Construction of Railway Sidings

*By Saleemullah Khan,**

The first step is to decide whether a railway is at all necessary. A railway is usually the cheapest means of transport where a large number of heavy loads have to be carried. A roadway might wear out quickly or be rendered unmotorable in bad weather but a railway track if properly located and constructed will stand heavy traffic without much maintenance. Road vehicles can at best maintain a limited output, but while such vehicles can deliver materials right on the job which a railway usually cannot, considerable initial expenditure is necessary to purchase an adequate number of units for a particular job. The maintenance and running expenses are heavy and unless the materials and stores required for the project are locally available it would generally be found that railway transport is most convenient and economical.

Having come to a conclusion that a railway is necessary, the next step is to fix the point of take-off. A connection taking off from a point between stations on a busy passenger line must be avoided and only considered if an alternative alignment is impossible. Such connections require much time to construct as the Railway has to examine such a situation with great care, and become costly as full station facilities with complete signalling, loops and sidings are usually necessary. The connection should, therefore be taken, as far as possible, from an existing station yard or from an existing siding.

The point of take-off, the length of line and the approximate alignment having been decided, there now remain two courses open to the demanding agency. The line may either be constructed by the Railway or by the agency itself. If the line is of short length it is good policy to have the Railway construct it. The mechanics of this problem are as follows. On demand from the agency, the Railway prepares an estimate of costs which is sent to the proposer for acceptance. This usually takes four to six months. The acceptance having been received, the Railway, then asks for advance payment for the cost of work. The sum is either deposited in cash with the Railway or in the case of Government Departments an adjustment of actual costs is made on completion of the work, the department placing the requisite funds at the disposal of the Railway. The actual construction is generally done expeditiously if materials are readily available. The project engineers may, however, keep in close touch with the Railway and pursue the matter in their own interest. The original estimate is prepared by the railway Division in which the work is situated, the sanction to the work is given by Railway Headquarters Office and work is executed by the Railway Divisional Engineer. The track materials are supplied by the Track Supply Officer. A liaison maintained with each of these railway offices to expedite the work at each stage, will be of advantage.

**Executive Engineer, North-Western Railway.*

The construction of railway lines considerable in length may generally not be undertaken by the Railway due to paucity of staff. The question is mainly of time; the agency in need of the line is usually in a hurry and is able to undertake the construction itself with its own staff. If this is the case, the first point which requires a decision is whether the rolling stock to be used will be owned by the agency or by the Railway. In case of the latter, the line may have to be constructed with clearances and dimensions as laid down by the Railway. This information can be obtained officially from the Railway authorities before the location surveys are taken in hand. A reference may again be necessary after the preliminary surveys have been completed, regarding the design of bridges which will have to constructed according to Railway requirements. The standard of permanent way, the method of operation, the standard of maintenance and yard facilities may also have to be decided with the Railway authorities before the construction is commenced. Finally, the procurement of track materials is a problem which is vital to the success of the scheme, and this is usually solved by purchasing surplus material from the Railway. If the line has to be built on Railway standards a list of materials is easily available, and the purchase is effected through the Railway Controller of Stores. The Railway can generally supply all the track materials usually required, except sleepers.

In the case where the line is constructed by the agency itself and where it is to be operated with the agency's own rolling stock (or stock purchased or hired from the Railway) the first step to be undertaken is to prepare a list of materials required for the track, so that negotiations can immediately be started with the Railway for the purchase of these materials. With no previous experience of permanent-way it would be of great advantage to the agency if a retired railway permanent-way inspector were appointed for the preparation of the list of materials, the construction of the line, and for subsequent maintenance. These lists are based upon certain factors which are explained in the following.

The standard of construction

From a preliminary assessment of the situation it should be possible to work out the total tonnage and the period in which it has to be moved. Assuming that a 4-wheeled B.G. wagon can carry about 22 tons, the total number of wagons to be moved can be calculated. Considering the unloading facilities available and other factors such as the length of the line, etc., it should be easy to find the number of trains that can be run in 24 hours. This would also depend upon the hauling capacity of the locomotive and the speed at which it will haul the train. The speed will also depend upon the standard of permanent-way as constructed and as maintained. For the purpose that such sidings are normally constructed it should be possible to work to low speeds and though this would reduce the number of trains per day on the section, a heavier load may be possible per haul provided the locomotive is powerful enough. The permanent-way standard may thus be fixed; it should be capable of a maximum speed of 20 m.p.h. As regards bridges, which would generally be of small spans, the stresses may be calculated by using the locomotive loads or the loaded wagons whichever are higher. A loaded broad gauge wagon gives a load of about 16 tons per axle without impact, while a light locomotive capable of hauling 40 wagons at 20 m.p.h. may have an axle load exceeding this figure. The locomotive governs the strength of the bridges required and, therefore, its axle loads and the increase of this axle load due to hammer blow, eccentricity of the

connecting rod, etc., should be known beforehand.

The locomotive

The type of locomotive required can now be considered. An engine capable of hauling 40 broad guage wagons (total train load equivalent to 1,300 tons) at a speed of 20 miles per hour over a maximum gradient of 1 in 200 and uncompensated (for grades) curves of 10 degrees, would meet normal requirements. Such a locomotive can either be imported in which case a Diesel unit would be more convenient and economical considering that fairly good maintenance facilities are usually available on major projects, or an old steam locomotive can be purchased from the Railway. In both cases, the characteristics and dimensions of the locomotive should be obtained from the supplier for the design of bridges, etc.

The permanent way

This consists of rails, fish plates and fish bolts and sleepers with fittings (bearing plates and dogspikes in case of wooden sleepers). New rails for such sidings are a luxury and secondhand surplus rails complete with fishplates, bolts and nuts can be purchased from the Railway within a much shorter time than it takes to import new materials and at a much lower cost, notwithstanding the saving in foreign exchange. Wooden sleepers, the type of sleepers most suitable for such lines, cannot be spared by the Railways and should be purchased from local and foreign sources. Other fittings and fastenings such as bearing plates and dogspikes are available in plenty with the Railway.

For the standard of construction already decided upon, 75 lbs. secondhand rails are quite suitable for the main line. For yards and other sidings an even lighter section of rail say 60 lbs. and 50 lbs. may be adopted. The availability of the rails having been established by negotiations with the railway, the lengths in which the rails are to be supplied may now be ascertained. This information is required to compute the number of joints in the length of the proposed line and consequently the number of fish plates and fish bolts, and to work out the number of sleepers required. The length of a rail as used on the Railway, is a multiple of yards, and second hand rails of 75 lbs./yard or 60 lbs./yard are usually available in lengths of 24', 27' and 30'. The number of sleepers are generally specified as number of sleepers per rail-length. This is known as Sleeper Density and is a function of the speed and intensity of traffic, the conditions of formation and ballast, and the type of sleeper. If the rail is N Yards in length, then sleeper density is indicated by N plus 3, N plus 4 and so on. N plus 3, for example, would mean that 13 sleepers would be required for a 30 feet rail. A sleeper density of N plus 1 on a construction main line for the standard of construction adopted earlier, and of N minus 1 on sidings and yards would be quite suitable unless the formation is very soft and cannot be stabilised. The line may be packed with earth and about 4 inches of 1" stone or brick ballast used under points and crossings only. A fairly accurate estimate of the number of sleepers required can thus be made and arrangements made for their procurement well in advance. At this stage the use of reinforced concrete sleepers may also be considered, for although such sleepers are rather difficult to handle, they can supplant wood which is extremely difficult to obtain these days and if properly constructed, last a long time. On major projects for which such lines are usually required, concrete is widely used and the manufacture of concrete sleepers would be fairly easy and if properly organised, even cheaper than wood sleepers. Further details can be obtained from the Railway authorities if so desired.

While on the subject of sleepers, it may also be mentioned that the spacing of sleepers along a rail length is generally not uniform, the sleepers being close together near the joints. The maximum spacing may not exceed 3 feet centre to centre of the sleepers. It is also possible to utilise a number of composite sleepers on the straight portion of low speed running lines, on sidings and in yards. A composite sleeper is made out of two blocks cut from old wooden sleepers each 3 feet long and connected by a mild steel 2" x 1|2" flat, 5 feet 3 inches long fastened by two coach screws at each end. The guage-holding property of composite sleepers is not so good and therefore not more than 50% may be used with at least two full sleepers at the ends and four near the middle of rail length judiciously distributed.

A number of sets of points and crossings is always necessary and these can be purchased complete from the Railway. The demand for a set is placed for a particular rail section and for a particular crossing number. The crossing number is the cotangent of the angle of crossing and is designated by 1 in. 8½, 1 in. 6 etc. The crossing normally used on the broad guage is 1 in. 8½ which gives a radius of curvature of about 800 feet, a curvature easily negotiable at low speeds (about 10 m.p.h.) by 4-wheeled wagons. The points-set and the crossing assembly are supplied separately and intervening length of track (called the 'Lead') is made up at site from ordinary rails. Layout diagrams can be obtained from the Railway for each crossing number and section of rail. For the setting of points a separate assembly of rods and a lever is necessary which may be purchased from the Railway separately. For all turnouts of this type, special long sleepers are required which will have to be arranged for in addition to the ordinary sleepers.

For the actual construction of the permanent-way, a number of tools and equipment will be required, details of which may be collected from the Railway. A reference to the Railway for most of this information would be unnecessary if an old railway Permanent Way Inspector is employed. It is extremely difficult and time-consuming for a non-railway engineer to programme and execute the laying of permanent way.

The Rolling Stock

Wagons of the 4-wheeled type, open, closed or low-sided and others of a special design may be purchased from the Railway or loaned from other departments. The number required would depend upon the quantity and type of materials and stores carried. A number of guards' brake-vans would also be necessary to suit the number of trains that may be run. Loaded Railway wagons arriving from other parts of the country can usually be taken into the construction siding for direct unloading on a hire system details of which have mutually to be agreed upon with the Railway. An agreement of the terms and conditions is usually entered into and is finalised before the operation of the line actually begins.

