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ON OBSERVATION

(Extracted from 'The Engineer'—April 22, 1949).

THE space that separates the various sciences, one from the other, grows less and less daily. That is especially true of engineering, upon whose threshold stand many of the other sciences. Amongst them we number surgery, which is akin to mechanical engineering, in that manual skill is as important to the surgeon as it is to the engineer, and because many surgeons have shown in the design of mechanical equipment for their high craft an inventiveness of which an engineer would be proud.

It is with notable pleasure, then, that we acknowledge the receipt of a copy of the Hunterian Oration, which Mr. H. S. Souttar, Senior Surgeon of the London Hospital, delivered in London a few weeks ago.

A familiar definition of science is that it is the ability to recognise resemblances and differences. As Mr. Souttar remarks, "Observation itself demands a background of conscious knowledge." On this background is projected a host of phenomena. The observer begins by selecting those that appear to him to be constant. On these he founds laws, that from time to time are consolidated into great generalisations, such as universal gravitation.

That, indeed, was, of all generalisations the grandest recognition of resemblance that man has ever made, the recognition that the forces which constrained all heavenly bodies in their courses were the same as those that made an apple fall.

It is the constant endeavour of scientific philosophy to increase the background of knowledge; it seeks ever to find new generalisations; to harmonise, on a large scale or a small one, the divagations that Nature appears to present. The first step is to recognise differences. That is the business of induction, of the experimentalist and researcher.

Deductive philosophy plays its part later by attempting to blend into generalisation the ascertained facts. Now the recognition of differences calls for observation, a far, far, less easy thing than might appear, the fruit of a gift given to few men and the proper keynote of education in research.

Mr. Souttar takes an excellent example. "The mere fact that our attention has been attracted shows that something unusual has occurred, either in the external world or in its impact on our mentality. It is usually the latter, for Nature is very conservative and rarely allows a variation, but in any case, the important fact is that to us the event was exceptional.

"I suppose that for countless aeons of time men watched the stars stream across the sky before one of these men noticed that one of the stars had moved from its place. But notice that that man himself must have watched the stars for years till their permanent relation was fixed in his mind and he was startled to find that one had changed its place."

Speaking from great experience as a teacher — and teachers in engineering will confirm his view — Mr. Souttar declares that "Even elementary observation is the most difficult thing for a student to learn, and trained observation is only slowly acquired, but it is a power at which every student should aim from the first moment, and of which every teacher should enforce the value."

He offers two essential factors in observation. The first is "curiosity" to some men "the breath of life," and to others "anathema." "Whatever its true nature" says Mr. Souttar, "it — curiosity — is undoutedly an instinct essential for fruitful observation and one with which every teacher should seek to inspire his pupils."

But it can only make the background; something more is required for fruitful observation, and that something is "the training of the power of observation itself."

The history of science shows how few are the really great observers. They are born, not made, and it would be idle to expect any form of education or training to produce, *ab ovo*, even one of them. But the advance of knowledge and industry demands many humble workers, and it requires that these workers shall be skilful in observation, even though they lack the fiery curiosity which inspires the great discoverers.

ROADS IN HIMACHAL PRADESH

THE new State of Himachal Pradesh came into being on the 15th April 1948 and comprises the territories of 30 Punjab Hill States which lay round about Simla. As a result of its genesis the State is a straggling area covering 10,600 sq. miles with 950,000 population, mostly living in small hamlets. The state is divided into four administrative districts: Mahasu, Sirmoor, Mandi, and Chamba.

The main products are potatoes, vegetables, fruit, timber, firewood, wool, etc. Recently huge deposits of rock salt have been discovered in the Mandi district. The State is the largest source of coniferous timber in Northern India. Forest conservation is essential not only from the point of view of the State but on the protection of these forests also depends the steady and equable flow of rivers like the Yamuna, Sutlej, Beas, Ravi, and Chenab.

The area is mountainous, rising from the plains near Ambala to some of the highest Himalayan regions. The country is on the whole difficult from a road builder's point of view.

As some of the main products of the region are highly perishable, for example, potatoes, vegetables and fruits, quick transport is of vital importance to this region. Although there are some good roads in the State, a much bigger network is required.

The existing motorable roads and bridle tracks in Himachal Pradesh are tabulated below.

Type of Surface	N. H. 22 (Mahasu Distt.)	Other Than National Highways				Total	Grand total
		Mahasu	Sirmoor	Mandi	Chamba		
1	2	3	4	5	6	7	8
Motor Roads							
Surfaced:							
(i) B. T.	9.5+21P	1	26.5	4+47P	—	78.5	109
(ii) W. B. M.	6.1	—	12	—	—	12	18.1
Unsurfaced	36.4	33	81.6	83+32P	28	257.6	294.0
Total	52 +21P	34	120.1	87+79P	28	348.1	421.1
Bridle Paths							
Uusurfaced	201	484	3	170	484	1141	1342

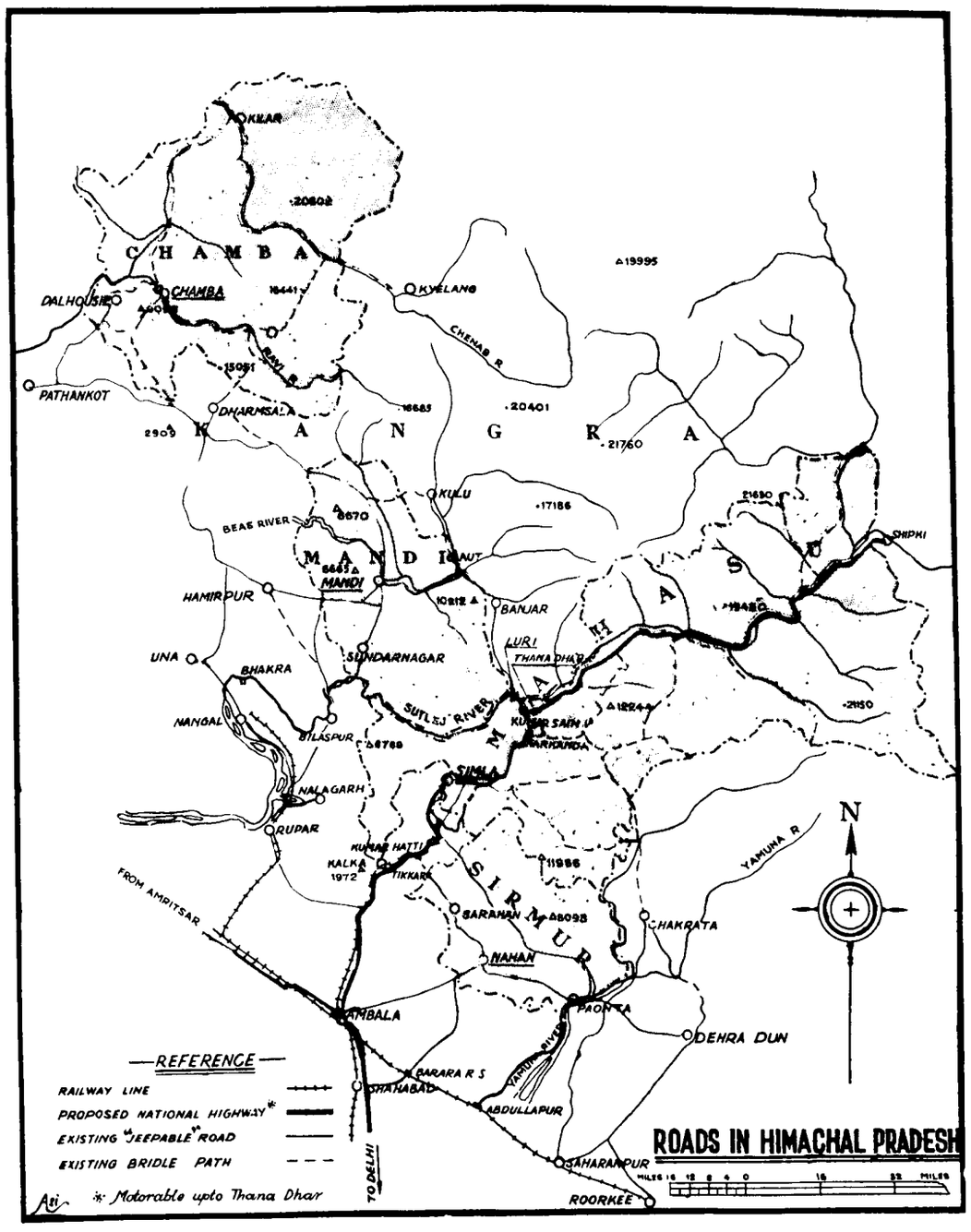
The total length of motorable roads is 421 miles, 127 miles being surfaced and 294 unsurfaced.

The milage of bridle tracks is 1,342. This figure does not include the tracks in the charge of the Forest Department.

Milages marked P are within Himachal Pradesh but are maintained by the Punjab P. W. D. They are portions in Himachal Pradesh of :—

Kalka-Simla Road (N. H. 22)	...	21 miles
Pathankot-Mandi Road	...	47 ,,
Mandi-Kulu Road	...	32 ,,
	Total	100 miles

The entire length, 127 miles, of the surfaced motorable roads is (except for the 18 macadamized miles) black topped and in excellent condition.



