter-State restrictions, taxes, etc.

Turning to the traffic congestion in the city, Mr. Nadirshah held the view that the only real and safe solution for the problem of pedestrian traffic on important traffic arteries like Queen's Road and Churchgate Street, was the introduction of pedestrian subways or overbridges. He also pleaded for the inculcation of traffic sense in school children.

Backward Bombay

Mr. Nadirshah stated that Bombay was more backward in respect of having a good

communication system than other States in the country. Per hundred square miles of area, States like the U.P., Bihar, and Bengal have 35 to 55 miles of roads, whereas Bombay has no more than 26.8 miles, he pointed out. Urging the immediate creation of a Highway Department in Bombay, he appealed to the Government to give top priority for roads in their development programmes.

Concluding, Mr. Nadirshah pleaded for the acceptance of the recommendations of the Motor Vehicle Taxation Enquiry Committee, which would give some relief to motorists.

(From the "Bombay Chronicle"—26-4-51)

8. REJUVENATING OLD ASPHALT PAVEMENT

RESTORING rough, old asphaltic pavements to further years of usefulness has been the subject of an extensive field study carried out by the California Division of Highways on two lanes of a section of 4-lane U. S. 40 near Sacramento. The process of rejuvenation which was tested includes the following operations: (1) ripping up old pavement, (2) pulverizing, (3) mixing the pulverized material with a newly developed asphalt softener in a travelling road plant, and (4) relaying the resultant mixture on the old base by road-mix methods. The liquid asphalt softener is a product developed during the last few years. It is an aromatic petroleum product in the gas-oil boiling range, and has a weight and viscosity close to diesel oil.

Prior to the State test, it had been tried for several years on pavements in Cali-

fornia municipalities. These first applications were usually made by direct spraying on the old pavement to soften it in preparation for reworking and re-laying by conventional road-mix methods. This method was not generally successful because of loss of softener through excessive run-off due to the low porosity of the traffic and weather hardened road surface. Another method consisting of applying the softener to the partially broken pavement prior to pulverization proved rather ineffectual due to loss of softener to the base. The key development introduced in the current test involved adding the softener to the wind rowed mix after maximum mechanical breakage was effected.

(Extracted from "Highway Construction" September, 1950)

[A similar method is in use in Bombay and is called "Recondo". Ed.]

9. AND NOW, A COMMITTEE

ROADS. A very large number of our villages are not connected by road with any urban centre or railway station. Most of the existing village roads are fair weather roads, which, when the monsoon arrives, are turned into mud, slush, pools of dirty water and become unusable. There are few permanent bridges and culverts and consequently each nullah be-

comes an unmountable obstacle in the rainy season. We are paying heavily for not having enough good roads in our rural areas. The backward state of our agriculture and rural population is partly attributable to poor communications.

(“Report of the Local Finance Enquiry Committee, 1951”.)

* The West Bengal Legislative Assembly on 20-3-51.

10. THE LEEDS SWORD

OUTSTANDING and upstanding at the main entrance to the Building Week



Exhibition which was held at Leeds recently, was a sword made in prestressed concrete which, with its illuminated tip, served as an unusual marker. The sword, which was designed to show some of the outstanding properties of prestressed concrete, is 50 feet high and weighs 5 tons.

There are three 7/8 in. diameter vertical bars in the hilt and blade and transversely four 3/4 in. diameter bars in the hand guard. This latter is of especial interest because it consists of a curved cantilever member with an unsupported projection of 17 ft.

The concrete, which has a minimum crushing strength of 8,000 lb. per sq. in., was made in short sections, assembled with dry joints and prestressed on the site. The steel skeleton with which the concrete is prestressed consists of seven bars having a total weight of only 560 pounds. To show the flexibility of the Lee-McCall system on which the sword was constructed, it was dismantled at the conclusion of the Exhibition to be rebuilt on another site without affecting the strength of either the steel or the concrete.

(Extracted from 'Civil Engineering and Public Works Review' - No. 532, October 1950.)