Operation

The operation of a line has to be done on a proper system for which certain rules and regulations have to be framed. The main object of such a system is to avoid the loss of life and property, and to ensure a safe, economical and speedy movement of trains. A set of rules and regulations can be drawn up in relation to the type and volume of traffic expected and the equipment available. Certain key men such as drivers, guards, shunting staff, etc., can be trained in the working instructions and with a very little effort in this direction a safe and rapid means of transportation can be quickly developed.

During operation a certain amount of maintenance and running repairs are always necessary. The locomotive will require water and water supply arrangements will be necessary at suitable intervals. The locomotive will also need periodical cleaning and check-up and therefore a small service station will be required. The rolling stock will need periodical attention to axle-boxes for which attention will be required at both ends of the line. The electrical equipment will need some looking after too. Finally, the maintenance of permanent way. This is usually neglected with the result that the track becomes unsafe for even low speeds and derailments become numerous. A gang of 10 men including a mate and a keyman must be maintained throughout the busy period for a length of line between 2 to 5 miles. This gang can be formed by recruiting men who have worked before on the Railway and who are familiar with track tools and their use.

Junction arrangements

At the point of take-off, a portion of the line is constructed and maintained by the Railway, the boundary being clearly demarcated. Provision for the Railway portion has to be kept in the estimates of casts both for the initial and recurring expenditure. These figures have to be obtained from the Railway authorities as soon as the proposed junction is agreed upon and approved by the Railway.

ENGINEERING CONGRESS NEWS

The Executive Council of the West Pakistan Engineering Congress has been meeting regularly every month since its election in February, 1956, and has taken a number of decisions on items of importance to the Congress and its members.

During all its meetings the Council has felt the necesity of regular meetings of its members in Lahore and other local centres where problems of mutual interest could be discussed and technical lectures arranged for the benefit of members. A beginning was made in the Lahore centre where monthly meetings have become a regular feature. So far four eminent engineers have been invited to address the members on some vital aspect of the profession, whether technical or otherwise. The Council is very keen that similar meetings should be started in other important towns of West Pakistan where there are reasonably big concentrations of engineers.

HEADQUARTERS FOR CONGRESS

The present Council prides itself on the fact that it has taken some substantial steps to give practical shape to a long-felt desire and need of the Congress members. Every member of the Congress has at some time or the other expressed the wish to see the Congress lodged in a permanent headquarter where it could hold its meetings, arrange social gatherings and provide a good reading room and library. The Council is sparing no efforts to acquire a suitable peice of land where this headquarter building could be built.

UNPAID ARREARS

While working on the budget, which this year is being prepared on a commercial basis, the Council was pained to discover that unpaid arrears from Congress members amounted to Rs. 11,000. If the Congress is to play its proper role, especially in view of the fact that it has decided to construct a headquarter building, it is imperative that none of its members, who should nomally have the good of the Congress at heart, should fail to pay up their subscriptions, etc. The Council shall make every effort to recover this huge amount and hopes that all such members who for one reason or the other have not cleared their arrears will do so at a very early date.

The new Council at its very first meeting decided to put "the Engineering News" on a sound footing. Finance for this venture, which has been very popular with members of the Congress and other engineers, was arranged and the Council expressed its determination to see that the journal was published regularly and properly.

TECHNICAL PAPERS

At each meeting the Council considers the progress of the receipt of technical papers for the next session of the Congress. It endeavours to despatch these papers to the members at least one month before the annual session so that they may have sufficient time to study them and prepare their comments. So far the following papers have been approved by the council and are under print:-

Uses of Sulphur for Lowering the Soil Alkalinity, by Doctor A. G. Asghar;

Study in some Hydraulic Features of the Design of Taunsa Barrage, Part II and III, by Dr. Mushtaq Ahmad.

The following papers have been received and are being revised:-

Chuharkana Acquifer Test, by Hamid and S. M. Minhas; Use of Concrete for the Construction of Chittagong Port ,by Salim Ullah Khan; Water Supply and Waste-Water Disposal Problem of Industries, by I. A. Zafar; Sedimentation of Reservoirs on Indus River System, by Dr. Nazir Ahmad and A. Hamid; Planning and Construction of Package Material Industries, by S. Hamid and S. M. Minhas: Development of Satellite Town in West Pakistan, by M. Hamid-ud-Din and S. A. Mukhtar; Improving Engineering Education in Pakistan by Mubashar; Influence Lines for Continuous Concrete Bridges, by A. A. Jamal-ud-Din.

It is proposed to give a brief introduction of each paper in the next issue of the "Engineering News" which is expected to be out before the Congress meets for its annual session in February, 1957.

ANNUAL SESSION PROGRAMME

The Council has drawn up a tentative programme for the 41st annual session of the West Pakistan Engineering Congress. The session will be inaugurated on February 14, and on that day beside the inaugural ceremony a symposium on housing will be held. The next day various technical papers will be read and discusesd in two sessions. On February 16 the business session will be held in the morning and in the evening the members will leave for Karachi by special train to see some of the important industrial and engineering installations there. The special train will leave Karachi on February 19, reaching Lahore the next day.

Members desirous of taking part in the trip are requested to pay their subscriptions up to date and remit the railway charges in advance. The last date for the remittance of the expenses will shortly be notified to the members individually.

INSTITUTE OF ENGINEERS

Readers will recall that some of the Congress members were very keen to enroll as members of the Institute of Engineers, Pakistan, but the high rate of admission fee and the very high annual membership subscription of the Institute was not encouraging. The Council ,therefore, invited the President of the Institute to discuss the subject so that members of the Congress could be enable to enroll in the Institute of Engineers in much larger numbers. During the discussion it was suggested that engineers who were already qualified and in service should pay only nominal charges to become members of the Institute and that the Provincial Government should be moved by the Executive Committee of the Institute of Engineers to sanction travelling allowance for Government servants attending the sessions of the Institute. It was also suggested that the age limit for corporate membership of the Institute should be relaxed to a certain extent to enable engineers who were qualified but had not yet attained the age of 30 to become full members.

The Council is happy to announce that in a recent communication the Institute of Engineers has informed that 50 per cent reduction in the admission fee and annual dues has been approved by it in response to the wishes of the West Pakistan Engineering Congress. The new rates will be Rs. 25 for admission fee as members, Rs. 12 as associate member, Rs. 5 as junior member and Rs. 250 as

affiliate member. The annual subscription will be Rs. 25 for a member, Rs. 15 for associate member, Rs. 12 for junior member, Rs. 6 for student member and Rs. 50 for affiliate member.

Now that the request of the Congress has been acceded to it is hoped that members will join the Institute in large numbers and take advantage of the facilities offered by it at Lahore. The Lahore centre is situated in spacious premises in a very central locality. The address is Masson Narsingdas Buildings, The Mall ,and a library, a reading room and a lounge are provided.

CORRESPONDENCE

(The views expressed by correspondents are entirely their own and it is not necessary that the Editorial Board should agree with them.)

Sir,

Qazi Zahur Hussain in his letter published in the June issue has raised some very interesting and pertinent questions regarding advisibility of Mangla Dam at the proposed site. His observations warrant serious consideration and I shall try to answer his questions from my own point of view.

Along with technical feasibility, every development scheme has to be judged for its utility and expediency, and Mangla Dam Project is no exception. In the context of post-partition problems facing the country, Mangla Dam has a high degree of expediency besides being a very sound scheme on purely technical merits. The present discussion is confined only to the discussion of its technical feasibility.

Flood protection, navigation, storage of water for industrial or domestic consumption, irrigation or water-power are some of the functions for which a dam is usually constructed. A well-planned project generally combines several of these functions in one structure with more emphasis on its primary objective. Conservation of flood waters to increase the cropped area in West Pakistan has been stated to be the primary object of Mangle Dam Project. Hydro-electric power, flood protection and fish culture, etc., are additional functions of this dam which make it a multi-purpose project.

The average discharge of the river at Mangla is said to be nearly 23 million acre-feet, out of which a total of 10 million acre-feet are being utilised for irrigation through the linked canals. The balance of 13 million acre-feet per year escape to the sea during the flood season. The object of this dam naturally is to conserve as much of this water as is practicable. The other two supplementary functions, of flood control and power, also require maximum storage capacity and highest uniform withdrawals.

A reference to the contour survey map of Jhelum River above Mangla would show that the valley just upstream of Mangla is the only place which promises any sizeable storage. The gorge further upstream is both steep and narrow and does not offer any opportunity for adequate conservation of flood waters. If any storage is to be achieved it has to be at or near Mangla. The topography of Jhelum Valley does not offer very many sites to pick and choose and vicinity of Mangla is the only choice available.

According to Qazi Zahur Hussain the construction of a dam at Mangla would preclude the possibility of building any replacement dam lower down when Mangla Reservoir is silted up, and this appears to be his main objection to the project. This statement is not wholly correct. It is true that the entire capacity of Mangla Reservoir would not be easily replaceable by a dam in Jhelum river further downstream, but opportunities do exist (and have already been taken note of) for having off-channel storage in some of the tributaries to offset the loss in capacity of Mangla Reservoir. Even possibilities for having an equal amount of storage in Jhelum

river are also not totally extinct, and could be exploited when warranted.

Moreover, what is the bar against putting in more dams further upstream in the Jhelum River and its tributaries? Such dams could serve the triple purpose of storing and regulating more supplies and checking entry of sediments into Mangla Reservoir, thus enhancing its life and producing more power. Such reservoirs in fact are required in giving more adoptability to the water and power output. Some of the plants might even work as peaking stations and produce a well knit and well-balanced power unit.

Some eyebrows might be raised on this downside first development of a river system, but this will not be the first time this has been done. Many places do exist where exigencies of the situation have dictated even more queer solutions.

