I.U.F.R.O. - DIVISION V

S5.03 SUBJECT GROUP "WOOD PROTECTION"

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"THE INTRODUCTION OF WOOD PRESERVATION INTO PAPUA NEW GUINEA AND ITS EFFECT ON THE RURAL ECONOMY"

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SUMMARY

The preservation of round poles, sawn timber and other woody material using water-borne preservatives has been developed for use in urban and rural areas in Papua New Guinea. Increasing use of wood preservation in rural areas has been encouraged by the publication of a "Manual of Rural Wood Preservation" and by the establishment of a timber-pole building design service.

Highly portable sap displacement equipment is being introduced to permit on-site treatment of poles for use in bridges and wharves. These developments will bring substantial economic benefits by increasing self efficiency and self reliance and assisting in keeping the bulk of development funds circulating in rural areas.

A simple market stall using treated Teak and Bamboo in Port Moresby.

INTRODUCTION

This paper describes the long sequence of events leading up to the introduction of techniques of wood preservation into rural village communities in Papua New Guinea, and the benefits that this can bring to these rural communities.

Papua New Guinea has a land surface area of 467,500 km^2 and is located between the equator and 12°S and longitudes 141° - 156°E. It shares a common land border with Irian Jaya in the west and is separated from the Australian mainland by the 160 km wide Torres Strait.

The mainland of Papua New Guinea together with its six hundred islands makes up the eastern extremity of the great arc of fold mountains extending through the Himalayas and Malaysia into the Pacific Ocean.

Mt. Wilhelm rising to 4,590m is the highest peak and, together with other peaks of 3,960 is subjected to occasional snow falls; above 3,700m frosts occur. However, apart from these extremities, atmospheric temperature and humidity are uniformly high throughout the year, with a mean maximum temperature of about 32°C and mean minimum of about 23°C in coastal areas.

Annual rainfall varies from an extreme minimum of 950mm in Port Moresby to more than 7,600mm in parts of New Britain and the Gulf of Papua. The range is mostly between 2,000 and 3,000mm.

(For more details of climate, topography and the forests see "New Horizons", Forestry in Papua New Guinea, Jacaranda Press, Australia 1973).

In 1969 the population was estimated to be about 2,000,000 persons of whom only some 6% lived in towns with a population in excess of 500. Since 1969 there has been considerable urban growth and a new town Arawa, with the second largest population of any town in Papua New Guinea has grown up around the Bougainville copper mine.

However it would be a safe assumption to make that in 1974 about 90% of the population still live in rural communities and traditional villages.

Some 70% of the land area of Papua New Guinea is clothed in virgin forest and villagers rely almost entirely on the products of the forests for their building materials. These include round, split and sawn timber; bamboo, reeds, wild sugar cane, palms, bark, rattan cane and grass.

As these villagers gain the means to earn cash incomes, either through cash cropping or selling their labour, there is an increasing tendency to use more durable building materials. These unfortunately consist of very high cost imported building materials such as corrugated iron, asbestos cement, and portland cement, which while bringing perhaps an element of prestige and of course more durable buildings, seldom result in an overall improvement in living conditions.

The cool of a grass thatch roof is replaced with the heat of corrugated iron, which during the often heavy rain causes such noise that conversation is impossible and so on; and the money spent on these imported goods is lost to the villager and to Papua New Guinea.

However most of the villagers of Papua New Guinea seem prepared to put up with the expense and the discomforts of many introduced building materials to obtain durable houses and to free themselves from the never ending problem of rebuilding their traditional houses.

In the following pages an outline is given of the steps taken to assist the villager to retain the comfort and convenience of his traditional home, given increased durability of his traditional building materials through the application of techniques of wood preservation. In addition, developments in the field of wood preservation in rural areas which have a direct influence on the livelihood and welfare of the villagers are discussed.

The Early Years of Wood Preservation - Diffusion Treatments

During the rebuilding phase following the end of the hostilities in 1945, it soon became apparent that most of the timbers growing in Papua New Guinea were of very poor durability and that the selective logging of the new durable timbers would soon deplete this resource in areas with reasonable access to growth centres. The major need in these years was for durable rough sawn timber for house frames as the Australian Administration hastened the pace of development.

Some system of preservative treatment was needed to enable the use of the run of the forest timbers and because a given sawmill might have to mill 100 different species out of the more than 300 species available and could in fact mill 10 or more different species in a single day, the preservative process had to be universally applicable.