11. TO THE YOUNG ENGINEER

TO the young Engineer, I shall say that the profession which he enters today secures him and all a happy, contented and useful life. Of no other profession can this be said with grater assurance. Twenty years ago, perhaps, I would have said: "Oh! What will become of you. Your prospects are so gloomy." But, now, the picture is rosy. The country and leaders expect us to help them in solving the country's problems. If we would only rise to the occasion, lead dedicated lives and fulfil in some measure what is demanded of us in this crisis, which the country is passing through, our profession would go down in history as the saviours of our Motherland.

A dedicated life would mean that you should concentrate all your attention and energies not only on being a successful practical engineer, but never cease to be a student. Never should we forget what Plato has said that Education is a life-long process in which the student can only make a beginning during his college course. What matters is the relish for knowledge which puts life both in the student and the professional Engineer and which ultimately makes the Engineering schemes and Science in the country throb with life. Another important point I should mention that we may play our part in the building up of the future of the country.

(Continued on page 20)

BUILDING RESEARCH CONGRESS IN LONDON

A comprehensive Congress on building research has been planned to take place in September 1951, in London and will be the first of its kind ever to be held. The purpose of the Congress will be to review the progress made in research in relation to architecture, building and the associated branches of civil engineering.

There have been rapid developments in all branches of building science and papers presented at the Congress will review these developments and will consider their significance and their effect on future trends. Papers will be contributed by authors from various countries.

Date and Place

The Congress is to be held from the 11th-20th September, 1951, and will be centred at the Institution of Civil Engineers. It will take place during the period of the Festival of Britain, 1951, and visitors attending the Congress will have an opportunity of seeing the various exhibitions in connection with the Festival.

Programme

For the purpose of the technical sessions, the Congress has been planned in three divisions holding concurrent meetings:

Division 1 concerned with the engineering and structural aspects of building,

Division 2 concerned with building materials, and,

Division 3 concerned generally with the various factors which influence the comfort and efficiency of the people using the buildings.

The papers, which will be discussed at the Congress, have been invited specifically by the Organizing Committee of the Congress with the intention of providing a comprehensive survey of the field of building science. These papers will be printed and circulated to Congress members before the Congress begins and will be introduced briefly during the Congress sessions, the majority of the time thus being available for discussion. Contributions to the discussions will be welcomed.

Excursions

Excursions and visits are being arranged for the period of the Congress. In addition to the excursions of technical interest, some visits of more general interest are being arranged for Members as well as for relatives accompanying them.

Membership open to all

Membership of the Congress is open to all on payment of the Congress fee of 50 shillings, which will cover attendance at the Congress sessions and also will ensure that members receive all the preprinted papers. The fee does not include the cost of excursions nor attendance at the Congress dinner.

Any body who is interested may write for further details to the Organizing Secretary, Building Research Congress 1951, Building Research Station, Watford, Herts, England.

The contractor's wife found her spouse in a bar, sampled the highball he was drinking, and exclaimed, "How can you drink such horrible stuff?"

"See!" said her husband, "and all the time you thought I was out enjoying myself!"

TECHNICAL INFORMATION

(i) BRITISH INVESTIGATIONS OF THE SOIL AS PART OF A ROAD STRUCTURE

(Extracted from 'Roads & Engineering Construction'-Sept., '50.)

(Continued from our last issue)

Foundations and Subgrades

THE basic problem in pavement design is the determination of the minimum thickness of pavement required for a given wheel load and a subgrade of known characteristics. In practice, this involves the determination of the strength of the soil comprising the subgrade, followed by computations from the test results. In order to check available methods of pavement design, detailed studies have been made of some of the tests for determining soil strength, and investigations have been made into the causes of pavement defects due to foundation weakness.

Experimental Relationships

In the case of both the California bearing ratio (C. B. R.) test and the unconfined compression test, experimental relationships were derived relating the soil strength with the dry density and moisture content for typical soils. The results indicated the importance of adequate compaction of the soil and of constructing roads on clay soils at a season when the soil is in a relatively dry condition. A loss of strength of at least 10.1 can result from the neglect of these requirements. A comparison of the results obtained with the two tests on the same soil (a medium clay) showed that it is the requirement of soaking the soil for four days which results in the C. B. R. method giving a conservative design. If tests are made on unsoaked samples the method gives thickness of construction in fairly close agreement with those given by the shear strength method, which is based on the results of the unconfined compression test.

Development of Technique

The period under review has seen the development by the Laboratory of a technique for examining the causes of pavement defects due to foundation weaknesses.

