THE INSTITUTION OF ENGINEERS CEYLON

TRANSACTIONS FOR 1967

(VOLUME - III)

'To promote the acquisition and interchange of technical knowledge among Engineers and Members of Allied Professions and to Regulate Professional Activities'

THE INSTITUTION OF ENGINEERS CEYLON

(Formery The Engineering Association of Ceylon. Established 1906)

TRANSACTIONS FOR 1967

(VOLUME - III)

This Institution does not, as a body, hold itself responsible for statements made or opinions expressed either in the Papers read or the discussions which have occurred at the Meetings.

C. RASIAH, B.SC. (Lond.), B.A. (Cantab.) M.I.C.E., M.I.W.E., M.I.E. (Cey.)
Honorary Secretary

PUBLISHED BY
THE INSTITUTION OF ENGINEERS, CEYLON
LOWER CHATHAM STREET,
COLOMBO 1.

PRINTED BY
THE WESLEY PRESS, WELLAWATTE,
COLOMBO 6.

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To ensure the prompt delivery of the Annual Volume of Transactions and of other communications from the Institution, it is essential that every change of Address be notified to:

The Honorary Secretary,
The Institution of Engineers, Ceylon,
Lower Chatham Street,
Colombo 1.

THE INSTITUTION OF ENGINEERS

President's Introductory Address

Hon. Minister, Your Excellencies, Distinguished Visitors and fellow members.

It is my pleasant duty to extend to you all a very cordial welcome to this Conference. The presence of so many distinguished visitors is a great encouragement to the members of this Institution and a happy augury for the success of this Session.

We are grateful to the Hon. C. P. de Silva, for having accepted our invitation. He is no stranger to this Institution. He has been with us on more than one occasion. It is very appropriate that he should open this Session, in particular, when water resources form a theme of discussion in the country.

I have great pleasure in calling upon the Hon. C. P. de Silva, Minister of Land, Irrigation and Power, to inaugurate the 61st Annual Conference of the Institution of Engineers, Ceylon.

THE INSTITUTION OF ENGINEERS, CEYLON

Opening Address

by The Hon. C. P. de SILVA,
Minister of Land, Irrigation & Power.

Mr. President, Your Excellencies, and Gentlemen,

This is the third occasion I have been given the privilege of addressing the Annual Conference of the Institution of Engineers, Ceylon. My Ministry, as you all are aware, has two important Engineering Departments—Irrigation and Power. I believe it is for this reason that I have been given the honour of addressing you for the third time. As I have referred to in one of my earlier addresses, my interest in engineering and my association with the members of this Institution have been longstanding beginning with my career in the Ceylon Civil Service.

In the context of the economic difficulties our country is going through and the great effort we are making to overcome this both in the agricultural and industrial sectors, the vital roll the members of your profession have been called upon to play and will be called upon to continue to play cannot be over stressed; whether it be in the field of providing the necessary infra structure like roads, electricity, telecommunication or in the field of irrigation and industrial development, or whether it be in the field of social services like housing the essential role which the engineers have to play is recognised. Unless there is rapid expansion both in the agricultural and industrial sectors, our economic difficulties will continue.

Over the last few years noteworthy advances have been made in the various sectors. The output of the provision of irrigation facilities to agricultural lands in 1966 was 37,000 acres which is about 300 per cent of the previous years' output of the Irrigation Department. A similar acreage will be provided with irrigation facilities according to the progress made in the current year. I have in my foreword to the Implementation Report of the Ministry for 1966 complimented all irrigation engineers and other technical personnel of the Irrigation Department on its achievement which was possible in spite of the very antiquated machinery which the Department had to make use of. Most of you would have also read in the press the closure of the river at Uda Walawe Reservoir. The river closure involving about 250,000 cubes of earthwork had to be completed in a period of two and half to three months; the machinery used again was

reconditioned machinery over 15 years old. The successful completion of the river closure within a target date with a daily output of 4,000 cubes a day using this antiquated machinery is an achievement which any engineering organization in the world can be proud of. I am glad that one of the Papers which is being submitted before this Conference is entitled "Planning by Network for Construction of Uda Walawe Headworks". Most of you are also aware of the great achievements made by the State Engineering Corporation in the construction of several industrial and other building projects.

From a perusal of your programme for the 61st Annual Conference of 1967, I find that the general emphasis is on the development and utilisation of water resources in which my Ministry is vitally interested in. Our requirements of power for industry and lighting have been increasing at the rate of 20 per cent each year. This will necessitate the completion of a sizeable hydro power project once every three to four years. Substantial progress has been made in the construction of Maskeliya Oya Stage I which has a capacity of 75 MW. of installed power. Preparation of Plans, Designs and Estimates for the Maskeliya Oya Stage II Project to meet the next power shortage which is likely to arise in 1971-1972 is well in hand. Along with the completion of the Maskeliya Oya Stage I Project a vast expansion in the transmission and distribution system is planned. Work has commenced on the construction of the transmission lines to Anuradhapura-Paranthan-Chunnakam in the North and Anuradhapura-Kantalai-Trincomalee in the East. With the completion of this transmission system most of the important towns in the island will form part of the country's network of power distribution.

One of the important achievements of this year has been the issue of the Interim Report of the U.N. Special Fund Team on the Mahaweli Ganga Irrigation and Hydro Power Survey. This project is vital for both the agricultural and power development of Ceylon. The Project Report provides for the utilisation of 4,700,000 acre feet out of the total water resources of the Mahaweli Ganga amounting to 6,000,000 acre feet. It will completely transform the agricultural economy of the Northern half of Ceylon covering the North Central, Northern and Eastern Provinces and the Matale District. The power resources under the Mahaveli amounting to about 460 MW. of installed capacity will more or less meet the country's power needs over the next 15 to 20 years. The project, as envisaged, will bring under cultivation 627,000 acres of new land and will provide irrigation facilities to 273,000 acres of existing paddy fields making a total of 900,000 acres. The project involves the construction of 16 irrigation and multi-purpose projects, as well as several small reservoirs on the tributories of Mahaweli. The work on the first phase of the project, the Polgolla Diversion and the Polgolla-Kala Oya

Channel, at an estimated cost of Rs. 395,000,000 inclusive of land development and infra structure expenditure should commence in 1969. This project will benefit 96,000 acres of which 56,900 acres are new areas and will provide for 34 MW. of installed power with an annual output of 260 million KW. Another major engineering project which the Government has approved and which will commence shortly is the reclamation of the low-lying areas in Colombo and suburbs for building purposes. The setting up of a separate Board to undertake this project has also been approved by the Government.

In these projects, which concern my Ministry, as well as the projects under other Ministries, the Members of this Association have a vital role to play. The Government recognises the valuable services rendered by engineers and other technical personnel in the development activities of the country. Most of you are aware, the salaries of engineers have been recently revised upward which, is a measure of the recognition by the Government of the valuable services which the engineers render. As most of you are aware, an engineer has also been appointed additional Permanent Secretary to my Ministry to look after the technical aspects of irrigation and power development. While the Government will continue to recognise your valuable services and take every possible step to ameliorate your conditions of service, I earnestly appeal to all members of this Association to put in their wholehearted and full efforts towards developing our economy in the current desperate economic situation.

I wish to thank you for the honour extended to me in inviting me to address this gathering. I have great pleasure in declaring open the 61st Annual Session of the Institution of Engineers, and wish it all success.

THE INSTITUTION OF ENGINEERS, CEYLON

Presidential Address 1967

by Mr. S. ARUMUGAM, B.Sc. Lond., B.Sc. (Eng.) Lond. M.I.C.E., M.I.W.E., M.I.E. (Cey.)

Hon. C. P. de Silva, Your Excellencies, Ladies and Gentlemen, Fellow Members:—

It is my happy responsibility to welcome you, Sir, and other distinguished guests.

It is indeed a fitting tribute to the engineering profession that you all have accepted our invitation and are with us today at our 61st Annual Conference. We appreciate this ever so much. It is my pleasant task, at the outset, to introduce our guests who have come from abroad to grace this occasion of the Institution and to contribute to our deliberations.

On behalf of the Institution, I offer a very sincere welcome to all our distinguished guests both from abroad as well as from within Ceylon, and thank them for their presence.

