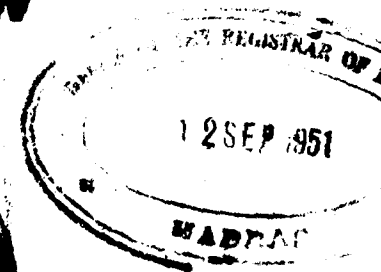


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## MONTHLY REVIEW

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August 1951

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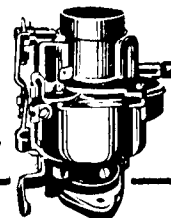
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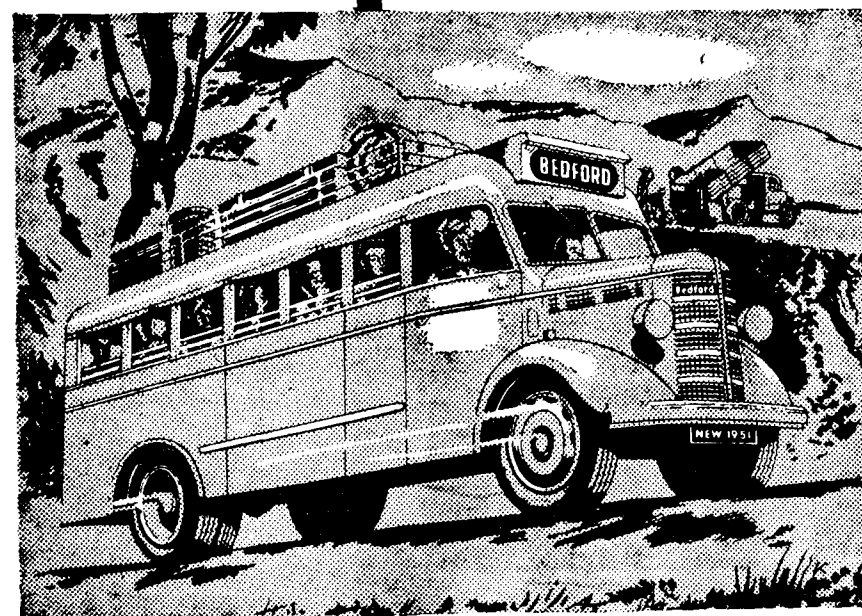
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## ENGINEERS AND "ADMINISTRATORS"\*

IF we consider the whole framework within which we live, we see the hand of the engineer at every turn; but not every member of the public is aware, all the time, that the houses, the public buildings, the roads, the water, the gas, the electricity, the sewerage and the like are provided only as a result of highly skilled and imaginative professional thought by engineers and allied professional men.

It is no exaggeration to insist that the engineer has such a great responsibility as regards his fellow-men, that in a perfect world, and with engineers who combined with technical skill an all-pervading wisdom, they need only be turned loose with plenty of money and all will be well. Under certain political systems, of course, this sort of thing, to one degree or another, has happened before. The Roman system of roads and water supply, the layout of modern Paris, the German **Autobahnen** are cases in point which have been successful, but it would be a brave engineer who would seek to have such power in a democratic world. Money has to be found, and broad lines of policy settled, by elected representatives of the people.

The rate of progress in engineering development under a system whereby laymen take decisions of a political character, and thereby possibly discount evident physical necessity, may, however, be open to serious criticism. Engineers under these conditions may be excused for feeling their responsibilities acutely if they appreciate, as they should, that their main urge should be not merely to make an honest living, but to offer an imaginative and helpful service to the community.

Obviously, decisions should not be taken by the elected representatives in an atmosphere where the merits of the skilled conclusions of the engineer are hidden in a cloud of political expediency, as is happening to the roads of this country at this moment. Neglect goes on year after year; the skill and training of the engineer

are completely discounted and discouraged; the technical education of a rising generation of engineers is seriously interfered with, and it almost looks as if the saying "that there are no votes in roads" is true. If a dictatorship of the engineer, no matter how enlightened, is undesirable, just how undesirable is a state of affairs under which the complete and unanimous view of a highly skilled body of road engineers is completely disregarded?

The bright idea, coupled with a certain intransigence of mind, recognised politely as the **id'ee fixe**, or more commonly just plain crankiness, has a merit not always appreciated. The "dreamers of dreams" can "trample a kingdom down" and among engineers there will always be a few well before their time. Such must be encouraged, and it is a matter for their employers to see that they are. Such rare spirits are unlikely; however, to command the confidence of lay councils or parliaments. Their advisers, while highly skilled technically, must add to professional knowledge the qualities of knowing their fellow-men, and cultivate a general wisdom based on a wide knowledge of men and affairs. They should know the value of money, and this knowledge, coupled with a clear demonstration that they do have regard to the place of their technical activities in the general scheme of things, will lend power and persuasion to their arguments.

The word "administration" is used frequently nowadays when no more than management is involved. The chief engineer running his own department manages it on the basis of a wide and thorough technical knowledge, to which he adds qualities of leadership, and that general knowledge of things and people which makes him a good manager. To think of this activity as being administration is a mistake, because it presupposes further qualifications to be added to his engineering qualifications, and creates an impression that engineers without further

\*Presidential address by Arthur Floyd, C. B. E., B. Sc., M. I. C. E., to Conference 2 (Engineers and Surveyors) at the Health Congress of the Royal Sanitary Institute, held at Southport from April 28 to 29, 1951. Abridged from 'Engineering' May 4, 1951.

qualifications in "administration" are incapable of managing. In the complex machine of government presented by a large local authority with a wide range of departments, each under its own manager, there is a place for a senior administrator to act as a catalyst between the departments and a focus for the general policy and the co-ordination of the activities of the council. But such a one is in the singular, and his subordinates do not automatically become administrators merely because they are associated as liaisons with the technical departments.

When it comes to a single technical department, such, for instance, as the newly-formed River Boards, a well-qualified engineer ought to be able to manage such an activity without any link in the person of a senior administrator between him and his board. This is a slight on an honoured and skilled profession. Admittedly, records have to be kept and certain legal advice given, but these are incidental to real work in the shape of engineering; and the trend exemplified in this case of River Boards is a far cry from the times (yet to be shown as being inefficient) when

the chief engineer, say, to a Water Board, was accepted as the chief officer and general manager.

Let the engineer in training remember, however, that if he concentrates on the technical side at the expense of the general side in his education, he will run the risk of those who may ultimately employ him deciding that they must have a non-technical man of affairs generally to run the show for them.

A certain freedom in engineering, whereby its exponents may expect to be indulged as regards the technical aspects of their work, is in the interests of progress and improvement. Engineers will the better prevail if they clothe their technical knowledge with a certain worldliness and knowledge of men and affairs, and **they should not be obliged to claw their way through a net of administration or a cloud of administrators before getting on with the job.** The representatives who provide the framework will do well to see to it that the chain is as direct as possible between them, the engineer and the job.

### DESIGNING A TANK

*Before you embark upon designing a tank for the army—General Patton medium tank (M-46), for example—you may have to study*

13 *Testing and miscellaneous Specifications*

17 *Process Specifications*

58 *Component Specifications*

125 *Material Specifications,*

*and 25000 Drawings, which are part of the specifications and describe the manufacturing details.*

*These figures illustrate the complexity entailed in engineering products for the military services.*

## DEARTH OF ROADS IN INDIA

(Extracted from 'Roads and Road Construction'—F.b. 1951)

SPEECH at the annual meeting of the Indian Roads and Transport Development Association in December last, by the president, Mr. M. N. Dalal.

In almost every field of Indian enterprises the dearth of good roads is making itself felt to such an extent that it is doubtful whether any real progress can be achieved in any sphere, until and unless this question of road improvement is tackled with greater honesty and energy than we have so far witnessed.

Not only India's prosperity, but her very survival as an independent, self-sufficient country is inextricably tied up with her system of communications. As matters stand today, facilities for transport are so unsatisfactory that not even the most optimistic of observers can find cause for complacency.

It is becoming increasingly clear that India, agriculturally speaking, is in a most unenviable predicament. Whilst the Government of India feel it will not be necessary to import foodgrains after 1952, the various State Governments find it necessary to ask for larger and larger quota of imported foodgrains for their respective States.

Until the Indian Government and the Indian people realise the urgency for an extensive network of arteries linking every corner of this great peninsula, the attainment of self-sufficiency in food by 1952 is likely to remain a cherished and unfulfilled dream. Not to understand this would be the greatest folly; to ignore it after having understood it would be a calamity of the first magnitude.

According to the most conservative estimates, for every hundred acres of land sown in India, there are approximately fifty acres of arable land which are uncultivated. If India's depleted granaries are to be filled, it is absolutely imperative that we should investigate all possible ways and means whereby this unproductive land can be made to yield its quota of crops.

Almost invariably it will be found that food crops are scantiest in those areas

which have no transport facilities. One does not need to be a real estate agent to know that tracts of land adjoining main thoroughfares have the greatest value. This is equally true whether in rural or in urban areas. As we proceed away from the roads into localities where more primitive methods of transport have to be employed, it is forcibly brought home to us how all forms of agricultural activity begin to diminish or to cease altogether. Most of the uncultivated land has so far not been ploughed or irrigated because there are no convenient roads running through those areas. Many potential agricultural lands remain virtually as jungles today and will so remain until roads are constructed.

The absence of roads hits the peasant living in inaccessible regions in more ways than one. The extra cost of transporting his crops to marketing centres will not permit him to sell his commodity at a competitive rate. To make matters worse, he pays more for his seeds, his fertilizers and his crude farming implements, than does the farmer whose holding is more favourably situated. Again, to remodel his farming machinery as done in Western countries is, to him, out of the question as such machinery cannot reach him.

There are of course other contributory causes such as insufficient water supply, lack of fertilizers and primitive ploughing and sowing methods, all of which help to make farming a natural hazard in many districts, but in the final analysis it is the acute shortage of cheap transport that is the root cause of the peasant's difficulties. This has been admitted not only by the Royal Commission of Agriculture (1928), but also by the numerous committees that have submitted reports from time to time.