Qazi Sahib has suggested that "the problem of siltation of the reservoir be satisfactorily settled and the possibility of building a replacement dam eliminated altogether." I have not been able to understand what he actually means by settling the problem of siltation. If he contends that the reservoir should be kept clear of silt by either checking its entry or "slucking" it out then I am afraid this contention is not based on true conception of this problem. A flowing stream always carries some silt in suspension and drags some heavier sediments along the bed. The quality and quantity of these materials depend upon the physical conditions of catchment and slope and velocity of the stream. Whenever this flow is checked, the sediments start falling out so that in a big reservoir, similar to one that can be created anywhere in Jhelum River, almost all the sediments would settle down and only a portion of clay in colloidal state would ever pass out.

The phenomenon of sedimentation observed in reservoirs all over the world indicates that when the stream flow enters the reservoir, the heavier particles drop out. Experience shows that these particles, which constitute about one third of the entire sediments, settle down outside the limits of the reservoir to form a delta similar to the one formed by a river entering the sea. Less third of the total fall-out inside the reservoir at the upsteram end) and only fine suspended sediments are carried down the reservoir through the action of the density currents. These particles settle down in front of the dam and occupy the dead storage usually provided for that purpose. The deltaic deposits formed near the head of the reservoir would progress gradually downstream thereby reducing the grade of the river upstream. Flatter slopes will induce settlement of more and more coarser particles outside the limit of the original reservoir. This situation, some authorities believe, promises greater life for reservoirs than estimated originally from sediment data of a stream. For instance, the life of Lake Mead created by the Hoover Dam is now estimated to be much more than initially contemplated. No definite scientific data, however, is available on this point so far.

It is, therefore, evident that sluicing even if practicable, would not have any effect on the sediments deposited in the upper reaches of a reservoir. If the extent of the reservoir, which stretches for miles above the dam, is also kept in mind, the futility of sluice gates at or near the dam become abundantly clear. Mangla Reservoir for instance would be 20 miles long and it is not hard to perceive that any attempt at sluicing out of sediments would be ineffective.

At the most, such sluicing can induce fine sediments deposited in the pool just above the dam to flow out. At one or two places attempts were made to instal low elevation openings for this

purpose. Experience has shown that either such openings are completely choked up or if they are kept open by frequent running at the expense of storage and power production, the effect is limited to cutting of a short steep conical segment in the reservoir bed just in front of the opening and the silt deposit elsewhere are not disturbed at all. These experiments have conclusively established the ineffectiveness of such attempts even in comparatively small reservoirs.

Qazi Sahib has further remarked that "the river below the site of the earth dam is much restricted to flow between the hills." This observation is also not factual. The elevations of right abutment on this site are lower than the contemplated height of the dam and in order to attain the same elevation we again have to fall back to almost the same length. Moveover the right abutment is weakened by a deep canyon running behind it and the abutment is so narrow that the axis of the dam cannot follow its crest. This site was in fact investigated but was abandoned in favour of the present location. Geologically, the formation in the canyon around Mangala and the entire length of the reservoir is practically the same. It is not correct to say that a good rocky formation, strong enough for a masonry dam, is in existence at the lower site.

From this letter it transpires that there is some sort of bias against a "zonal rolled fill earth dam", and I feel this prejudice against earth as a material for construction of dams is shared by many other engineers in this country. About a couple of scores of years ago the construction of an earth embankment to retain a great depth of water was certainly considered hazardous, but since then better conception of mechanics of soils, their behaviour and compaction have lifted that embargo placed arbitrarily on earthen dams by early builders. A well-planned and properly constructed earth embankment is considered more stable and much less vulnerable in peace and war, than any other form of structure. The one thing that can destroy an earthen dam is inadequate capacity of spillway and the resultant over-topping of it. Mangla Dam fortunately has sufficient guarantee against that.

Your readers might be interested to note that the proposed Aswan Dam in Egypt, which has created such an explosive situation in the world is also a "zonal rolled earth fill structure." The salient feature of Mangla and Aswan Dams present a very interesting comparison:

	MANGLA	ASWAN
Height	365 ft.	361 ft.
Quantity of earth	53 m.c. yds.	55 m.c. yds.
Storage	4.1 m.a. ft	4.1 m.a. ft.
Cost	0.75 billion Rupees	6.5 billion Rupees

It is significant to note that the proposed Greater Aswan Dam is upstream of the present Aswan Dam which is a masonry structure.

Both geologically and topographically there are comparatively few storage sites in our country where dams other than earth fill embankments could be built. The predominance of upper and middle Siwaliks in this region promise more of earthen structures than any other in both wings of Pakistan.

Considering all the pros and cons of Mangla Dam Project it can be safely said that construction of this dam cannot and will "create many untold difficulties in the future." In fact, physical, economical and practical aspects recommend this site for storage on Jhelum River more than any other site further upstream.

MONAWAR ALI,
Executive Engineer,
Lahore.

NEWS AND NOTES

WHAT IS WRONG WITH PAKISTANI ENGINEERS:-

Following are extracts from a speech made by Qazi Zahur Husain, Chairman of the Lahore Centre of the Institute of Engineers, Pakistan, at a meeting held on October 30, 1956.

Any one seeing a number of foreign engineers and engineering firms in Pakistan, working as advisers, consultants and contractors, must wonder and ask what is wrong with Pakistan engineers and why are they not more conspicious in playing their part in the development of their own country.

These are pertinent questions and unless they are satisfactorily answered, the questioner is likely to conclude that the Pakistani engineers are incompetent to plan and execute large works and Pakistan Government is left with no option but to import foreign engineering consultants and firms of contractor. Such a conclusion which appears to be correct at first sight, is totally wrong and is nothing short of a slur on the sons of the soil who had been eagerly awaiting the opportunity of serving their country, but are being deliberately deprived of this privilege, due to the Government's policy which appears to have been dictated by some of the foreign advisers and possibly backed up by the members of C.S.P.

This notion has already been created. This can be proved by a statement made by an adviser of the Planning Board who has said that Pakistan Government shouid appoint some foreign Consultants and import a few engineering firms of contractors to carry out the 5-year Plan, as according to him, Pakistani engineers had no experience of major engineering projects and had only been trained for repair and maintenance jobs.

Such a view is based on the assumption that there is a lack of engineering talent in this country. This is entirely wrong. Apart from a very large number of talented and experienced engineers in Government services of Pakistan, there are some highly qualified and experienced retired engineers with such long, varied and valuable experience of planning and execution of large engineering undertakings, that they can very well be fitted into any consulting engineers firms in England or American like their old colleagues who are working as such in Britain and elesewhere. These men can give their advice on all problems from the planning stage to execution.

RESOURCEFUL ENGINEERING CONTRACTORS

There is a dearth of good and resourceful firms of engineering contractors, but with change of conditions big contractor firms are coming into being A proof of this statement is furnished by Messrs. Omarsons Ltd., who are executing, besides some large works at Dacca, a very important work for the Karachi. Joint Water Board. The other outstanding firms in Pakistan is Gammons Ltd., which is doing some excellent work, and in addition to these two, some other engineering firms are also entering the field and it looks that Pakistan will soon be self sufficient in

this respect. The suggestion of Planning Board's adviser for the import of foreign firms into the country is, therefore, inopportune and unworthy of consideration, and if implemented it will not only kill the useful nation-building concerns mentioned above, but will also affect very adversely Pakistan's very meagre foreign exchange by draining away huge sums of money from the country in the shape of profits which the foreign consultants and engineering firms must make.

CIVILIANS AS SECRETARIES

The advantages of Pakistani engineers doing their country's work through the agency of Pakistani firms of contractors are too obvious to need a mention, but it is a great misfortune that there is no engineer who has a voice in running the affairs of the Government. Their places have been filled by members of Pakistan's Civil Service who having no knowledge of engineering science and practice are no better fitted in the engineering department than some square pegs in round holes. The result is, that while the engineers, being thoroughly disgruntled and dissatisfied, cannot give their best in this irrational set-up, some of our highly paid Civilian Secretaries who had been trained for an entirely different job, cannot do justice to the assignments which are so radically different from their legitimate functions. Although the Government had previously been cautioned against the unpleasant consequences which might follow if the engineering departments were placed under the C.S. officers and a deputation of Chief Engineers, also waited upon the Chief Minister of Punjab in 1955 in this connection, yet the men of "steel frame" fame had dug their toes in, so firmly, that all efforts to avert this move proved to be futile and the engineer, who is known to fight his way through all obstacles placed in his path by man and Nature, had to submit to this new arrangement. It is not known how this step has improved the administration, but it looks, on the other hand, that the introduction of a Civilian Secretary with utter lack of engineering knowledge and practice between a Chief Engineer and the Minister, must act as a hurdle and further retard the slow-moving Government machinery.

PRACTICE OF BRITISH REGIME

The old Indian Civil Service was the greatest privileged service during the British regime and every I.C.S. officer was a watch-dog to keep an eye on activities of the people and Government departments. The British put I.C.S. officers as the heads of Accounts, Postal, Customs, and even Forest Departments, but in spite of this imperialistic policy, they refrained from putting their curly-haired boys to boss over the destinies of engineers. The secretaryship of engineering departments remained exclusively reserved for Chief Engineers, and even the responsible posts at the Centre were filled by men of engineering profession. But now in Pakistan the members of the C.S.P. have asserted themselves with a vengeance which was not seen even during the British days. In accordance with the well-known proverb "charity begins at home "the most responsible post of Chairman of the Central Engineering Authority which had been held by a well-known engineer of high qualifications and excellent merit for 8 years, was allotted last year to a C.S.P. officer of comparatively short service having not the remotest acquaintance with engineering profession, with the result that instead of guiding his staff of engineers he is standing in need of their guidance.