THE DEVELOPMENT OF WATER RESOURCES CONSERVATION AND UTILISATION IN CEYLON

In the selection of subject for my address, I desire to conform to the time honoured practice established by my predecessors, of this sixty year-old Institution, whereby the President speaks on an aspect of the engineering speciality, to which he is dedicated. No apology is therefore made to the nature and contents of the subject matter; I would however preface with the following introductory mention that I am no historian, but the marvels of engineering technique shown in the execution of the ancient water conservation works lured me to it. Whenever I visited a work site, its historical back ground never escaped my notice. That helped me in taking an intelligent interest in the restoration of ancient works.

Introductory

Ceylon is a tropical island with a land mass of 25,332 sq. miles; the island is subject to two monsoons. On the basis of distribution of rainfall the island is divided into two distinct areas—the wet and the dry zones. The dry zone, comprising over 12 million acres is arid and dry and well suited for development with irrigated agriculture.

Water Resource and Its Conservation for Development

The only form of precipitation of water in Ceylon is direct rain fall; A net work of over six hundred rain guage stations, some of them over hundred years old, maintain records of the rainfall. Quantitatively mean annual precipitation amounts to 89 million acre feet, of which 57 million occur in the dry zone.

The area of Ceylon can be divided into 103 natural river basins: over ninety stream guaging stations are established all over the island to measure the flow in the rivers. The total run off from the rivers in Ceylon is assessed to be 41.5 million acre feet, divided equally between the wet and the dry zone areas.

Taking good stock of the above and well aware of the developmental potential of the dry zone, the ancients devoted their attention to the conservation of water resources and the development of the dry zone regions of Ceylon.

Rice Cultivation

The staple food of the peoples of Ceylon is rice; successful growth of rice is dependent on water. The development of Ceylon's Water Resources thus becomes fundamental for the very existence of the people.

The conservation of water and its distribution for rice cultivation became the foremost and solemn duty of the Kings of Ceylon and those Monarchs who discharged this obligation were held in high esteem and veneration by the people, through the ages.

Prehistoric

The ancient chronicles of Ceylon viz. Mahawansa, Culavansa, etc. make mention of tanks existing in Anuradhapura even during the pre-Christian period of the 6th and the 5th centuries B.C.

The Tissa wewa, City Tank of Anuradhapura, is attributed to King Devanampiya Tissa (250-210 B.C.).

Conservation practice by diversion of small streams and small privately owned storage tanks is recorded to have been developed by the first century B.C.

Development by the Early Sinhalese Kings

Soon afterwards, development progressed from privately owned storage works to major works of utility, where not one individual but a whole group or community was benefited.

King Vasabha (65-109 A.C.) was responsible for the construction of eleven tanks and twelve canals, thus earning the name en-

dowed on him by posterity, as the "First of the great Tank Building Kings." Six of these works have been identified, including: Panickkam Kulam (Vaha Vapi), Manankattiya (Mahanikkavatti) Hirivad unna (Aggivaddhamavaha), Willachiya Tanks (Mayant) and Mayetti tanks), and of the canals only the Elahera (Alisara) canal is now known, to perpetuate his name.

Minneriya Tank

Development progressed actively thereafter and larger conservations works, in fact the celebrated sixteen large storage reservoirs of *King Maha Sena* (276-303 A.C.), the Great Tank builder, are then recorded. Eight of the sixteen works constructed by him are identified today:—Mahagama Vapi, Challura Vapi (now known as Huruluwewa), Khanu Vapi (Mahakandarawa tank), Kokavata Vapi, Mahamani Vapi (Maminiya near Maradan Kadawela), Dhemmerama Vapi Kumbalaka Vapi (Kimbulwana now known as Nirmulla), Vahana Vapi Rattamalakandka Vapi (Padaviya tank), Velangaviththi Vapi, Tissavadhamanka Vapi (Kaudula Tank), Mahagallaka Vapi, Cira Vapi, Mahadaragallaka Vapi (Mahagalkadawela), Kalapasana Vapi (Karampankulam), and *Manihira Vapi (the celebrated Minneriya tank)*, the foremost of them, where he is worshipped today at a shrine on the tank bund, a fitting tribute to the legacy left by him.

He was also responsible for the construction of the great Pabbatahata canal *identified now as the present Minipe Canal.*

Kala Wewa

King Dahatusena (459-477 A.C.) became immortal with his foremost Kala Vapi work—(The present Kalawewa) built across the Kala Oya and the Jaya Ganga (Kala wewa Yode Ela)—the 54 mile long canal which conveys Kala Wewa Waters to the city of Anuradhapura. Besides the twin tanks Kala vava and Balaln vava, he is recorded to have constructed 18 tanks of which 4 were major works, including:—

Mahadatta (Madatugama at 51st. M. S. Dambulla-A'pura rd.), Maha Eli (Mealiya Vava on 12th mile Ibbagamuwa-Polpitigama road).

A king who distinguished himself in literary scholarship and in development work alike was Mogallana II (535-555 A.C.). During his reign were constructed, Pattapasana Vapi (Nachchaduwa tank) along with a five mile feeder channel (now a natural stream) from there to Nuwara Wewa, in Anuradhapura. To him is also attributed restoration or enlarging of Padawiya tank (Dhana Vapi).

Tanks and Canals

To Aggabodhi I (575-608 A.C.) a model King, who ruled for 34 years, is attributed the water conservation works of:—

1. The Manimekahala Dam—The anicut across the Mahaweli Ganga at Minipe, along with improvements to about 17 miles of the Minipe Ela Scheme, built earlier.

2. The Minneriya Kantalai Yode Ela, conveying water from Minneriya tank to Kantalai.

3. Kurunda Vapi, now known as Thannimurippu Tank, off Mullaitivu.

Aggabodhi II (608-618 A.C.) continued the development works commenced by his uncle Aggabohdi I and constructed the Gangatata-Vapi (Kantalai Tank), into which the 54 mile Minneriya Kantalai Yode Ela terminated. To him is also attributed the construction of Giritata Vapi (Giritale Tank), fed by a branch of the Elahera canal.

Thus by the seventh century A.C., the following were among the larger storage reservoirs accomplished:—

Minneriya, Mahakandarawa, Kaudulla Tank, Hurulu wewa, Padaviya, Kalawewa, Nachchaduwa, Thannumurippu tank, Kantalai Tank, Giritale Tank, Thusa Vapi, and the river diversion works and canals:—

Elahera canal, Kalawewa Yoda Ela and Tissa wewa, Feeder channel to and Nuwara wewa, Minipe anicut and 17 miles of Minipe Yodi Ela, Minneriya Kantalai Yode Ela, Hattota Amuna and channel.

The Kalawewa spill is reported to have been strengthened by King Mahinda II (777-797), when a feeder channel was also constructed from there to Tintinigamaka Vapi (now called Usagala Siyambalagamuwa Tank).

The Minipe Ela Scheme was extended to a total length of 47 miles, during the reign of King Sena II (853-887), when an augmentation scheme was also provided to Mahakandarawa Tank by a dam near Maradankadawela.

Restoration and consolidation of water conservation works was later done by Vijayabahu (1055-1110).

The Parakrama Period.

Parakrama Bahu I (1153-1186), assumed charge of his own principality of "Dakkinadesa", contained in the area between Kalu

Ganga and Kala Oya. *Conservation and Development was his key-note to the path of plenty.* He demonstrated his own dictum that water that comes from *rain must be made useful to man.*

The Deduru Oya (Jajjara Nadi), the river of his principality of Dakkinadesa, was first harnessed by damming at three major works sites. The Kottabaddha anicut with the present Sengal Oya near Chilaw, the Sukaranijjhara (Ridi Bendi Ela anicut) and the uppermost dam, Doradattika, below the present anicut site at the junction of the two streams Hakwatunu Oya and Kimbulvana Oya. Along with this fifty-three tanks were restored or improved in the area, chief of which was panduvas-nuwara, near Hettipola which was given the title of the first "Sea of Parakrama".

With the military conquest over his rivals and the subjugation of their territoties, his own development plan spread out, eventually to cover the whole of Ceylon. No water conservation work built before his time escaped being put into working condition to ensure productivity everywhere.

Period of Prodigious Achievement.