It is in times of emergency that the weakness of our system of communications is laid bare for all to see. When, for instance, insect pests ravage the countryside, it is the Government's duty to send immediate aid in the form of expert advice and pest-killers. However, when the affected area happens to be difficult to reach, help often arrives too late for the

scourge to be dealt with effectively, or with any hope of success. Each year thousands of tons of crops that might otherwise be saved, are lost to the depredations of locusts, weevils and other pests.

It is not only the crops in the fields that are subjected to such wanton destruction. The production and consumption of such perishable items as milk, fish, vegetables, and fruits can immeasurably increase if the country has good roads.

A few days back I had occasion to read some reports on obstacles to the "Grow-More-Food" campaign. A recent investigation conducted by two agricultural economists of the Bombay University ascribes the existence of vast areas of fallow land and cultivable waste to the lack of facilities and resources such as "communications and drinking water." It is a sad commentary on the grow-more-food campaign; they say, that no serious thought has been given to the problem of utilising waste lands and fallow lands. They quote a district agricultural officer as saying that there is large scope for stepping up food production if attempts are made to open up these lands and make the people settle and cultivate them. Indeed, how can an area be opened up, I ask, without constructing roads? Famine has reared her ugly head in many parts of the country and unless we take drastic measures to step up production we are in grave danger of allowing disaster to overtake us. It cannot be disputed in this connection that had the country given greater attention to the Nagpur Plan, our agricultural position would have been very much sounder today.

In my school days I remember seeing many books prescribed for study in lower classes eulogising the benefits of British rule in India, particularly the advances made by India in keeping abreast of civilization. A road system which is considered to be the best symbol of civilization everywhere else, has certainly not been one of the blessings conferred by the British rule here. If we consider road mileage in terms of square miles of area, we find that Great Britain is at least ten times better off than we are. For every square mile of territory in India there exists one-fifth of a mile of road, whereas

in Britain they have 2 miles of roadage for every square mile of area. For every million inhabitants in the United States there are 2,500 miles; in India, for the same population, there are 90 miles of roads, some of which are no better than paths.

The Nagpur Plan of 1943, it was hoped, would remedy the situation to some extent by adding 100,000 miles of new roads and by improving the condition of the existing ones.

The Central Government and the Provincial Governments never made a real effort to put the proposed plan into practice, and drastic curtailments in the figures originally allocated for the implementation of the plan have succeeded in wrecking whatever hopes were entertained at one time. At present price levels, the cost of the Nagpur Plan is roughly Rs. 700 crores, of which the first five-year plan, commenced in April 1947, was estimated to cost about Rs. 150 crores. Three years out of the five-year period expired in March 1950, and the expenditure incurred till then is below Rs. 30 crores, i.e., one-third of what should proportionately have been spent during the three years.

To the unwary it might appear that the recently formulated Colombo Plan is a step in the right direction, but the consequences would be disastrous if we were to allow ourselves to be lulled into a false sense of security.

The plan calls for an expenditure in India of £ 1,379 millions over a period of six years. Thirty-three per cent of this amount is to be spent on agriculture and 38 per cent, or about 700 crores, will be utilized for improving transport and communications. However, it is doubtful whether this latter amount will be used where it is most urgently needed. The railways have been allotted 480 crores of rupees, whereas only 59.7 crores have been earmarked for road-building.

I should like here to quote an amazing example of how road construction is benefiting another undeveloped country, Mexico. A report I have just come across reads as under:

Five years ago the mountainous state of Nayarit on the central part of the Mexican west coast, had about nine miles of crude roads. Today it has 65 miles of first-class paved highways in a 325-mile road network, just completed.

Almost overnight the astonished 220,000 inhabitants find themselves in an industrial, agricultural and social revolution, almost unparalleled in modern times as a result of the new road system.

Here are amazing figures!

Land under cultivation has been increased by 25 per cent. Corn production has increased 570 per cent to 178,000 tons. This year will see an estimated 12,000,000 dollars fruit crop, which before the new roads, was less than one-third of that. Before, Nayarit barely produced enough rice for its own population. Today the value of its exported rice crop is expected to be 98,000,000 dollars.

The new roads have permitted the opening of new lands, the easy export of all surplus commodities, the import of all new kinds of farm equipment and machinery, and a wholesale opening up of this rich territory.

Following on the heels of this agricultural prosperity have been many social gains. Schools have mushroomed all over. Hospitals and dispensaries, staffed by able nurses and doctors, are quickly licking the diseases among the people which until now have been regarded as a necessary evil of living. Crime has been reduced to a new low and alcoholism is disappearing.

A few years ago a movie theatre was something no one in Nayarit was sure

existed. Today there are many of them.

The majority of India's villages resemble the condition in which this Mexican village was situated prior to the construction of roads. Is it beyond our power to do what Mexico is doing for developing such area? To plead lack of resources is untrue. What has been lacking is the WILL to do it.

The time has come, if national calamity is to be averted, for all who have the interests of this country at heart, to take a firm stand. What this country needs is a central Road Board, similar to our Railway Board, which will press our demands for a minimum increase in road mileage from 250,000 to 500,000 miles.

The anticipated increase in revenue will more than compensate the Government on its outlay. Revenue from motor transport has already reached the astounding figure of Rs. 35 crores annually and will double itself if roads are improved. Moreover, our industries will expand, the general standard of living of our people will improve, and most important of all, our agricultural economy will benefit to such a degree that self-sufficiency in food will be raised from the level of a politician's promise to that of a living possibility, for it is only when India has more roads, and the country hums with the music of a thousand wheels that our food drive will achieve complete success.

If the fledgling nation that is India today is to take wings and become a full grown power and take her rightful place in the comity of nations, then she must have more and better roads. She must follow the broad open highway. For that way lies prosperity and happiness for the millions of India.

*The ship was sinking and the captain called all hands aft. "Who among you can pray?" he asked.*

*"I can," replied an ensign.*

*"Then pray, shipmate," ordered the captain.*

*"The rest of you put on life jackets, we're one short!"*

## THE ACCURACY OF STATISTICS

(Condensed from U. N. Statistical Commission Documents)

**Introduction.** It is now realised that in business operations as well as in policy making in public administration statistics serve as a very useful guide. When a businessman or an administrator is interested in representing a situation only in broad terms he need not insist on the highest degree of accuracy of the statistics he depends on. But whenever scientific research is conducted to determine the relationship between social and economic phenomena or some economic or social programme is planned in public administration or elsewhere, accurate statistics become almost indispensable.

In general any statistical survey should be necessarily preceded by a thorough examination of the problem involved. Failure to define the scope and purpose of the survey beforehand and also the units and classes to be adhered to while collecting information very often reduces the usefulness of the data. In regard to surveys undertaken periodically for general knowledge such as population censuses, agricultural and industrial censuses there may be several purposes, some of which may not be known in advance, but the basic objectives of the surveys should not be lost sight of.

Generally statistics furnished by administrative records are found to suffer from several incongruities. There may be easily recognisable differences between records and actual facts. Defective definitions or classifications, for example the distinction between urban and rural areas according to administrative criteria, very often lead to inaccurate results in demographic, social, and economic investigations.

**Incomplete Coverage.** Another defect usually met within statistical data, official or otherwise, is incomplete coverage, i.e., the data generally cover only partially the facts which must be considered as relevant for the study. Conclusions based on partial data which might have been gathered merely for the ease of collection, will not

be true for the whole population. For instance, while statistics of industrial products are collected, only large and medium-sized plants are taken into account and numerous small workshops are covered to a small extent or totally left out. So far as the total industrial output is concerned, the omission may not be serious, but it will affect the results considerably when individual products are considered. This difficulty of incomplete coverage arises not only in regard to industrial production but in many other fields where statistics are to be collected by contacting several private organisations and institutions.

**Units of Measurement.** For facility of comparing statistics of various countries, it is desirable that there should be standardised measures. As an example of lack of standardised units of measurement, we may mention a bale of cotton which has a different standard weight according to the country of origin. Very often for the sake of comparisons it may be necessary to apply reduction scales as in family budget surveys where the size of each family is reduced in terms of "equivalent adults". The reduction scales, if not properly chosen, may lead to entirely misleading conclusions.

**Common Errors and Handling of Data.** In all statistical surveys the data are quite generally subject to some kind of bias. The common tendency on the part of the respondents to overstate or understate as it suits them is a factor to be reckoned with. Planning and execution of statistical surveys call for very great attention. Definitions and instructions should be translated into a language intelligible to the respondents; too many details should be avoided and suggestions should not be forced. Great care should be taken in tabulating and processing the data.

Apart from the systematic errors likely to creep in, in any set of observations there exist sampling errors which are to be taken into account in assessing the reliability of

any estimate arrived at from the data. The development of sampling methods and statistical techniques during the past few decades has resulted in increased accuracy of the results. But while dealing with data not collected "at random" we should beware of the limited applicability of Statistical techniques.

Grouping and processing of data result in loss of information which may be sometimes serious. If the range of values to be examined is very large and their frequency distribution quite skew, the arithmetic mean or average of such values will have very little meaning. For example the average salary of a group of employees who represent an extremely unsymmetrical population will have no physical significance and will not be susceptible of any proper interpretation without the entire data. Nevertheless such averages are sometimes made use of to represent variations in the general level of salaries.

U. N. Statistical Agencies and Improvement of Official Statistics.

In many countries a scientific approach has been made to improve official statistics but the

specialized statistical agencies under the United Nations still find difficulties in compiling and publishing international official statistics. The U. N. statistical office takes care to see that the data are generally accompanied by information on underlying definitions and concepts, methods of compilation, coverage and so on.

It is necessary to develop international standards and definitions to improve national statistics. Work undertaken by international agencies in this direction is progressing. The organisation of statistical surveys, the techniques used for collecting data, tabulation and presentation of data etc., have been dealt with in the Population Census Handbook prepared by the U. N. It is necessary to impress upon individual Governments the utility of improving basic national statistics and increasing their reliability. Rapid progress in this direction is unlikely but it is quite desirable that every country's statistics should be supplemented by better information as to the methods of compilation and the limitations to which the figures are subject.

## THE LAW AND THE MOTORIST:

*A Solicitor friend of mine was called upon to defend two motorists who had allegedly offended in precisely the same way. The two cases came up in the same week. One motorist was fined 40 s. The other got three months.*

*"On subsequently meeting the chairman of the bench", my friend told me, "I asked the reason for the difference." "Oh, said the magistrate "The evidence was much stronger in the one case than in the other".*

[Extracted from *Modern Motoring & Travel*, March, 1951].