PROVINCIAL GOVERNMENT WENT A STEP FURTHER

West Pakistan Government have not only replaced their Engineer-Secre-

taries overnight and replaced them by Civilians, but they have also gone a step further, by directing all their engineers from Sub-Divisional Officers to Additional Chief Engineers to pay homage to the Deputy Commissioners of the districts and the Commissioners of the Divisions in which they are stationed, as in accordance with the new orders issued by the Government, the annual confidential reports on these eegineers are to be written by the Civilian Officers named above.

There is no doubt that the engineers in Pakistan feel thoroughly disillusioned and disgruntled for being given such a step-motherly treatment, and are handicapped in giving their best to the country in an atmosphere which is both hostile and full of suspicions. This in itself is a very serious matter, but what is still worse, is, that its effects are farreaching and very detrimental to the development of Pakistan. No country can hope to progres and thrive without the aid of its engineers, for the story of progress of modern nations is the story of their engineers who laboured veryhard and braved every kind of risk in opening up the country and converting barren wastes and wild tracts of land into fertile fields.

ENGINEERS AND CIVILIANS MUST DO THE JOBS FOR WHICH THEY ARE TRAINED

The Civilian Secretaries having no engineering training and experience cannot appreciate the technical schemes prepared by Chief Engineers, much less decide between different proposals put up by Pakistani and foreign experts, except by the old and time-worn method of preferences, acording to which a white man was more efficient than a brown one and a 'valayati' article was superior to a 'desi' product. I am not saying this in a spirit of levity and I have no wish to underrate our Civilian Officers who are recruited from the best material which Pakistan can offer. Some of them are undoubtedly men of outstanding merit, and can hold their own amongst the best civil servants anywhere, but I will be guilty of exaggerating their abilities and running down the engineering profession if I say that they can profitably be deputed to control the engineering departments. The Government has no doubt done an injustice both to engineers and C.S.P. officers by bringing into being this new set-up which is obviously detrimental to the efficiency of the State, but it is never too late to mend and resile from the position they have taken. They will do well to restore the status qua, by removing the C.S.P. Officers from their awkward position and deputing them to do the jobs for which they have ben trained and are best suited.

The engineers are best suited to do the engineering jobs and to run the engineering department as they have done before. They know the conditions obtaining in Pakistan better than any foreign engineers, and as such they can better prepare the development projects by taking into consideration the local conditions, building and human materials available in the country and if necessary, by referring their difficulties in planning and execution to some of the experienced engineers in Pakistan or if need be, to some foreign experts. This will not only help in fostering in them the initiative and sense of responsibility, but will also provide them with a wealth of such useful experience, grit and determination as have characterised the great engineers all over the world. I suggest in this connection the setting up of a Board of Pakistani Consulting Engineers under the aegis of the Institute of Engineers which has on its rolls the cream of engineering talent in the country.

There can be no two opinions that Pakistan must stand on its own legs, and utilise its own resources in men and money if its independence is to have any meaning. Pakistani engineers are second to none in their love and devotion to their country and have also the necessary talent, grit and stamina of the engineers of the past. Their work was highly praised by the Government as well as the public only last year after the last devastating flood but the echo of this praise had hardly died out, when they found to their great surprise and disappointment, that they had ceased to enjoy the Government's confidence. The posts of Secretaries which they had filled for more than half a century to their credit, had to be vacated by them, and they had to take their hats off to the Civilian officers of districts and divisions. This somersault of the Government is quite inexplicable. It has done much harm to our country, by smothering the engineering talent in the foul atmosphere of mistrust and suspicion, and has shattered all hopes of producing such engineering giants as have revolutioned the engineering science in other countries. Is it too much to expect that the Government will consider the matter dispassionately and change its policy?

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P.I.D.C. CHAIRMAN ON FOREIGN EXPERT ADVICE

Extract from the remarks of Mr. Ghulam Faruque, Chairman, P.I.D.C. published in "The Pakistan Times" of 16th November, 1956.

Mr. Ghulam Faruque, Chairman, P.I.D.C., after his return from China stated that "We must concentrate on basic industries like iron and steel, fertiliser, light and heavy engineering and chemicals." Pakistanis should primarily depend on themselves for economic planning and development of the country. It was useful to take into consideration the advice given by foreign experts but the main burden of decision in national interests be kept to ourselves.

Mr. Faruque stated that foreign experts often advised Pakistan against new methods which were being followed in their (experts) own countries with success.

A number of Pakistani officials, mainly concerned with industry and the execution of development projects, believe that foreign expert advice has more often been wrong and even its rejection has done the country good.

They assert that there are two reasons for misguided advices by these foreign experts—firstly, they do not fully understand the local conditions and sometimes want to follow what might have been right in other countries and, secondly, they always give primary importance to the interests of their own countries as opposed to Pakistan.

For instance, foreign experts, mostly from the United States, have unanimously advised Pakistan against developing some of its heavy industries. It is pointed out that on three occasions it has been proved that the foreign expert advice was far from being in the interests of this country.

(1) The United States Steel Mission of 1950, advising against steel industry in Pakistan, placed this country's future requirements of steel at an extremely low level. Now it is seen that the present requirements of Pakistan have gone up many times more than the United States mission estimated. The incorrectness of that advice has been proved beyond any doubt.

(2) Foreign experts strongly advised against the setting up of the Multan power station.

It was said such a power station was not needed in that area. But it has

already been proved that power produced at this station would be fully utilised in the region.

The World Bank advised against the development of jute industry in this country. It was pointed out in earlier stages of the country's industrialisation that jute industry would be "uneconomical." But it can now be seen that it is one of the important foreign exchange earning industries of the country.

Pakistan experts concerned with development also point out that almost all of the eight American experts working with the Planning Board are opposed to the setting up of a steel mills in Pakistan. Mr. Faruque today said that reputed Swedish expert, Mr. H. J. Erdin, whose advice had been sought over the steel mills controversy, had expressed the opinion that it would be a success if "political and private" influences did not hamper its development.

He said the real backing for the currency of a country should be her capacity to produce the goods needed within and the capacity to earn profit from outside, and not necessarily gold, dollar and sterling. Support to it needed some imagination to work out a financial and economic policy which was not difficult to do, he added.

For Pakistan, in her given circumstances, heavy or basic industry meant nothing but iron and steel mills, machine and tool manufacturing units, fertiliser producing plants and plants for providing cheap power to be utilised for modernising agriculture handloom and other small-scale industries. He rejected the idea of entirely depending on the opinions of foreign experts.

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SOME RECENT DAMAGE ON IMPORTANT RIVER WORKS

Following is a summarised version of an address by Ch. Muhammad Nazir, Deputy Chief Engineer, Irrigation, at the monthly meeting of the Institute of Engineers held in August 1956.

Lately serious damage has occured on some of the important river works. Upstream pavement in front of 4 bays of Balloki Head Works was ripped off during the flood of 1954. A similar damage had occured in four adjoining bays during flood of 1955. Had the flood lasted a little longer the damage would have taken a more serious turn.

During super flood of 1955 in river Ravi, Ravi Syphon had been damaged very extensively. The main structure has collapsed in a length of 200' on the left and 130 feet on the right.

It has now been reported that upstream pavement in front of four to five bays of Panjnad Head Works has been washed away. These headworks had worked in a satisfactory manner for the last 25 years and this serious damage had now occured when the river never rose above the normal summer discharge.

DAMAGE TO DYKE

A very substantial dyke on the left side of river Ravi was reconstructed for the protection of city of Lahore after flood of 1950. Crest level of the dyke allowing a free board of 5 feet was provided in the design and should correspond to a gauge of 21.7 opposite Shahdara Bridge. This dyke breached during the flood of 1955 when Shahdara gauge rose only up to 18.7.

There is a long system of flood levees along Indus below Sukkur. Several breaches had occured in these embankments during flood of 1955 most probably by overtopping.

It is a curious coincidence that damages at Ravi Syphon, Balloki Head Works and Panjnad Headworks had all been on the upstream side. This phenomenon may be justified to some extent though not entirely in case of weirs

with gated control. In case of Ravi Syphon the river was uncontrolled and higher degree of concentration of discharge should have been anticipated. Study of the prevailing scour in this river at Railway Bridge and noses of the groynes at Balloki reveals flood depth varying from 60 to 70 ft. In the face of this information being available at the time of designing protection against scour at Ravi Syphon it was not justified, rather it was absurd to use conventional method which is based on too many assumptions.

At Balloki Headworks there is a well consolidated bela formation which is masking 50 per cent of the bay. All the discharge that had passed through right bays had to come by a parallel flow quite close to and in front of upstream pavement of the left bays. This concentration resulted in the damage of pavement in two consecutive years. In order to improve river approach to the weir it has now been divided in two portions by an earthen groyne which extends beyond the canal regulator bifurcating the river at a distance of about 1,400 feet from the weir line. Slopes of this groyne in the length of upstream pavement has been pitched with stone and the nose has been heavily armoured to withstand flood depth. Thus the scour which was being experienced quite close to the major work had been removed to a respectable distance where ample stone has been dumped to provide against scour. All scouring tendency in front of left bays had disappeared and the river has been opened up on the right giving considerable relief to the left side.

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HYDRO-ELECTRIC POWER PLANTS

In the monthly meeting of the Lahore Branch of West Pakistan Engineering Congress held on 4th September, 1956, Mr. Will M. Heiser* spoke on Hydro-Electric Power Plants and discussed the type of plants, relative cost of steam and hydro power and capacity of their development. He classified the hydro-plants into five classes on functional basis. Run-of-River plants are such which work on low head and use the water as it comes to the plant and there is no provision for storage. The capacity of these plants is seldom useful and their principal function is to supplement the power in a thermal system to save fuel. The usefulness of a plant is increased if pondage is available. This type of plant belongs to the second category and annual capacity factor for this type usually lies between 40 to 65%. Plants with annual capacity factor varying between 70 to 100% are termed as Base Load plants. The fourth type is the Peak Load Plant for which a larger reservoir is essential. Peak load hydro-plants are adopted as stand-by to supply peak load requirements of steam power. The last class is the Pumped Storage Plants in which water from tail water pond is pumped up to head water pond during off-peak hours and thus serves as a seconday hydro energy during peak load requirements.