The unsurfaced motorable roads, 294 miles in length, are mostly hill roads with narrow formation widths (10 to 12 feet), sharp bends, steep gradients, and rough surfaces. That is so as most of these were originally bridle tracks. They have been made "motorable" by carrying out minor improvements, consisting largely of widening the formation to 10 to 12 feet. They are not fully bridged. Motor traffic is possible on them only in the fair weather. Even then one is forced to drive slowly and cautiously and only skilled drivers go on them. During the rains many unbridged streams become impassable and the road surfaces are skiddy. As the country is difficult and mountainous it will take many years and enormous funds and other resources to make roads safe and all-weather (surfaced and fully bridged).

The Bridle Paths

Although some motor traffic is intermittently possible now along these so-called "roads" the bridle tracks, 1341 miles, are still vital to the economy of this State. They straggle all over the face of the mountainous and wooded land. Essentially they are village roads as the towns they connect are hardly bigger than villages in the plains. In the days of the Rajas, much work was done on these tracks through village labour. The practice cost little or nothing and was very efficient. Whenever a track was damaged the nearest villages quickly supplied voluntary labour and repaired it. The village headman looked after the work. Now the position has changed People expect Government to do everything. Funds are limited and it is not possible for a Central P. W. D. agency to reach all places in time. In these circumstances it is conceivable that all damage is not repaired in time and, on account of lack of proper supervision, the meagre available funds are not well utilized. It is not improbable that some of these tracks have deteriorated recently.

The people of Himachal Pradesh are agitating that the roads of the State have been deteriorating since the State was formed. This is not the precise truth. The roads are being gradually improved and extended although some of the bridle tracks may have deteriorated in places. It seems necessary that the responsibility of keeping these tracks in good repairs should be somewhat decentralised and the people themselves should accept a good measure of it.

If Himachal Pradesh had its own budget like Class A States, the current year's budget would be roughly figured as under :—

(The figures are taken from the Government of India's Budget for 1950–51 and have been rounded off.)

Receipts	Rs (Lakhs)
From Area Heads	188
Share in Income Tax	12 approximately
	200
Expenditure	
On Area Heads	139
Under Other Demands	11 approximately
	150

Thus there is a surplus of Rs 50 lakhs.

Himachal Pradesh is a backward State, socially and economically. It has to be developed and therefore it has a claim to some Central subvention. On this assumption we ought to be spending more on nation building activities in Himachal Pradesh than we are at present.

This year Himachal Pradesh is spending nearly Rs 11.00 lakhs for the maintenance and development of roads (including National Highways). This is about 5.5 per cent of the State's revenue and is on the low side as, in a well developed State, expenditure on roads should amount to 6 to 9 per cent of the revenue. Rs 20 lakhs a year would be a more fair allotment for this purpose. All this grant will for many years be absorbed by the essential improvements of the existing roads and some urgent extensions thereof.

The following road schemes are long term projects and could be undertaken when normalcy is restored and finances improve.

(i) **Connecting Simla with Mandi.**

This will require the construction of a new road, about 70 miles long, from Narkanda to Aut via Luri. Aut is on the Mandi-Kulu road and Narkanda is on N. H. 22. The terrain from Narkanda to Aut is mountainous and difficult for road construction. The project will cost Rs 200 lakhs approximately. Nearly 80 per cent of the road will be in the Punjab. A proper motorable road would mean a large scale realignment of the existing bridle track. In the meanwhile the bridle track could be improved in those sections which are certain to form a part of the future larger scheme The portion Narkanda-Kumarsain-Luri, which lies in Himachal Pradesh, can be developed now.

(ii) **Connecting Simla with Dehra Doon via Nahan.**

From Kumarhatti on the Simla-Ambala road (N. H. 22) an entirely new road, about 15 miles long, will have to be constructed to Tikkar. The terrain is mountainous and the cost will be high, about Rs 15 lakhs.

From Tikkar to Nahan (38 miles) the existing road is classed as "motorable unsurfaced". Here no large scale realignment is required. But the road is narrow and dangerous, and widening and surfacing in this section is needed.

From Nahan to Paonta and further to Rampurghat (on the right bank of the Yamuna) a good motorable road exists. The length is 32 miles. Twenty miles of it are unsurfaced and some streams are unbridged. This section is now receiving attention.

At Rampurghat there is a ferry across the Yamuna. From the other (left) bank of the river the road system of Uttar Pradesh begins. We come to milestone 41 of the Saharanpur-Chakrata road.

There is a general shortage of tools and plant everywhere in the Himachal Pradesh. Another difficulty is due to the political history of the Pradesh. Before integration some of the major States, like Sirmoor and Chamba, owned some road-building equipment, for instance steam road rollers and tar boilers, but these parts of Himachal Pradesh are not inter-connected and have hundreds of miles of intervening mountains. Thus a situation has arisen that the few tools and plant which are available cannot be put to full use, for they cannot be transported to the various parts of the State. It may be possible for the State to come to some understanding with the neighbouring districts of the Punjab (I) for mutual loaning of tools and plant.

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THE ENGINEER AND THE CAT

Spare that cat! Army Engineers, who claim to be stopped by nothing, have been. A cat family—mother and three kittens—which moved into the gear box of a huge crane at the engineer Research and Development Laboratories at Fort Belvoir, Va., has refused to move or be moved to make way for a painting project. When paint shop employees prepared to move the crane into the foundry for the painting, the feline family was found in the gear box. Starting of the machine would produce only catburger, while dismantling of the gear box would mean hours of labor and considerable money. The paint job was postponed.

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THE CIVIL ENGINEER AND ROAD TRANSPORT

(Extracted from 'Highways and Bridges'— May 31, 1950)

A recent article in the Press grouped the occupation of the newly-elected members of the House of Commons. Lawyers and trade union officials were numerous, but engineers, particularly civil engineers, were conspicuous by their absence. **The absence of this type of man from the councils of the nation is to be regretted.**

The civil engineer is a man whose job in life is to get things done. At present, he generally comes into the picture rather late in the day, often after decisions have been made that additional facilities for the benefit of the community are required.

The Institution of Civil Engineers in their Charter describe the civil engineer as a man who is concerned with "the art of directing the great sources of power in Nature for the use and convenience of man." It is, unfortunately, true that politics do not seem to interest the engineer to any great extent: he is a technician, interested in ways and means of doing constructive things, and the technical consequences of those things. This is a pity, for his trained technical brain has something of value to contribute to the affairs of the nation. At his institutions and learned societies he discusses engineering works which have been, or are to be, carried out, and other matters connected therewith, such as the economics of various forms of engineering construction, the giving of engineering evidence, the procedure to be followed as an arbitrator, etc., but all these things follow on after policy has been decided, and with policy itself he has nothing or very little to do.

The engineers of this country and of Europe do not lack the knowledge of how to do things, either in their own countries or overseas. There is no magic about building highways, and no mystery about the most modern methods of construction and layout; it is a scientific technical process, requiring skill, labour, machines, material and money, but the opportunity to construct an up-to-date road system is lacking. If more civil engineers would interest themselves in the overall economies resulting from the carrying out of engineering works, which can be proved to be necessary in the economic interests of the country, and at the same time project themselves into surroundings where their opinions would carry weight, more opportunities would arise. In no sphere is this more apparent than in the realm of road transport.

The following quotation from the American Highway Engineer's Handbook, by Blanchard, is of interest. After discussing various methods of financing the carrying out of road works, Blanchard says: "There is a notion quite generally prevalent, even among engineers themselves, that their proper function is to plan and execute the work, but that the duty of determining general policy, more particularly that relating to financial considerations belongs to the administrative heads of the highway department, whether of state, county, city or township. The engineer has a distinct responsibility for every phase of his work and he should not shirk it. Self-interest as well as professional pride should urge him to assume a stronger position than he has hitherto taken. **It is the duty of the engineering profession to enable the public to get a dollar's worth for a dollar's expenditure, whether it relates to public or private work, and this means an engineering organization from top to bottom."**

Plea to the Higway Engineer

My plea to the highway engineers is to take more interest in policy when reporting on road projects and always to include reference, supported by the fullest economic facts, to the important economic benefits to be obtained from road transport by a modern up-to-date highway system. This is not to be taken as meaning that highway engineers are indifferent to these questions. I should like to take this opportunity of paying a tribute to the excellent report of the County Surveyors' Society of May 9, 1949, to the County Councils Association on "The Allocation of Government Funds for Highway Purposes." Among many instructive things, they say:

> "The annual rate of resurfacing Class I roads for 1949-50 is one mile in 44 years, and on Class II roads one mile in 68 years, the average for both classes being one mile in 53 years". Their comment on this is: "We are bound to advise that surfacing materials cannot be expected to remain in condition for such periods of time as 53 years. Deterioration in those circumstances will be an accelerating process and may in the ultimate involve the almost total reconstruction of some roads which could otherwise have been kept in condition." ..... "it would be economically wasteful substantially to repair certain roads now urgently requiring attention without at least the minimum of concurrent realignment."

No comment is needed from me as to the resulting adverse effect on the cost of road transport if there is to be no improvement in the present rate of maintenance and improvement.

* * *

Economic Advantages

The economic advantages to be obtained from highway development is no academic theory A study of this subject is an instruction in the history of any country, and invariably shows that industrial development, increased prosperity, and a general rise in the standard of living, follow the construction of roads. That this must be so is obvious, for the facilities for movement enlarge the outlook of the population, provide means for freer and safer intercourse, increase the demand for commodities, and give scope for social progress.

* * *

[The Author then gives a brief sketch of the benefits of road building from the year 1391 to 1828.]