*"I think my wife is getting tired of me."*

*"What makes you think so?"*

*"Every day this week she's wrapped my lunch in a road map."*

## INSPECTION OF BRIDGES

(Extracted from 'The Surveyor'—Feb. 23 & Mar. 2, 1951)

### Inspection Routine

THE periodical routine inspections are usually yearly events in the case of highway bridge authorities. The estimates for the forthcoming financial year are built up from the results of these inspections.

Opinions differ very considerably as to the best arrangement of an inspection report form which is probably because there is no "best arrangement." It should at all events make provision for particularities rather than generalities. It should not invite a collection of "fairs," "goods" and "excellents" like school reports since the extensive use of these adjectives is unimaginative and tends to dull the senses.

It may well be assumed that all parts of a structure are in a passable condition unless otherwise noted as this is what will be found in the vast majority of parts inspected. Therefore much writing will be saved by making this assumption. It should always be an aim to keep clerical work to a minimum in all writings, especially recurrent ones.

Predictions of impending failure are risky as experience has shown that structures sometimes keep on year after year in the same dilapidated condition without getting any worse. It goes without saying that such a condition should not be allowed to persist or the day may come when emergency work will be necessary with all its inconvenience and avoidable excessive expenditure.

As a matter of principle, repairs should not be postponed until they become urgent but a good standard of all-round maintenance should be the constant objective. Invisible but real economies result from the observance of this rule.

### Equipment Needed for Bridge Inspections

The Inspection of a bridge must be performed in a leisurely manner and the

examiner should preferably be alone so that he can contemplate, think, sketch and measure. His equipment should include a five-foot rod, a plumb-bob, a linen measuring tape with a weight at the end to enable vertical dimensions and soundings to be taken and to anchor the ring in default of an assistant, when taking horizontal measurements, a pair of external calipers for ascertaining the thickness of flange plates, a long handled descaling hammer with a one-pound head for removing deposits of rust as a preliminary to calipering metal thicknesses. Other gadgets may be found useful for specific purposes, but for routine inspections the above list is generally sufficient.

Certain bridges cannot be included in the daily itinerary because of special difficulties at the site, for instance, a boat or a raft is needed in some cases to enable examination of the undersides of bridges over rivers where the water is deep, a 14-ft boat hook is also needed for probing foundations to find out whether scour is occurring which might undermine foundations.

Rubber boots and thigh boots are essentials, and an aluminium extension ladder is required in many cases.

There are, of course, bridges where prudence dictates the desirability of two persons undertaking the inspection, such as railway bridges when being examined from the railway track; if it is liable to be a detailed and lengthy business a flagman is also needed. Other bridges over rivers where there is deep mud should be examined by two people, there being a risk of getting stuck in the mud and not being able to draw anyone's attention to the predicament.

If there is a special way of gaining access to the underside of a bridge the examiner should note it down in his report for the information of any other person who may later on have the job of making an inspection. If rivets are suspected of being loose a small rivet inspector's hammer should be available for testing

them. A club hammer is also useful for tapping masonry or brickwork when it is suspected there may be hollowness.

It will be found that after a few inspections and entering up of the results on the report form the bridges will soon be familiar in all their details to the examiner and he will speedily detect any change that may have developed since his last inspection. But each successive inspection of an important structure will reveal to him some aspect or feature of design or construction which he had not noticed before.

### Inspection of Timber Work

The perishability, inflammability and unreliability of timber are the three principal factors which have ruled it out for extensive use in bridges. Excessive cost, and scarcity have been added in recent years to the other three objections. However this may be, timber in one form or another is still to be found in many bridges and the inspector must be versed in the technique of examining it and reporting on its condition. There are timber piles, dolphins and fenders, parapets and decks of opening bridges, not to speak of temporary bridges and sundry members still to be found on old structures carrying unimportant roads, bridleways and footpaths.

It is not unusual for timber members to look sound from the outside, but to be rotten inside. If a pricker fails to give a reliable indication of the true condition, a small auger should be used to explore the inside and to secure samples of the wood.

Sometimes, even oak, may be found to be riddled with the borings of wood worms.

Careful attention must be given to timbers which have had coat upon coat of tar which gives the appearance of soundness, although it may happen that there is nothing much beyond the tar shell remaining.

Nothing should be taken for granted with old timber structures although pitch pine is probably one of the most reassuring varieties which have been used in the more lavish periods of the past. The rich content of resin and turpentine makes

this timber almost immune to decay. If and when the luxury timbers, greenheart or teak, have been introduced into any part of a structure it is probable that they, too, will have retained their soundness.

### Mass and Reinforced Concrete Structures

It was fondly imagined at one time that these bridges would be immune from deterioration and would even increase in strength with passage of years, but it now has to be admitted that they are no freer than other structures from the ravages of time.

The mistake made in the early days of reinforced concrete, that is to say, before World War I, was the lack of attention given to field control of the concreting. Such faults as insufficient cover to the steel, porous concrete, debris or shavings left in the shutters and inadequate punning were common and the mischief resulting from them is evident to-day. Fortunately, the designs of these pioneer bridges were good, and the fact that multi-span structures were made monolithic has prolonged their lives beyond what would otherwise have been their duration. A monolith can lose part of its substance without its strength being seriously impaired in a way which would not be possible in the case of a structure made up of separate members fastened together.

Water is probably the greatest destructive agency affecting all materials of construction. As it is seldom that even the best concrete can be relied upon to be waterproof it follows that poor concrete is bound to suffer from the penetration of water. Therefore when carrying out an inspection the presence of water in the wrong place should be noted. The physical effects of water seeping through concrete are highly destructive, but there are in addition, chemical effects which may be even more disastrous. The sulphates of calcium, magnesium and sodium when in solution all attack concrete and if they are sufficiently concentrated will speedily reduce it to a mush. All or any of these sulphates are liable to be found in ground water and modern concrete technique makes provision for resisting them.

Sea defence works, where in situ concrete has been used are vulnerable to sulphate attack and in some extreme cases the use of concrete is undesirable, although precast members are more resistant owing to the greater density of the concrete. Therefore if the examiner finds evidence of softening of the concrete the probability is that sulphates are at work and he should procure a sample of the seepage water for analysis.

### Cracks

Cracking and crazing are defects much in evidence in concrete work which does not possess the useful property of "give" which characterises brickwork in lime mortar. Instead of accommodating itself to small movements, mass concrete will develop cracks and so will concrete lightly reinforced. Heavily reinforced concrete may resist cracking under the effect of movement, but at the expense of unnecessary internal stresses, which sooner or later may lead to serious trouble.

Really well designed work permits movement at pre-selected places by the provision of joints or flexible members of various kinds. There are, however, very few structures so well designed that they are entirely free from some disfiguring cracks which may or may not be indicative of a defect more serious than disfigurement. It is in the nature of cracks that they bring about easement of internal, bottled-up stresses and unless their formation is accompanied by threat of collapse or speedy disintegration, they may not be detrimental to the stability of the structure.

Full information about the whereabouts and extent of cracking should be recorded by the examiner and in some of the more alarming cases photographs should be taken and cement tell-tales placed across the fissures. Photographs taken at intervals from the same vantage points

provide valuable data concerning gradual movement of earth retaining structures.

It is one of the incidental advantages of regular inspection of structures that it enables frequent observations of the development of weaknesses to be made and their true significance adequately weighed.

Continued movement even if of small extent is a danger signal and unless it can be stopped by shoring or other means, collapse is only a matter of time.

A warning is called for in case familiarity breeds contempt in so far as inspections tend to become cursory when no apparent change occurs from year to year until suddenly with the unpredictableness of the forces of nature a collapse occurs.

### Inspection of Cast-Iron Structures

When inspecting cast-iron structures, a thorough look round is necessary in a search for any incipient cracking of the metal and all splices should be scrutinised to make sure that the bolts are tight and intact. Skewbacks of arch ribs and bed stones of girders should be firmly bedded and undamaged. Any signs of crushing are serious since any displacement of the ends of the members will upset the distribution of stress. The makers' name and date of casting are often embossed on the principal members and the inspector should record this information.

Sometime the depth of filling over the superstructure of a bridge is reduced in order to remove some of the dead load or to diminish the hump in the road. It may be a mistake to do this, as although the calculated stress in the flanges is reduced yet the damping of vibration and the load distribution are adversely affected and the nett result may be more harmful than beneficial.

(To be continued.)

## REPLACING MASONRY RAILWAY BRIDGES WITH REINFORCED CONCRETE

MANY old masonry bridges on the Italian railways have been replaced in recent years by reinforced concrete structures.

Two important factors in this connection are the increase of 30 per cent to 50 per cent (depending on the span) in the live loads, and the provision of lighter structures so that the foundations of the old masonry structures could be used without expensive strengthening. Whereas

the viaduct at Desenzano, near Lake Garda. The viaduct comprises sixteen independent portal frames, each pair of contiguous posts bearing on one of the old foundations, the pressure on which is now only about half that imposed by the old masonry arches.

The need to use foundations that cannot economically be strengthened has led to the adoption of light reinforced concrete bridges of types that in the past were not



Desenzano Viaduct, Italy

before the war the greatest span of reinforced concrete girder bridges for railways in Italy was about 40 ft. for simply-supported beams and 60 ft. for continuous beams, the corresponding spans are now 82 ft. and 145 ft. respectively, while bridges with ribbed-slab decks have been built up to 56 ft. span.

considered advisable for railways because of the dynamic action of large live loads predominating over the static loads. Now open-spandrel reinforced concrete arches have been constructed with the depth at the crown less than 2 per cent of the span. In one bridge the depth at the crown is 3 ft. 6 in. and the span is 197 ft.

An example of a structure designed for a heavier load on existing foundations is

(Extracted from 'Concrete & Constructional Engineering'—October 1950)

"The Government of India has decided to control the export of elephants. A provisional number of 75 elephants has been fixed for export in a year. There is no destination quota fixed."

["The Eastern Economist, July 6, 1951."]