The result was the introduction of the "Dip Diffusion Process" for the treatment of tropical building timbers in 1964. The process and its application are adequately described elsewhere (1,2*); it is sufficient here to say that the PNG Building Regulations required that timber treated by this or by some other approved process be used in all buildings which come under the control of the regulations. Some 70 treatment plants are operated at sawmills throughout Papua New Guinea and about 100,000 cubic metres of sawn timber is treated annually.

The "Dip Diffusion Process", while ideal for timber used out of the ground and protected from the weather, is of course quite unsuitable for timber exposed to rain wetting, in the ground, or in water. Steps were therefore taken to introduce the fixed preservatives of the C.C.A type to provide for high hazard end uses.

The Introduction of Vacuum Pressure Treatment with C.C.A.
(Copper Chrome Arsenic based preservatives)

As a first step, representative timber samples from each of five trees of 91 species of PNG timbers were collected and sent to the then Forest Products Division of C.S.I.R.O in Melbourne, Australia for treatability tests with C.C.A and with creosote. After evaluation of treatability, treated samples were exposed in a graveyard in rainforest area about 20 miles from Port Moresby. The C.C.A treated samples have been exposed for some 10 years, the creosoted ones for 7 years. Of the 91 species tested, only 10 were easily treatable in both sap and heart wood, another eleven had a wide treatable sapwood and/or reasonably uniform heartwood penetration. As a general rule then most of the PNG species tested were not suitable for pressure impregnation

* The number in parenthesis refer to references. (See page 15).

as sawn timber for use in high-hazard situations.

As a result of this the major emphasis on the development of C.C.A treatments was placed on natural round timbers. Because the Department of Forests had plantations of Teak in the Port Moresby area and *Eucalyptus robusta* and E. *grandis* at Kindeng in the Western Highlands, the pressure treatment of thinnings from these plantations was developed at treatment plants owned and operated by the Department.

In addition the treatment of Teak (3) the Department also treats a wide range of poles and also of sawn timber for full-scale inservice testing in wharves and bridges, and constructed workshop facilities in Port Moresby at the Forest Products Research Centre using C.C.A-treated pole buildings, using seventeen different species.

In the Western Highlands YAR (*Casuarina olig. don*) is the main species treated as the plantation Eucalypts cannot meet the demand for treated rounds for fencing and similar end uses there.

Teak has only a narrow timetable sapwood zone (4) and in young plantation thinnings the truewood has little natural durability; so the C.C.A treated teak was not ideally suited for fencing and other very high hazard uses. The Central District of PNG where Port Moresby is situated is a low rainfall area where fierce grass fires occur each year thus making the use of C.C.A-treated fence posts quite hazardous.

However, small poles were traditional building materials in Papua New Guinea and the Department was keen to advance a return to the cheaper traditional building styles provided durability could be improved by preservative treatment. Hence ways in which this could be done were actively sought.