The technique consists in opening up two trenches across the full width of the road, one on the site of a defective area and the other where the road is sound. By comparing the surfacing, base-course and subgrade at the two sites it is usually possible to infer the cause of the defects. It is sometimes possible to deduce the cause by investigating one trench only. In order to make the comparison and to obtain exact information about the nature of the soil, a range of soil tests is made including identification, density and strength tests. Where an excessively wet subgrade is suspected to be the cause of the trouble, the moisture distribution in the subgrade is determined in order to locate the source of the wetness.

Several of the investigations enabled a check to be made on the shear strength design method for clay subgrades; using the method, it was found necessary, for main road conditions, to base the design on a 12,000-lb wheel load and to equate the shear stress of subgrade to the shear stress derived from the Boussinesq formula. Some information was also obtained on the relation of the thickness of concrete and sub-base for main roads and the Westergaard modulus of subgrade reaction; for instance, on a clay subgrade with a modulus of 100 lb./sq. in./in., 8 in. of concrete laid on an 8-in.-thick sub-base was found to be necessary to provide a sound road surface.

Settlement

The settlement of structures founded on compressible soils is usually estimated from the results of consolidation tests on samples of the soils. If reliable estimates are to be obtained the factors affecting the results of these tests must be understood. There is surprisingly little published information on this subject and to fill this gap an investigation has been made using remoulded samples of clay. The effects of the dimensions of the specimen, the design

of the apparatus, the test procedure and the temperature during the test have been studied.

Temperature was found to have an important effect; the rate of consolidation at 25 deg. C. was twice that at 5 deg. C. This may be related to the change in the viscosity of the water in the soil pores.

Specimens of soil of 5-cm. diameter suffered about 25 per cent less consolidation than specimens of 10-cm. diameter owing, it is thought, to the greater effect of side friction on the specimens with the smaller diameter.

Soil Drainage

One of the most frequent causes of deterioration of a road surface is the reduction of the strength of the subgrade due to an increase in moisture content. Water may enter the subgrade: (a) directly through a porous surface or by gravitational flow from surrounding high ground, or (b) indirectly, either as a result of the suction force exerted by the water already present in the subgrade, or in the form of water vapour.

The laws which govern the movement of water under the action of gravity in saturated soils are fairly well understood. Research has therefore been directed to studying the flow of moisture due to suction gradients and to the movement of moisture in the vapour phase.

Three methods for determining the soil suction/moisture content relationship have been used at the Laboratory and curves for a number of different soil types obtained. These curves show that whilst movements of moisture occur in a soil of uniform type from points of low suction to points of high suction, adjacent soils of different types may have widely different moisture contents when in suction equilibrium. It has been found in the case of one soil that a knowledge of the soil suction/moisture content relationship enabled a reasonably accurate estimation of the equilibrium moisture conditions above the water-table to be made.

The speed of water movement due to suction differences depends on the unsaturated permeability of the soil, which

is itself a function of the soil moisture content. Apparatus for studying the soil permeability/moisture content relationship has been devised.

The vapour pressure of the water in unsaturated soil is lower than that of free water, the difference being appreciable only at very low moisture contents. The vapour pressure/temperature relations for soil water and free water are of a similar type. There is therefore a tendency for soil water to move in the vapour phase: (a) from wet to dry areas, and (b) from points of high temperature to those of low temperature.

Following reports of road failures in the U. S. A. and elsewhere, in which movements of vapour in the subgrade soil were associated with temperature gradients, experiments were carried out in which steady temperature gradients were applied to soil samples of different densities and moisture contents. It was found that the rate at which movements of vapour occurred depends largely on the percentage of air voids present in the soil. These movements can therefore be controlled by compaction under suitable moisture conditions. In practice, however, the migration of moisture from this cause may occur from depths at which compaction is impracticable. Experiments in which temperature gradients comparable with those found in practice were used showed that the moisture content of the soil immediately under a road surface might be increased rapidly as a result of vapour movements. The investigation also showed that whilst the transfer of moisture vapour might, under certain temperature conditions, be cumulative, corresponding upward and downward movements in winter and summer are likely to occur.