## HERE AND THERE

### 1. FRENCH TRAIN SPEEDS

THE Paris-Lyons trains are the fastest in Europe. One covers the Paris-Dijon section in 2½ hours at a speed of 124 kilometers an hour; and the Paris-Lyons section in 5 hours 6 minutes at a speed of 120 kilometers per hour. The new trains called "MISTRAL", accomplishing the 863 kilometers in 8 hours 36 minutes, make for the very rapid Paris-Marseilles

journey; moreover, because of the autorail taking up passengers from Marseilles, NICE is only 11 hours 18 minutes now from the Capital of France.

Similar amelioration now obtains on other lines: PARIS-BORDEAUX in 5 hours 37 minutes at 103 kms. an hour.

(*French Tourist News—30th June, 1951*).

### 2. "ELEPHANTS FOOT" AND "SHEEPS FOOT"

"EARTH fill compaction by flocks of sheep (which is of course what the sheeps-foot roller is designed to duplicate) was preceded in India by elephants. When the upper Ganges canal was built a hundred years ago, the earth dikes that contain it high above the surrounding plain, were built in nine inch layers, each compacted by the tread of elephants"

feet—perhaps the forerunner of the huge pneumatic tires of the present that act as earth compactors. In any event, the dikes of the 200 feet wide canal are still water-tight today after carrying a 4-knot current for over a century".

[*Engineering News Record, March 8, 1951*]

### 3. WATER SUPPLIES AND HIGHWAYS

TWO quite different public facilities—municipal water supply and highways—raise a common question: How can enough be provided to meet the need?

It is no great task for engineers to estimate well in advance the volume of water supply or the amount of highway construction needed for long-range programmes. But that is not enough. Failure to get public support, official approval or adequate financing for any needed improvement, be it a water supply or a highway, invariably seals its doom and keeps it in the "proposed" stage when it should be advanced to construction.

A prime example of this, and one from which highway engineers can take a warning is New York City's water shortage. It was the same old story—long-range plans by the City's Board of Water Supply made as far back as the late 20's, failed to materialize from one cause or another. Yet when the water shortage became alarmingly acute last year, who received the major blame? Not the municipal or other public agencies which helped to bottleneck the development of an ade-

quate water supply, but the water works engineers themselves.

Are we going to let a similar situation develop in the highway field? We talk of how highway obsolescence is rapidly getting ahead of new construction, and realize that it may eventually lead to a major crisis in our transportation system. Highway engineers not only must develop long-range practical plans for building an adequate system of highways; **but they must carry their message repeatedly and strongly to the public to secure and maintain its support for their programmes; they must drive relentlessly for sufficient funds to finance the work;** and they must gear their construction programmes to meet increasing traffic demands. Failing to do so, they will incur increasing public criticism as our transportation system continues to break down and become obsolete. If and when this happens, it will not be enough for the highway engineer to say, "I told you so 5, 10 or 20 years ago." Now is the time for concerted action, not after the damage is done.

(*Extracted from 'Engineering News Record'—June 22, 1950*)

### 4. BASIC ROAD STATISTICS U. K. 1950

1. THE United Kingdom's export of motor vehicles and chassis reached the record and rising figure in 1949 of £ 141,373,885. In 1938 the figure was £ 12,918,856.

2. Motor taxation for the financial year 1949-50 reached the record sum of £ 106,472,000. In 1938 it was £ 79,049,000.

[NOTE: In the current financial year it is estimated that motor taxation will reach a figure of £ 220,000,000.]

3. In 1949 the total number of killed and injured in road accidents was 176,779 (4,773 killed, 172,006 injured). Highest number of persons killed in any one year was 9,169 in 1941 (a black-out year).

4. Motor vehicles on U. K. roads totalled a record figure of 4,107,652 in

1949. This figure is still rising. The corresponding 1938 figure was 3,084,896.

5. Britain has lost her claim to having the most densely trafficked roads in the world. **Unfortunate** Belgium now leads with 17.7 vehicles to the mile. The United Kingdom comes second with 16.9 (one vehicle for every 100 yards of road); Switzerland third with 15.7. U. S. A. are fourth with 14.2.

6. From a peak figure of 14,413 in 1927, the total number of tramcars had decreased to 5,300 in 1949.

7. The average railway fare has increased from 11.4 pence in 1938 to 27.6 pence in 1949.

(*Extracted from British Road Federation's Bulletin No. P26—50 dated 29th November 1950*).

### 5. BOMBAY LEADS THE WORLD

#### In Traffic Accidents

THE Danish Government recently gathered statistics on urban traffic accidents in 33 cities throughout the world with a population of more than 500,000.

On the basis of the number of people killed per 100,000 motor vehicles in operation, Pittsburgh is the top American city on the list, ranking twenty-third among the 33 cities. In 1948 there were 59.56 Pittsburghers killed for every 100,000 motor vehicles in operation.

Topping this list is **Bombay, India**, with a fatality rate of 769.66 per 100,000 cars and trucks—about one traffic death a year for every 100 motor vehicles. Other cities around the world followed in this order: Cairo, and Rotterdam, Netherlands—271.76.

Milwaukee was lowest on the list with only 22.06 deaths per 100,000 vehicles. Other low rankers of the nine American cities included in the compilations were

Los Angeles - 27.86; Detroit - 32.36; Cleveland - 34.75; and San Francisco - 36.92.

Even in the number of persons killed in traffic accidents per 100,000 inhabitants, major American cities look good in comparison with other big cities of the world. Los Angeles is the only U. S. city in the top half-dozen with low fatality rates. The record is held by Johannesburg, South Africa, with a fatality rate of 22.50 per 100,000 residents. Next comes Melbourne - 18.1; Sydney - 17.60; Los Angeles - 14.39; Vienna - 13.60 and Cairo - 13.05.

Figures contained in the Danish Government's publication, "World's City Traffic", were reported by the individual cities and in many cases may not give an exact picture of conditions because of the variations in methods of recording statistics from country to country.

(*From 'Highway Research Abstracts' April 1951*.)

## 6. TRANSPORT COSTS

IT is seldom realised just how much transport, both internal and external, can add to production costs. It has been demonstrated recently that internal transport costs may amount to anything from 5 to 55 per cent of the total labour costs of an article. Even if they are as low as 5 per cent, if they are capable of being still further reduced, the amount of that reduction will be a direct reduction in the total manufacturing costs, since materials handling adds nothing to the value of the product. By

careful study of component movements between one operation and the next, or by going into an inter-operational store for inspection, the amount of labour and handling equipment called for to deal with transport can be seen to reach quite staggering figures.

[Extracted from 'The Sixth Manchester Association of Engineers Lecture' delivered in Manchester on Friday-February 2, 1951: 'Engineering'—March 2, 1951.]

## 7. HYPNOTIC EFFECT OF MODERN ROADS

Can highways hypnotize?

This question may soon be placed under intensive study by medical men and psychologists, with the Pennsylvania Turnpike as the testing ground and truck drivers as "guinea pigs," the American Automobile Association reports.

Possibility that some modern types of highway, which do not provide sufficient breaks in driving monotony, may exert a hypnotic influence on the motorist has long been suspected, said Burton W. Marsh, director of the AAA's traffic engineering and safety department.

"There appear to be extraordinary numbers of accidents caused by drivers 'dozing' or falling asleep at the wheel on some stretches of modern highways," he said, "leading to the possibility that factors other than fatigue are involved." He explained that when a vehicle leaves

the highway or crashes into another vehicle without leaving skid-marks, it is generally assumed that the driver has dozed off.

"Many motorists have had the experience, when driving long distances on comparatively straight highways, of finding themselves becoming unduly sleepy," Marsh said. "The fixation of attention and the lulling sound of the motor going at a steady pace and of the tyres whirring on the pavement are akin to methods used by psychologists in inducing hypnosis."

"The driver's sleepy state, oddly enough, can often be counteracted by turning on the windshield wipers or the car radio; either action helps to distract the fixated attention. But the best thing for a motorist to do when he gets drowsy is to pull off the road and take a nap."

[From "Highways Research Abstracts"—April, 1951.]

## 8. AN INTERESTING SURVEY

BUS passengers, standing or seated, who have been jolted as a result of sudden breaking may (or may not) be interested in tests carried out by the Road Research Board and referred to in the Board's recently issued report for the year 1949.

A survey indicated that 70 per cent of standees stand sideways holding on with one hand. Then eight observers, taking up various seated and standing positions, "were asked to describe their feelings when subjected to various declarations

produced when a bus travelling at 30 m. p. h. was braked to a standstill." Unfortunately the report does not indicate the words actually used by these observers to describe their feelings. All it says is that it was concluded that 10 per cent of seated passengers and 65 per cent of standing passengers experienced discomfort for a declaration of 0.2 g. Where do we go from here?

[Extracted from 'Motor Transport'—March 17, 1951]

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## 9. PERPETUAL WORK

WHAT do we mean by work? Men sleep for about eight hours each day. But they are awake and active for the remaining sixteen. Does a man's brain stop thinking, do his muscles cease acting when he is not officially at work? The young man whose health, it has unequivocally been proved, suffers if he "works" longer hours than about eight each weekday is not, in fact, so fatigued by his "work", that he cannot pursue an energetic sport in the evenings and at week-ends, nor is the executive after labouring mentally all day so worn out that he cannot play chess or bridge or read a learned book or indulge in quick-witted conversation afterwards.

daily ready to keep minds and bodies active upon some thing else? What is the difference between work and this recreation that fits us to work again? Why are we incapable of working all our waking hours?

It is, perhaps, significant that we tire more easily when we lack interest in our employment than when we find it absorbing. If so, is it not possible that what we really need for continued health is not short working hours as such, but constant change of employment? Is not fatigue, in fact, a sign, not so much of muscular or intellectual weariness as of approaching boredom?

Why, then, is there so low a limit to working hours when men leaving work are

[Extracted from 'The Engineer'—April 6, 1951].

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## STATISTICS

"You wrote a policy on a 92-years-old man!" gasped the insurance Branch Manager.

"Sure," replied the new Salesman. Statistics show that very few men die after 92."

A customs officer, while examining a sailor's baggage, discovered a bottle of whiskey. "I thought you told me there were only night clothes in that suitcase?"