These examples from the past are given as a matter of interest and to show the effect of roads in Great Britain. Ever since those days the construction of new roads and the improvement of existing roads has similarly benefited the community, but the public has not been made fully conscious of this, or of the possibilities of road transportation. I need only refer to the increase of land values, and the advantage to traffic, and industry, which resulted from the construction of the arterial roads round London after the 1914-18 war.

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What of the Future?

So much for the past. What of the future? The pressure of economic factors which gave us our present roads still operates, but to an increasing extent. The original cry of the people was: "Get us out of the mud." The cry now surely is: "Get us out of the muddle—give us the opportunity to make the fullest use of road transport." The Road Haulage Executive, in a recent advertisement, have themselves stated the case when they say: "They can undertake express transit of perishable goods because they are so flexible, and can carry any type of load because every type of vehicle is available." There you have the gist of the advantage to the nation of road transport. **The efficiency of the modern vehicle has outpaced the efficiency of the track on which it travels, and the nation's responsibility is now to unshackle road transport by providing a track as efficient as the machine.**

Present Problem

Thus we reach our present problem of persuading all Governments in their national interests to agree to a programme of road works and to provide funds over a term of years to enable highways to be constructed and modernised so that they can deal with vehicles travelling with safety at speeds of from 50 to 70 miles an hour in the open, and to circulate without congestion at a uniform speed in the built-up areas, without killing and maiming people at the present high accident rate.

In the proper solution of this transport problem lies the answer to much of

our future prosperity, and all highway engineers can, and should, take a very active part in bringing the problem and the economic facts connected with it fully before the public.

Road transport in built-up areas is increasingly penalised by the growing traffic congestion. It may be that our concentration on the advantages of the modern highway for quick passage between centres of population has to some extent clouded our outlook to the fact that the city and its environments are becoming the main traffic bottlenecks. In some cities, we are possibly watching slow economic strangulation as the increasing volume of 20th century traffic tries to force its way through 18th century streets. Today, the highway system is not a complete system, but really a rural one, interrupted by weak city links. This is not a real highway system and it is doubtful if any of us fully realise what a highway system could be, with the potential development of road transportation. The motor vehicle has already had a fundamental effect on industry, agriculture, education and recreation, and on many other activities of life. It will continue, and can no more be stopped than King Canute found to his dismay when he tried to stop the tide coming in.

In this country, a high percentage of road traffic is relatively of short distance, especially in the neighbourhood of large cities. Whatever is done to expedite the movement and passage of traffic through rural areas, and whatever development takes place in the air, the fact remains that short-distance city traffic will be with us as a problem long after the long-distance transport has been solved. It is in the built-up areas, where traffic volumes are heaviest, the accident rate highest, congestion greatest, and unfortunately, where the costs of remedial works are heaviest.

Ring roads or By-passes?

In large concentrations of population the major traffic difficulties occur towards the centre. The solution of the traffic problem depends on the size of the town and the nature of the traffic. In some cases, a ring road is required primarily to act as a distributing road for traffic proceeding to different parts of the town, and to take care of any through traffic there may be. Investigations have shown that in many large cities, of the total converging traffic 80 to 90 per cent may require to enter the area, whilst in smaller towns the traffic requiring to enter the area may be as low as 10 to 15 per cent. In the one case a ring road is the answer, and in the other a by-pass, both designed to pass traffic to its objective with the least delay and minimum interference with purely local traffic.

* * *

Traffic Increase

In the meantime, traffic continues to grow, the growth in numbers of industrial vehicles being most marked. The freeing of petrol will undoubtedly increase the tempo of this growth, particularly in the number of private cars; and in this event traffic movement, already hampered by inadequate roads, the parking of cars on the highway, and other obstructions, would be still further penalised.

If the use of private cars into congested areas is to continue, **parking facilities** must be provided, but not at the expense of street space. The problem is acute, and continued pressure should be exercised on those erecting large domestic and commercial premises likely to attract traffic to provide facilities off the highway. In other words, they should be called upon to provide facilities to "consume their own cars".

The road transport facilities required can now be provided in less time and with less expenditure of manpower by the use of machines than at any time in the past. Machines and organization methods have made it possible to increase the productivity of labour very considerably and to reduce costs. This needs to be borne in mind when allocation of labour is under consideration.

How to Reduce Costs

The question of the cost of highway works is an important one. **A definite continuous programme of highway works spread over a term of years would reduce constructional costs, be-**

cause such a programme would justify the acquisition of modern constructional machines, and continuity of work for these machines would be assured.

* * *

The question of efficient and low-cost transport is scarcely a party issue, and it is odd that none of our ambitious statesmen have taken interest in a subject which effects the cost of everything and therefore all of us, but history seems to teach that so far as Europe is concerned democracy never has been much interested. It is possibly because it is one of those intangible things which cannot be readily grasped by the electorate. Be that as it may, it has been left to the dictators, beginning with the Caesars, and in modern times Napoleon, Hitler and Mussolini, to be the great road-builders—a sobering thought—and it was only during the decline of the Roman Empire that the Romans occupied themselves with "bread and games." Is there a lesson here for us?

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Quiz Corner

ROAD MILAGE QUIZ

DO YOU KNOW?

1. The metalled extra-municipal road milage per 1,000 Sq. miles of area, in India is

   (a) 44 (b) 74 (c) 104

2. The metalled road milage per lakh of population is

   (a) 29 (b) 39 (c) 49

3 The unmetalled road milage per 1,000 Sq. miles of area is

   (a) 24 (b) 74 (c) 124

4. The unmetalled road milage per lakh of population is

   (a) 48 (b) 108 (c) 208

Answers:

1(b); 2(a); 3(c); 4(a).

THE HISTORY OF FEDERAL AID FOR HIGHWAYS IN THE U. S. A.

(Extracted from 'California Highways and Public Works'—January—February, 1950)

INCREASED automobile production and use in the United States between 1910 and 1915 brought an increasing demand for more and better highways.

The growth of the country was spreading back from the railroads and farmers wanted better means of reaching the nearest towns and railroad stations than were provided by local existing roads, most of which were dusty in summer and bog holes in winter.

The financing of the improvement of these roads by local and state bond issues had become such a drain on local resources that the states turned to the Federal Government for financial assistance.

Act Passed in 1916

The Congress of the United States, recognizing its responsibility to the states in the construction of these rural roads, passed the Federal Aid Road Act which became law on July 11, 1916. Their authority was Section 8 of the Constitution of the United States, which granted power to the Federal Government to establish post offices and post roads for the transportation of the mails.

This Federal Aid Road Act provided for the improvement of any rural road over which the U. S. mails then were or might thereafter be transported, a provision so broad as to include almost any rural road. However, it prohibited expenditure of federal funds on any road or street within the built-up portion of any place of more than 2,500 population. It appropriated a total of 75,000,000 dollars to be spent over a five-year period and permitted federal participation in payment for the roads constructed up to 50 per cent of the total cost or a maximum participation of 10,000 dollars a mile, the remainder to be paid from state funds.

Formula Used

The act prescribed a formula to be used in apportioning the federal money to the states. The formula employed ratios, each with identical weight, which were the percentage relations of the area, population and post road mileage of each state to the total area, population, and post road mileage of the United States.

The Office of Public Roads and Rural Engineering, a part of the Department of Agriculture, administered this federal money.

States' Initiative

This original act preserved for the states the initiative in determining what roads were to be built and type of improvement. It authorized the Secretary of Agriculture to approve or reject the states' proposals. It placed immediate supervision of construction in the hands of the state highway departments but required that such construction must be accomplished in accordance with sound engineering practices. This it did by **withholding final federal payment on a project until it had passed federal inspection**. In addition, it required that the states advance their own funds and pay for the work undertaken. Finally, it imposed upon the states the duty of adequate maintenance of the completed federal aid project.

The projects were identified in each state numerically the first improvement being number 1, with the prefix F. A. P.

World War I seriously handicapped the states in expeditiously obliging the federal aid provided by the initial 1916 act.

* * *

As a stimulus to increased highway construction following the armistice, Congress provided an appropriation of 200,000,000 dollars of federal funds for highway construction and increased the federal share from 10,000 to 20,000 dollars a mile. This was accomplished under the Post Office Appropriation Act of February 28, 1919. This act also provided for the distribution to the states of surplus war material, equipment, and supplies which could be utilized for federal aid highway

improvement and subsequent maintenance operations thereon.

MacDonald Made Chief

To efficiently supervise this increased federal aid programme the Office of Public Roads and Rural Engineering was re-organized into the Bureau of Public Roads with Thos. H. MacDonald from the Iowa State Highway Department as the head. His title was Chief of Bureau

* * *

With these additional federal funds and the lifting of wartime restrictions the provisions of the Federal Aid Road Act were promptly put into practice and an outstanding defect of omission in the federal legislation was quickly discovered. The rather loose provision for the improvement of rural mail routes resulting in their construction at widely scattered locations precluded the possibility of any reasonable completion of connected improvements. The jigsaw pattern of these mail roads, while designed to provide mail delivery to our rural population, did not necessarily follow those roads on which traffic was concentrating. **The need for a system of roadway development was eminent.**

Congress Acts

This condition was promptly remedied by Congress with the passage of the Federal Highway Act of 1921 which provided for the selection of a system of federal aid routes and limited the expenditures of available and future federal aid apportionments to these routes.

The system, to be designated by the highway departments of the states, was limited to 7 per cent of the total rural road mileage of the state as existing at the time of passage of the act.

* * *

This initial "Seven Per Cent System," as it was commonly referred to, was composed of highways interstate and intercounty in character and included the most important state highway routes then in existence.