It is recorded that Parakrama Bahu I was responsible for the construction, restoration and enlargement of:—

163	—	Major storage Reservoirs,
2,376	—	Minor tanks,
165	—	River Diversion works,
3,910	—	Miles of Canals,

a most stupendous achievement ! !

Foremost of all the works initiated during the period is the present *Parakrama Samudra Scheme;* it consisted of the Angamedila anicut across the Amban Ganga (Kara Ganga) and the Conveyance of the diverted flow by an inlet channel (Akasa Ganga) to Parakrama Samudra which earlier were three tanks Topa Wewa, Dambitilu Wewa and Eramaduwewa; now these are merged (on restoration) to form the present Parakrama Samudra at Polonnaruwa.

12th Century resume

Thus by 12th century, Water Resources Development reached its zenith in Ceylon with a record which was the greatest achievement in history.

Decline in Development

In the centuries that followed, no new development was promoted: activity was probably confined to maintenance in working order of the works in the neighbourhood of the capital cities of Dambadeniya, Yapahuva, Kurunegala and Gampola.

The position did not change with the arrival of the Portuguese (1505-1656), whose interest in agricultural enterprises was confined to cinnamon only.

Development by the DUTCH

The Dutch were in Ceylon for about 150 years from 1656 A.C. Unlike their predecessors, attention was paid by them for the agricultural development of Ceylon. Grants of lands were freely made for the purpose and a regulation published in 1666 prohibited owners of rice fields from leaving them uncultivated. Another order in 1744 announced seizure of such uncultivated lands to be given to other "more diligent cultivators". The Dutch found it good economy to encourage agriculture in the low-country and aided this with costly undertakings, by the construction and restoration of engineering works.

The most striking contributions made by the Dutch in Ceylon are the well-known Dutch canals. These were excavated primarily for economical water transport but also aided agricultural development by draining the neighbouring areas and rendering them suitable for cultivation.

(1) The Negombo and Kalutara canals facilitated the drainage of Muthurajawela and the Kotte areas.
(2) The Maha Modera canal in Galle was expected to relieve flooding in the neighbouring low basin.
(3) Similarly the Nupa and Talagahagoda canals in the Matara area.

Paddy cultivation in the Colombo and Galle areas received much attention by them as "a great part of the crops were being lost either having too great or too small a quantity of water". A long earthen embankment over seven miles in length was constructed along the northern bank of the Kelani Ganga, now known as the Kelani North Flood Protection Bund—to prevent the periodic inundation of the paddy fields in the low basins around Kelaniya. The lands situated adjoining the Nilwala Ganga were drained and irrigation facilities provided by suitable dams, etc. The Kirama Oya was regraded and facilities provided for diversion of water to paddy fields.

By far the foremost of the Dutch Water Resources Engineering works is the Urubokka Dam in the Southern Province completed in 1787 by Lt. Foenander for the development of 8,000 acres of rice cultivation.

Other works include the Irakkaman dam and the Amparai tank repair works by Bunnand; improvement works to Kantalai was vigorous in the latter half of the 18th century during the administration of Vandegraaff.

The BRITISH—Revival and Restoration of Water Resources Development

The British took command of the maritime areas of Ceylon by 1798 and the entire Island in 1815.

Following the pattern set up at Urubokke, the Kirama Dam was constructed in 1825, across a tributory of the Nilwalaganga.

With the removal of the Rajakariya system in 1832 the communal machinery by means of which works had been kept in good repair from the very ancient days, terminated, without a substitute in its place: So the maintenance upkeep of communal conservation works was not the responsibility of any and the works just wasted into general decay.

Even Kirama and Urubokke Dams breached in 1837.

Enthusiasm of British Governors

To Sir Emerson Tennent, Colonial Secretary 1847, belongs the credit of reviving interest in irrigation development by legislative authority. This idea, culminated in the hands of Sir Henry Ward, Governor of Ceylon (1855-1860). The "Irrigation Ordinance of 1856" described as the "Ordinance to facilitate the revival and enforcement of ancient customs regarding the Irrigation and Cultivation of Paddy Lands", was enacted. The Act was to be in force for five years from 1st January, 1857, and was limited in scope of application to those areas in Ceylon where there were large tracts of paddy lands dependent on a single source of irrigation.

Under the terms and conditions of the Ordinance, funds were obtained and Sir Henry Ward was able during his term to put back into working condition the works of the Dutch, viz., Irakkamam work in Batticaloa and the Urubokke and Kirama dams in the South.

The Irrigation Ordinance of 1861 was a renewal of the first, but the revised Irrigation Ordinance of 1867 embodied the required modifications with a wider scope covering repair of village tanks and minor works as well.

Consequently, the following works were executed during the seven years 1865-1872: Kekanadara Tank, Hali Ela Tank, Tissamaharama Tank and Udukiriwela in the South; Deduru Oya scheme, Kospotu Oya scheme, Tinipiti wewa and Wennoruwewa in N.W.P., Periyakulam, Rugam tank and Pulukanavakulam in E.P.; Horabora wewa, Buttala Ela and Kuda wewa in Uva and about 25 others, with a record expenditure (considered then, as astounding) of Rs. 1,050,000.

Governor Sir William Gregory who was keen on development continued with the following: Urapola anicut in S.P., Allai scheme. Sakamam, Chandiyantalawa, Kantalai tank in E.P., Basawakkulama, Madawachchiya tank, Yode Ela from Kalawewa and Elahera canal in N.C.P., Maha Uswewa, Galgamuwa tank in N.W.P., and a large number of village tanks, the restoration which was the special interest of Sir William Gregory whose requirement was "that at least one hundred village tanks be properly repaired each year".

Sir Arthur Gordon (1883-1890) once again revitalised irrigation development and kindled enthusiasm which had worn out with the departure of Sir William Gregory and several works were taken up for restoration during his regime.

The restoration of Kalawewa was taken up, costing Rs. 405,095. The restoration of Kalawewa Yode Ela (Jaya Ganga of Old) was then (1889) undertaken, costing Rs. 304,484. Along with these the City Tanks of Anuradhapura, Nuwara-wewa, Tissawewa and Bassawakulama were also restored.

Central Irrigation Board

In 1887 an Ordinance was passed creating a *Central Irrigation Board*, with the Governor as President, for the general management and promotion of Irrigation Development. Provincial Boards were also set up with the respective Government Agents of the area as Presidents who were entrusted with the execution of all works in their areas. No special staff was, however, provided and the works were executed by the staff of the Public Works Department. Restoration Works taken up included:—Hambegamuwa tank in Uva, Bodi Ela in C.P. (3 miles), Kitulbokke Scheme in Sab. P., Kanagarayankulam in N.P., Lahugala Tank in E.P. and Maha Nanneriya in N.W.P.

During the next five years construction and restoration work were commenced and in many cases completed at:—Kumbukkan Anicut (Uva), Bowatenne Ela (C.P.), Bodi Ela (C.P. had breached seriously and taken up again), Irakkaman, Sagamam, and Thumpankerni (in E.P.) Rugam (which had breached in 1881), Badula Ela (Uva), Hingura Ara Tank (S.P.), Deduru Oya Works (N.E.P.), Yode Wewa (S.P.), Madukande, Cheddikulam, and Periyakulam (in N.P.); work at Giant's Tank was slow and later received a setback due to an epidemic of Cholera (1898).

In 1896, it was decided to vest entirely on the Director of Public Works the responsibility for the execution of Irrigation works, relieving the Government Agents of this task. For this purpose a special Irrigation Assistant (Henry W. Parker) and a number of Junior Engineers were added to strengthen the P.W.D.

A new Irrigation Manual was published on the 18th of March, 1899, which helped to define responsibility for the maintenance of irrigation works.

The Irrigation Department

In order to expidite the execution of irrigation works, the Irrigation Department as distinct from the Public Works Department was formed on the 15th of May, 1900, with H. T. S. Ward as first Director of Irrigation, H. W. Parker, Irrigation Assistant, and seven Irrigation Engineers: E. W. Cade (Walawe and Kirindi), J. W. Nunn (Kalawewa), E. G. Eaves (Minneria), R. F. Morris (Unichchi), O. D. Watts (Rugam,) S. H. Bower (Sagamam) and G. H. O. Brian (Vakaneri).