"Right," replied the gob, "that's my nightcap."

## THE ENGINEERING OF RIVERS\*

### River Control and River Mechanics

AN essential principle which must be stated with regard to river control is that, for a scheme of any size to be effective the river being dealt with must be examined as a whole. Full information and data, described later, must be obtained before a scheme of river improvement is put in hand.

It must be understood that a river may be coaxed but never conquered. Hasty, ill-planned and rough treatment of a river will produce violent reactions eventually. Indeed, this is the very reason for the troublesome behaviour of some of our rivers at the present time. They have been, and are being, abused and they take every opportunity to hit back.

### Models or Mathematics?

The habits and reactions of a river cannot be analysed mathematically—not, at any rate, in precise detail. The ordinary laws of fluid mechanics are not strictly applicable, since a river usually flows through shifting material for a great part of its journey. In River Engineering, the "knowledge of experience" comes to the fore and useful laws are more likely to be obtained from model experiments than from pure mathematics.

River Control may perhaps be defined as "an attempt to restrain a river within certain confines, at the same time minimising erosion and eliminating flooding at points where this is undesirable." It is an art and not a science.

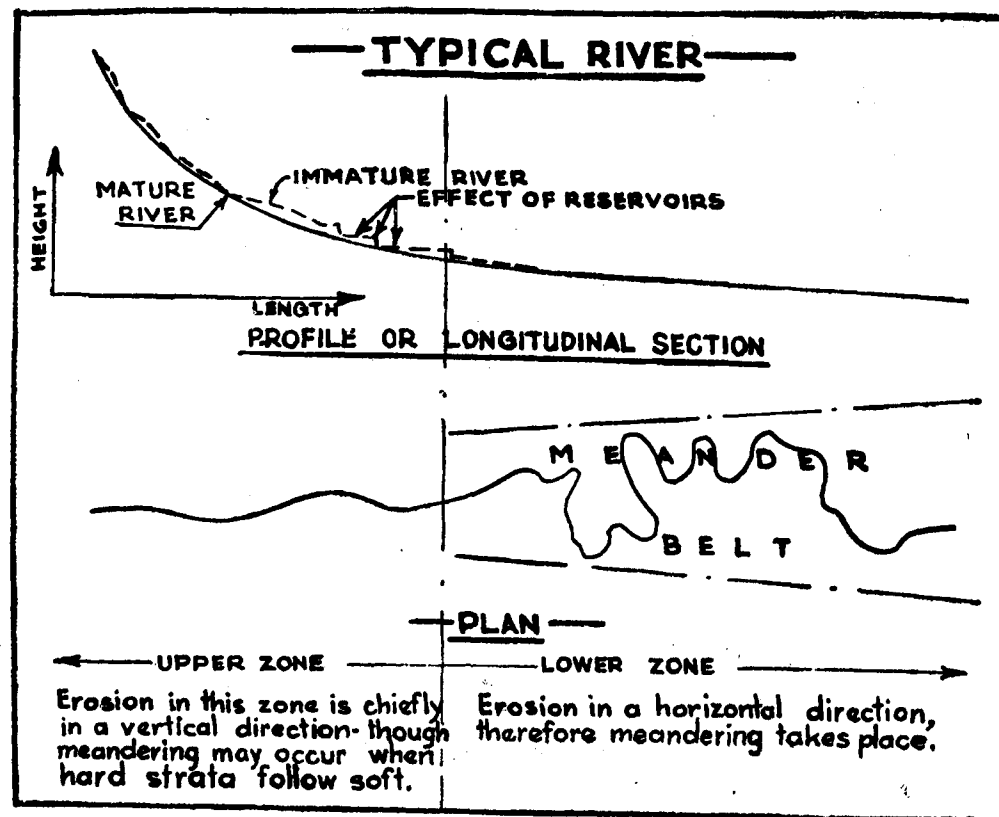


Figure 1. PROFILE AND PLAN

\*From a Paper entitled "The Administration and Engineering of Rivers" by Peter Sutcliffe, B. Sc., A. M. T. C., M. R. San. I., presented to the Public Works and Municipal Services Congress on the 14th November, 1950.

Normally a river occupies itself by attempting to attain a state of equilibrium; it tries to adjust its length to some critical value which, coupled with the total fall, will produce a certain velocity resulting in "contentment". In the steep uplands, close to its source, a river flows rapidly, but when it reaches the lower country it slows up, and it is in this lower country that the "length adjusting" process takes place. The river is said to "meander"; the strip of land or plain over which this meandering may extend, is often referred to as the "meander-belt" (Fig. 1). This belt may be completely covered in times of flood, when the river channel becomes surcharged.

In meandering or shifting its course, a river wears away, or "erodes" its banks; this erosion produces complementary silting. The material which is broken away from one part of the bank is dumped elsewhere, when the velocity of the fluid is not great enough to carry it any further. The velocity of the fluid is greater on the outside of a bend than on the inside; consequently erosion is likely to take place on the outside of a bend and deposition, or silting, on the inside. Figure 2 shows this diagrammatically and also shows how "ox-bows" are formed.

There is a great deal to be said in favour of leaving the "meander-belt" and flood-plain untouched for the river to "play in." In other words development should not be undertaken in the area where the river is likely to wander or overflow its normal channel.

Erosion may be prevented or minimised by strengthening the banks to a given degree. Some engineers have suggested the replacement of the natural river bed by a concrete-lined channel. But the enormous cost of such a channel renders this idea impracticable, and from an aesthetic point of view this would be undesirable. For a river is, once free of the large industrial towns, a scenic feature, and as such should be bounded by grassy banks. Within the large industrial towns there is a case for the concrete channel or at least, for reasonably massive river walling. But in the more pleasant setting

of the country town, use should be made of revetments, which are reasonably economical to construct.

When a river is flowing too rapidly, violent erosion takes place. This may be checked by constructing a series of weirs along the river—these "steady up" the flow.

Flooding is the result of the river channel becoming surcharged—the excess waters overflow the banks and spill out onto the surrounding land. It occurs naturally, but it can be caused or increased by Man's efforts. A badly designed bridge, for instance, leaving an inadequate waterway, may cause a backing up of the waters and flooding may occur at some point upstream. Many rivers are now taking a far greater flow than was intended by nature. The construction of towns, metalled roads and the like has increased the "water-proofed" area, resulting in a more rapid run-off\*.

There are several ways of preventing, or at least minimising, flooding, such as :-

- (i) The existing waterway may be increased, thus enabling it to carry a great flow. The waterway, or cross-sectional area available to flow, may be increased by cleaning out the bed, by erecting flood banks and walls, or by widening the channel.
- (ii) An overflow channel may be built to carry the excess flood waters. (It may be more economical to make use of an auxiliary channel). Such a channel could discharge back into the river at some point beyond the town, where the waterway was adequate.
- (iii) Flood storage reservoirs may be provided. For many cases this method may well be the most economical, provided a suitable area of low-lying land is available for use as a reservoir. Entry of the excess waters to the reservoir would be regulated by some type of weir, and later, when the river level had dropped, these waters would be fed back to the watercourse through sluices. This process may be termed "controlled flooding."

\* Indiscriminate deforestation has similar results....Ed.

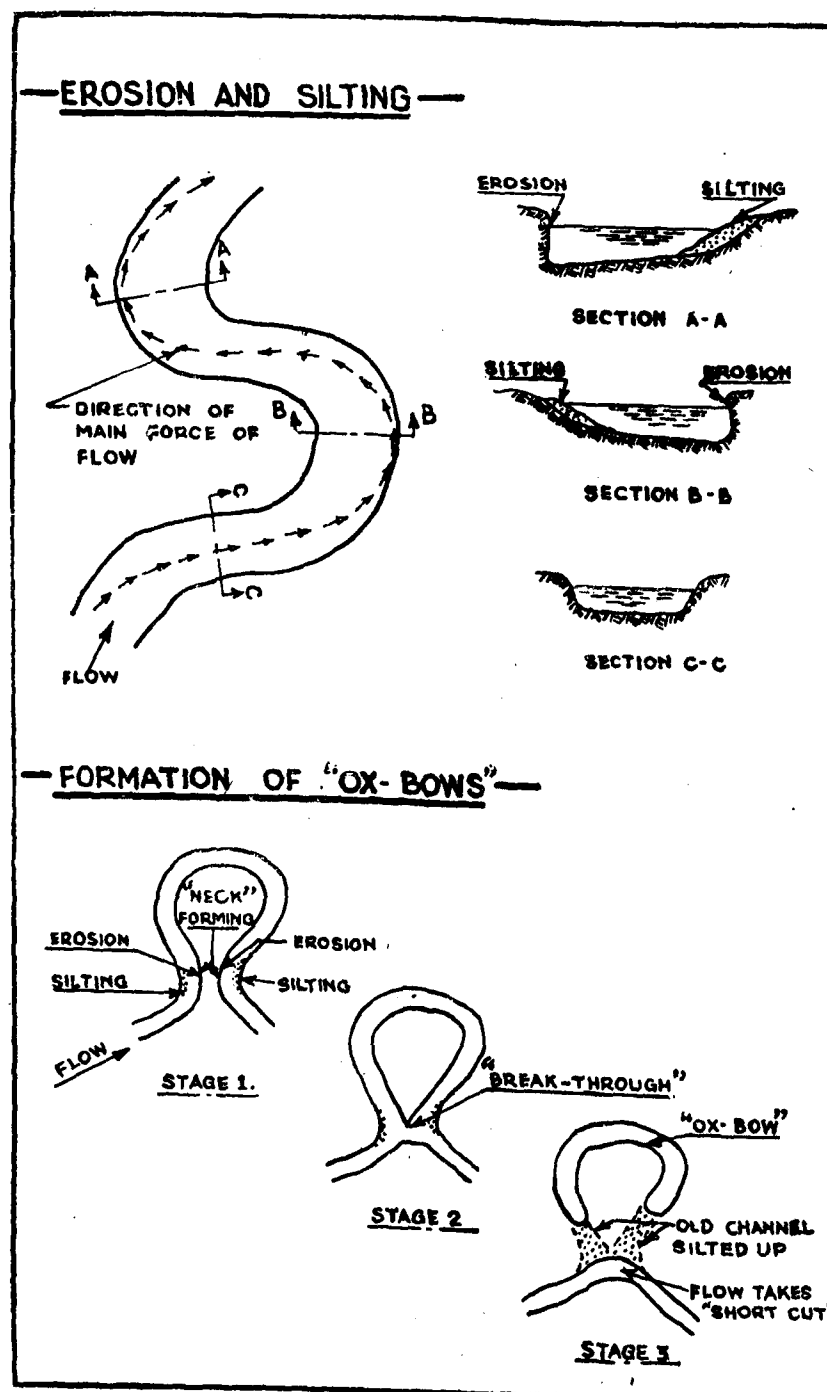


Figure 2. EROSION, SILTING & OX-BOWS.