Public Lands Legislation

Large areas in the western part of the United States are composed of public lands, and Congress, realizing the Federal Government's responsibility in the improvement of federal aid roads that might be built therein, provided for an increased ratio of federal participation in such states. The Federal Highway Act of 1921 stipulated that, in any state containing unappropriated public lands in excess of 5 per cent of the total area of all lands in the state, the federal share of the costs of improvement would be increased by 50 per cent of the per cent of unappropriated public lands in that state. Thus California, with approximately 18 per cent unappropriated public lands, benefitted to the extent of an additional 9 per cent, resulting in the federal share of participation in the cost of a federal aid project of approximately 59 per cent.

Adequate Powers for States

Perhaps one of the most important features of the Federal Highway Act of 1921 was the strengthening of the provision requiring a state to have an adequate state highway department in order to avail itself of the federal aid provided. The act required that the state highway department must have adequate powers and be suitably equipped and organized to discharge to the satisfaction of the Secretary of Agriculture the duties required thereunder. Rules and regulations were established by the Secretary of Agriculture to carry out the provisions of the act and serve as a guide to the proper administration of federal funds.

The Federal Highway Act of 1921 was so sound in principle that it has served as a basic law for governing the federal aid programme for over a quarter of a century.

Matching Funds

With the Fiscal Year 1923 Congress began the practice of authorizing appropriations for a succeeding period of two to three fiscal years which has enabled the states to plan ahead and provide enabling state legislation for procuring the anticipated necessary state matching funds. Aside from authorizing and appropriating federal sums during the period 1923-30, no attempt was made by Congress to alter the conditions governing the expenditure of these funds except in respect to the maximum federal participation per mile. The mileage limitation was changed in 1923 from 20,000 to 16,250 dollars per

mile for that year and 15,000 dollars per mile thereafter and in 1930 it was changed to 25,000 dollars per mile.

All limitations with respect to payments on a mileage basis were removed by a subsequent act of Congress on June 18, 1934.

Depression Relief

The depression in the early '30's necessitated federal assistance to the states for the relief of the unemployed.

The first major relief legislation was the passage of the National Industrial Recovery Act on June 16, 1933. Under Section 204 of this act the sum of 400,000,000 dollars was granted to the states for construction of public highways. Seven-eighths of this sum was apportioned among the states on the basis of the original Federal Aid Act formula; that is, on an area, population and post road mileage basis. The remaining one-eighth was apportioned in the ratio which the population in each state bore to the total population in the United States.

This federal grant was not required to be matched with state funds and could be expended to pay the entire cost of preliminary engineering and construction of projects on the Federal Aid Highway System and extensions thereto into and through municipalities and for the improvement of secondary or feeder roads to be agreed upon by the Federal Government and state highway departments. The money could also be utilized for eliminating hazards existing at railroad-highway grade crossings by the construction of seperation structures and the installation of adequate protective devices.

Secondary Roads

The rules and regulations promulgated for the administering of the funds provided by this act defined secondary or feeder roads as farm-to-market roads, rural free delivery roads, and public school bus roads which are not a part of the Federal Aid Highway System. They could, however, be either part of the state highway systems or important local highways leading to shipping points or which would permit the co-ordination or extension of existing transportation facilities, including highways, rail, air and water.

* * *

(To be Continued)

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KERNELS FROM THE RESEARCH MEETING

Research needn't all be formal. Research-type thinking can go on every day.

* * *

There's not enough investigation of the case-history type, everyone being so engrossed in getting on with new work.

* * *

Better tie-up between state highway department and engineering colleges needed in many states. Encourages postgraduate highway engineering study; sets stage for better job of applied and fundamental research; fosters closer teamwork and greater interest in highway careers; vitalizes teaching.

* * *

The "in-between" urban projects, meaning arterial streets and expressways at grade, need more attention in the scheme. Most cities cannot afford full-dress limited-access construction.

* * *

(Extracted from 'Roads and Streets'—January, 1950).

MARSHALL AID FOR FRENCH EQUATORIAL AFRICA

THE following description of road building in FRENCH EQUATORIAL AFRICA, which has been extracted from material recently received from the Information Division, E. C. A, Special Mission to France may be of interest as an example of the use of metropolitan Marshall Aid funds for Colonial road development.

This vast country, five times the size of France is, at the moment, the largest producer of cotton, wood, diamonds and gold of any French colony and will, undoubtedly, in a short time, become an important source of oils, rice and secondary fibres. The two main draw-backs to its development, however, are the great distances involved and its small and widely scattered population.

Firstly, the problem of distances has to be overcome by a modernised network of highways, waterways and railroads, in order to facilitate access to and from world markets. Then such questions as drainage and irrigation and the clearance of tracts of dense forest for the purpose of cultivation, the development of mineral resources, agriculture and education have to be solved. A "Ten Year Equipment Plan" has, therefore, been drawn up embodying these various projects.

French authorities and African experts are agreed that **the most urgent need is a modern highway system, for without roads the territory will remain primitive and undeveloped for years to come.** Under the "Ten Year Plan," it is estimated that some 16 thousand million francs should be set aside for highway development alone: this to be undertaken with the help of heavy road-building equipment imported from the United States, under the Marshall Plan.

Ten-Year Road Programme.

This programme includes the building and improvement of some 8,500 miles of roads, the first phase of which involves 3,125 miles of main roads linking the ports of LIBREVILLE and POINTE NOIRE with the main cities of BRAZZAVILLE, DOUALA, BANGUY and FORT LAMY.

Marshall Aid equipment, which includes some 40 heavy tractors and bulldozers; 3 mobile machine shops; 3 gravel-making plants; 7 tree-dozers; 25 dumpers for the transport of gravel, and other miscellaneous machinery and plant, for maintenance purposes, has already been shipped through LIBREVILLE. Such items as steamshovels, draglines, rock-crushers, compressors, scrapers and two giant derricks have been despatched to BANGUY, via the Congo-Ocean railroad.

A force of only eighty Europeans, with the help of native labour, is in charge of this highway project, and LIBREVILLE, formerly a settlement for freed slaves, is today the scene of intensive training of their descendants, who are being instructed by the French in modern mechanical methods.

Engineering surveys for the project include some of the first aerial surveys to be made of this part of Africa and the mapping of various sectors of the territory through which the proposed roads will pass.

Until now, the potentialities of French Equatorial Africa have hardly been tapped, but when such fundamental problems as distance and mechanization have been solved, its potentialities are likely to be almost unlimited.

As far as French economy is concerned, transport improvements in Equatorial Africa will mean a more plentiful supply of, and hard currency savings in, such commodities as cotton and coffee.

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ROAD REPAIR TECHNIQUE: FINDINGS OF THE D. S. I. R.—SURFACE DRESSING WITH TAR

(Extracted from 'Municipal Review'—May, 1949).

Some 100,000 miles of the 180,000 miles of road in the U. K. carry their traffic upon surface dressings. These are used on a wide variety of roads, ranging from heavily trafficked trunk roads to lightly used residential streets. The binder for most of this work is tar.

SURFACE dressing is by far the cheapest form of road maintenance. The next cheapest, the carpet, is several times more expensive Surface dressing assumes, therefore, particular present importance when funds for road work are so severely restricted. Many recent examples have been brought to light of roads, surface-dressed before the war that have since withstood heavy traffic without further treatment. A life of five years is frequently quoted, and cases of over ten years are not uncommon.

Yet, in spite of such records, surface dressing is regarded in some quarters as a necessary evil, and the engineer responsible for main road maintenance is often in doubt as to whether or not he should use it. This is because the risk of early failure is greater from surface dressing than from a carpet. In spite of examples of lives of ten years or more, cases are not infrequent in which dressings fail within a year of being laid.

If a life of ten years can be obtained on some occasions, why not always? A considerable amount of research has been undertaken into this matter as part of the co-operation between the Road Research Laboratory (of the Department of Scientific and Industrial Research) and the British Road Tar Association. As a result a fairly good understanding of the principles that must be followed to ensure good results has been achieved.

Results of researches have shown that the most important factor in technique is **the rate of spread of tar.** Premature failure of a dressing by loss of stone results usually from inadequate thickness of binder film in relation to the size and type of chippings and to the condition of the old road surface.

Without repeating here the details of these documents, attention can be drawn to the more important factors affecting the quality of surface dressings. As surface dressing is adopted on such a big road milage, relatively small improvements must lead to substantial financial savings.

A surface dressing consists of a single layer of stones held to the road by a film of tar or other binder, and it cannot restore the riding qualities of a road become misshapen. The functions of the surface dressing are to provide—

a sealing coat preventing the ingress of water to the fabric and foundation of the road;

a fresh binder at the road surface which arrests disintegration, and

a non-skid surface to a slippery road.

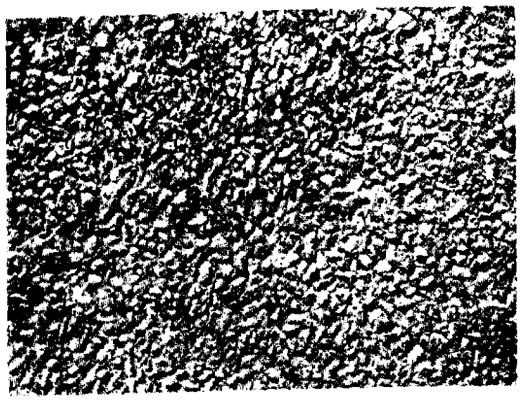
It is the function of a "carpet," and not of a "surface dressing," to take out the waves and other irregularities in a road surface.