THE COST OF STEAM POWER

If power can be produced more economically by steam when fuel, equipment, condenser water supply is available, the cost of a steam plant in U.S.A. will vary from Rs. 500 to 1,000 per k.w. of installed capacity. The cost of hydro development however varies from Rs. 750 to Rs. 2,000 per k.w. of installed capacity as topography, geological conditions, transmission over long distances, etc., increase the initial outlay on the plant.

**Project Engineer for Justin and Courtney, Philadelphia, U.S.A. Consultant for CHICHOKI HYDEL PROJECT*

Determination of the capacity of a proposed hydro-electric project and its feasibility is a difficult problem as this depends upon innumerable factors, each one of which should be carefully considered and their inter-relationship determined. The most important of these factors are the steam flow and all its forms, pondage, draw down, cost of dam installation, machinery land operation, maintenance, repairs, quantity and rate of energy output and transmissions expenses.

That project is successful which meets the maximum load demand from the minimum flow of steam. Interconnection between steam and hydro power in the same system can produce large saving through diversity in load, reduction is reserve capacity, diversity in construction programmes and higher capacity factors.

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OUR HOUSING PROBLEM

In the third monthly meeting of the Lahore Branch of West Pakistan Engineering Congress held on 4th October, 1956, Mr. S. A. Rahim, Town Planner, Lahore Improvement Trust, spoke on our housing problems. He stated that housing is one of the vital problems confronting us today. Home is the fundamental unit of society and if majority of people are homeless, or badly housed, society cannot progress and aspire for higher values of life which after all, are the basic objects of the civilization that we wish to achieve The social and cultural development of mankind, therefore, depends on the home and environments. Social and civic surveys conducted in any part of the world would establish beyond doubt that people who are properly housed in a healthy environment make much better citizens than those who are either homeless or badly housed. It is common knowledge that the majority of creminals and anti-social elements are to be found in the slums of towns.

HOUSING SHORTAGE

It is estimated that the present housing shortage in the world is to the extent of 150 million dewellings out of which 120 million account for the under-developed countries. There is no satistical data for our country, but it can safely be assumed that one third of our population of 80 million are without suitable homes. On a very conservative estimate the cost required comes to 15,000 million rupees and to deal with the yearly increase of population we need another 1,200 million rupees per year.

INCREASE OF POPULATION AND INADEQUATE INCOME

With improvement in the field of medical science, industrialisation and gradual replacement of the joint family system, the demand for housing is increasing all the more.

The per capita income of the people in most of the countries of the world is inadequate to enable them to meet the cost of building their own houses. Although the governments of the world have not been considering housing to be their responsibility, the present conditions are such that without the active participation of the Government there can be no hope of the solution of this problem. There are many items which are outside the scope of the individual families and where Government help is essential.

COMMUNITY DEVELOPMENT

A national programme for housing and community development is essential for our country. Our Government has realised the need for a housing programme in their five year development

plan and have recommended to provincial Governments and subordinate authorities to provide funds.

There is great dearth of qualified architects, planners and builders in our country. There are at present limited facilities for such training. It is, therefore, necessary to set up new technical institutions to turn out a sufficient number of trained personnel.

Statistical data about the prevailing conditions and our needs, is the most urgent requirement. No proper programme can be framed without this information.

ZONING AND DEVELOPMENT COST

For healthy development, the provision of separate zones for industry, commercial establishments, housing and buildings of different categories, is most essential. In the central part of a town where the pressure on land is great we should encourage multi-storeyed buildings. The Russian experiment has shown that four-storey flats are most economical units from the point of view of development cost. In outer parts of a town zoning may vary according to the type of houses for various classes of people.

SATELLITE TOWNS

By a satellite town we mean a town which is complete and independent of the parent city in all its functions except for its major requirements. Care should be taken to set up such towns at suitable places and not to allow a city to expand and become unwieldly Karachi is one example of this type of unwise expansion.

RENT CONTROL AND TAXATION

Taxation is definitely hindering the progress of house building. House Tax and Property Tax, combined with the income tax, are a heavy burden on the resident-owner. The first two could easily be amalgamated and the third done away within the case of resident-owners.

FINANCE

The last and the most essential problem is that of finances. Private financial sources are necessarily limited and organisations like the House-Building Finance Corporation, house-buildings societies should come forward to advance long-term loans. At present no bank advances money for house-building. All banks and insurance companies should do their bit to encourage house-building in our country by making loans available on reasonable interest.

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FLOOD CONTROL WITH PROTECTIVE BUNDS

In an article published in "The Pakistan Times" of 14th October, 1956, Mr. K. A. Ghafoor, retired Chief Engineer, Irrigation, criticised the present method of flood control by constructing protective embankments for low areas. In his opinion this method is most primitive and the correct approach to the problem is to reduce the intensity of flood flow in rivers. Western nations have done good deal of research on these lines and adopted effective measures with a considerable amount of success.

UNRELIABLE BUNDS

Although we have made considerable advance in every field of enginering yet we have not been able to construct dependable bunds. The existence of our bounds gives a false sense of security and when breaches occur in these bunds they cause death and destruction of a far greater magnitude than if there were no such bounds at all. When big earthen dams hundered of feet

high can stand without mishap why can we not build bunds which are to stand a head of hardly a few feet of water?

SUGGESTION FOR CONSTRUCTION OF RELIABLE BUNDS

(i) Standard design and specification of the bunds require revision. As these bunds are uncared for the greater part of the year, rodents and reptiles keep on burrowing holes in them rendering them unsafe. Perhaps increasing the margin of safety to make them leak-proof might be necessary.

(ii) Departmental rules prescribe proper scientific compaction for such bunds but if due to rush of work, the specifications are ruthlessly ignored failures are bound to occur. For hurriedly executed work the higher officers should be held responsible.

(iii) Personal responsibility is very much lacking these days. Usually corrupt officials arrange to get lucrative construction jobs, execute work without caring for quality and specifications and manage to get away before the works are put to test. These so-called construction experts are somehow singled out for more important urgent construction jobs elsewhere, leaving their bad work to other unlucky individuals. This wicked manoeuvering should be stopped and officers and overseers should be brought back and put incharge of the works they have constructed, at least for the flood season. There should be special rewards for those whose work stands the test.

(iv) Bunds under strong action of water should be protected from the inner slope by instituting 'pilchi' or 'sarkanda' growth well in advance of the flood season.

(v) Well organised systematic watching should be organised on all newly-constructed bunds and experienced officers should be put in charge of the supervision. Mates, 'mistries' and 'beldars' should all be trained how to tackle small controllable leakages. Quick action under proper discipline and the availability of the requisite implement and machinery within reasonable distance, are essential for such emergencies. It will also be beneficial if demonstration parades are held for training the watching squades just before the flood season.

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INSTITUTE OF ENGINEERS' ACTIVITIES

The Institute is holding regular meetings at its Lahore Centre since August, 1956, where prominent engineers are invited to address the members and guests on technical subjects of interest to engineers. The first talk was by Ch. Muhammad Nazir which has been summarised in this chapter. In September, Mr. L. H. E. Jones, engineer-representative of Expandite Ltd., addressed the members on "Joints in Concrete Structures", illustrating his talk with an extremely interesting colour film. Mr. Jones emphasised in his talk that of recent years it had become increasingly apparent that engineers and architects in most Eastern countries were faced with a big problem in designing for structural movement owing to the wide temperature variations and unsuitable ground conditions. He told how civil engineers were becoming more and more "joint conscious" and were realising that the design and treatment of joints was as important as the design of the structure itself.

The October lecture was by Qazi Zahur Husain, Chairman of the Institute's Lahore Centre. This is also reproduced as a summary in the earlier columns of this chapter.

SYMPOSIUM ON ARID ZONES

A symposium on arid zone research in Pakistan was held in Quetta from November 3 to 5. This was organised by Mr. S. N. Naqvi, Director of the Meteorological Service, and was a great success. Thirteen papers on a variety of subjects connected with arid zone research were read at the symposium and discussed by the participants.

SCIENCE CONFERENCE

The ninth Pakistan Science Conference is being held in Peshawar from March 11 to 18, 1957. It will again be attended by prominent scientists from abroad and by the best-known scientific brains in Pakistan. There will in all be eight sections in which the Conference will be divided, covering more than two dozen subjects ranging from Agriculture to Psychology. Details may be obtained from the office of the Pakistan Association for the Advancement of Science, 57-A, Ferozpur Road, Lahore.

Clippings & Recent Papers

ON PAPER

Following is an interesting editorial from the issue of "Water and Water Engineering" which is reproduced for the enjoyment of our readers.

WITHIN living memory the amount of typescript which an engineer has to persue during the course of a day's work has increased at least tenfold. The harassed executive is faced every morning with a pile of letters, reports, memoranda, instructions and records which he must transfer from "IN" to "OUT", and this transport problem often becomes the most important consideration of the day. These pieces of paper, together with those that originate in his own brain, are tools by which he carries out his job. They are not the only tools, but they are rapidly becoming the most important ones. As a means of communication, in the world of commerce the human voice is becoming obsolete, in spite of the telephone, dictaphone, public address equipment and other such aids. Organisations are getting bigger and more complem, more people have to be informed, so that the passing of information by word of mouth can no longer be relied upon. The simplest telephone arrangement must now, it seems, be confirmed in writing. As for instructions, no man can now be expected to do what he is told, unless what he has been told to do is subsequently handed to him typed out on a piece of paper. Such is our reluctance in the world of industry, engineering and big business to trust our memories and each other.