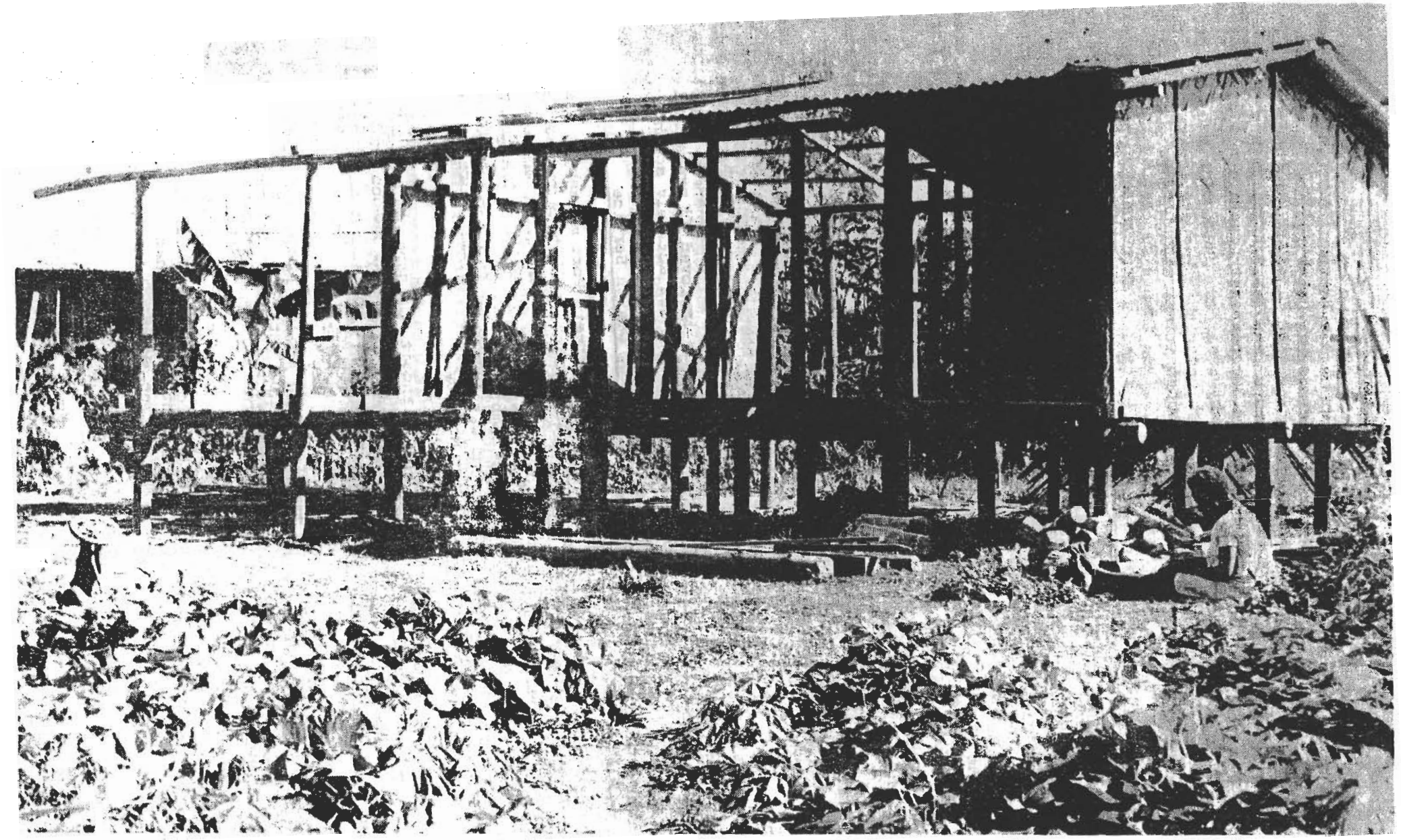
The Establishment of a Treated Pole Building Design Service

In 1972 Mr. T.S. Gibb the Manager of Koki Market, Port Moresby's then only native market, was trying to improve the market facilities but wanted to keep to traditional PNG building designs. As a result Mr. Gibb, who was a CUSO volunteer, designed a seven sided "round house" in which C.C.A-treated teak columns, beams and rafters, treated bamboo purlins and a grass thatch were used. This building was erected and was followed by many more at Koki and new markets established around Port Moresby.

Interest in treated pole buildings grew and it was soon obvious that if people were to use treated poles a special design service was needed, not only to teach people in the large towns how best to use poles, but also, for us to learn much more than we knew at the time.

As a result, another CUSO volunteer, Mr. P. Lattey joined the staff at F.P.R.C on loan from the Public Works Department, to establish the design service. The work that Mr. Lattey did is set out in Forests Department Publication (5) and elsewhere (6).

Basically the function of the design service is to provide plans of schools, hospitals, homes, churches, community centres etc., that can be built using treated round timbers, treated wood roofing shingles and treated woven bamboo etc.



A low-cost house using C.C.A.-treated Teak and Bamboo.

However this service was based on the use of treated round timber available only from the Department's plants in Port Moresby and at Banz in the Western Highlands.

For many years the Department had been providing detailed advice to people all over Papua New Guinea on simple treatment methods which could be applied in the field. With the upsurge in interest in treated pole buildings because of our work in Port Moresby, and also the stated objectives of the Government for more self reliance, it was no longer possible to think out answers for every individual enquiry.

The Manual of Rural Wood Preservation

As a result a "Manual of Rural Wood Preservation" was published. This manual is written for the layman and represents the best technical information we had available. However, already we think we can improve significantly on some of the techniques recommended. Although the manual does cover sap displacement methods the objective was to list those techniques which needed no mechanical devices and which were safe to use under field conditions. The manual has been distributed to field officers in almost every district of Papua New Guinea and there are at the time of writing dozens of buildings either under construction or being planned in rural areas, for which methods of wood treatment recommended in the manual are being used or will be used.

We believe that a major reason for the ready acceptance of the use of treated round timbers etc., in rural areas was the extent to which, through the Department's own treatment facilities and its design service, treated round are extensively used in the capital city, Port Moresby. The Department of Forests now employs an architect, Mr. Andrew Powter, (another CUSO volunteer) who provides a design service to all sections of the community.