Longitudinal Cracking

Cases of longitudinal cracking in bituminous roads on heavy clay were reported to the Laboratory following drought. Investigations at several of these sites showed that the subgrade under the edges of the carriageway was considerably drier than that under the crown of the road, and that the resulting settlement near the shoulders was sufficient to

account for the cracking. It was considered that surface evaporation from exposed shoulders and transpiration from vegetation near the road were responsible for a slow movement of moisture from beneath the surfacing. In view of the rare occurrence of severe drought economical measures for preventing this type of damage on existing roads may be difficult to find. Experiments in which vertical impermeable "cut-off" walls are used on each side of the carriageway are proposed as a preliminary approach to the problem.

Effect of Vegetation

During these investigations it was difficult to assess accurately the part played by vegetation in reducing the moisture content of the soil. Work at the Building Research Station had shown that fast-growing vegetation could be responsible for the settlement of structures with shallow foundations, even with normal rainfall. To examine whether roads were similarly affected a survey was carried out with the assistance of a number of highway authorities in areas where clay predominated. Numerous cases of damage or suspected damage were investigated. The broad conclusion was that fast-growing trees planted close to roads are liable to cause surface settlement, particularly during the early years of growth. Where such trees are set in a paved footway the settlement is likely to be greater.

Pavement Design

Better methods of pavement design are being sought in two ways. One, the long-term approach, seeks a sound theory for determining the stresses and at the same time aims to develop methods of measuring the properties of the materials that take account of repetition of load and other factors. The other, the short-term

approach, is concerned with improving empirical methods of design based on the observed behaviour of pavements.

As part of the long-term approach the Mathematics Division of the National Physical Laboratory is undertaking a mathematical analysis of the stress distribution in layered systems consisting of elastic pavement layers resting on a semi-infinite subgrade layer of a lower modulus of elasticity. The results of the analysis for a two-layered system have already been published and progress has been made with the analysis of a three-layered pavement. Assuming that the pavement and subgrade behave elastically, these analyses show that the true stress in the subgrade is considerably less than that calculated on the assumption, made in several existing methods of pavement design, that the pavement and subgrade form one uniform elastic medium. Experiments are in hand to compare the actual deformation at the surface of a two-layered system of sand-cement construction on a sandy gravel subgrade with the deformation calculated from the elastic theory, and plans have been made for an extensive investigation of the actual stress distribution in soil and lowered systems of road material.

Most Reliable Method

Work on the short-term approach has been concerned mainly with the California bearing ratio method. The effects of type of soil and its condition, and the test procedure, on the results obtained with the strength test associated with this method have been examined. The reliability of this and other empirical methods has been tested by means of road failure investigations. Results so far show that the California bearing ratio method is the most reliable of existing methods for designing flexible pavements.

(ii) "STRIPPING" OF AGGREGATE IN BITUMINOUS WORK USE OF MAGNESIUM STEARATE.

(Extracted from 'Main Roads'—September, 1950.)

The past few wet seasons have brought into prominence in New South Wales the danger of water displacing bitumen films from aggregate particles in bituminous road pavements. This is generally known as "stripping" of aggregate. Several failures of pavements have resulted in New South Wales from this action.

The Department has been conducting in its laboratory a series of experiments designed to determine the extent of the danger of "Stripping" failures and investigate possible remedies. The most common type of remedy has been the incorporation in the bitumen of some "additive" intended to increase the adhesion of the bitumen. These experiments have shown:-

1. That an unexpectedly high proportion of New South Wales aggregates are liable to stripping.
2. That, contrary to the widely held belief, many "basic" rocks (basalt, dolerites, etc.), are liable to stripping and some "acid" rocks (quartzite, etc.), are not.
3. That certain commercial additives which are available in New South Wales prevent stripping with many aggregates, but are ineffective with other dangerous aggregates. (They are in general effective with "acid" aggregates only.)
4. That sodium and calcium salts of phenolic acids, also suggested as possible additives, are inferior to the commercial additives.
5. That magnesium stearate added to the bitumen (approximately 1½ per cent) is the most promising additive

yet tested. For quite a wide range of aggregates, both acid and basic, it produces a substantial improvement in the adhesion of bitumen in the presence of water. This improvement seems to be sufficient to prevent dangerous stripping with all aggregates tested.