### Maintenance - Direct Labour Works

There is always work waiting for a river authority—the bank may need patching or the bed need cleaning out. Such work may be classed as maintenance of an existing channel or it may form part of a long-term river improvement scheme.

Direct labour is well suited to river works—it is exceedingly difficult to measure with any accuracy the quantities involved when cleaning out a river bed or tidying the banks.

### Data and Information

Full information about the river or river system must be "on tap" before a comprehensive river improvement scheme is designed.

(i) Maps are obviously essential. The following are suggested:—

- Ordnance Survey Sheets, primarily for office use, on the 1/2500 or 1/1250 scale, covering the course of each river.
- Folder maps (6 inches to one mile) for engineers to take with them when making inspections.
- One inch to one mile Ordnance Sheets covering the whole catchment area.
- For built-up areas the 1/500 Ordnance Sheets may be very helpful.

(ii) It should be the policy of each river authority to produce, in respect of the river (s) under its control longitudinal sections and cross sections. The former will show for the whole length of each river, such information as the levels of bed, banks, dry-weather flow and flow in times of flood. On it too, will be marked the positions of the cross sections. These should be taken at intervals down the river, say at every thousand feet, and also at each bridge face or critical point such as a "bottleneck." The longitudinal sections may be drawn with the direction of flow running across the sheet from right to left, and the cross sections plotted looking downstream so that the right bank and left bank appear at their correct positions. The cross sec-

tions may be plotted to a natural scale, say ten feet to one inch.

(iii) Figures relating to flow, rainfall and storms together with other meteorological data have to be recorded for some years before they attain full value.

(iv) The geology of the river course and the nearby district should be available.

(v) The situation of any sewage work and outfalls, water-works and "draw-off" points are important.

In addition, everything known or discoverable which in any way affects the river (s) should be recorded.

All this information would be used in the design of river improvements; it is also required by the river authority when the latter is approached by other organizations.

### Surveying

The "ball-and-socket" pattern of quick-set level, sometimes called a builder's level, is very handy for river works. Scotch pattern levelling staffs are useful for taking levels on flood banks, when vertical intervals may be great, and for taking soundings. For cross section work a manageable dinghy, with a trained boatman and two bank men, is essential.

Before taking cross sections, levels and chainages must be obtained along whichever bank of the river be the more accessible. Bank levels may be taken, say at every 200 feet, and a temporary bench mark should be established wherever a cross section is needed. Chainages on the site may be temporarily related to fixed objects such as bridges, and subsequently adjusted, in the drawing office, to the centre-line of the river, the downstream end of the river being taken as the origin.

Tacheometry may sometimes be used with advantage when "picking-up" the new course of a river which has meandered.

Flood levels must be noted very quickly while the waters are at their height. Some rivers remain at flood level for several hours; others reach their peak and then

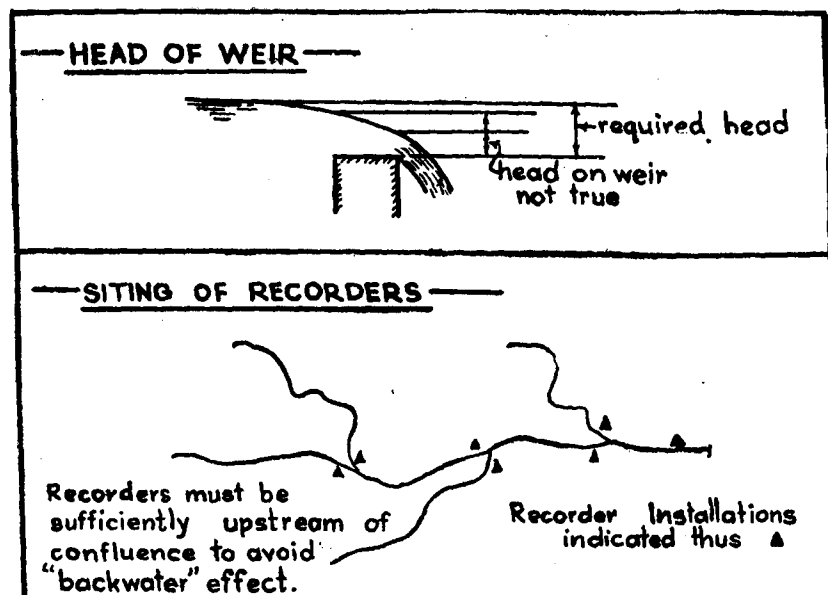


Figure 3. SITING OF RECORDERS.

drop away again very rapidly. One way of noting the height to which the water rises is to send out all available engineers and surveyors to observe and, if possible, mark the levels to which the water has risen on bridge abutments, flood banks, and the like. Later on these points can be levelled by instruments. Another useful method, which may be employed in cases where an aircraft is able to reach the scene before the floods subside, is that of aerial survey. This may well be cheaper than a land survey.

#### Flow and Rainfall Records

There are many ways of gauging flow—some kind of automatic recorder, which will attend to itself for several days, is desirable for a river authority. Float recorders are one suitable type, and if there happen

to be weirs situated at convenient points the recorders may be installed nearby. They should be placed upstream of the actual weir, since the depth of the water near to the weir does not give a true value of the head on the weir—See Figure 3. One rule for the distance of the recorder from the weir is  $10 \times H$ , where  $H$  is the maximum head on the weir to be expected under normal conditions.

The accompanying figure (No. 3) shows the siting of recorder stations on a river system.

In order to obtain advance warning of possible flooding it is possible to have a recorder float installed some way upstream from the threatened area and linked by landline to a recording drum fitted at the engineer's office.

## PUNJAB CIVIL WORKS BUDGET, 1951-52

THE following extracts pertaining to Civil Works Budget for the year 1951-52 have been taken from Government of Punjab Civil Works Budget for 1951-52 :

(In lakhs of Rupees)

|                                               | Actuals<br>1949-50 | Revised<br>Estimates<br>1950-51 | Budget<br>Estimate<br>1951-52 |
|-----------------------------------------------|--------------------|---------------------------------|-------------------------------|
| <b>I. Revenue (Civil Works)</b>               |                    |                                 |                               |
| (i) Rents                                     | 8.07               | 6.68                            | 7.18                          |
| (ii) Ferry Receipts                           | .05                | —                               | —                             |
| (iii) Transfer from Central Road Fund         | 1.45               | 23.38                           | 46.31                         |
| (iv) Miscellaneous                            | —                  | 8.67                            | 10.73                         |
| (v) Receipts in England                       | 7.15               | —                               | —                             |
| (vi) Refunds                                  | -.81               | -.31                            | -.20                          |
| <b>Total Revenue</b>                          | <b>15.91</b>       | <b>38.42</b>                    | <b>94.02</b>                  |
| <b>II. Expenditure (Civil Works)</b>          |                    |                                 |                               |
| (i) Original works                            | 75.04              | 106.79                          | 148.96                        |
| (ii) Repairs                                  | 63.18              | 71.84                           | 53.74                         |
| (iii) Tools & plant                           | 1.57               | 2.30                            | .73                           |
| (iv) Grants-in-aid                            | 4.48               | 4.77                            | 4.77                          |
| (v) Suspense                                  | 32.58              | -12.00                          | 4.00                          |
| (vi) Deduction                                | -51.00             | -59.88                          | -26.40                        |
| <b>Total Expenditure</b>                      | <b>125.85</b>      | <b>113.82</b>                   | <b>185.80</b>                 |
| <b>III. Expenditure (Communications only)</b> |                    |                                 |                               |
| <b>Original Works.</b>                        |                    |                                 |                               |
| (a) Provincial                                | 15.20              | 5.09                            | 17.84                         |
| (b) Financed from Central Road Fund           | .18                | 3.00                            | 6.00                          |
| (c) Punjab Govts'. ordinary share             | .25                | 20.11                           | 40.00                         |
| (d) Post-war Schemes                          | —                  | 4.23                            | —                             |
| <b>Total Original Works.</b>                  | <b>15.63</b>       | <b>32.43</b>                    | <b>63.84</b>                  |
| <b>IV. Receipts from Roads</b>                |                    |                                 |                               |
| (i) Ferry Receipts                            | .05                | —                               | —                             |
| (ii) Transfer from Central Road Fund          | 1.45               | 23.38                           | 46.31                         |
| (iii) Receipts under Motor Vehicles Act       | 15.11              | 14.49                           | 14.58                         |
| (iv) Motor Spirits Sales Tax Receipts         | 9.70               | 13.02                           | 13.02                         |
| <b>Total Receipts</b>                         | <b>26.31</b>       | <b>50.89</b>                    | <b>73.91</b>                  |

NOTE:—Figures of expenditure on communications-repairs are not separately available.

(Continued on page 24)

## TECNICAL INFORMATION

## 1. DISCUSSION ON CONCRETE PAVEMENT DESIGN

*(Extracted from 'Highways and Bridges'—Dec. 27, 1950).*

Various questions were put to the panel of experts, who gave the following answers:—

Q. How thick should a base course be?

**Professor K. B. Woods** (Associate Director, Joint Highway Research Project):

A. We do not need to assume that all pavements need soil bases. Many miles of pavement 30 or more years old are in service, and are performing entirely satisfactorily without base courses, even under the very heavy traffic which they are now receiving. Others, constructed on poor soils, less than ten years old, have been very unsatisfactory. There is no set rule to establish the thickness of soil bases. However, some experimental and field data indicate the possibility of obtaining excellent results with bases perhaps under 6 in. in thickness, particularly where frost heave is not an item of great concern.