In 1974 designs for some fifty pole buildings have been provided for rural areas of which thirty are currently being constructed or have been completed. One building was specially designed for erection in the New Hebrides, and considerable interest has been shown in our techniques by other South Pacific countries.

Summary of Treatment Methods Recommended in the Manual

For wet service we recommend C.C.A-type preservative; for dry service, boron-based diffusing preservative; in both cases where appropriate we suggest the additional use of tar and/or water repellent preservation treatments.

- Sap replacement treatment with C.C.A is used for treatment of round timbers used in ground contact. We have subsequently found that sap replacement may be used to treat freshly split wooden shakes or in some cases to treat the round timber before it is split.

- Wooden roofing-shakes are soaked in C.C.A solution. This treatment is only successful when the shake is quite thin, as transverse penetration of only about 2mm is obtained.

- Where no leaching hazard exists, posts, poles and bamboo are treated by a "dip" diffusion method using sodium octaborate preservative solution.

Other Related Developments

At the moment of writing, the Department of Forests is involved with the N.Z. Government Aid Mission in the demonstration and evaluation of the "High Pressure Sap Displacement" (H.P.S.D) system developed by Mr. C.G. Mason of New Zealand. It is the Department's intention to promote the H.P.S.D system for the on-site treatment of bridge poles and wharf piles, and our preliminary work indicates that the system will work in the field. This is of very significant economic importance as will be shown later.

The Department of Forests has designed a small transportable vacuum treatment plant specifically for the treatment of wooden roofing shingles and shakes. Graveyard tests have demonstrated that some of the low density non-durable hardwoods, treated with C.C.A, have similar durability characteristics to the C.C.A-treated coniferous timbers. In addition, the thin boards used for shingles and shakes are treatable by a vacuum process. A prototype of the treatment plant, large enough to treat some 75 to 100 shingles 600mm x 150mm in size, in about 90 minutes is being constructed. It is envisaged that treatment units of this type will be used for treating shingles on or in the vicinity of actual building sites where the shingles will be used.

The Spread of Wood Preservation Techniques to Rural Areas

1. Through Government Departments

Sawn timber, treated by the "Dip Diffusion Process" has been available in most rural areas since 1964. Most of this timber was in fact used to service the needs of the population in the larger towns, and there was but a minor impact upon building practice in villages or related community projects.

Some of the major difficulties faced by those seeking to promote the use of treated wood were the poor acceptance of wood by Government and at village level, and also the sheer rapidity of development.

The pace of development in the 1960's in Papua New Guinea left little room for the introduction of new and admittedly often insufficiently tested techniques.

However as Independence approached, (PNG became self governing on December 1st 1973) there was an upsurge of nationalism and the people began to examine attitudes to imported customs and practices. There was also the realisation that greater use must be made of the natural resources of the nation to meet the increasing demand for more development.

Development in rural areas meant for many people the coming of roads, schools, hospitals and medical aid posts and new farming techniques.

Up until now a new school or hospital meant steel pipe frames clad in asbestos cement sheeting and roofed in galvanised iron all imported from overseas. People despaired of the rotting timber log bridges and demanded permanent steel and concrete bridges.

However none of these developments brought cash to the rural areas. The materials were almost always imported and skilled artisans from the towns did most of the work.

Two of the largest Government departments, Health and Education, are now embarking on a program where as far as possible local building materials are to be used in all the rural building projects. Timber will be used in the natural round form and will be treated with preservatives.

Groups of villagers will be trained where necessary to do the treatment and the building construction, and to as great an extent as possible all building materials will be obtained from the immediate vicinity of the project.

The key to this procedure is the availability of techniques of wood preservation which may be used in these rural areas to render the natural bush timbers durable building members, and of course the will of the relevant authorities to take advantage of these techniques.

These schemes have great economic significance for the rural communities in Papua New Guinea, which may be summarised as follows:

- The building materials needed can be largely bought in the district where the hospital or school is being built.

- Villagers in the district, who are traditionally skilled in the construction of pole buildings, will be employed on the projects

- Thus a large proportion of the projects' cost will be spent in the district where the work is being done. That is if the Government earmarks say $100,000 for a large school in a certain district up to $70,000 of this may stay and circulate in the district as a result of the peoples' involvement in supply of materials and construction.