All surveys, designs, construction of new works, restoration and maintenance of large schemes were the responsibility of the new Department. The Government Agents (the Provincial Board being abolished) were concerned about the upkeep of minor works carried out by the Villagers themselves.

Henry W. Parker

In 1904, *Henry W. Parker, Irrigation Assistant*, who had by that time become a most valuable officer and whose *reports* on the *ancient irrigation schemes* are even now works of authority, retired from Government Service. The Director of Irrigation (H. T. S. Ward) writes:—"He (H. W. Parker) served in all the malarial districts of the Island and knew more about the ancient irrigation works than all the rest of the inhabitants of the Island put together. He spoke Tamil and Sinhalese fluently and was a Pali scholar.

He designed Deduru Oya Works, Giants Tank restoration, the Karachchi Scheme and reported on numerous irrigation schemes all over the Island....". To-day he is more well known than any Director of Irrigation of Old.

W. L. Strange, loaned by the Indian Government, reported on "Irrigation in Ceylon" in 1909. Work on Iranamadu Tank which was a new construction work was proceeding steadily and the Dri Aru Tank was done in 1908 as a preliminary work to cater for the labour camp and the water supply, etc. Amparai, Kondavaddavan and Vellathipathi Tank in E.P. were completed and Illankantai tank in Trinco executed in one year (1912) by L. P. Emerson, I.E. An estimate for Rs. 374,700 was approved in the same year for the restoration of Tabbowa Tank.

The existing Irrigation Ordinance was revised and the new "Irrigation Ordinance, No. 45 of 1917", was enacted framed in accordance with the recommendations of Strange's Report of 1908.

Irrigation rates were now made variable with development and no longer remained fixed.

Iranaimadu Tank, commenced in July, 1902, was completed and filled for the first time and was spilling in November, 1920.

Colombo Flood Scheme

C. C. Harward, D.I.E., commenced investigation of the flood problem in Colombo area from Jaela to Kalutara in 1920; his proposals were accepted and he commenced work on the Colombo South Flood Scheme on 18th October, 1923.

Colombo South Flood Protection Works and the Colombo North Flood Protection works, which were commenced in 1924 were completed in time to save Colombo from the 1926 flood; the Left Bank Irrigation Scheme under the Liyangatota anicut, Walawe Scheme was done. The restoration work of Tabowa, which was *recommended* in 1921, was effected in 1925 and the tank filled for the first time and was spilling on 8th December, 1925.

A new Irrigation policy was announced by *D. S. Senanayake*, Minister of Agriculture and Lands in 1932, whereby improvements to *village irrigation works* also became the work of the Irrigation Department.

Advent of Earth moving machine

An event of great importance was the utilisation of heavy mechanical equipment, for the first time, in the execution of development works. A Ruston Bucyrus Excavator excavating Channels and a Caterpillar Tractor assisting breach closure work at the Eramadu Gap, P. S. Scheme are events of 1936-37.

Construction work was commenced in 1938 at several large major works:—Topa Wewa (P.S.S. 1st stage), Ridi Bendi Ela, Minipe Ela 1st stage, Bathmedila Ela 1st stage, Colombo South Drainage-Wellawatte Canal, Attanagala Oya scheme and Elahera Scheme. Mahaweli Ganga was harnessed for the first time in recent years by the restoration of the Minipe Anicut during February-March, 1939.

New Land Policy

A *new land development policy* was then initiated; it was considered insufficient to construct tanks and the irrigation channel system only; it was considered that in addition to the land being opened up, aswedumization should be also done before the colonists were settled.

A new land development unit embarked on clearing land and erection of colonist cottages at:

Minipe, Kahagama, Elahera and Parakrama Samudra Schemes. P.S.S. filled for the first time on February 22nd, 1944.

As part of the post-war programme of development, a six-year Programme of Development was commenced in the year 1947-48, which included:—

Elahera, Raja Ela, Minneriya, Kahagama ext., Nuwara Wewa Ext., Bathmedial, Minipe Ext., Ridi Bendi Ela, Dewahuwa, Gal Oya, Kantalai Ext., Allai Ext., Walawe Rest, and Huruluwewa.

Gal-Oya Scheme

The Gal Oya Project consisting of a 154 feet high earthen dam about three-quarter mile long and made up of over 2 million cubes of compacted earth, for benefitting 120,000 acres of cultivation and generating 10,000 K.W. of electric power, was commenced by opening up roads and erection of buildings in 1948.

Actual construction work on the Gal Oya Dam was commenced in March, 1949, with excavation of the foundation. Work was also commenced at Nalanda Reservoir scheme at the same time. Restoration of Huruluwewa Tank was also commenced in 1949.

The Gal Oya dam was completed and the Senanayake Samudra commenced issuing water for the first time on the 10th of December, 1951.

Disastrous Flood of 1957

But a most tragic event overtook all development activity in 1957. *Torrential rains*, unprecendented in living memory, fell on the 24th, 25th and the 26th December, 1957, causing such catastrophic devastation as never experienced before;—rainfalls recorded at Habarana were 16.48 ins. on 24th, 18.76 ins. on 25th and 13.59 ins. on the 26th; serious damage was caused to 35 major works and 1,300 village tanks; and among the major tanks that breached were:—Kala wewa, Hurulu wewa, Nachchaduwa, Giants tank, Akkarayankulam, Pavatkulam, Iratperiyakulam, Unichchai tank, and Rugam Tank, etc.

Repairing all these ravages and putting back into commission many of these giants of old, necessarily slowed the momentum that would otherwise have accomplished new constructional development.

But soon afterwards the pace of development was renewed with even greater vigour and several large conservation projects, storage reservoirs, and river diversions were embarked upon, among which are the Minipe Ela Extension Scheme, Muttu Aiyan, Kaddu Kulam

Work, Vavunikulam Reservoir, Akkarayan Kulam, Allai Extension Scheme, Morawewa Extension Scheme, Hakwatunu Oya Reservoir Scheme, Maha Kandarawa Scheme, Padaiviya Extension Scheme, Rajangana Wewa, Angamunuwa Scheme, Kandulla Scheme, etc.

Harnessing Walawe Ganga

Construction work was commenced in 1963 on the *Uda Walawa* Dam across the Walawe Ganga, for the development of over 60,000 acres by the conservation and storage of over 200,000 acre feet of water.

Work on the storage reservoirs at Muruthawela and at Nagadeepa was commenced in 1966.

Water Resources and Land Development

We thus get a background picture of the development of our water resources, through the ages. The tempo has been quickened recently and heights have been reached which were hitherto unheard of; posterity would acknowledge the gratitude of the country to Hon. The Minister for this achievement.

Our position now is, as a result of the annual rainfall, we obtain an average run off of 41.5 million acre feet, each year. Consequent to the various conservation projects which have been executed, both by the restoration of ancient works and the construction of new works, a quantity of over a million acre feet of water is detained and stored in our storage reservoirs to aid development (this amount is only $2\frac{1}{2}\%$ of the annual run off). But the amount of water resources used up annually in agricultural enterprises is more than five million acre feet.

Water resources utilisation for generation of Electrical Power

Ceylon's water resources are used for electrical power generation in the hydro-station at Laxapana which commenced operation in 1950, with supply conserved in the Norton Dam Reservoir. Then with the completion of the dam at Castlereagh, generation was increased. The 730 Acre feet stored in Norton and the 43,800 Acre feet in Castlereagh are used for the total annual generation of 393 million units of electrical energy with an installed capacity of 110 M.W.

The Maskeliya Oya, a tributary of the Kelani Ganga is being dammed at Mousakelle to conserve 88,000 acre feet of water. This would eventually serve for the generation of 700 million units, with an installed capacity of 172 M.W.

The 10 M.W. plant installed at the outlet sluices of Senanayake Samudra, Gal Oya Scheme, annually generates about 60 million units.

Development of Domestic Supply

The development of water supply for domestic consumption is effected from storage Reservoirs, River Flows, and Wells. The Labugama and Kalatuwawa Reservoirs supply Colombo. Supply for Kandy is drawn from the Mahaweli Ganga, for Negombo from Maha Oya, etc. Most of the other Schemes, over a hundred in number, are from wells. In all about a hundred million gallons are utilised daily for domestic water consumption.