Magnesium stearate was suggested by the Department's chemists. Subsequent to the suggestion and to the work that followed and led to (5) above, British publications have been received showing that road research authorities in Britain have found similar promising results with other heavy metal soaps. Magnesium stearate is, however, preferred as in New South Wales it is the most readily commercially available material of this type.

Actual field works conducted with the recommended addition of magnesium stearate to the binder have demonstrated that the process is simple, free from difficulty, and reasonably economical. The actual cost of the material amounts to about two pence per gallon of binder. Laboratory work is being extended to verify that the new "additive" is effective with all aggregates, or to ascertain what type or types of aggregate fail to respond.

LIST OF APPROVED ROAD DEVELOPMENT SCHEMES

S. No.	Job No.	Name of Work.	Amount approved Rs	Remarks.
BOMBAY.				
1.	461 BM. 8	Dust proofing mile 132/2 to 132/7 of National Highway No. 8 in Vapi Town.	19,724	
2.	464 BM. 8	Construction of a bridge over the Chitpada Nala in mile 85/3 of Bombay-Nadiad-Rajputana-Delhi Road.	1,46,315	
WEST BENGAL				
3.	460 BG. 31	Construction of a road bridge over the Gheesh river on Bihar Assam N. H. No. 31.	9,31,300	
PUNJAB				
4.	462 PB. 1	Widening Grand Trunk Road in Rajpura Town (mile 137/5 to 138/2) in Ambala District.	37,400	

List of Books added to the Roads Organization Library during March, 1951

- HIS MAJESTY'S STATIONERY OFFICE, LONDON.**
1. **Tree Planting in Roads and Streets in Urban and Suburban Areas.** Circular No. 24-1947.
 2. **Roads in Rural Areas-Memorandum No. 653.** Some amendments and additions to Memoranda Nos. 575 & 577.
- AMERICAN SOCIETY FOR TESTING MATERIALS, PHILADELPHIA-3.**
3. **Procedures for Testing Soils, Nomenclature and Definitions, Standard Methods; Suggested Methods.** (July, 1950.)
 4. **Symposium on Dynamic Stress Determinations.** Special Technical Publication No. 104 (June, 1950).
 5. **Symposium on Use of Pozzolanic Materials in Mortars and Concretes.** (August, 1950).
 6. **Symposium on Application of Statistics.** Special Technical Bulletin No. 103. (July, 1950).
 7. **Symposium on Accelerated Durability Testing of Bituminous Materials.** Special Technical Publication No. 94. (February, 1950).
 8. **A. S. T. M. Standards on Cement.** (with related information). May, 1950.
 9. **A. S. T. M. Standards on Mineral Aggregates, Concrete and Non-Bituminous Highways Materials.** (April, 1950.)
 10. **Procedures for testing Soils, Nomenclature & Definitions, Standards, Methods, Suggested Methods.** (September, 1944.)
- WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS, U. S. ARMY, VIEKSBURG, MISSISSIPPI.**
11. **Undisturbed Sand Sampling below the Water Table.** Bulletin No. 35, June, 1950.
 12. **T.M. No. 3-271-Soil Compaction Investigation Report No. 5. Miscellaneous Laboratory tests.** (June, 1950.)
13. **Review of Co-operative Research Road Tar Research Committee, Road Tar Bulletin No. 3** (The British Road Tar Association, 1950.)
 14. **Magic Carpets, Drawing Guide** (one Set). (Ozalid Company Ltd., 62, London Wall, London).
 15. **Principles of Public Finance** by Hugh Dalton. (Routledge and Vegan Paul Ltd., Broadway House, 68-174, Carter Land, London, E. C. 4.)
 16. **A First Course in Statistics** by D. Caradog, Jones. (G. Bell & Sons, Ltd., London, 1946).
 17. **Principles and Use of Surveying Instruments** by J. Clendinning. (Blackie & Sons, Ltd., London).
 18. **London Travel Survey 1949.** (London Transport Executive, Westminster, London, 1950).
 19. **Waterproofing Lining of Structures Below Ground Level (L' Experience et la Technique An Service De L' Etancheite Le Culvelag No. 151, October 1950.)** (Annales De L' Institut Technique Du Batiment et Des Travan Publics Paris).
 20. **Highway Safety-Motor Truck Regulation: A Report to the Governor's Conference on Highway Safety and Motor Truck Regulation** by Hubert R. Gallagher. (The Council of State Governments, 1313 E. 60th Street, Chicago, Illinois).
 21. **High Speed Computing Devices.** (Mc-Graw Hill Book Co. Inc., New York, 1950).
 22. **Specifications for Concrete Pavement Construction,** (American Association for State Highway Officials, National Press Building, Washington, D. C. July, 1950).
 23. **The New Howrah Bridge.** A Brochure. (The Commissioners for the Port of Calcutta).
 24. **LIST OF EQUIPMENTS** (Typed) Research Station. U. P., P. W. D. (B & R), Lucknow.
 25. **Runway Testing in India** by V. B. Tawadey. (Engineer-in-chief's Branch, Army Headquarters, New Delhi).