2. Through Local Government Councils

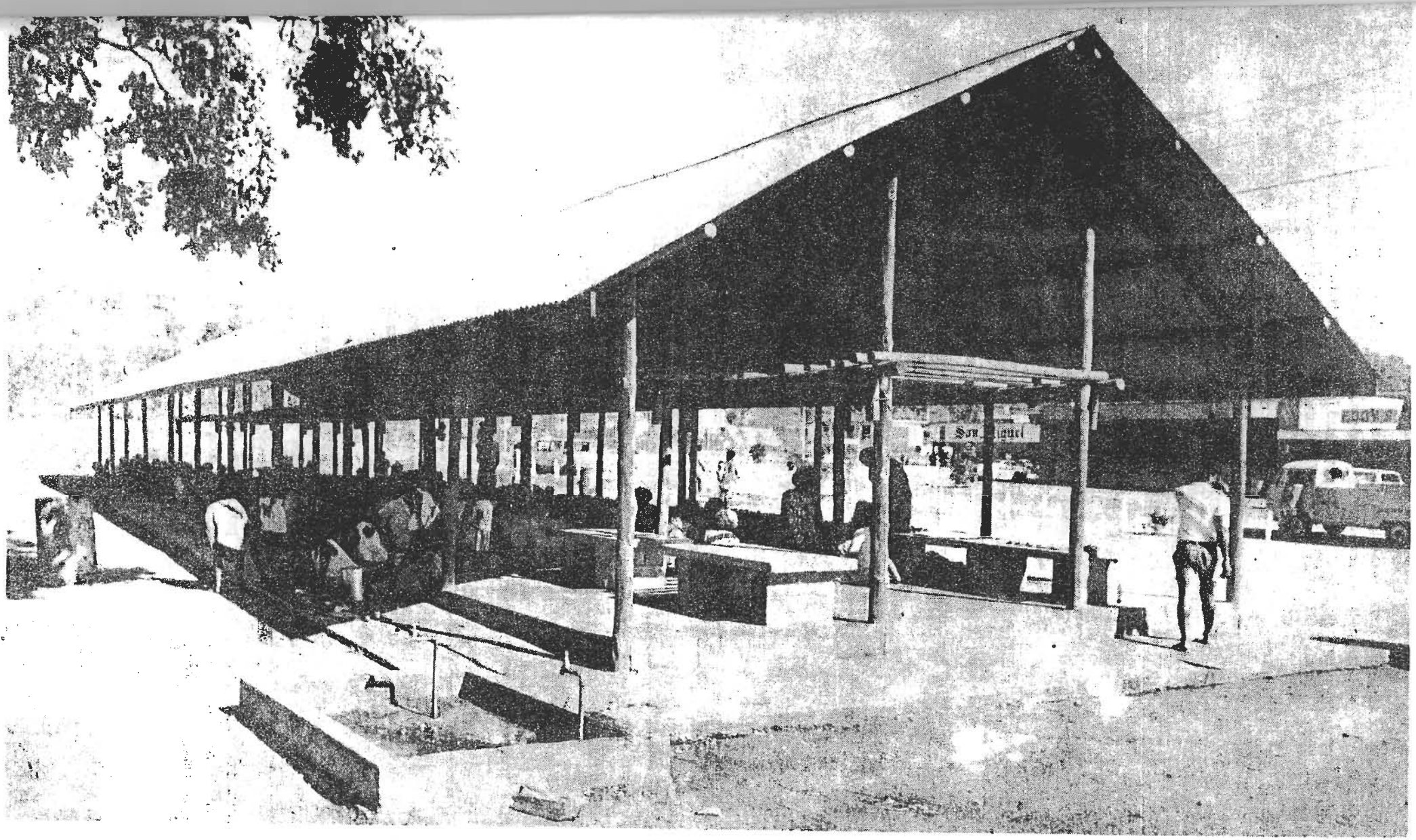
Many Local Government Councils have sought to construct their meeting places and community centres in traditional styles but have been hampered by the lack of suitable designs and of techniques of wood preservation. These needs are now being satisfied by the Department's design service and the availability of treated round timbers from the Department's plants and/or application of the methods recommended in the "Manual of Rural Wood Preservation".

3. Through Vocational Centres

Vocational Centres were established here to train young people, who have completed their primary schooling but could not proceed to secondary school, to take their place in the community. The schools aim at complete self support and are being encouraged by the Department of Forests to make use of wood preservation techniques in their building projects and as a service to their communities.

One vocational school is already accepting building contracts in which the major building elements will be poles treated by sap replacement and hand split shakes for roofing treated by C.C.A soak.

Another vocational school has constructed piggeries, broiler-chicken sheds, stores and numerous other buildings using C.C.A-treated Teak supplied by the Department of Forests.