The Mahaweli Project

In the subject of the Water Resources Conservation and utilisation, we in Ceylon, are just now in the midst of an epoch making era when a most stupendous project, far bigger than any, ever thought of, is being evolved.

The *Mahaweli Ganga*, our longest and largest river is to be harnessed, whereby six million acre feet of water is to be conserved to aid the development of nine lakhs acres. The work would cost about Rs. 6,000 million and is spread over a period of twenty years.

The architect of the project is Hon. The Minister for Lands, Irrigation and Power, Mr. C. P. de Silva, who is with us today. The man at the helm is Hon. The Prime Minister, Mr. Dudley Senanayake, who will be with us on the 29th October. He, as Minister for Agriculture and Lands, in 1950, swung the country to a program of resurgence in Water Resources Conservation and Development.

This era excels the Parakrama period.

Thank you all for listening to me patiently.

INSTITUTION OF ENGINEERS, CEYLON

SUPPLEMENT TO THE PRESIDENTIAL ADDRESS

PUBLIC WORKS DEPARTMENT

Road and Bridge Works.

(a) **Northern Approaches to the New Kelani Bridge.**

The Project estimated to cost Rs. 10 million consists of a "Super highway" commencing from the northern end of the New Kelani Bridge. This road consisting of a dual carriage-way, each of 24 ft. with median strip and shoulders each 10 ft. wide is 2¾ miles in length and includes 1 mile across the Telangapatha marshes after which it bifurcates and meets the Colombo-Kandy and Colombo-Negombo roads on the 6th and 5th miles respectively. The scheme includes five (5) "Fly-overs" costing Rs. 6 million (approx.) to give uninterrupted 'free flow' over the present level crossing, all intersecting roads and railway lines.

Two of these "Fly-overs" 60'0" wide over the rail track at Kelaniya (2 end spans of 40'0" and centre spans of 75'0") and that over the Colombo-Kandy road (2 end spans of 32'0" and a centre span of 44'0") are under construction.

A novel feature of construction is the filling of the road embankment by dredging the bed of the Kelani river and pumping the sand to the site—This is being done by the State Engineering Corporation.

(b) **Ella-Wellawaya Road.**

The scheme for Rs. 7.65 millions provides for a 20 ft. carriageway and 5 ft. wide shoulders for 18 miles of road. The central 9½ miles was through very rocky terrain on very undulating land and the first trace was decided after carrying out investigation with the aid of Aerial Photographs—work has commenced from both the Ella and Wellawaya ends.

(c) **Galle Marine Drive**

The scheme costing Rs. 1.9 million is for producing a Marine Drive of about ¾ mile to bye-pass the Galle bazaar area. A 40 ft. carriageway with two foot walks is to be provided and the work consists of a boulder wall on the sea side for practically the whole length.

(d) **Weligama Bye Pass.**

The work costing Rs. 3 million comprises of 2.56 miles of modern highway to bye-pass the narrow section of the Galle-Hambantota road at Weligama.

(e) **Idangoda-Ayagama-Kukulegama and Kalawana-Dependene Road.** This project costing Rs. 2,000,000/- for widening and improvnig 15 miles of minor road is expected to be completed in 1968.

(f) **Other important road projects.**

Ohiya-Horton Plains road—The existing bridle path is improved as an all weather motorable road. The New Roads to replace existing P.W.D. Roads that will be submerged by the Hydrel Schemes in the Maskeliya Oya Project are also being carried out by the Department.

Major Bridges under construction are as follows:—

i. Bridge No. 75/4 on Colombo-Galle-Hambantota Road (24'0" wide and 3 spans of 44'0") at Waggalmodera. Estimated cost Rs. 940,000/-.

ii. Bridge No. 72/1 on Colombo-Galle Road (50'0" wide and 3 spans of 75'0") at Mahamodera. Estimated cost Rs. 2,000,000/-.

iii. The two 'Fly-overs' with 60'0" wide beam deck to provide for a dual carriageway on the Northern approaches to Kelani Bridge referred at (a) above.

iv. The bridge across Maskeliya Oya owing to diversion, the existing road at the Hydrel Scheme having 2 ends span of 40'0" and a centre span of 92'6". Estimated cost Rs. 1,300,000/-.

v. Bridge No. 41/1 on the Akkaraipattu-Sanganam Road consisting of 6 spans of 45'0" ft. each, and 22'0" roadways. The total estimated cost including approaches and acquisition is Rs. 1,350,000/-.

vi. Bridge over Naval Aru on the Pottuvil—Panama Road, consisting of 7 spans of 35'0" and 12'0" roadway and costing Rs. 800,000/-.

vii. The bridge over Kala Oya on the Padeniya-Siyambalagamuwa road which replaces the existing Causeway, has 5 spans of 102'0" each and provides a roadway 24'0" wide. This bridge which has reinforced concrete abutments and piers with post-tensioned beams and deck slabs, is the largest bridge undertaken by the Bridges Section. As a part of the Scheme for the diversion of the Padeniya-Anuradhapura road is a bridge over Siyambalagamuwa Oya. The total cost of both Bridges is Rs. 2,750,000/-

Major Building Works.

(i) **C.T.O. Building, Fort.**

This nine storeyed building was completed at a little over Rs. 6 million.

(ii) **O.T.S. Building, Fort.**

This is a nine storeyed building costing Rs. 5.7 million is under construction through the Bridges Section.

(iii) **Design** for the following buildings were undertaken:—

(a) The New Secretariat, Anderson Golf Links, Colombo an 8 Storeyed structure 231'6" long by 60'0" wide approximate estimated cost is Rs. 5 million.

(b) The Secretariat, Galle, of 8 Storeys, 6 of which are only to be taken up in the first stage. It is to be 225'3" long by 68'6" wide with provision for a 24,000 gallon tank over the roof. Approx. estimated cost is Rs. 7 million.

(c) The Ceylon National Archives, Colombo, has a central triangular tower 155 ft. between apexes of 7 storeys round the base of which there is a 2 storeyd section which extends at the apexes radially outwards into three wings 120 ft. long by 50 ft. wide, the floors in the central tower being of grid beam arrangements. Approx. estimated cost is Rs. 2.8 Million.

THE INSTITUTION OF ENGINEERS, CEYLON

IRRIGATION DEPARTMENT

Samanalawewa Project

The Technical Report was completed. The project envisages the construction of a reservoir in the upper reaches of the Walawe Ganga having a storage of 164,000 acres but, capable of irrigating 24,000 acres under Sugar Cane and Subsidiary food crops, and generating 398 million k.w.h. of firm power annually.

Mahaweli River Basin Development

A preliminary interim report was issued in the mid year by the F.A.O.

The Scheme is programmed to benefit 900,000 acres and generate about 2377 million k.w.h. of power annually at an estimated cost of Rs. 6,000 million. The project reports for Nagadeepa Mahawewa, and Muruthawela Reservoir schemes were completed and issued by the Department. These will benefit a total of 11,000 acres.

Feasibility Reports on (i) Reclamation of Swamps in and around the City of Colombo and (ii) Reclamation of Muthurajawela for housing were published as Sessional papers **xxvi** and **xxi** of 1966.

2. **National "Land Use"** soil maps to a scale of 1:250,000 has been prepared and is now available for the whole of dry and intermediate zones of Ceylon.

3. **Resistivity Traverses** are being conducted in Puttalam, Mannar, Pooneryn, and Hambantota areas to locate suitable water bearing formations. These are done in conjunction with drilling work where resistivity is for co-relation. It is intended to utilise these studies to locate deep tube wells and supply water for cultivation of subsidiary food crops. Two Artesian wells have been already drilled in Puttalam.

Sea water inter face observations are being conducted at Kankasanturai and Kondavil in the Jaffna Peninsular.

DEPARTMENT OF GOVERNMENT ELECTRICAL UNDERTAKINGS

Staff Training—Technical Training Centre, Castlereagh.

This centre which was opened in January 1965 with the aid of the Government of France is modelled to run on a modern system called "System Pedagogique" as adopted in the Technical Training Centre at Gurcy-le-chatel in France, where Electricite de France provides an accelerated technical training for their technical personnel—from Engineers downwards to skilled workmen of all categories.