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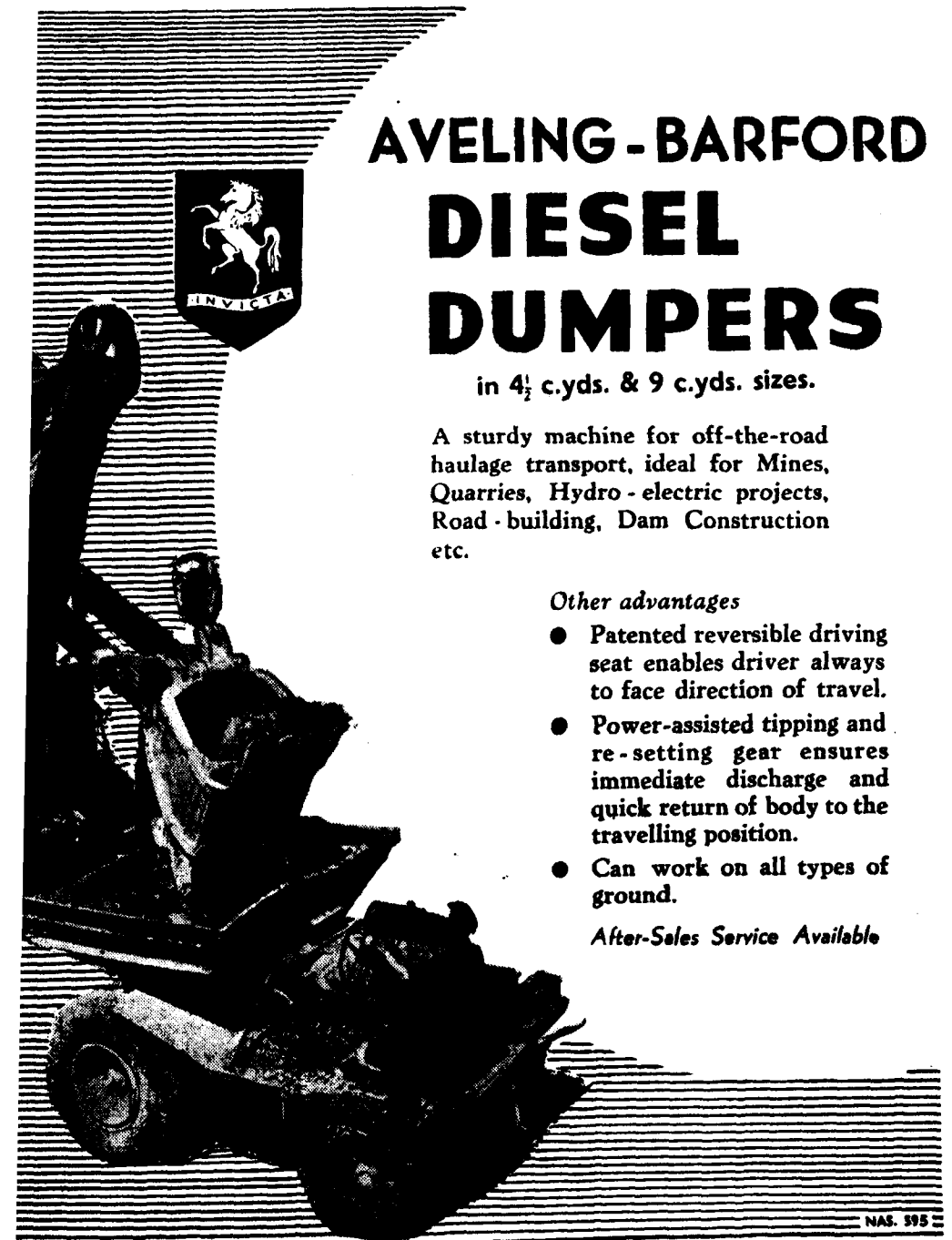
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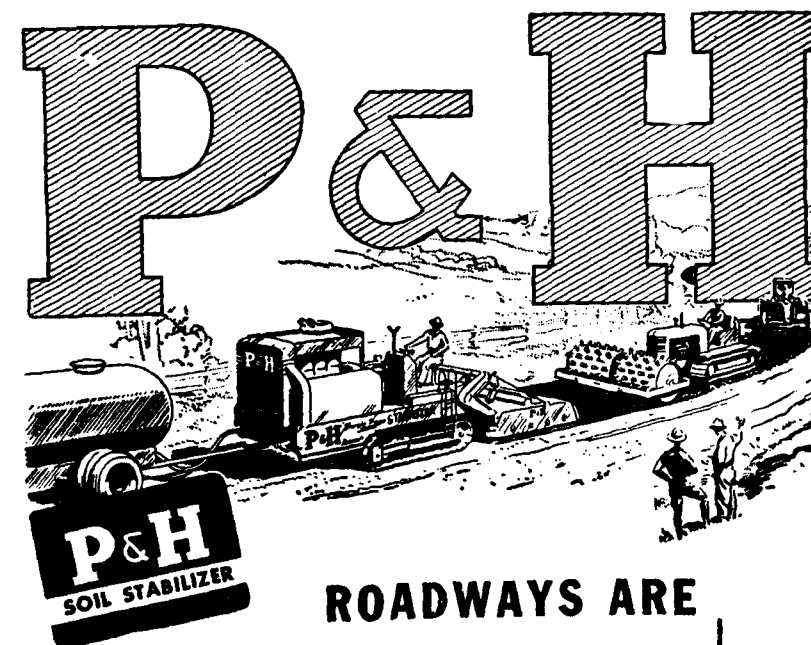
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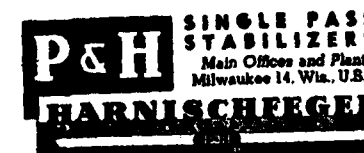