A large market stall. The timber used is C.C.A.-treated Teak.

The activities of the schools in this work is important in two ways; firstly they get cheap durable timber buildings and secondly their students become accustomed to the treatment and use of timber, and can take their experience back to their villages.

4. Through Field Officers in the Department of Forests

Following the establishment of the Department's treatment plant at Banz in the Western Highlands, large quantities of C.C.A-treated posts were distributed in the Southern, Western, Eastern Highlands, Chimbu and Enga Districts.

These were used for fencing, small foot-bridges and culverts, piggeries and cattle yards and even the short term results over three years were so impressive that a considerable market for treated round timbers rapidly developed.

For many years the Department has encouraged the planting of woodlots by villagers, particularly in areas where shortages were developing.

The introduction of the "Manual of Rural Wood Preservation" and the extension service provided by the Department now permits the thinnings from these woodlots to be used as durable structural members in housing, fencing etc.

The Economic Benefits

The economic benefits accruing to rural areas from rational use of timber preservation techniques will be self evident or have already been mentioned. However they are important enough to restate:

i. As Papua New Guinea takes on complete responsibility for its own affairs, maximum use must be made of its natural resources, traditional building techniques, traditions and skills and the maximum spread of benefits obtained for its people.

   Timber is both its natural resource, (and is renewable) and the traditional building material with which the people are familiar.

   Timber preservation provides the technological input which makes timber an acceptable durable building material.

ii. Suitable timber is available in every district of Papua New Guinea to provide, when treated by a suitable preservation process, virtually all the construction material for rural development projects.

   By using the natural timber resources as the construction materials, and the villagers themselves as the builders, the maximum value is obtained from development money - extra money which circulates in the rural areas as a result of such activity can be a positive contribution toward reducing urban drift and the associated social problems.

iii. The use of durable treated timber products reduces the outflow of cash from the nation for imported building materials,

enables more projects to be completed with a given amount of money and encourages local small-scale artisan activity.

iv. Timber preservation permits greater use of traditional building techniques and styles and in so doing can encourage a greater awareness of the traditional values and skills of the people. In a newly emerging nation this is a most important development and could have a tremendous socially important and favourable impact.

v. With the increasing amount of time required by villagers for cash cropping and other income earning activities, and the reduction in the quantity and quality of readily available poles and other traditional building materials, timber preservation is increasingly necessary in the construction of permanent village houses. The economic advantages which can accrue are related to release from the work involved in replacing houses every three years or so, with more time available for earning cash and/or simply saving on imported building materials.

Problems of Timber Preservation

Although field trials in PNG and elsewhere have demonstrated adequately that non-durable tropical hardwood can be given greatly increased durability through use of toxic wood preservatives, developed primarily for coniferous timbers in temperate countries, this increased durability is subject to many difficultly obtained service conditions.

For instance, C.C.A-treated hardwood poles placed in the open in ground contact generally rapidly deteriorate at the ground line due to decay caused by soft rot fungi.

Because of our specialised design service we are able to specify building techniques which permit of good drainage around the pole and we tar the pole for 150mm above and at least 600mm below ground line to give added protection.

We do not recommend C.C.A-treated hardwood poles for use as electricity distribution poles because adequate drainage of the soil around the pole is not possible. While experience indicates that in large poles creosote treatment is superior to C.C.A treatment, in Papua New Guinea creosote is a very expensive commodity and it appears no longer possible to obtain economies in its use by dilution with oil. In addition to this creosote is not suitable for use in poles in buildings.

While we believe that, by taking precautionary measures, such as tarring and drainage of the soil surrounding poles, the onset of soft rot can be delayed, it is apparent that C.C.A is not a truly satisfactory preservative for tropical hardwoods used in ground contact, and that a new and better water-borne preservative system is needed urgently.

CONCLUSION

In Papua New Guinea, the techniques of wood preservation have been introduced at village level by a long and at times circuitous process.