Q. What should be the characteristics of the material to be used for soil bases for concrete pavements?

**Mr. Van Breemen** (Research Engineer, N. J. State Highway Department):

A. The roads of New Jersey have some of the heaviest traffic in the country. We try to construct soil bases which are non-pumpable and will minimise differential frost action. Some years ago we noted that silica-clay types of soil resulted in cracking of concrete pavements accompanied by frost action, and sandy soils could not be properly compacted.

On heavy duty pavements our present practice requires the construction of 12 in. of soil base in two layers. The first layer consists of 7 in. of relatively clean granular material with moisture content of not more than 4 per cent. This is covered with 5 in. of stone or gravel having at least 45 per cent retained on No. 4 sieve and has 4 to 7 per cent binder material. These

soil bases are extremely stable under rolling action.

## Air Entrainment

Q. Has the value of using air entrainment in concrete pavement been definitely established?

**Mr. Allen** (Research Engineer, Ohio Highways Department):

A. In my opinion, the value of air entrainment has become definitely established for both pavement and structural concrete. It is of interest that the original concrete pavement in Bellefontaine, placed in 1890, has 6 per cent air and is still in excellent condition.

Q. Does air entrainment entirely eliminate surface scaling?

**Mr. Allen:**

A. Concrete containing approximately 4 per cent air is many more times resistant to scaling than non-air entrained concrete. For practical purposes I believe that it can be considered the answer to the scaling problem. However, it is possible to scale air entrained concrete with heavy repeated applications of salts used for snow and ice removal. If salt applications are delayed until the pavement has a chance to dry out, there is little likelihood of scaling where normal applications of salts are used. Air entrainment does not eliminate scaling due to over-finishing.

Q. What are the effects of air entrainment on concrete strength, surface hardness and pavement cracking?

**Mr. Allen:**

A. Our experience shows that 4 per cent air entrainment decreases strength about 12 per cent and decreases bond about 6 per cent. There are no data available on hardness, but no difficulty has been experienced. I rather doubt that there is any reduction in cracking due to air entrainment.

**Mr. Russell** (Engineer of Materials, Illinois Highway Division):

A. So far as we know, there is no change in cracking of air entrained concrete compared to concrete without air entrainment.

## Reinforcement

Q. Should the amount or weight of the reinforcement used be a function on the length of slab?

**Mr. Van Breemen:**

A. My answer to this question is very definitely "yes." In terms of the amount of longitudinal reinforcing steel that is normally installed, there is absolutely no question about the fact that there is a critical length of slab which, if exceeded,

will result in failure of the reinforcing steel at any transverse cracks that occur at or near the middle of the slabs. Any such failure of the reinforcing steel will, in turn, allow the cracks to open excessively. Under conditions of heavy truck traffic this is a condition which cannot be tolerated.

Our present standard practice in New Jersey is to construct reinforced slabs 80 ft. in length. Our investigations indicate that it would be unduly hazardous to increase the length of these slabs without proportionately increasing the amount of longitudinal steel. We have, however, constructed a number of experimental slabs of greater length in order to try to find the critical limit.

\* \* \*

## 2. RIDING QUALITY OF CONCRETE ROADS

*(Extracted from 'Highways and Bridges' Jan 31, 1951)*

THE Road Research laboratory has recently carried out tests during the laying of a new concrete road in Glamorgan. The tests were designed to find out what effect the workability of the concrete and the method of dumping it in front of the spreading machine had on the riding quality of the finished road. Some observations were also made on the method of finishing the concrete surface and the accuracy of form laying.

A wet-surface profilometer was specially designed and made for use in the experiments. The machine records irregularities on the surface of the concrete while it is still wet enough to be altered.

The tests provided considerable information on the factors influencing the riding surface of the road. The evenness of the finished surface and the uniformity of the compacted slab depend on the evenness of spreading. At the site the best results were obtained when small heaps of about 1 cu. yd. of concrete were dumped from both sides of the slab at fairly regular intervals.

## Workability of mix

Even when the spreading technique was poor, a reasonably good riding surface could be achieved on a fairly level stretch

of road by increasing the workability of the concrete from "very low" to "low." The wetter mix, however, was difficult to handle, and caused some honeycombing at the bottom of the slab. Unevenness was also increased when there was a steep cant on the road.

Each pass of the vibrating machine makes it more difficult to level out irregularities. An accurate record of the profile of the road should be obtained before the second pass so that particularly uneven parts can be tackled.

An improvement in the riding quality could be obtained by increasing the weight of the front screed of the finishing machine, but it is possible that this leads to a lower skidding resistance. The setting of the form work and its settlement during the passage of the machines was responsible for about one-third of the total irregularity in the best surfaces.

The experiments proved that better riding quality could be produced with more efficient spreading machines. It would also be an advantage to have finishing machines fitted with surface profile recorders. More robust rails and forms are essential, and stoppages must be reduced to a minimum.

## List of Approved Works on National Highways

| S. No.             | Job No.   | Name of Work                                                                                              | Amount approved<br>Rs | Remarks |
|--------------------|-----------|-----------------------------------------------------------------------------------------------------------|-----------------------|---------|
| <b>ORISSA</b>      |           |                                                                                                           |                       |         |
| 1.                 | 483 RS. 5 | Establishment of a survey Sub-Division for surveying National Highway No. 5 from Dharamsala to Panikoili. | 15,600/-              |         |
| 2.                 | 484 RS. 5 | Ferry service over the Mahanadi and Birupa rivers.                                                        | 1,70,500/-            |         |
| <b>BOMBAY</b>      |           |                                                                                                           |                       |         |
| 3.                 | 485 BM. 8 | Acquisition of land in mile 150 near Railway crossing No. 98 on National Highway No. 8.                   | 83/-                  |         |
| <b>WEST BENGAL</b> |           |                                                                                                           |                       |         |
| 4.                 | 465 BG. 6 | Replacement and remodelling of the bridge over the Cossye river on H. N. No. 6.                           | 1,06,400/-            |         |

(Contd. from page 21)

## A Brief Review of the Punjab Budget

(With special reference to Civil Works)

THE Punjab Budget for 1951-52 provides for total revenue receipts of Rs. 16,40 lakhs and expenditure chargeable to revenue of Rs 16,70 lakhs leaving a deficit of Rs 30 lakhs. The revised estimates for 1950-51 indicate a surplus of Rs 34 lakhs with the revenue receipts amounting to Rs 16,51 lakhs and expenditure to Rs 16,34 lakhs.

Revenue expenditure on Civil Works for 1951-52 estimated at Rs 185.80 lakhs is about 63% higher than the corresponding expenditure in 1950-51 (Revised Estimates). It forms nearly 11% of total estimated State expenditure in 1951-52, the corres-

ponding figure for both the preceding years being about 7%.

The Budgeted provision for communications under the head 'Original Works' is about Rs 64 lakhs in 1951-52 being nearly double the corresponding amount in 1950-51 (revised estimates). So far as the expenditure on Civil Works under 'Original Works' is concerned, the proportion of buildings to communications is 4:3 in 1951-52 against 7:3 in the preceding year. This shows a marked improvement this year in the provision for communications vis-a-vis buildings.

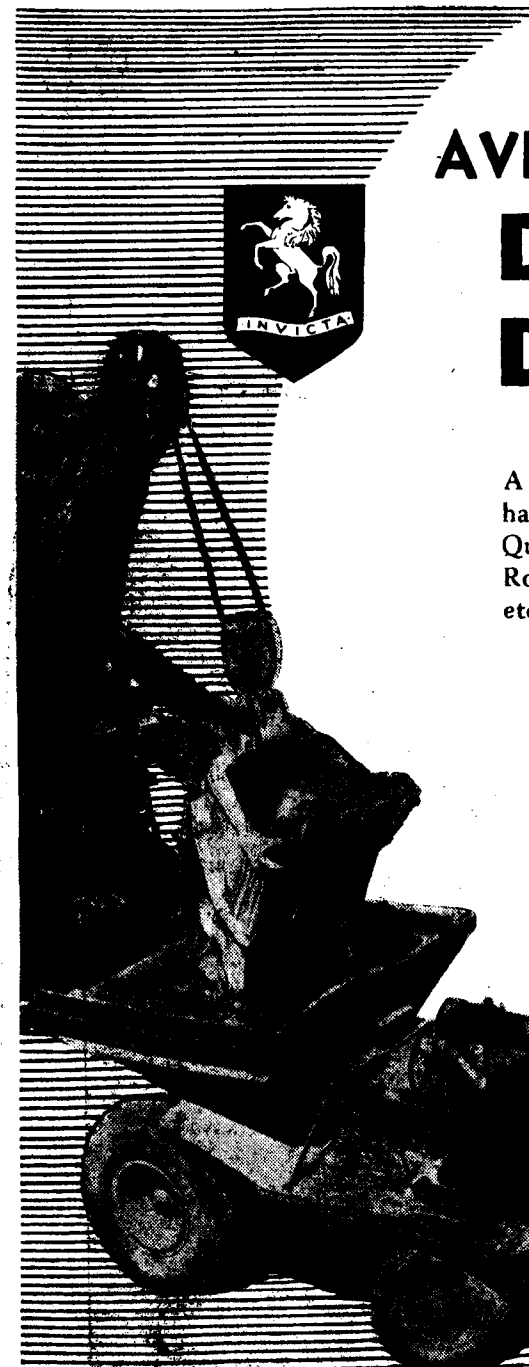
## List of Books added to the Roads Organization Library during June, 1951