A dressing that fails prematurely does so either by "scabbing" through early dislodgment of the stone, or through the binder working to the surface and causing "bleeding." The production of a good surface dressing thus consists primarily in preventing either of these defects.

Surface dressing is a particular case of an adhesive process in which tar acts as the bond between the stone and the road surface. The principles involved in making a good adhesive joint must therefore apply here also. The tar adhesive must, when applied, be fluid, so as to "wet" the road and the stone. It must then set so as to hold the chippings firmly in position.

Good wetting is helped by road and tone surface reasonably free from moisure or dust. Stone chippings have a greater affinity for water than for tar, and herefore will not be wetted by tar until hey are comparatively dry. When the tones are dry, good wetting can occur if he tar is sufficiently fluid at the road emperature to flow into the stone surface exture. The tar gradually "sets" by ncreasing in viscosity through evaporation of its volatile constituents.

A joint is, of course, stronger if the components interlock. This occurs in a remarkable manner in a good surface dressing by the stones forming a close mosaic. Such a mosaic is illustrated.



CLOSE MOSAIC FORMED by Stones interlocked in a good surface dressing, after five years wear.

Although the actual process of applying a surface dressing is simple and straightforward, there are so many factors affecting the results that this type of treatment really constitutes quite a complex problem.

These factors may be divided into the following groups:

The properties of the materials used:

Pertaining to the tar—

type and quality

and

viscosity

Pertaining to the stone chippings—

type and strength,

size and shape, and

surface properties (texture, porosity, dryness and dustiness).

Method of application:

quantity or rate of spread of tar,

do do of chippings,

weight and type of roller, and time interval for opening road to traffic.

The above items are all within the control of the engineer and must be chosen so as to meet the requirements imposed by the following:

External conditions:

conditions of the old road surface, traffic, and

weather and time of year.

External conditions are not controllable, but can be defined within certain limits. Weather is the most difficult of the external conditions to allow for, since in this country (U. K.) it is impossible to predict except for short periods.

(To be continued.)

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SEX IN BOOKS

"The perfect hostess will see to it that the works of male and female authors be properly separated on her bookshelves. Their proximity, unless they happen to be married, should not be tolerated."

From an old book "Etiquette" by Lady Gough.

London, 1863 on Etiquette.

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HERE AND THERE

1. ROADS AS BUSINESS

RAILWAYS are recognised as one of our greatest national assests.

The same recognition has not been accorded to roads though they are as important an asset as railways are.

So long as they were only a convenience provided by Government for the use of all and sundry, their neglect was understandable though not excusable.

Now that road transport has been undertaken by Government as a business, carelessness in road maintenance is less excusable than ever.

The figures of the loss incurred by the Government in the working of the Bombay State Road Transport Corporation because of the badness of the road surface are surprising.

The Chairman estimates that if the main highways of Bombay State are given concrete surfaces, there would be a saving of about Rs 2 crores annually in the Corporation's budget.

The capital cost involved in the concreting of 22,000 miles of roads would be cheap when the annual savings are considered.

Unlike railways, roadways are a great economic asset also to the general public.

Good roads will step up efficiency of transport to the great benefit of the villagers.

In pre-war days Germany set the example in the making and maintenance of fine roads.

We should try to follow that example.

Immediately after the war, great plans were announced for roads running from one corner of the country to the other.

There was, for instance, a scheme for a Bombay-Cape Comorin Road which would serve the railwayless regions of the West coast.

Nothing much is heard of these schemes now.

Government should treat expenditure on roads not as charity to the public but as investment on which excellent dividends will be paid.

(*Extracted from 'Free Press Journal'—Bombay, 5-7-1950.*)

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2. THE TRANSPORT PROBLEM—OPPOSING CONCEPTS

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SIR CYRIL HURCOMB, in a speech at Darlington, to which we referred last week, was able to point to some worthwhile achievements in railway traffic working, whilst in a subsequent address to the Manchester Statistical Society he gave a masterly review of the steps which are being taken to solve the transport problem, which is by no means peculiar to this country. He reminded his audience that integration of transport is not, as many people seem to think, an experimental exercise in political economics but the natural and logical end of a process of growth in the means and equipment of transport. There were two conceptions in sharp contrast to one another. The first was that no effective steps should be taken to co-ordinate one form of transport with another: that the railways, with their capital guaranteed by the Exchequer, must do their best in isolation from other activities, whilst road transport was to be free under the shelter and protection of the licensing system.

And the other conception was that trade and travel as a whole should meet the cost of the unified provision of essential public transport services without necessarily making identical contributions to overhead capital charges. This, of course, is the principle embodied in the Transport Act.

Twenty years ago it was chosen as the solution for the London traffic problem, and we ourselves have yet to be persuaded that there is any other means of providing, in the long run, cheap and efficient transport in this country.

On the other hand, we are with those who would oppose any attempt to use one branch of transport to bolster up another. Five months ago, in a report to the United Nations, the International Chamber of Commerce recommended that:

Nothing should be done which would hinder the development of any particular form of transport or disguise the advantages it could offer, or which would discourage its use in order to provide artificial support for any alternative form of transport. The basis of co-ordination must be dynamic, not static.

This principle appears to have been recognised by the Commission, for its chairman is insistent upon the need for regarding each of the executives as separate entities. "We must look to each of our executives," he says, "to deve'op their own efficiencies and by this means to maximise their earnings, but it will happen that at different times one executive can reasonably make a larger contribution to central charges and interest in relation to the investment it represents than another."

(*Extracted from 'Modern Transport'—April 8, 1950.*)

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3. MULTUM IN PARVO

FROM data collected by London Transport for a survey of the travel habits of Londoners it was found that out of 100 working Londoners 58 travelled to work by public transport, 17 walked, 14 cycled, 4 motored and 2 went by other means.

Tests by the United States Bureau of Public Roads show that trucks can haul almost unlimited loads without harm to surfaces provided that the burden is spread over a sufficient number of axles.

The Chairman of the Joint Committee on the Economic Report, United States, has stated that highway transport expenditure in that country amounts annually to a minimum of 30,000 million dollars or one-eighth of the total national expenditure.

(*Extracted from 'I.R.F. Bulletin No 8'—Mar.—Apr., 1950.*)

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4. RUBBER FREEZES AND BECOMES BRITTLE AT(—)60° F

A synthetic-rubber polymer that will bounce instead of shatter at temperatures of—75°F has been developed by the Firestone Tire and Rubber Co. of Akron. Company officials say the ability of the new rubber to remain resilient at low temperatures may help solve some of the problems connected with the operation of airplanes, motor vehicles, and machinery in the arctic.

Rubber tires, hose, belting and gaskets normally are frozen stiff when the thermometer ranges around the—60°F mark. But tires made with the new polymer do not stiffen or develop flat spots, and treads neither harden nor chip out, even at—75°F, Firestone technicians report.

(*Extracted from Highway Research Abstracts Jan. 1950*).

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5. PLANS AND PLANNERS

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THE words 'plan' and 'planners' call for a caution. In politico-economic talk they have been widely used in a regrettably loose way and have thus acquired a kind of hackneyed prominence in the press during the last twenty or thirty years; with the result that many people have become suspicious of such 'planners' and use the word as a term of contempt or abuse. The true meaning of the word is quite neutral. Let me quote the Oxford Dictionary in its third meaning for the verb; 'to arrange beforehand', and for the noun 'a scheme of action'. The Century Dictionary says for the third meaning of the noun, 'a formulated scheme for the achievement of some object'; and for its fourth meaning 'a method or progress' and adds a quotation from **Rob Roy's Grave** by Wordsworth which some of you may think apposite to the atmosphere of politico economic thinking, which has so tainted the modern use of the word. This is the quotation :—

'For why ? the good old rule
Sufficeth them, the simple PLAN,
That they should take who have the power
And they should keep who can.'

(*Extracted from 'Journal of the Town Planning Institute'— March April, 1948.*)

6. NEW TOWNS OR ENLARGEMENT OF OLD ONES?

THE planning exponents of the new science of land use have invented a horrible jargon of their own. In this nomenclature the industries and population so to be removed from over-big-towns are called 'overspill." Oddly enough the new science has not invented a name for the reception areas, urban or rural, to which the migrants are destined to go, as their new home. Let me offer them the name of 'intakes'. It is as crude end uncouth as their own 'overspill ,' but it maintains their metaphor of a fluid spilling over from its source into a receptacle.

Where the overspill is to go—or, in my jargon, what intakes are to receive it - is in itself a vexed question; a problem of national policy executive in character but full of administrative difficulties. Is it a good thing to send or entice the overspill to new towns of 30,000 to 60,000 to be created under the New Towns Act, 1946, and if so, how far away from the mother town? Or is it better to make a series of lesser, though still substantial additions to small existing country towns, each to come forthwith under the government and guidance of its own local authority? Can the worn-out towns of the depressed areas be revived and revitalised by new industries? Any deliberate transference of population and industries from their ancient **habitat** to a new home is a task which in a free country presents obvious difficulties at both ends. Free Englishmen cannot be transported like cattle to a Smithfield abattoir; they must choose their own destination; in short they will not go to a suggested destination, unless it presents sufficient attractions to make them want to live there.

(*Extracted from 'Journal of the Town Planning Institute'—March April, 1948*).