The major steps in this process have been:

i. the accumulation of experience in the preservation of timber in the tropics

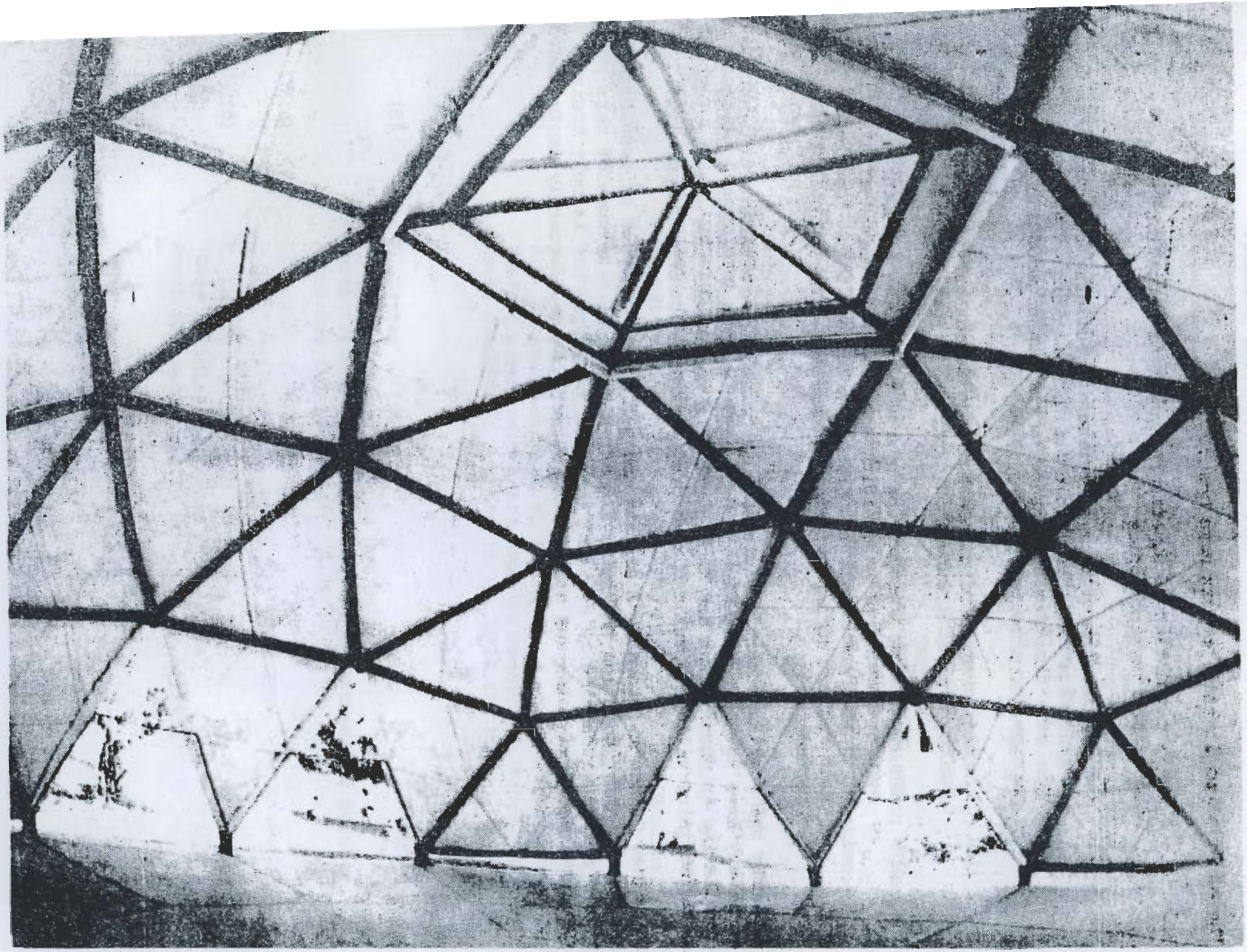
ii. the application of this experience to building in urban areas, to establish suitable building techniques and at the same time give prominence to the use of wood and in particular poles in urban building

iii. the organisation of a pole-building design service, and the publication of a "Manual of Rural Wood Preservation"

iv. the continuing introduction of new techniques in both wood preservation and building and the involvement of all concerned, government and private agencies in the development and use of appropriate wood preservation and building techniques.

Probably the most important effects the use of wood preservation in rural areas may have on the economy are in helping to keep development finance circulating in these areas and in reducing the non-productive work involved in maintaining village homes and community buildings constructed in wood.

Papua New Guinea is, in many districts subject to earthquakes of considerable intensity and in addition the soils are often unstable. Because of this timber pole construction is an ideal building technique but is only truly effective when the poles and other woody materials are adequately protected against biodegradation.



The interior of a geodesic dome using treated Teak as the main structural elements.