1. Public Library provision and Documentation Problem (Papers for discussion at the 9th All-India Library Conference, Indore. 11-14 May 1958 by S. R. Ranganathan, (All India Library Association, Delhi, 1951). Publications of the Superintendent, Government Press, Madras, 1950.
2. The Madras Road Traffic Code, 1940 (corrected upto 31-12-49)
3. Proceedings of the Board of Communications, Madras, held on 31st August, 1950.
4. English translation of speech delivered in Hindi by the President, Dr. Rajendra Prasad at Pilani on Sunday, the 11th February, 1951.
5. English translation of the speech delivered in Hindi by the President, Dr. Rajendra Prasad, on the occasion of the Annual Prize Distribution function at Mayo College, Ajmer, on the 13th February, 1951.
6. Damodar Valley Projects. (The Publication Division, Ministry of Information and Broadcasting, Govt. of India). Columbia University Press, New York, 1950.
7. Underpinning-Its practice and applications (Second edition-Revised and Enlarged) by Edmund Astley Prentis and Lazarus White,
8. Cofferdams by Lazarus White and Edmund Astley Prentis.
9. Conference on Civil Engineering problems in the Colonies—A Collection of papers presented at the Institution in July 1950. (The Institution of Civil Engineers, Great George Street, London, S. W. 1)
10. Supplementary progress Report for the month ending March 1951 (Roads Station on the work done in the Karnal Soil Laboratory. Roads and Building Research Laboratory, Karnal.)
11. Trunk Roads The Shrewsbury Whitechurch-Warminster Trunk Road (Lee Brockhurst Division) Order, 1951—1952, No. 15, Publications of His Majesty's Stationery Office, London, 1951.
12. Types of Road Surfacing and Maintenance using Tar or Asphaltic Bitumen—Road Note No. 5 (Second edition) (Issued by the Director of Scientific and Industrial Research, U. K.) 2 copies
13. Design of Concrete Mixes—Road Note No. 4. (2nd edition), (Issued by the Director of Scientific and Industrial Research, U. K.)
14. Building Research, 1949—(Issued by the Director of Scientific and Industrial Research, U. K.)
15. Test Walls for Assessing Construction Times with New Building Blocks—National Building Studies Technical Paper No. 9 by W. Kinniburgh.
16. London Traffic—Parking Places—The London Traffic (Parking Places) Consolidation (Amendment) Regulations, 1951, No. 23.
17. Highway, England—The Stopping up of Highways (London) (No. 1) Order 1951 No. 5.
18. Highway, England—The Stopping up of Highways (Bristol) (No. 1) Order, 1951—No. 26.
19. Highway, England—The Stopping up of Highways (Gloucestershire) (No. 1) Order, 1951—No. 27.
20. Highway, England—The Stopping up of Highways (Essex) (No. 1) Order, 1951—No. 31.
21. Highway, England—The Stopping up of Highways (Glamorgan) (No. 1) Order, 1951—No. 32.

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22. **Trunk Roads—The West End—North of Bassett Trunk Road Order, 1951—No. 34.**
23. **Trunk Road—The Swansea—Manchester Trunk Road (Stamford Bridge Division) Order, 1951—No. 46.**
24. **Highway, England—The Stopping up of Highways (Somerset) (No. 1) Order 1951—No. 54.**
25. **Highway England—The Stopping up of Highways (Rutland) (No. 1) Order 1951.**
26. **Highway, England—The Stopping up of Highways (West Ridding of Yorkshire) (No. 1) Order 1951—No. 92.**
27. **Highway, England—The Stopping up of Highways (Derbyshire) (No. 1) Order 1951—No. 94.**
28. **Highway England—The Stopping up of Highways (London) (No. 2) Order 1951—No. 96.**  
Publications of the Testing Laboratory, Department of Highways, Kentucky, 1947.
29. **Field Manual for Design and Control of Concrete Mixtures.**
30. **Manual for Design and Control of Asphalt Plant Mixes and Other Bituminous Materials, Revised, 1950.**  
Publications of the State of Illinois, Deptt. of Public Works and Buildings, Division of High ways, Springfield, Illinois, 1948.
31. **Further Investigation of the Effect of the Sand Fraction Passing the No. 50. Sieve on the properties of Concrete.**
32. **Investigations of the Effect of the Sand Fraction Passing the No. 50 Sieve on the Properties of Concrete.**
33. **Traffic Survey—Analysis of the Results of Four years Counts: 1945, 1946, 1947, and 1948 (City of Montreal, City Planning Deptt.)**  
Issued by the Ministry of Transport, Govt. of India.
34. **Report of the Ministry of Transport 1950—51 Part I. Other than Road Development.**
35. **Report of the Ministry of Transport (Roads Organisation) 1950—51, Part II: Road Development.**
36. **Annual Report (Technical) 1948 of CWIN Research Station Poona—Research Publication No. 14. by D. V. Joglekar (The Manager of Publications, Delhi).**  
Publications of the Superintendent, Government Printing and Stationery, Bombay, 1948.
37. **Administration Report of the Public Works Department in the Province of Bombay for the year 1941—42 with detailed review of the Civil Works.**
38. **Administration Report of the Public Works Department in the Province of Bombay for the year 1942—43.**
39. **Administration Report of the Public Works Department in the Province of Bombay for the year 1943—44 with a detailed review of the Civil and Military Works.**
40. **Administration Report of the Public Works Department in the Province of Bombay for the year 1944—45.**
41. **Irrigation Administration Report in the Province of Bombay for the year 1943—44 — Part I.**  
Publications of McGraw Hill Book Co., Inc., New York, 1950.
42. **German—English Technical and Engineering Dictionary (1st edition) by Lewis Vries.**
43. **Reinforced Concrete Masonry Structures (2nd edition) by Hool and Kinne.**
44. **Automobile Facts and Figures (30th edition), 1950. (Automobile Manufacturers Association, New Central Building, Detroit 2, Michigan.)**

45. **Properties of Plain and Reinforced Limerock Concrete—Bulletin Series No. 36 by S. L. Bugg and D. A. Firmage. (Florida Engineering and Industrial Experiment Station, College of Engineering, University of Florida, Gainesville).**
46. **Study and Recommendations for improving traffic movement in the Central Business District—City of Chicago, by Mayor Martin H. Kennelly. (Prepared by the Mayours' Traffic Survey Committee for the Central Business District).**
47. **Air port Paving—May 1948. (U. S. Department of Commerce, Civil Aeronautics Administration, Washington, D. C., 1948)**
48. **The Engineer Directory and Buyers Guide 1951 edition. (The Manager, The Engineer, 28 Essex Street, Strand, London, W.C.2.)**  
**Specifications for the Construction.**
49. (i) **Subgrade section 14 2 copies**
50. (ii) **Bituminous Materials—For Asphalt Cement section 25. 2 copies.**
51. (iii) **Bituminous surface Treatment—Section 28—Type 'C' 2 Copies.**
52. (iv) **Bituminous Penetration Macadam Type 'D'—Section 30. 2 copies.**
53. (v) **Bituminous Pavements—Type I—I Section 32 2 copies. (American Association for State Highway Officials, Washington).**
54. **Engineering Economy by H. G. Thusen. (Prentice Hall Inc., 70, Fifth Avenue, New York 11, N.Y.)**
55. **Engineering Hydraulics, Proceeding of the fourth Hydraulics Conference, Iowa Institute of Hydraulic Research, June 12—15, 1949. (Edited by Hunter Rose. John Wiley & Sons, Inc., New York)**  
Publications of the American Concrete Institute, Michigan.
56. **Proceedings of the American Concrete Institute. Vol. 31, 1935.**
57. do. Vol. 32, 1936.
58. do. Vol. 33, 1937.
59. do. Vol. 34, 1938.
60. do. Vol. 35, 1939.
61. do. Vol. 36, 1940.
62. do. Vol. 37, 1941.
63. do. Vol. 38, 1942.
64. do. Vol. 39, 1943.
65. do. Vol. 40, 1944.
66. do. Vol. 41, 1945.
67. do. Vol. 42, 1946.
68. do. Vol. 43, 1947.
69. **The 29th Annual Report and Technical Papers to be read at the 29th Annual Session Bombay. (The Institution of Engineers, (India), Bombay Centre.)**
70. **The Science of Turf cultivation by R. P. Faulkner. (The Technical Press Ltd., London).**
71. **Calculating Instruments and Machines (1st edition) by Douglas R. Hartree. (Cambridge University Press, London).**



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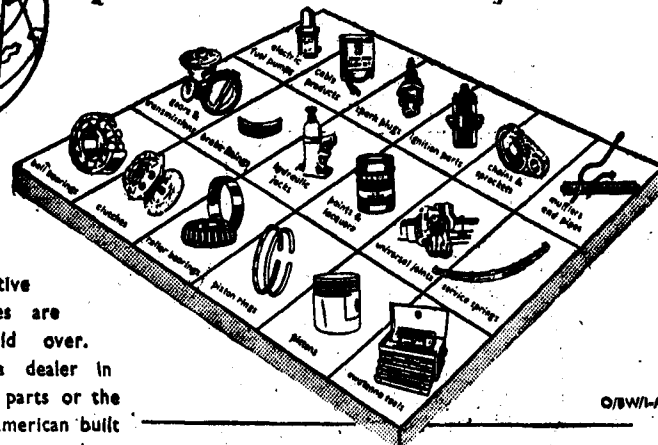
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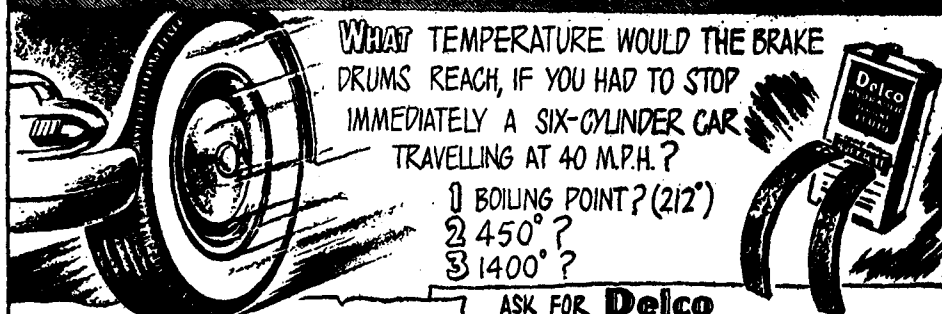
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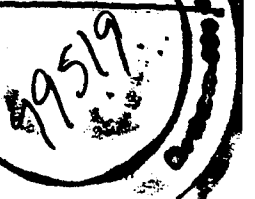
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| 25.           | Road Research Bulletin No. 1                                                              | ... | ... | 5                              | 0  | 0  |
| 26.           | I. R. C. Standard Specifications and Code of Practice for Road Bridges<br>in India (1937) | ... | ... | 1                              | 8  | 0  |

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