The training they receive at this Centre is three-fold:—

(a) Technical training to develop to the maximum their aptitude for observation and application with the help of experiments and practical work.

(b) Physical training to develop their physical strength necessary for various motions in the trade, which will enable them to work with ease and safety.

(c) Training to develop a sense of responsibility and initiative and a liking for work as public service.

Polpitiya Hydro Project

The power scheme which is now under construction consist of a main storage at Mousakelle, a diversion dam downstream of the existing Laxapana Power House. and intake and water conveyance through a 13' diameter tunnel of capacity 1,250 cusecs and 23,650' long.

Water discharged from the existing Plant and the now Plant extension at Laxapana plus the river inflow of the 6.4 sq. miles drainage area of the Maskeliya Oya below the diversion dam at Theberton and any spillage at that point will be collected in a small regulating reservoir at the above mentioned dam site and conveyed to the Polpitiya tunnel. This Scheme will yield 313 million kwh. per annum.

THE INSTITUTION OF ENGINEERS, CEYLON

DIVISION OF WATER SUPPLY, DRAINAGE AND LOCAL GOVERNMENT WORKS

The Government made a request in March 1966 to the UNDP (SF) for assistance in making a Pre-Investment Survey of the South West Coastal Area Water Supply and Sewerage needs. The area identified was the Coastal strip from Negombo to Galle covering over 360 square miles in extent with a population of about 2,000,000.

The Consultants are now carrying out the Pre-Investment Survey Study with the assistance of the staff of the Department.

In this Survey, high priority has been awarded to five areas viz. Galle, Towns North of Colombo (Kelaniya to Kandana), Ambalangoda, Towns South of Colombo (Wadduwa to Bentota), Ja-Ela and a study of the most urgent Sewerage problems of the South West Coastal Areas. This survey is expected to be completed in 11 months.

The present position of some of the major construction works in the Island is as follows:

1. **Towns South of Colombo, Stage II (Kelani Ganga River Pumping Scheme)**

   This scheme has now been commissioned to provide 20 million gallons of water per day and the supply is given to five important towns in the suburbs of the City of Colombo viz. Dehiwela-Mt. Lavinia, Moratuwa, Panadura, Kotte and Kolonnawa. The estimated cost of the scheme is Rs. 21,800,000/-.

2. **Kandy Water Supply Scheme (Mahaweliganga Pumping Scheme)**

   This scheme estimated to cost Rs. 21,000,000/- has been completed and the town is now being provided with water. The treatment plant has at present an output of 5 million gallons of water per day and this will be adequate to meet the demand for the next 20 to 25 years at 50 gallons per head per day.

3. **Kegalle Water Supply Scheme**

This is a river pumping scheme estimated to cost Rs.8,000,000/- The scheme is being constructed in two stages. The first stage which comprises the Headworks including Treatment Station, the Pumping Main, a Reservoir and Supply to the new hospital, has been completed. The second stage which will provide pipe borne water to the entire town, will be taken up shortly.

4. **Kuliyapitiya Water Supply Scheme**

This is a river pumping scheme estimated to cost 4,650,000/- It is being constructed to supply 250,000 gls. of purified water per day with an ultimate capacity of 500,000 gls. per day to an expanded population of about 12,000 persons. This scheme is expected to be completed early in 1968.

5. **Kadugannawa Water Supply Scheme**

This is a river pumping scheme estimated to cost Rs. 2,386, 500/-. It is now being constructed to supply 250,000 gls. of purified water per day with an ultimate capacity of 375,000 gls. per day. This scheme is expected to be completed by the end of this year.

6. **Kelaniya Preservation of the Sacred Area Water Supply Scheme**

This is a pumping scheme which is now being constructed to provide pipe borne water to the temple and the Sacred area. It is expected to complete the scheme by end of the year. The estimated cost of the scheme is Rs. 262,800/-.

7. **Maskeliya New Town Water Supply Scheme**

This is a pumping scheme with bore hole wells as the source. The construction has just started. The work is expected to be completed in about 12 months. On completion it would supply 100,000 gls. of purified water per day for the new town with an extended capacity of 120,000 gls. during the Pilgrim Season. The Estimated cost of the Scheme is 1,050,000/-.

A number of rural water supply schemes and other Local Government works including large bridges are also being carried out by the Division.

COLOMBO PORT COMMISSION

3rd Graving Dock for Colombo

The Graving Dock which was started by the Admiralty during the last war to be used for submarines was abandoned by them after the cessation of hostilities. In accordance with an agreement reached between the U.K. Government and the Government of Ceylon, the half completed dock was handed over to the Port Commission. The Port Commission undertook repairs and completion of the dock at a cost of Rs. 5.5 million, this was completed and is now in use. The dimensions of the dock are 400 ft. by 54 ft. and the sill level is 18 ft. 6" below low water. This dock will be mainly used for docking the craft belonging to the department and government agencies, thereby relieving the main dock and the inner graving dock to be used by ocean liners, thus helping to earn valuable Foreign Exchange for this country.

The 2nd Pump House and Pump at St. Sebastian Gate

With the completion of the new 100 ton locks and the increasing traffic through the locks, it became necessary to instal an additional pump to maintain the level of the lake. A 420 h.p. pump with a 24" discharge was installed and completed this year. This pump has a discharge capacity of 22,000 gls. per minute.

The total cost of the installation is Rs. 430,000/-.

Out-Ports

In Galle a 1400 ft. quay wall was put into use for the first time for the import of Gypsum and the export of Rubber. The transit sheds on this quay presently under construction, have 100 ft. x 100 ft. pre-stressed concrete shells as roofs. The entire roof weighing 300 tons was cast on the ground and lifted to place.

Work on the main Breakwater at Galle has now started and some of the equipment for this work has already arrived and some are expected shortly.

A 250 cu. yd. per hour capacity cutter suction dredger was purchased for Rs. 650,000/-. The manufacture of the pontoon was undertaken by the department. This dredger will be used for dredging and reclaiming land in the Galle Harbour.

THE INSTITUTION OF ENGINEERS, CEYLON

STATE ENGINEERING CORPORATION OF CEYLON

Northern Approaches to New Kelaniya Bridge

Stage I of this project is the construction of the highway from the New Kelaniya bridge across the marshes linking up with Negombo Road and Kandy Road. Length of the roadway to be constructed is approximately 2 miles. The filling operation is to be carried out by dredging the Kelani river with the help of a 12" Cutter Suction Dredger with a capacity of 225/250 cu. yds. of material per hour. The dredger will discharge approx. 34,000 cu. ft. of sand and water per hour.

Approximate cost of the work undertaken by the Corporation is Rs. 2.5 million.

Puttalam Cement Factory

This contract was awarded to our Corporation after world wide tenders were called by the Cement Corporation. The main buildings to be constructed are the Cement Mills, Raw Material & Clinker Storage, Raw Mill & Heat Exchanger, Kiln building & Burner Platform. Lime Stone crushing and Handling Scheme, and Workshop & Stores.

Estimated value of the project is approximately Rs. 20 million.

Steel Factory—Oruwela

This project was executed in such a manner whereby the Corporation undertook the construction based on Soviet designs, employing direct labour, the Soviet Specialists providing technical supervision and the Steel Corporation acting as the client in respect of payments for work done on invoices submitted. The major buildings constructed were:

Rolling Mill, Central Stores, Cold Wire Dept., Compressor Plant, Fuel Oil Tanks, Canteen Building, Laboratory, Scale Pit and Settling Tank, Cooling Towers, Water Tower and Flats. The project was completed in April 1967.

Hardware Factory—Yakkala

Although this project was under Polish aid, all structural designs were prepared by this Corporation, including the designs for the services. Payments for this contract was made on a lump-sum basis. The main buildings constructed were the three Production Buildings, the Administration Block, Hostel and the Water Tower. The project was completed by April 1967, and the final value of work done was Rs. 3.8 million.

Cast Iron Foundry—Enderamulla

This Project has been undertaken with aid from the Federal Republic of Germany. Work commenced in May 1967. The estimated value of this project is Rs. 4,334,523.27 and is due to be completed by June 1969.