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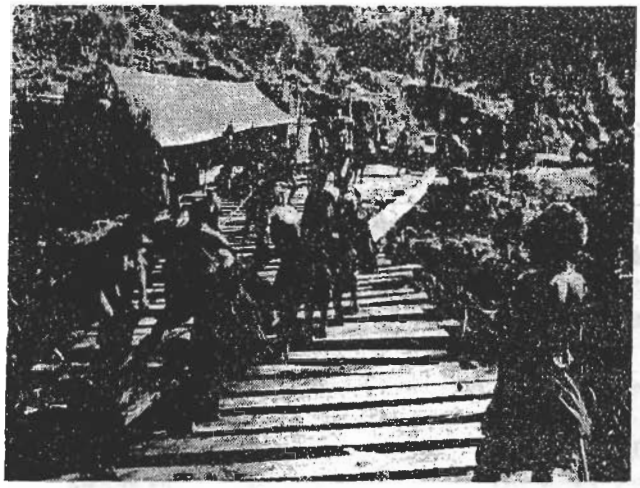
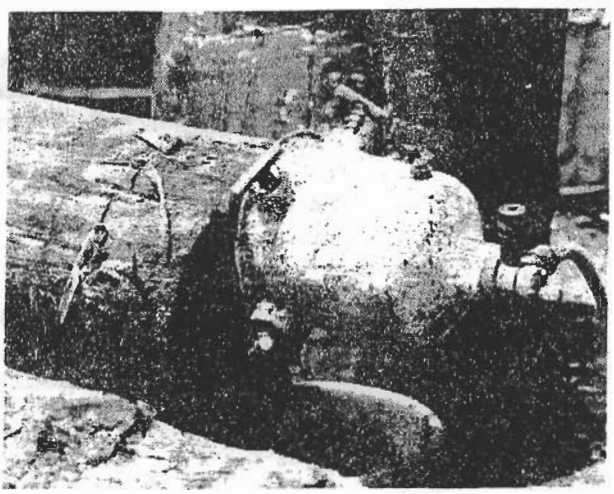
FIELD TREATMENT OF BRIDGE LOGS BY HIGH PRESSURE SAP DISPLACEMENT



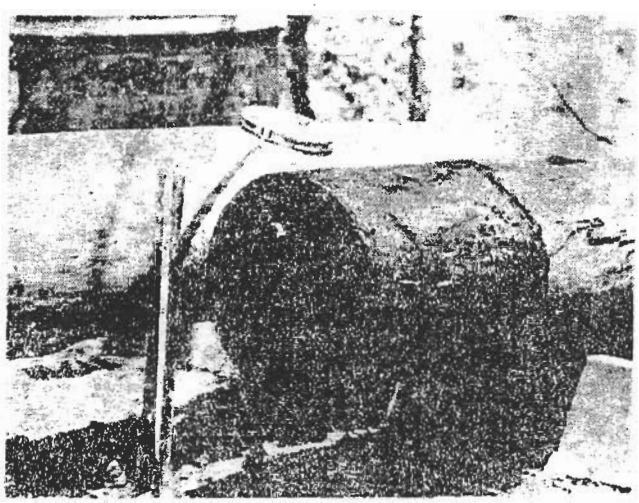
Hauling a 12m *Casuarina oligodon* log over the old bridge for H.P.S.D. treatment.

Treating a log at night by H.P.S.D. using a 30cm cap.

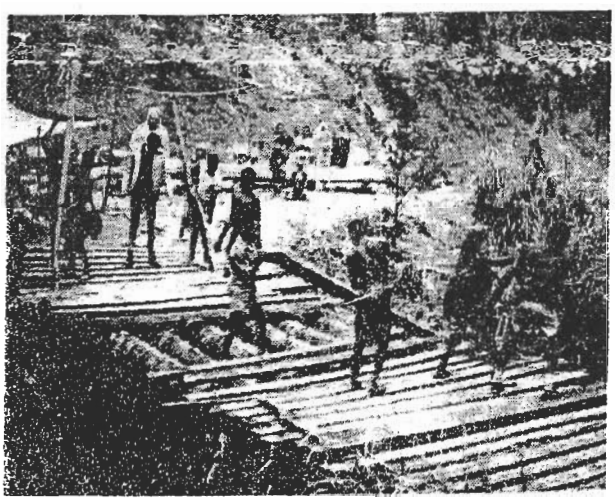
Treating logs by H.P.S.D. using a 12.5cm cap. Pump and manifold can be seen in foreground.



A 12.5cm cap offset on the end of a log.



The ends of H.P.S.D. treated logs were coated with a P.C.P. paste on the ends and tarred to give added protection.



Pulling out the old bridge.

PHOTOS: I.S. HUNT.