Not that there is no merit in the written word. On the contrary, writing it down is often the surest way to clarify a statement. The drawback with the written word lies in the fact that the writer has to wait for the recipient's reaction, and sometimes has to wait too long. For example, if we tell a turncock to shut the valve outside The Red Lion, we can tell by the look on his face whether he has understood the instruction or not. He may react by saying "The 4 in. or the 10 in. valve by The Red Lion?" which allows us to modify the first instruction. A written instruction may be imprecise to the point of being useless or misleading, without means of immediate clarification, and for this reason great care should be taken in drafting instructions in writing. This should apply to all writing.

"The moving finger writes and having writ
Not all thy piety and wit
Can cancel half a line, nor all thy tears
Wash out a word of it."

What is written down remains as evidence for as long as the paper lasts and the print remains legible. And yet writing is a cumbersome instrument for the conveyance of ideas compared with the spoken word. The minutes of any discussion never convey quite the impression of the discussion itself. The tone of voice, the gesture, the emphasis, the conviction, the hesitancy never get put across in the printed report. In fact, the written word, except as composed by a few masters, is largely impersonal, chiefly because of the lack of

immediate response. It has therefore a serious drawback when used in the conduct of industrial relations. The personal touch is difficult to get. Those who compose circular letters to the staff congratulating them on this and that, praising their loyalty and fortitude, or proffering the firm's good wishes should hear the response, often muttered "*sotto voce*".

The ease with which typescript copies are made has led to an abuse which has become almost an occupational disease. The practice of some executives is to have as many copies made as possible, to distribute them widely and file the rest. This results in files being cluttered up, a lot of people reading a lot of documents which are of no concern to them, and a great waste of paper. We sometimes think that if all letters had to be handwritten they would be shorter, more to the point and there would not be so many of them.

However, the impersonality of the written word, the ease with which it can be reproduced and distributed makes it the most important tool for the presentation of technical information. Not only has the engineer's personal correspondence and papers increased in volume, there has been an immense increase in the volume and importance of scientific communication.

Not only have the number of specialised technical and scientific societies multiplied exceedingly, but there have also arisen a great number of weekly and monthly periodicals devoted to the dissemination of technical and scientific information. The report, the paper to the institution, the article in the technical journal, the instruction take up more and more of the engineer's time, both in the writing of them and in the reading of them. Writing is the tool of business and is rapidly becoming an important tool of production. Nothing can now be produced without communication between large numbers of people, many of them specialists, often distributed in different parts of the globe. Communication is by the written word, and, therefore, writing must be designed and constructed to do its job efficiently. Writing must be made into a precision instrument. A badly drafted instruction may lead to a bigger disaster than the breakdown of machinery. If it is misleading, difficult to understand or vague, it wastes the valuable time of the recipient in re-reading and interpreting it. A statement that has to be re-read, which makes the reader turn the page backward and forward before he can master its meaning is like a car that will only start by prolonged and violent turning of the handle. It is a time-waster that should not be tolerated.

But the presentation of technical information must be more than unambiguous, it must be more than grammatical, more than just "correct English." Besides being clear and lucid, it must be persuasive. The writer's object is to influence the reader, temporarily to control his mind so that he will appreciate the facts as set out and draw the right conclusions from them. In order to do this the writer must keep the reader's mind receptive during the time required to read the script, he must put his points at places in the narrative where the reader will be ready to receive them, he must not burden the reader's mind with unnecessary detail, he must not underestimate the intelligence of the reader, nor over-estimate his knowledge.

It is not as easy to control a man's mind as to control a machine as intricate as a motor-car. It cannot be learned quickly, without effort. There is no driving school and no driving test. But engineers must learn the art of exposition if they are to take their proper place in the control of industry, commerce and Government. The arts graduate, the lawyer, the secretary and even the accountant have received more training in, and realise more the value of the correct and persuasive use of words.

It is perhaps typical that the engineer, who is more concerned with actual constructional work, with work in the engineering—that is the foot-pound—sense than the lawyers, secretaries, executives and managers, is particularly sensitive to what he calls "paper work". He does in fact tend to despise it and to leave it for his inferiors or subordinates to do. This is a grave mistake. Paper work is now part of engineering. The engineer who neglects it does so at the risk of losing his influence in his profession, in society, in the conduct of affairs. He who neglects his engineering for paper work runs the risk of losing his integrity. Writing is one of the tools that the engineer must use in its proper function. If he does not use it wisely, he will find that instead of paper being his servant, paper will become the master.

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MECHANICS OF EVAPORATION

A very illuminating paper has been published recently on the mechanism of evaporation by Prof. Maurice L. Albertson, Professor of Civil Engineering and Head of Fluid Mechanics Research in Colorado A. & M. College. This paper is based upon a thesis which the author submitted to the Faculty of Science of the University of Grenoble in France.

The paper is split up into seven chapters. Three chapters were published in No. 5, October-November, 1955 issue of "La Houille Blanche" and chapter 4 is published in No. 1, January-February, 1956, issue of the same journal. After defining evaporation, the author has given its conception based upon boundary-layer theory and its importance to the phenomenon and its connection with the theory of diffusion. The author introduced kinetic theory of gases to explain molecular diffusion and molar diffusion corresponding to laminar and turbulent type of flow. In this connection the idea of heat transfer associated with evaporation and reduction in saturated vapour pressure due to existance of dissolved solids on the evaporation have also been studied.

A persual of the past existing information showed that all investigation have tried refinement of Dalton law which was propagated in 1800 and there was much scope for further investigation and with this consideration a programme of experiment research on evaporation was undertaken and investigation were based upon measured evaporation from a plane surface kept in Iowa and in a wind tunnel at Colorado.

The author has developed theoretical formulae and has discussed the results in terms of shear velocity. The last items are still to be printed in the next issue of the journal and we shall try to reproduce it when the full paper is printed.

(Taken from "La Houille Blanche", No. 5, October-November 1955, and No. 1, January-February 1956, issues.)

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DISSIPATION OF ENERGY BY DOUBLE JET DISSIPATOR

Energy dissipation below hydraulic structures such as spillways, falls, weirs, etc., is generally brought about by the formation of a hydraulic jump. This requires a certain minimum depth of water at the downstream end. This may not be obtainable in all cases. A new type of dissipator known as Double Jet Dissipator has been developed.

It is a corrugated deflector with the troughs extended further downstream of the crests to form a second series of deflectors. It is constructed at a suitable point on the slope of a spillway or a fall. Flow taking place down the glacis is split up into a number of jets which interact with each other in the air and dissipate energy. An important

feature of the Double Jet Dissipator is that it has neither any part projecting into the high velocity jet nor does it involve any sudden change in the direction of flow.

Different aspects of the energy dissipator such as the spacing of the crests and troughs, position and angle of the second deflector, flare of the extensions, etc., were investigated on the existing hydraulic models of Bhakra Dam overflow spillway. A suitable design has been evolved. The experiments have shown this to be very efficient. The depth of scour in some cases has been reduced by over 90%.

(Article by H. L. Uppal and Gajinder Singh in "La Houille Blanche", No. 1, January-February, 1956, issue.)

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3. Graphic design of alluvial channels by Ning Chien, proceedings, American Society of Civil Engineers (U.S.A), Vol. 81, 1955.
4. Artificial replenishment of aquifers by Stenson Buchan, Journal of the Institution of Water Engineers (Great Britain), Vol. 9, 1955.
5. Investigating ground-water by applied geophysics by D. K. Todd, Proceedings A.S.C.E. (U.S.A.), Vol. 87, 1955.
6. Modern methods of developing ground-water supplies, by R. M. Leggette, Proceedings A.S.C.E. (U.S.A.), Vol. 81, 1955.
7. Ground-water flow in relation to a flooding stream, by D. K. Todd, proceedings A.S.C.E. (U.S.A.), Vol. 81, 1955.
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2. Monolithic and non-Monolithic gravity dams by G. S. Sarkaria, Water Power (France), Vol. 7, 1955.
3. Greece Gets nation-wide power system, by W. S. Merrill, Civil Engineering (U.S.A.), Vol. 25, 1955.
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2. Use and economy of concrete pipe in irrigation systems, by A. B. Reeves, proceedings, American Society of Civil Engineers (U.S.A.), Vol. 81, 1955.
3. Infiltration and soil water movement during irrigation, by Vaugh E. Hansen, Soil Science (U.S.A.), Vol 79, 1955.
4. Salination of soil by salts in the irrigation water, by L.D. Doneen, transactions American Geophysical Union (U.S.A.), Vol. 35, 1954.
5. Lysimeters for studying effects of salinity, leaching, and position of water table of plant growth, by R. C. Reeve, Soil Science (U.S.A.), Vol. 79, 1955.
6. An investigation of the alkali soils in Gujarat, by A. M. Trivedi, Journal of Soil and Water Conservation in India, Vol. 3, 1954.
7. Production of fresh water from salt or brackish water, by J. Leicester, The Engineer (Great Britain), Vol. 199, 1955.
8. Irrigation and hydraulic design, Vol. I, General principles of hydraulic design, by Serge. Leliavsky, Chapman and Hall Ltd., London, 1955.
9. Drainage in the Lewiston Area of Utah, by Orson W. Israelsen, Utah State Agricultural College, Agricultural Experiment Station (U.S.A.).

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BUILDING MATERIALS

1. Building Materials; Their elasticity and inelasticity, by M. Reiner, North-Holland Publishing Company, Amsterdam, 1954.
2. Simple calculation of deformation and stress in the shell of tin-walled cylindrical vessels by Karl I. Karlsson, Acta Polytechnica (Sweden), 1954.
3. On the deformation of elastic shells of revolution, C. Nevin De Silva, Applied Mathematics (U.S.A.), Vol. XII, 1955.
4. Photo-elastic analysis of stress concentrations around the sluice gate gallery of the Hirakud Dam by G. Ram, Irrigation and Power (India), Vol. 11, 1954.