Textile Mill, Thulhiriya

This project, the biggest so far undertaken by the Corporation is estimated to cost over Rs. 50 million. Work commenced in January 1967, with the levelling of the site. The buildings to be constructed are the Main Production Buildings, Finishing Plant, Workshop, Store and Garages, Refrigeration and Main Transformer Steam Generating Plant, Fan Cooler, Social Welfare building, Canteen, Administration Building, Water Works, Water Tank and a Housing Scheme consisting of 350 houses. These buildings cover an area of 1,346,330 sq. ft. The entire project is scheduled to be completed by January 1970.

THE INSTITUTION OF ENGINEERS, CEYLON
RIVER VALLEYS DEVELOPMENT BOARD

(1) HEAD WORKS :

(A) Construction of Hydro-Power Plant on the Right Bank with an Installed Capacity of 1,800 KW, at an estimated cost of Rs. 2,700,000/-.

(B) Construction of a River Sluice and the River Closure, at an estimated cost of Rs. 8,200,000/-.

(2) STRUCTURES ON THE R.B. MAIN CANAL :

(A) Construction of a Siphon Under-Crossing across Timbolketiya Ganga to convey the R.B. Main Canal from the Uda Walawe Reservoir, with a conveyance capacity of 650 cusec.

Diameter of Siphon: 10'
Length of Siphon: 1,100'
Estimated cost: Rs. 1,000,000/-.

(B) Aqueduct-cum-Bridge to convey the 650-cusec R.B. Main Canal across Maha Ara.
Estimated cost Rs. 300,000/-.

(3) MAIN CANALS :

Construction of 20 miles of Main Canals, of which 16 miles are on the R.B. and 4 miles are on the L.B., at an Estimated Cost of Rs. 8,500,000/-.

THE INSTITUTION OF ENGINEERS, CEYLON

CEYLON TYRE CORPORATION

The Ceylon Tyre Corporation's "Kelani Tyre Factory" started production in April this year. The capital investment for stage I of this project is Rs. 67.5 millions, made up as follows:

Land, Site development & construction work	25.5
Plant, Machinery & Equipment	30.3
Preliminary Expenses	11.7
Total capital expenditure	67.5

The equipment for factory together with technical assistance for setting up the plant was provided by the Soviet Union.

The factory buildings were constructed by the State Engineering Corporation whilst the installation of plant and equipment was executed by the Tyre Corporation. The Water Supply Scheme for the factory costing 3½ million rupees was designed and carried out by the Department of Water Supply & Drainage.

The plant out put for the first phase is 250,000 tyres and an allied number of tubes on an assortment of the most popular sizes which represents an annual turn over of Rs. 100,000,000/- on the basis of the present wholesale market prices. The Tyre Corporation expects to produce 50,000 tyres and 80,000 tubes this year.

DEPARTMENT OF NATIONAL HOUSING

Prefabrication flats

The Construction of Prefabrication flats has been undertaken for the first time in Ceylon and this is being carried out by the State Engineering Corporation.

In all 800 flats in 20 No. four storied blocks are being constructed at Anderson Golf lnks, Narahenpita,

CEYLON PLYWOOD CORPORATION

The year under review marked a turning point in the progress of the Corporation with a substantial increase in production.

A record production of 19.649 million sq. ft. of plywood was achieved. This is approximately 25% of the Island's requirements of tea chests, and it resulted in conserving nearly rupees 6 million in foreign exchange.

We hope to achieve self-sufficiency in tea chests in 1970 and simultaneously meeting the progressive demands on plywood for all other allied work such as radio cabinet manufacture, sewing machine industry, furniture, clock industry and also meeting the demands of some of the Corporations and Boards such as the C.T.B. for bus body building, R.V.D.B. etc.

THE INSTITUTION OF ENGINEERS, CEYLON

CEYLON PETROLEUM CORPORATION

1. Lubricating Oil Blending Plant

A contract for the construction of a Lubricating Oil Blending Plant was signed between the Ceylon Petroleum Corporation and Messrs International Co-operative Petroleum Association of New York in May this year. The construction time of the Plant, according to the Contract, is fifteen months from the date of signing of the Contract. This Plant is designed to process 20,000 tons of oil annually which is 95% of the lubricating oil requirements of Ceylon. The remaining 5% constitutes specialty items which will continue to be imported. The capital investment on this project is Rs. 3.8 millions, and it is expected to be recovered in approximately two years of operation. The Plant and equipment consists mainly of storage tanks, blending kettles equipped with agitators, dehydrators and pumps.

(2) Petroleum Refinery

The Corporation has entered into a Contract with Messrs. SNAM PROGETTI of Italy for the construction of a Petroleum Oil Refinery for processing Crude Oil into its component products of capacity 38,000 BPSD. This Refinery is more or less a self-contained Unit having its own electricity and steam generation facilities including water supply. The Refinery, which is mainly market-oriented, will be able to produce the following Petroleum Products:

1.	Chemical Naphtha	137,000 tons/yr.
2.	Gasoline 80 RON	49,500 tons/yr.
3.	Gasoline 90 RON	115,500 tons/yr.
4.	Kerosene	250,000 tons/yr.
5.	Aviation Turbine fuel	50,000 tons/yr.
6.	Automotive gas oil	220,000 tons/yr.
7.	Industrial diesel oil	140,000 tons/yr.
8.	Industrial Furnace Oil	400,000 tons/yr.
9.	Bitumen	50,000 tons/yr.
10.	Bunker "C"	180,000 tons/yr.

The estimated capital cost of the Project is Rs. 150 million and the Project is scheduled for completion in early 1969.

(3) Seismic Survey

This Corporation has entered into a Contract with Messrs. COMPAGNIE GENERALE DE GEOPHYSIQUE of France to carry out a comprehensive Seismic Survey, comprising of both reflection and refraction shooting, covering the Northern and North

Western area in Ceylon, including the sea bed immediately adjoining, with the object of deermining whether geophysical conditions exist in the area which favour oil accumulation in commercial quantities.

The estimated cost of the Survey is around Rs. 1.6 million and the Survey is scheduled for completion early next year. It will not be possible to definitely say at this juncture whether oil deposits exist in commercial quantities until the Survey has been completed and the geophysical results are interpreted by a team of experts.

CEYLON CEMENT CORPORATION

The construction of the Terminal Grinding & Packing Plant at Galle was completed and production of cement was inaugurated by the Prime Minister on 1st June 1967. This Plant is designed to produce a maximum of 100,000 tons of cement per annum and was constructed together with the Plant auxiliaries and other related items at a cost of approximately Rupees 19.6 millions.

The Second Kiln at the Kankesanturai factory constructed together with the auxiliary items at a cost of Rupees 64 millions was put into operation and the work on the improvements to the first Kiln was commenced. The improvements are expected to be completed by the end of 1968 which will increase the capacity of production of clinker at the factory to 275,000 tons per annum.

The construction of Stage I of the Puttalam Cement Factory designed to produce a maximum of 200,000 tons of cement was handed over to the State Engineering Corporation and a fair amount of progress has been made during the past several months. This work costing Rupees 79.1 millions is expected to be completed towards the end of 1969.

CEYLON STATE HARDWARE CORPORATION

The Factory was officially commissioned for production on 29th March 1967. The factory buildings were constructed in the previous 12 months by the State Engineering Corporation. The total capital invested is Rs. 18,000,000/-. The cost of general purpose machines like Lathes, Drilling Machines, Milling Machines, Presses etc., and other equipment which were imported from Poland is about Rs. 4 million.

The Factory consists of the following production shops:—

1. Brass Foundry
2. Heat Treatment Department
3. Machining and Assembly Department
4. Cold Forming Department
5. Forging Shop
6. Electroplating Department
7. Painting Department

The following Russian machinery imported at a cost of Rs. 800, 000/- (approx) was installed for producing mammoties:—

1 No. 250 ton Punch Shear
1 No. 160 ton Forging Roll
2 Nos. 250 ton Trimming Presses and
1 No. 1,600 ton Mechanical Forging Press

The full capacity of this production line which is 400,000 mammoties for a year, is now working at half capacity.

NATIONAL SALT CORPORATION

The National Salt Corporation proposes to construct a fully mechanised salt works at Chavakachcheri at a cost of about 20 million rupees with an output of 115,000 tons per annum.