7. THE ENGINEER'S CREED

1. To give the ratepayer the most efficient service available, be it on roads, bridges, sewers, street cleaning, street lighting, anti-flooding measures or housing.
2. To control the cost of such services so that full economy is exercised.
3. To prevent the waste of public money from any source whatsoever.
4. To control efficiently and with due economy all public property, stocks and services.
5. To ensure that supplies of materials necessary are in the right place, at the right time, at the right price and in the right quantities.
6. To see that contractors employed pay fair wages to their employees engaged on work.
7. To see that full measure of grant, subsidy, or statutory financial assistance is obtained from the particular Government Ministry charged by H. M Treasury to make such assistance.
8. To keep detailed cost accounts of work to prove the grounds for all demands.
9. To remember always that a soft answer turneth away wrath.

(*Adapted from "Costing for a Highways Department" by A. W. Muse—Journal of the Institution of Municipal Engineers—January 3, 1950*).

8. GOVERNMENT SERVICE AND SCIENTIFIC RESEARCH

* * *

YOUR Committee are disturbed by the impression they have gained that the conditions of Government service do not always create an atmosphere attractive to research workers or conducive to the achievement of scientific progress. This is not a matter of adjusting salaries and grades. Certain cherished freedoms are lost. Departmental control tends to have a deadening effect. Administrative routine though an essential part of the machine, sometimes gives the impression of being devised for no better reason than to harass and to put a drag upon advances. Many young scientists were temporarily employed in Departments during the war. Some have stayed, attracted by administrative work; others have left with a sigh of relief. These criticisms, whether ill or well-founded, have to be taken into account, if a fair share of the best recruits are to be attracted and held in the Scientific Civil Service.

(*Extracted from the "Third Report from the Select Committee on Estimates"— Session 1946—'47*).

9. STUDY ROAD ACCIDENTS TO IMPROVE ROADS

ONE of the methods adopted in New South Wales is to study the accident reports which often lead to the detection on a road of some unobserved hazard requiring correction. Accordingly copies of reports on accidents on main roads by Police are obtained in all cases where road conditions may possibly have been a contributing factor. The field conditions are then closely examined, and safety action is taken if necessary.

"Accidents are also recorded on maps by the Police Department. These maps are examined by the Department of Main Roads and photographed periodically and also aid in the detection of hazardous locations where road improvement may be required".

(*Extracted from "Main Roads"— March, 1950*)

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A recent study in Turkey revealed that certain commodities transported by horse and wagon cost 1.50 dollars per ton mile (accounting for the limited number of trips possible and the cargo capacity) as compared to three cents per ton mile by truck transport.

(*Extracted from 'I. R. F. London Bulletin No. 14' Nov. 1949.*)

CHOOSING PLANT FOR COMPACTION OF SOIL.

INTERESTING STUDY OF PLANT PERFORMANCE

[Extracted from "Highways & Bridges"—May 17, 1950]

THE advancement of the knowledge of soil as an engineering material has been enhanced by the publication by the D. S. I. R of investigations by the Road Research Laboratory into the compaction of five different soils. These soils were a heavy clay, a silty clay, a sandy clay, a sand and a gravel-sand-clay, and the performances of compaction plant-namely, a 2¾ ton and an 8-ton smooth-wheel roller, a pneumatic-tyred roller, and a frog-rammer-under varying conditions have been compared.

The study has been published by His Majesty's Stationery Office as Road Research Technical PaperNo. 17.

The maximum dry densities and optimum moisture contents obtained with the plant were compared with those obtained with the B. S. compaction test, the modified A. A. S. H. O. test and the Dietert test. The outputs of the plant were also studied.

The investigation was conducted in a covered circular track in which careful control could be maintained over the moisture contents of the soils and over the processes of compaction. Most of the tests, were made on 9 in. loose layers of soil which compacted to a thickness of about 6 in. Some tests were made on thicker layers of soils.

Smooth-wheel rollers.

The test results indicate that the two smooth-wheel rollers were more efficient than the other rollers tested for compacting the sand and gravel-sand-clay; few passes were required to obtain adequate compaction and they had a higher output than the other rollers on these soils.

On the three clay soils the 8-ton smooth-wheel roller had a relatively good performance, but its output was generally less than that of the pneumatic-tyred roller. The optimum moisture contents for compacting the clay soils with the smooth wheel roller were rather low and, except during dry summer months, rarely occur in the British Isles. Provided excessive sticking does not occur, however, satisfactory compaction can be obtained with the roller at moisture contents above the optimum.

The 2¾-ton smooth-wheel roller was less efficient on the clay soils than the 8-ton roller, because it was not heavy enough to compact the soils effectively through the full 6 in. of the compacted layer. The optimum moisture contents for compacting the clay soils with this roller were similar to those for the 8-ton roller.

Pneumatic-tyred roller.

The pneumatic-tyred roller was considerably less efficient for compacting the gravel-sand-clay than the smooth-wheel rollers and somewhat less efficient for the sand.

The roller was more satisfactory on the clay soils, for which the optimum moisture contents for compaction with the roller were relatively high and obtainable during most of the year in the British Isles. This is a particularly important advantage of this type of roller and is due to the lower pressures it exerts on the ground compared with other rollers.

Sheepsfoot rollers.

The sheepsfoot rollers were much less efficient than the smooth-wheel rollers for compacting the gravel-sand-clay and were unable effectively to compact the sand.

The optimum moisture contents for compacting the clay soils with these rollers, which were lower than those for the other rollers, rarely occur in the British Isles, even during the summer months. **The results indicate that sheepsfoot rollers are best suited to relatively arid climates.** To take full advantage of their performance, it is necessary to apply a relatively large number of passes and for this reason their output is not particularly high. It is also necessary to apply a large number of passes with the sheepsfoot rollers in order to ensure that all areas of the ground are compacted. For instance, one-fifth of the ground covered by the taperfoot roller remained uncompacted by the feet of the roller after 32 passes.

A further disadvantage of the sheepsfoot rollers is that when due allowance has been made for the loose mulch left on the compacted soil and account has been taken of the reduction in compaction through the compacted layer, they are only able to produce an effective depth of compaction of about 3 in.

It seems clear that only on rare occasions in the British Isles will it be more advantageous to use sheepsfoot rollers rather than either smooth wheel or pneumatic-tyred rollers. In arid climates, on the other hand, sheepsfoot rollers will usually be preferable on clay soils.

Frog-rammer.

The frog-rammer was able to compact all five soils effectively, but the optimum moisture contents for compacting the clay soils with the rammer were rather low for British climatic conditions. Althouth it was able to compact a greater thickness of soil than the rollers, as previously mentioned, its output was very low.

Laboratory Field Variations.

Generally speaking, the results indicate that the laboratory tests do not reproduce the conditions of compaction produced by the plant, i e. the optimum moisture contents and maximum dry densities derived from these tests do not always correspond with the values obtained by compaction plant in the field. The laboratory tests, are, however, useful as a means of classifying soils according to their compaction characteristics, and can be used in conjunction with other classification tests in the selection of fill materials.

Ultimate Choice

The ultimate choice of the type of plant, number of passes and thickness of layer will depend on the nature of the construction and on the moisture content, the latter depending on the prevailing climatic conditions.

The modified A. A. S H. O. test gave values of optimum moisture content in fair agreement with the corresponding values obtained with the two sheepsfoot rollers and the frog-rammer, but the maximum dry densities obtained with these types of plant were usually less than that given by the modified A. A. S. H. O. test but greater than that for the B. S. test.

With all types of plant, the first few passes produced a large increase in density, but with further passes the increase was less rapid until, finally, no further increase could be obtained. From four to 16 passes were required with the smooth-wheel and pneumatic-tyred rollers to obtain satisfactory compaction, but with the sheepsfoot rollers from 16 to 64 passes were required.

The moisture content of the soil had two principal effects. First, it affected the maximum dry density obtainable by compaction, maximum density being obtained at an optimum moisture content which varied with each soil and type of plant. Secondly, the moisture content affected the ease with which full compaction at that moisture content could be obtained; at the higher moisture contents compaction was effective to a greater depth, and fewer passes were required to obtain full compaction.

It was found that none of the rollers was able to compact effectively to a greater depth than 6 in.; for some soil conditions compaction was not fully obtained through more than 4 in. of the compacted layer. No experimental evidence was found to support the belief, sometimes held, that sheepsfoot rollers compact from the bottom upwards.

Draw-bar Pulls Required.

The calculated draw-bar pulls required to tow at 7 m.p.h. the pneumatic-tyred and sheepsfoot rollers under the most adverse conditions and under a more favourable set of conditions, when the five soils were compacted in 9 in. loose layers, are given below.

Draw-bar pull (lb.)

Soil type.	Soil at approximately highest moisture content for operating the plant on a 9-in. loose layer.			Soil approximately optimum moisture content for plant.		
	1st pass.			After 1 pass	After 12 passes	
	Pneumatic-tyred roller.	Club-foot sheeps-foot roller.	Taper-foot sheeps-foot roller.	Pneumatic tyred roller	Club-foot sheeps-foot roller.	Taper-foot sheeps-foot roller.
Heavy clay ...	950	1,060	1,150	250	530	500
Silty clay ...	2,000	1,020	1,060	650	530	600
Sandy clay ...	2,000	900	1,060	450	460	740
Sand ...	1,000	—	—	700	510	480
Gravel-sand-clay...	1,400	1,010	920	150	850	510

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LISBON INTERNATIONAL ROAD CONGRESS

As has been previouly announced, at the invitation of the Portuguese Government, the next International Road Congress will be held in Lisbon Commencing September 26, 1951.