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ENGINEERING MATHEMATICS

1. Theoretical Physics, Mechanics of particles, rigid and elastic bodies, fluids, and heat flow, by F. Woodbridge Constant, Addison Wesley Publishing Company, Cambridge (U.S.A.), 1954.
2. Advanced mathematics for engineers, by F. H. Miller, Wiley and Sons, New York (U.S.A.), 1955.
3. The existence and stability of Ultraharmonies and Subharmonies in forced nonlinear oscillations by T. K. Caughey, journal of Applied Mechanics (U.S.A.), Vol. 21, 1954.

BOOK REVIEWS

JOURNAL OF THE INSTITUTE OF ENGINEERS, VOL. V, 1955-56, PUBLISHED BY THE INSTITUTE OF ENGINEERS, RAMNA, .. DACCA.

This journal contains some extremely interesting papers. "Hardinge Bridge and its Training Works" describes briefly this famous railway bridge founded on probably the deepest well foundations in the world and sited in a most peculiar situation on the Lower Ganges. The paper describes the training works and their behaviour since construction and also the details of the elaborate system of maintenance. The second paper on 'Short Cutting of Loops of Rivers' will interest irrigation engineers in West Pakistan for it deals with a favourite subject. The meandering of certain rivers and their regime in deltaic areas is described and a method is suggested for short cutting loops. The next article of interest is the construction of pontoon jetties at Chittagong Port which describes the construction of a floating jetty, a novel idea perhaps for handling cargo. Other articles of interest are the 'Diesel Electrification of E.B. Railway', 'Soil Bitumen Roads—their suitability in East Pakistan' & the 'Dacca Stadium'.

'FOUNDATIONS: DESIGN AND PRACTICE' BY EDWIN E. SEALVE PUBLISHED BY JOHN WILEY & SONS, INC. NEW YORK; PRICE $16.00.

The design and construction of foundations is a problem which faces every engineer. This is probably the first publication of its kind which groups all types of foundations in one book in a most concise and practical manner. Separate chapters are included on retaining walls, underpinning, waterproofing, soil mechanics, specifications and complete tables for push-button designing of structures. An excellent book for all practicing engineers and a must for all engineering organisations.

RECENT BOOKS ON SUBJECT OF ENGINEERING INTEREST

1. Floods, by Hoyt W.G., Langbein W.D., Princeton University Press, U.S.A., 469 pages, 1955.
2. Electrical elements of power transmission lines, by Dwight H.B., The MacMillan Co., New York, U.S.A., 188 pages, 1954.
4. Elementary theory of nuclear shell structure, by Mayer M.G. and Jensen J. Hans D., John Wiley and Sons, N.Y., U.S.A., 269 pages, 1955.
5. Elements of hydraulic engineering, Linsley R.K., Franzine J.B., McGraw Hill Book Co., N.Y., U.S.A., 582 pages, 1955.
6. Wave diagram for non-steady flow in ducts, Rudinger G., D. Van Nostrand Co., N.Y., U.S.A., 278 pages, 1955.
7. Water hammer analysis, Parmakian John, Prentice Hall, N.Y., U.S.A., 161 pages, 1955.
8. Soil and water conservation engineering, by Frevert R.K., Schwab G.O., etc., John Wiley and Sons, N.Y., U.S.A., 479 pages, 1955.

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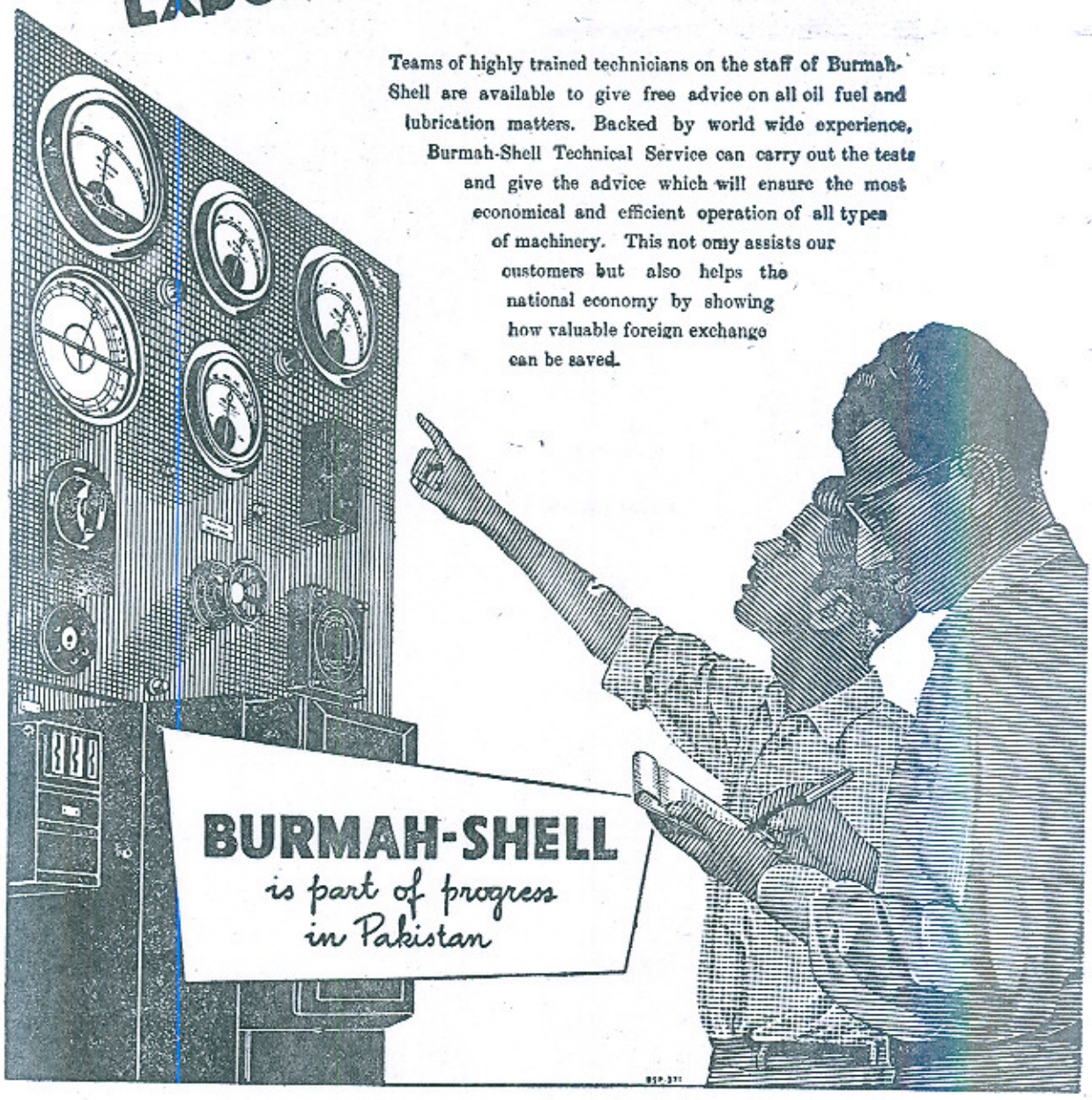

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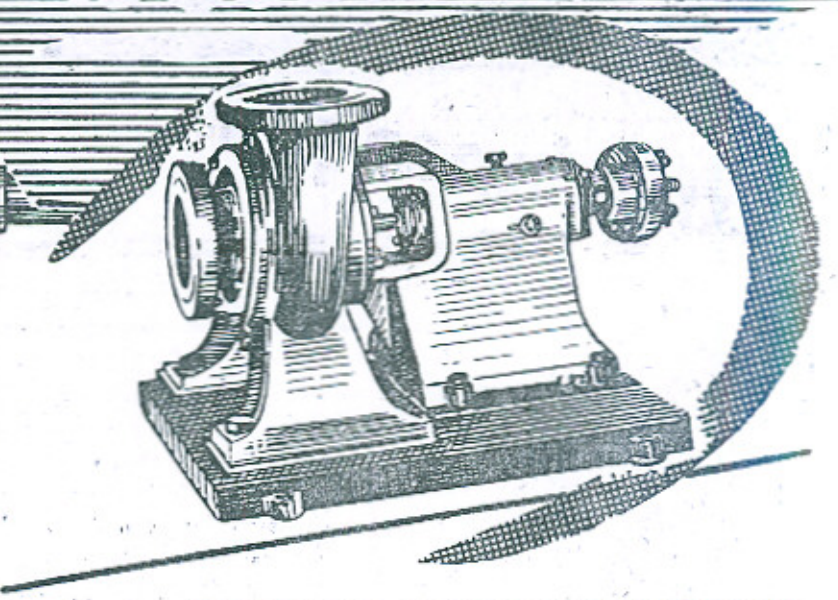