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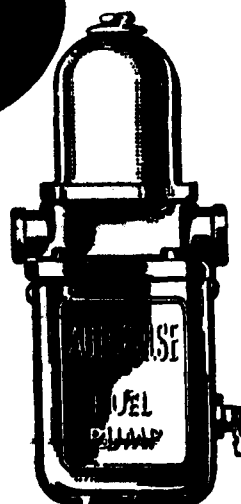
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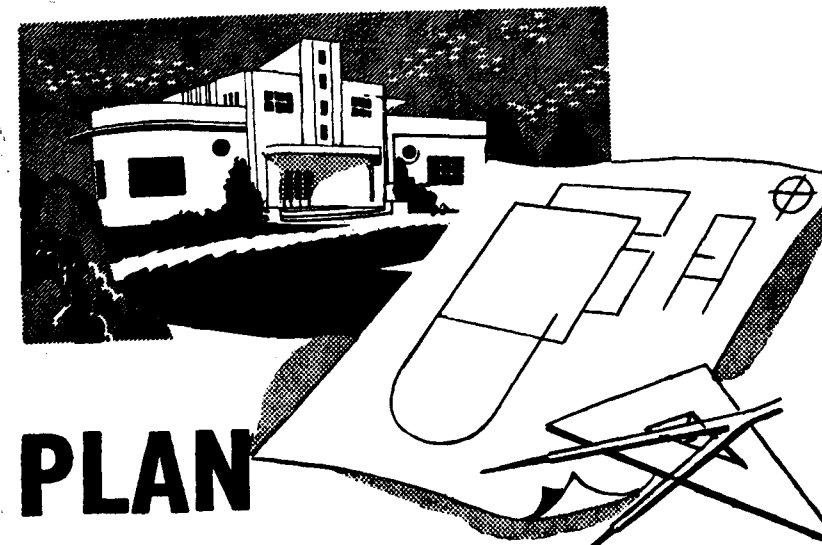
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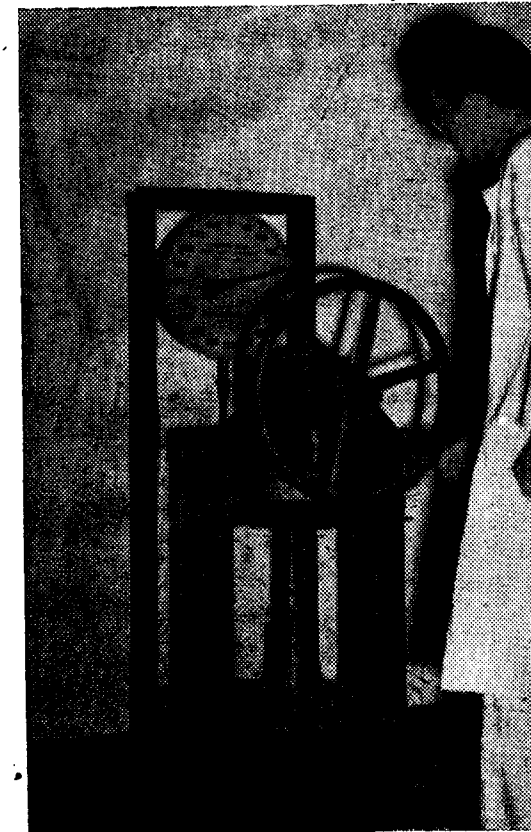