Government of Assam, P. W. D. Budget for the year 1950.51

The following extracts have been taken from the Govt. of Assam P. W. D Budget for the year 1950-51 in respect of revenue from and expenditure on civil Works.

REVENUE

Revenue Head	Actuals 1948-49	Revised Estimates 1949-50	Budget Estimates 1950-51
	Rupees	Rupees	Rupees
1. Ferry receipts	1,89,431	1,90,000	1,90,000
2. Tolls on roads	10,683	11,000	9,000
3. Transfers from Central Road Development A/C.	36,23,045	8,00,000	6,55,130
4. Contribution from the Govt of India towards the cost of construction of the Silchar-Tripura border road.	...	20,00,000	75,00,000
5. Other Heads.	4,24,882	9,07,900	10,65,870
Total Revenue.	42,48,041	39,08,900	94,20,000

EXPENDITURE

Civil works	Actuals 1948-49	Revised Estimate 1949-50	Budget Estimate 1950-51
	Rupees	Rupees	Rupees
1. Original Works (including Post-war development Schemes)	97,42,391	1,98,86,250	1,25,89,172
2. Repairs (including Post-war)	51,77,635	52,44,889	59,13,889
3. Stock & Suspense A/C	1,46,350	—49,900	—2,51,300
4. Grants in aid for communication.	12,50,869	4,00,354	5,33,409
5. Establishment charges.	16,46,314	23 58,250	23,85,499
6. Charges on a/c of Tools & Plants.	4,01,583	7,14,900	1,43,000
Total Expenditure	1,83,65,142	2 85,54,743	2,13,13,669
EXPENDITURE ON COMMUNICATIONS ONLY HAS BEEN AS FOLLOWS:—			
1. Original Works (exluding Post-war)	86,81,859	81,10,000	79,72,030
2. Original Work Post-war	—	57,20,000	11,01,940
3. Repairs (exluding Post-war)	43,12,546	42,73,889	45,33,889
4. Repairs (Post-war)	—	1,40,000	5,50,000
5. Grants-in-aid for communications	12,50,869	4,00,354	5,33,409

INFORMATION SERVICE

(i) STABILISED ROAD : PERFORMANCE AND MAINTENANCE

(Extracted from 'The Surveyor'—January 28, 1949)

REPORTS on the performance and maintenance of stabilised roads are conflicting, and are, no doubt, dependent to a large extent on climatic and soil conditions in the region in which the roads have been constructed.

Granular Stabilised Roads

Perhaps the best evidence of satisfactory service of granular stabilised roads under light traffic is the continued existence of gravel roads built many years ago in those parts of Britain where suitable supplies of gravel were available. **Where, however, there is any volume of traffic a wearing course of tar or asphalt is essential.**

* * *

Cement Stabilised Roads

The effects of weather and traffic on cement stabilised bases used without a waterproof surfacing have produced varying results, but in general, where the grading of the aggregate has been such as to produce a low-grade concrete, a good performance has been obtained.

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In America various surveys have been made of the performance of soil-cement roads, and the chief causes of defects have been low cement content, inadequate control of compaction, and or moisture content instability of the subgrade, severe weather conditions, movement of the wearing course on the base, excessive mixing time, and inadequate drainage.

The results of an American inquiry published in 1942 on roads with a stabilised base containing 3.5 to 14 per cent of cement, and with a bituminous wearing course on all projects, usually consisting of a thin armour coat or mixed-in-place surfacing ½ in. to ¾ in thick, were as follows:—

44 projects had less than 1 per cent of defective areas.

17 projects had between 1-5 per cent of defective areas.

3 projects had 15-30 per cent of defective areas.

It is added that sealing had often resulted when a bituminous priming coat was omitted.

* * *

Bituminous and Other Binders

The behaviour of roads in which bituminous emulsion has been used as the binder has depended mainly on climatic conditions, for whereas reports suggest that such roads have been successful in the hot, dry regions of America, very little success has been reported from wetter climates.

* * *

Conclusions

The choice of soil stabilisation in preference to other forms of construction for road bases and sub-bases is largely a matter of local conditions, especially the suitability of soil along the line of the road. The incidence of boulder clays and other heavy clays in Great Britain severely limits the areas in which soil stabilisation is economically possible by present methods. Where material has to be imported, it is questionable whether stabilisation methods are advantageous.

An initial soil survey with suitable tests is essential in order to determine whether the soil is suitable for stabilisation either alone or with the addition of stabilising agent, such as cement or bitumen.

Research at the Road Research Laboratory suggests that stabilisation procedure may be simplified considerably by the omission of sheepsfoot and rubber-tyred rollers, and their attendant crawler tractors, heavy smooth-wheel rollers having proved themselves adequate for compaction of the five soils of varying type tested. On most soils it is thought that heavy smooth-wheel rollers are likely to be the most economical.

In comparing the cost of a stabilised road base or sub-base with that of other constructional methods, consideration should be given to the many alternatives, the effect of stabilisation methods on the programming and cost of the work in progress, to any surfacing or resurfacing likely to be necessary a few months or a year after the initial construction and to the cost of maintenance.

Reports on the performance of stabilised roads emphasise the importance of attention to detail, such as drainage, the final compaction of the base by traffic before surfacing, and the use of a bituminous primer if good results are to be achieved.

* * *

(ii) LOW-COST CONDUCTIVE FLOORING DEVELOPED FOR HAZARDOUS AREAS IN HOSPITALS

(Extracted from 'Engineering News-Record— Dec. 8, 1949.)

CONDUCTIVE flooring to carry off static electric charges and prevent sparks can be constructed at a cost little greater than that of ordinary tile or terrazzo, if acetylene carbon black is mixed with the cement.

* * *

Recommendations for Terrazzo

The combination of test results led to the following rules of procedure for construction of terrazzo floors in hazardous locations in hospitals:

Construct as in commercial practice, in accordance with the standards established by the National Terrazzo and Mosaic Association, Inc., except that acetylene carbon black shall be added to the cement in both underbed and topping. This carbon is produced by the thermal decomposition of acetylene gas under carefully controlled conditions. It forms chains of particles when mixed with concrete, rather than groups as are formed by carbon black of coal, petroleum or natural gas derivatives, and the chain formation creates an electrical path.

For the underbed, the mix should consist of one part of portland cement, to which three per cent by weight of this carbon black should be added, and four parts of coarse screened sand. The mortar should be brought to a level not less than 5 8 in. below the finished floor.

DIFFERENCE BETWEEN PRICE AND COST

A price is an estimate or a policy, but a cost is a fact.

SEARCH OF SUCCESS

A successful municipal officer is he who suffers fools gladly.

CORRESPONDENCE

REGISTER OF NATIONAL HIGHWAYS

Sir,

WITH reference to the note on "Register of National Highways" appearing in the August 1950 issue of the Transport-Communciations Monthly Review, in which it has been mentioned that Uttar Pradesh envisages collection of some extra information for the Register of National Highways, I have the honour to point out that the Punjab (India) has also got, in addition to particulars like linear plans, surface diagrams, traffic intensities, details of bridges of 50 feet length and above, the following information regarding roads:—

(1) Temperature, rainfall and topography of the country ;

(2 Breakdown of the expenditure on ordinary maintenance into:—

(a) Establishment

(b) Road Structure—bridges and culverts,

(c) Collection—rene wals and petty repairs,

(d) Consolidation,

(e) Arboriculture,

(f) Miscellaneous,

(g) Surface treatment.

2. Information in the above form pertaining te some of the stretches of National Highways in Punjab (India) has already been supplied to the Consulting Engineer to the Government of India (Roads).

Yours faithfully,

Simla, Sept. 8th BRIJMOHANLAL

Chief Engineer Punjab, P.W.D.

READY MONEY FOR ROADS.

(A News item not from India)

Financial news brought ample confirmation that there's plenty of money available for well-planned, much needed highway work. In quick succession, the Pennsylvania Turnpike Commission announced sale of $ 77,500,000 bonds to finance extension of its road westward to Ohio; the New Jersey State Supreme Court upheld the constitutionality of revenue-secured financing of a $ 230 million, 118-mi. toll turnpike; Virginia sold a $ 19,000,000 revenue bond issue to finance ferry and bridge improvements.

(*Extracted from 'Engineering News-Record'—October 6, 1949.*)

List of Approved Road Development Schemes

S. No.	Job No.	Name of work.	Amount approved.	Remarks
			Rs.	
		WEST BENGAL		
1.	384 BG 31A.	Protective works to Anderson bridge on the Teesta Valley Road.	57,860/-	
		UTTAR PRADESH		
2.	389 UP 24.	Painting two coats, furlongs 7 to 8 of mile 42 (local mile 14) of the Hapur-Garh Road.	3,419/-	This represent cost of wor done a f t e 1 —12—'49
		PUNJAB		
3.	387 PB 1A.	Construction of the Mukerian-Pathankot section of the Jullundur-Mukerian-Pathankot Road.	31,75,500/-	
4.	388 PB 1.	Acquisition of land for construction of a byepass on the Grand Trunk Road near Karnal.	78,800/-	
		ORISSA		
5.	383 RS 6.	Construction of a bridge over Baitarni River on the Calcutta-Bombay Road.	6,64,000/-	
6.	385 RS 42.	Replacing the collapsed bridge at mile 28/2 of the Cuttack-Sambalpur Road.	44,911/-	
7.	386 RS 5	Construction of a bridge over the Taldanga canal on the Calcutta-Madras Road.	4,53,038/-	
8.	903 RS 6.	Construction of arch culverts on the Western approach road to Baitarni Bridge on the Calcutta-Bombay Road.	23,600/-	

—o—

Books added to the Roads Organisation Library during August, 1950

1. **Depreciation** by Engene L Grant & Bul T. Norton Jr., (The Ronald Press Company, New York.)