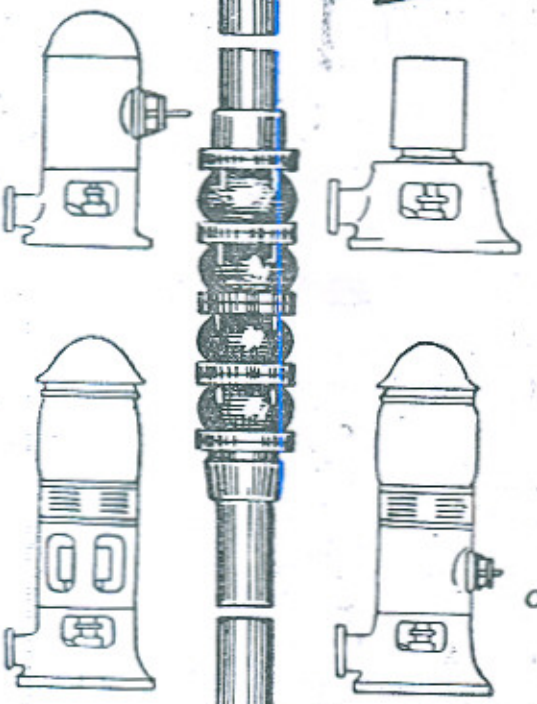

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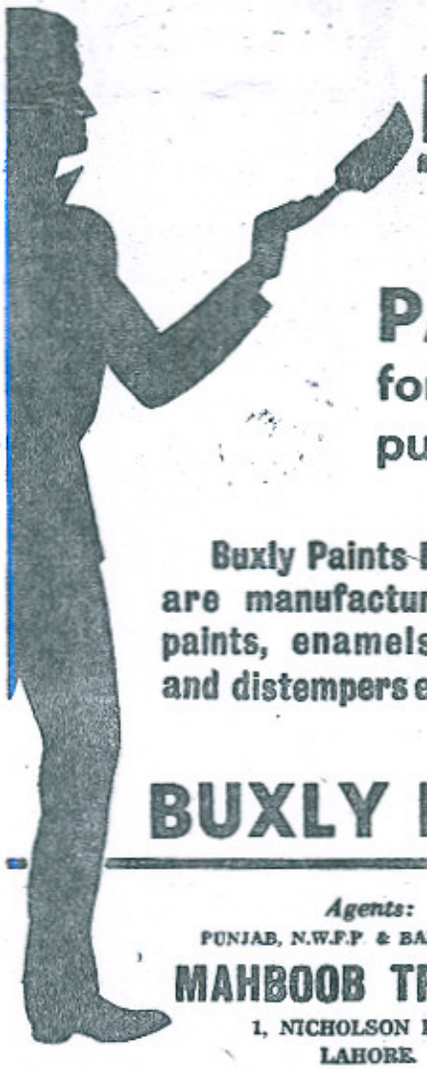

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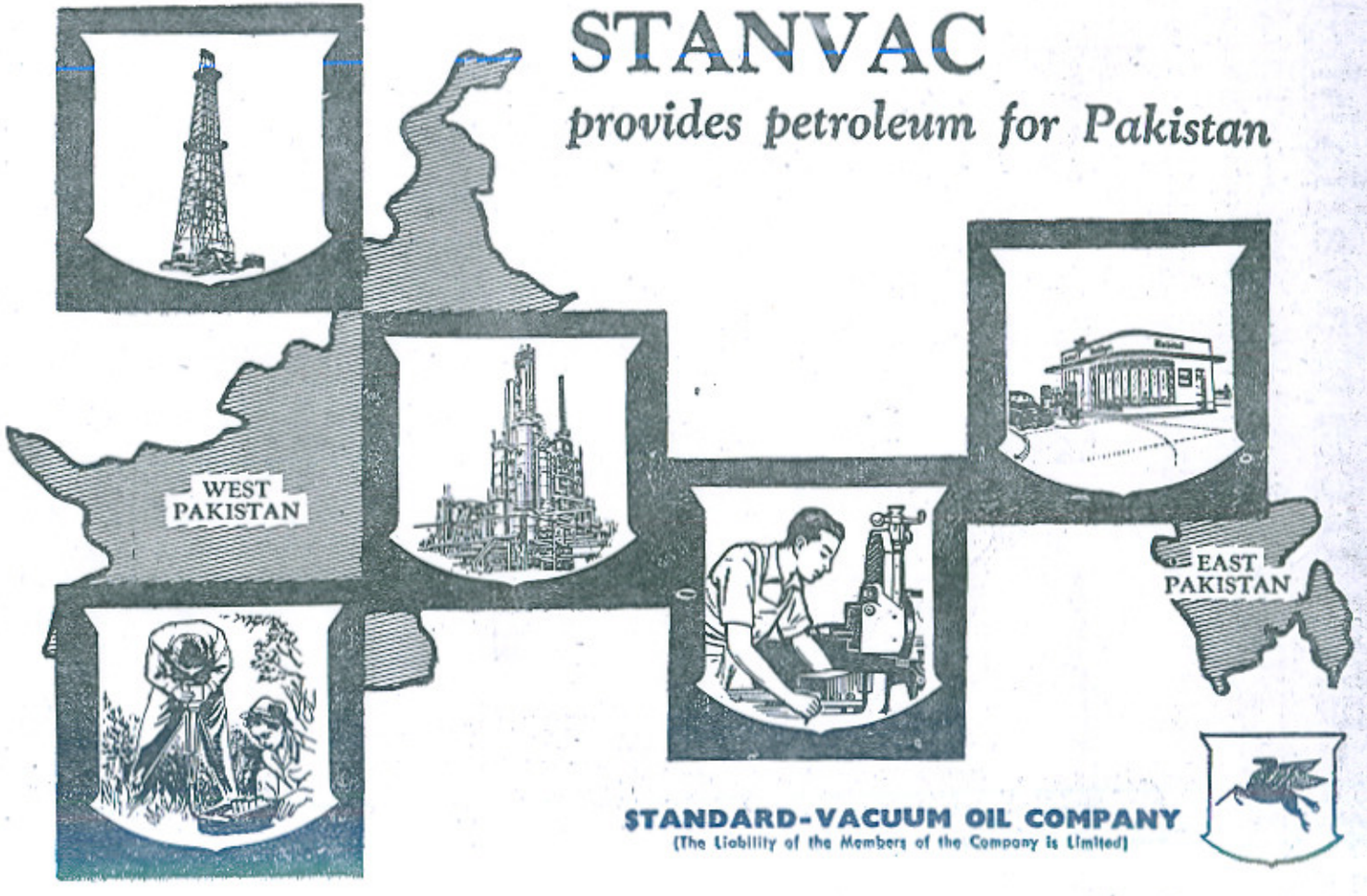

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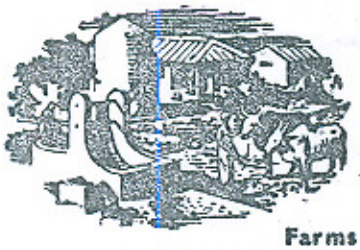

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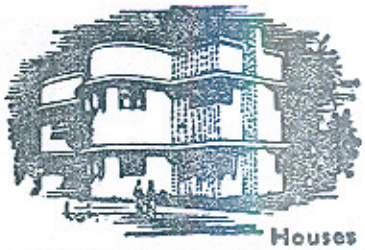

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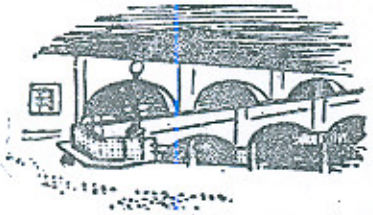

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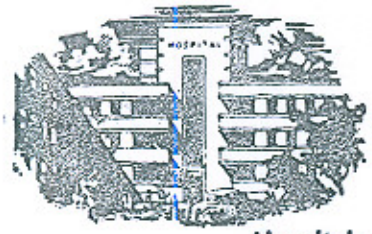

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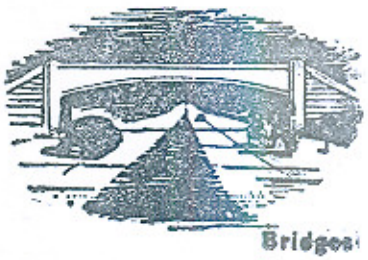

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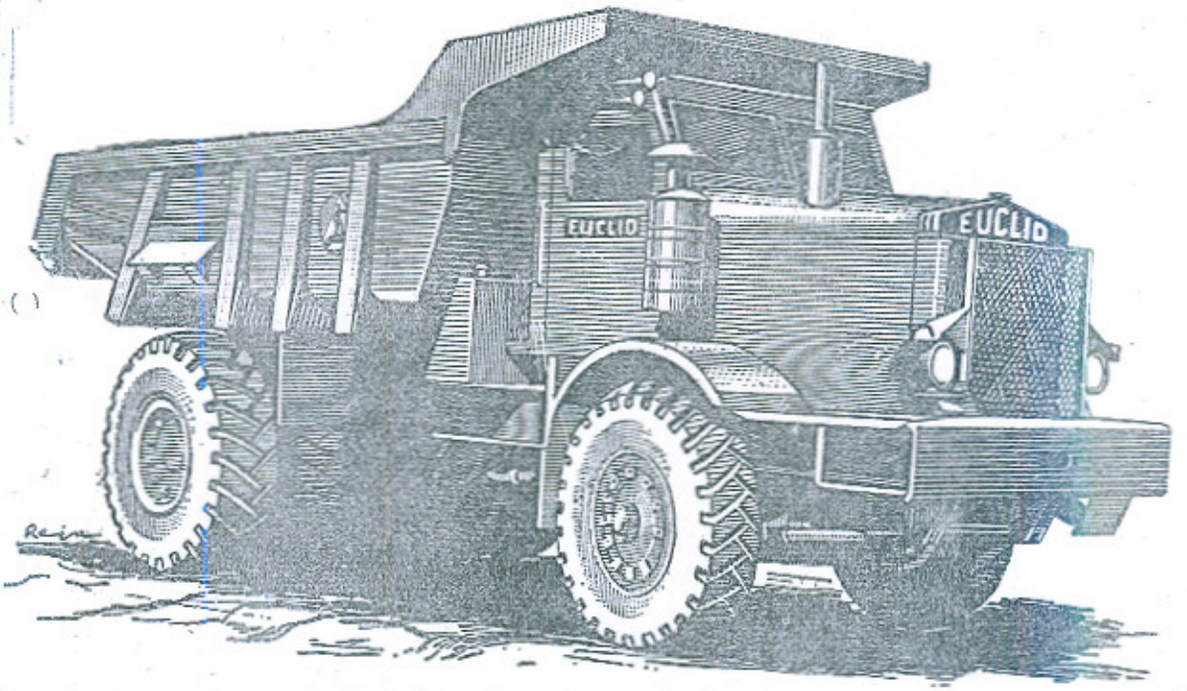

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