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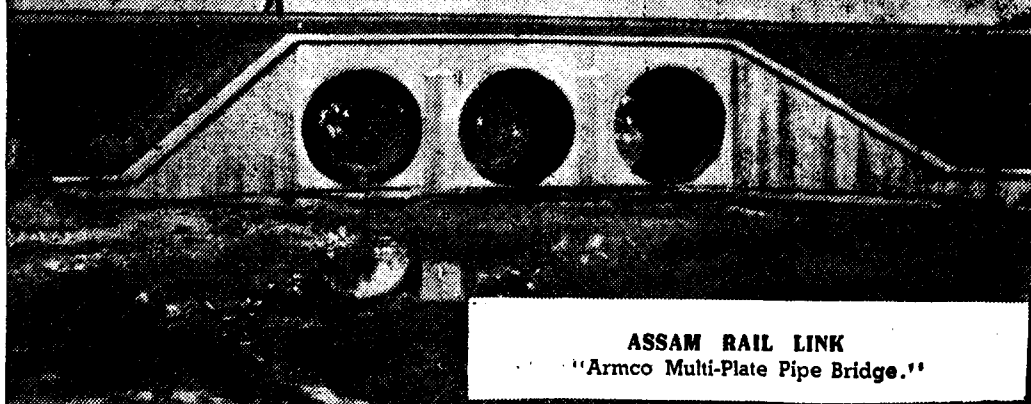
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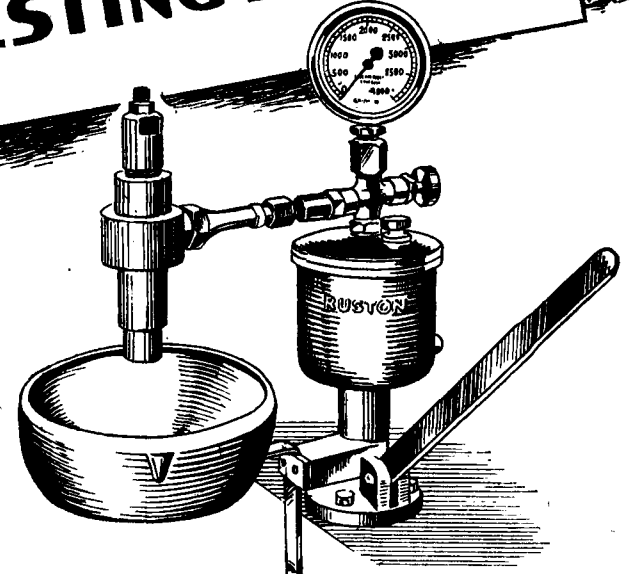
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