2. **Establishing and Operating a Service Station—Industrial** (small Business) Series No. 22. (U. S. Govt. Printing Office, Washington.)

3. **Thirty-Sixth Annual Report for the year ended 30th June 1949.** (Country Roads Board of Victoria, Australia, 1949.)

4. **The Road Vehicles (Registration and Licensing) Regulations, 1949—S. No. 1618.** (H. M. Stationery Office, London.)

5. **Town and Country Planning (Control of Advertisements) Regulations 1948—Circular No. 75.** (H. M. Stationery Office, London.)

6. **Annual Abstract of Statistics—No. 86, 1938—1948.** (H. M. Stationery Office, London.)

7. **Road Research 1946 and 1947.** (H. M. Stationery Office, London.)

8. **The Reaction of Oxygen with Tar Oils—Road Research Technical Paper No. 16.** (H. M. Stationery Office, London.)

9. **Damage to Roads Caused by the Drought of 1947**—Road Note No. 6 (H. M. Stationery Office, London.)

10. **Report by the U. K. Deptt. of Scientific and Industrial Research for the year 1947-48 with a Review of the Years 1938—48.** (H. M. Stationery Office, London.)

11. **Manual of Highway Engineering** by P. A. Krishnaswamy. (The Author Madras.)

12. **Concrete Production and Control—Tennessee Valley Authority Project.** —Technical Report No. 21. (U. S. Govt. Printing Office, Washington, 1947.) 2 copies

13. **Report of Committee on Compaction of Subgrades and Embankments.**—Highway Research Board Bulletin No. 5. (Highway Research Board, Washington, 1947.)

14. **Proceedings of the 27th Annual Meeting held at Washington, December 2—5, 1947** by Roy W. Crum. (Highway Research Board, Washington.)

15. **Theory of Statically Indeterminate Structures** by Walter Maxwel Fife and John Bunson Willur. (Mc-Graw Hill Book Co , Inc., New York, 1948, 3rd Ed.)

16. **Geophysical Exploration** by C. A. Heiland. (Prentice-Hall, Inc., New York.) 2 copies

17. **Theory of Elasticity** by S.Timoshenko. (Mc-Graw Hill Book Co., New York.)

18. **Structural Members and connections** by G. A. Hool & N. S. Kime, (Mc-Graw Hill Book Co,, New York.)

19. **Fundamentals of Soil Mechanics** by Donald W. Taylor. (John Wiley & Sons, Inc., New York,)

20. **Timber Engineers' Handbook** by Howard J. Henson. (Mc-Graw Hill Book Co., Inc., New York.)

21. **Elements of Photogrammetry.** Earl Chruch and Alfred O. Ounn. (Syracause University Press, Syracause, N. Y., 1948.)

22. **Sequential Analysis** by Abraham Wald. (John Wiley & Sons, Inc., New York.)

23. **A Handbook for Travellers in India, Pakistan, Burma and Ceylon.** (16th Edition), by Colonel Sir Gordon Hearn. (John Murray Alleemarte Street, London.)

24. **Report of Joint Committee on Location of Underground Services.** (The Institution of Civil Engineers, London, 1946.)

25. **Route Surveys** by Russel R. Skelton. (MC-Graw Hill Book Co., New York, London.)

26. **Advertisement Control.** A M. Lyons and S. W. Magnus. (The Thames Bank Publishing Co., Ltd , London, 1949.)

27. **Fourth Hatfield Memorial Lecture on the Plastic Behaviour of Solids** by Andrew MacCance. (Reprinted from the Journal of the Iron and Steel Institute, London.)

28. **Report of the Indian Tariff Board on the Continuance of Protection to the Dry Battery Industry.** (The Manager of Publications, Delhi 1949.)

29. **Discomfort Glare and the Lighting of Buildings**—Transactions of the Illuminating Engineering Society, London.)

30. **Building Boards in Relation to Fire Protection** by R. C. Bevan. (Building Research Station, Hests, England, 1948.)

31. **The Effect of Vegetation on the Settlement of Structures**—Excerpt from the Proceedings of the Conference on Biology and Civil Engineering held on 21, 22, & 23 Sept., 1948 by William Hallan Ward. (The Institution of Civil Engineers, London).

32. **The Effects of Fast Growing Trees and Shrubs on Shallow Foundations.** by W. H. Ward (Reprinted from the Journal of the Institute of Landscape Architects, London).

33. **The Mechanism of Sulphate Attach on Portland Cement.** (Reprinted from Canadian Journal of Research B. 27.297—302, April, 1949).

34. **Our Immediate Programme.** (The All-India Congress Committee, New Delhi).

35. **Soils, their Physics and Chemistry.** by A. N. Puri (Reinhold Publishing Corporation, New York). 2 copies

36. **Account Code Vol. I-General Principles and Methods of Accounts.** (Manager of Publications, Civil Lines, Delhi, 1949 Reprint.)

37. **Soil Survey Procedure**—Road Research Technical Paper No. 15 (His Majesty's Stationery Office, London, 1949).

38 **Report of the Road Research Board with the Report of the Director of Road Research for the year 1948.** (His Majesty's Stationery Office, London). 2 copies

39 **Proceedings of the Meetings of the Standing Finance Committee held on the 9th, 10th, 12th and 13th May, 1949 Vol. XXVI, No. 2.** (Manager of Publications, Civil Lines, Delhi)

40. **Bombay Provincial Municipal Corporation—Act, 1949**—Contained in the Bombay Govt Gazette, Part IV dated 19—12—49. [The Supdt. Govt. Printing and Stationery, Bombay].

41. **Bus Operation Principles and Practice for the Transport Student.** (Iliffe & Sons, Ltd., London 2nd Ed)

42. **Annual Report of Work done during the year 1949 at the Hydraulic Research Station, Krishnarajasagar,** (Hydraulic Research Station, Krishnarajasagara).

43. **Note of Inspection of Hydraulic and Other Laboratories in Europe and U.K. with diagrams and appendix (cyclostyled).**

44. **A Concise Encyclopedia of Weld Timbers,** by F. H. Titmus. The Technical Press, Ltd., Survey, London, 1948).

45. **Some Chemical Tests for Soil Engineering Purposes.** (Instruction Courses Session 47/48) by K. E. Clare. (DSIR, Road Research Laboratory, London, 1948). 46.....

46. **The Use of Local Chippings in Surface Dressing Works**—A Comparison of Five Types of Chipping on A 6 at Rowsley in Derbyshire. (DSIR, Road Research Laboratory London, 1950).

47. **Some Observations on the Paths, Timing and Grouping of Pedestrains at Pedestrain Crossings.** (with 2 diagrams). by Eileen D. Garner. (DSIR, Road Research Laboratory, London, 1949).

48. **The Effect of Illuminating Pedestrain Crossing Beacons on the Observance of the Crossing by Pedestrains & Drivers** by L H. Watkins. (DSIR, Road Research Laboratory, London, 1949).

49. **The Nature of Soils (Instructions Courses 47 48).** (DSIR, Road Research Laboratory, London, 1949)

50. **Performance Tests on Tar Emulsions** by C. M. Gough & E. H. Green. (DSIR Road Research Laboratory, London. 1949).

51. **Surface Dressing Machinery** by D. B. Waters & W L. Russell. (DSIR, Road Research Laboratory, London, 1949).

52. **The Effect of the Presence of a Policeman on the Usage of a Pedestrain Crossing** by Eilen D. Graner. (DSIR, Road Research Laboratory, London, 1949).

53. **The Relation Between Road Accidents Population and Vehicle Statistics in Great Britain** by Grace O. Jeffcoate & Dorothy J. Tarrant. (DSIR, Road Research Laboratory, London, May, 1949).

54. **Wartime Activities of the Road Research Laboratory No. 52,** (His Majesty's Stationery Office, London, 1949).

55. **Tests on the Uniformity of Distribution of Binder given by the Distributors doing Surface Dressing Work.** (DSIR, Road Research Laboratory, London).

56. **Notes on Dense Tar Surfacing.** (DSIR, Road Research Laboratory, London, March 1949).

57 **Report on to the Replacement of Failed Experimental Sections on Westiminister Bridge Road in 1947 & 1948.** (DSIR, Road Research Laboratory, London).

58. **Report on the Lying of High-Stone Content Tar and Bitumen Surfacings on Finborough Road, Kensington.** (DSIR, Road Research Laboratory, London).

59. **Report on the Laying of Seven Demonstration Lengths of thin Surfacings on Lambeth Road, Lambeth.** (DSIR, Road Research Laboratory, London).

60. **Performance Tests for Concrete Road Joint Sealing Compounds for Summer Conditions in Great Britain.** (DSIR, Road Research Laboratory, London.)

61. **A Road Experiment to Compare the Effect of Different Types and Weights of Roller in Surface Dressing Work.** (DSIR, Road Research Laboratory, London.)

62. **Inspection of Proprietory Reflecting Concrete Kerbs in Lancashire,** Nov. 1948. (DSIR, Road Research Laboratory, London.)

63. **The Study of Road Traffic**—a paper by W. H. Glanville. (Institution of Civil Engineers, London 1949.)

64. **A Report on the effect of Surface Marking Pedestrain Crossings on Pedestrain and Driver Behavour** by R. L. Moore. (DSIR, Road Research Laboratory. London.)

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