A preliminary investigation and design taken by Societe Industrielle Et Commerciale Des Salins Du Midi of France at a cost of 1.2 million rupees is in progress.

THE INSTITUTION OF ENGINEERS, CEYLON

Address

by The Hon. MONTAGUE JAYAWICKREMA
Minister of Public Works, Posts & Telecommmnications.

Mr. President and Gentlemen,

This Institution has about 600 members—both from the Government as well as the Private Sector—and they will be interested to know what the Ministry of Public Works, Posts & Telecommunications has done and what it has been doing during the last few years. The Public Works Department is at the moment constructing the super highway to the Katunayake Airport. Only a fortnight ago the Hon. Prime Minister laid the foundation stone for this very important project. This project is going to cost the country between 50 and 60 million rupees. The project was undertaken in collaboration with Mr. Kulasinghe, Chairman of the State Engineering Corporation and the Director of Public Works and his officials. This highway will have provision for six lanes of traffic and 5 major bridges are to be constructed.

It has now been decided to expedite this work. The State Engineering Corporation dredgers are now drawing the necessary filling material from the Kelani river and forming a bed for the super-highway. It is hoped to complete the construction of this super-highway within two years from now.

The first stage is up to Wattala. Apart from this major project, there is another important road construction work namely the Ella-Wellaways road. This road will be 16 miles, but about 9½ miles is yet unexplored. The gradients for the proposed road have been found suitable. It is proposed to take an aerial survey of this road for investigations and design. Work on the road is expected to be completed by the P.W.D. by the middle of 1969.

We are about to reclaim the sea in a certain area by constructing a sea wall and filling the gap with rubble. This project will be over in six months from now.

The other big projects are the bye-passes at Weligama and Dondra. These have been itemised in the budget and is now before the Cabinet. The main difficulties we are faced with are the lack of modern equipment. People are surprised to hear that we are carry-

ing on with such meagre and old equipment. This Government has placed orders for modern equipment and during the last year we obtained eleven million rupees worth of equipment. This year we have got six and a half millions for further equipment but the target will not be reached until we have spent approximately another 6½ million rupees for engineering equipment alone. Unless our engineers are given modern equipment the work will definitely be slow and it will not be of a very high standard.

Some eminent engineers from abroad have also arrived in Ceylon and are engaged in highway research. It has been decided to conduct this research in the Southern Province as it has all the varieties for such a project. This project is being sponsored by the Wilbur-Smith Group and will cost in the region of five to six million dollars. It is hoped to start the work within the next six months.

Finally, I would like to mention that we have called for tenders for the expansion of the Telecommunication system. The Central Exchange has a backlog of 16,000 applications waiting for telephones. Tenders for the Outer Colombo scheme came from Japan, France and Britain. There was very keen competition and the Central Telecommunications Board is now going into this matter. We hope to complete the installation by June next year. Thanks to the high technical skill and initiative shown by you, we are making headway and I can assure you that this Government is making every effort to do as much as it can with the limited resources at its disposal.

These are the main items in the programme of the Ministry of Telecommunications. I am indeed happy to be here this morning and I am also grateful to Mr. Arumugam, the President, for the kind words expressed by him. I know that the engineers of this country can produce what the people of this country need, provided they are given the necessary money and equipment and our country depends on our technical men. Thank you.

THE INSTITUTION OF ENGINEERS, CEYLON

Address

by The Hon. U. B. WANNINAYAKE
Minister of Finance.

President, Honourable Minister and Gentlemen.

I must at the outset say that I did not come here to make a speech to you. I really came to listen to some of the speeches which I was told were to be made here this morning.

I was given to understand that the Hon. Prime Minister, would be here to address you this morning, but I met him this morning and he said he would not be able to come here today but that he would address this Conference on a subsequent day.

The President requested me to speak a few words and express my appreciation of your work. Well, I thank you first of all, for inviting me to this Conference. I congratulate you on carrying on the activities of your Institution without interruption for a long period of 60 years, and very few Institutions can say that in Ceylon. You have carried on for 60 years and I think your Institution deserves to be congratulated for that.

I need hardly refer to the advantages of an Institution like this. It includes the achievements of the engineers and their usefulness to the country. The papers and discussions I am sure, will widen your knowledge and add to your efficiency and interest in the work you are engaged in.

The Hon. Minister of Public Works, Posts and Telecommunications gave an outline of the important schedule of work he has in view for his Departments. I am sure a good number of you are concerned with it and will give your fullest co-operation to him.

The Government is very appreciative of the services of the Engineers and in the present context, particularly, the services of the Engineers are becoming more and more useful. The development activity the Government has undertaken cannot be a success without the fullest co-operation of the technical men, the Engineers. The Government is prepared to make available to you all the facilities that are available. As the Finance Minister, I am not in a position

at present to make available to you all the resources you ask for, like personnel, equipment etc. I shall make available to you whatever possible within the resources available to the Government. I am appealing to you to make the most of the resources available to you. I once again thank you for inviting me to this Conference and wish the activities of this Conference all success.

THE INSTITUTION OF ENGINEERS, CEYLON

Vote of Thanks

Mr. L. C. WILLIAMS,
Vice-President.

The Hon. C. P. de Silva, Mr. President, Your Excellencies, and Gentlemen.

Due to the unavoidable absence of Professor R. H. Paul, I propose to move the Vote of Thanks on this occasion.

I think it would be presumptuous on my part if I introduce to you the Hon. Minister, who is one of our most experienced and able Statesmen in Ceylon and who has been associated with two of the largest engineering departments for several years. So one could say that he is as much an engineer as any of us. He mentioned about serving in the Civil Service before becoming a Statesman. This brings to my mind a story I heard of a young candidate who went up for the viva voce in a Civil Service examination. He was asked a question on how he would remove a boulder or rock in the bed of a stream. The young man thought awhile but could not find an answer, so, he merely said, damn the river and blast the rock, and I am sure that if such a question is asked of the Hon. C. P. de Silva he would not hesitate to give a reply befitting an engineer.

We heard a lot in the Presidential Address and also in the speech of the Hon. Minister of major achievements in the past in the field of Irrigation. We even heard of the considerable achievements of Parakrama Bahu. In the course of his address, the President referred to the Mahaveli project. It would appear that no one in Ceylon in the past has ever attempted to harness the great potential of that river, but I am glad that due to the keen interest and initiative and the drive of the Hon. Minister, it is proposed to harness the Mahaveli Ganga and I am sure when history is written, he would be the Parakrama Bahu of our era.

Now ladies and gentlemen, I would like to conclude by extending our thanks to the Hon. Minister and ask you to join me in expressing our gratitude and thanks in the usual manner.

THE INSTITUTION OF ENGINEERS, CEYLON

Welcome to the Hon. Dudley Senanayake M. P.

Prime Minister of Ceylon

by the President

Mr. S. ARUMUGAM

Your Excellencies, Distinguished Visitors and fellow members:

On behalf of the Institution of Engineers, Ceylon, it is my special privilege to extend a cordial welcome to the Prime Minister of our land who has been graciously pleased to address us this morning.

As members of the engineering profession, we have a large part to contribute in the development of the country, in particular in the food production efforts of the Government of Ceylon. I assure you, Sir that every single member of this Institution, be he the most junior student or the most senior veteran, is prepared to contribute his maximum effort in such activity. In our desire to translate this preparedness into effective action in a tangible way, my Council which consists of senior and mature engineers of the Island placed their services at your disposal in a memorandum sent to you in May this year which reads as follows: "The Institution of Engineers of Ceylon, has been watching with interest your keenness in the implementation of the proposals for the development of the country. Individual members of your Cabinet had at our last Annual Sessions pointed out to us the need for engineers and scientists to play a more important role in the formulation of policies and plans for the development of the Country. Our Institution which is a national professional organisation, includes among its members, experienced engineers who are prepared to offer their services to the Government. The Institution can impartially evaluate major development schemes and be of assistance to your Government. Before it decides on a development programme in the future, the members of the Institution feel that there is an urgent necessity for the Government to obtain impartial advice before it makes decisions on major development policies. The Institution as a body is willing to co-operate and provide the expert knowledge that would be required for the study of the projects."

We are, Sir, highly pleased with your reply of 12th June thanking us for the offer of assistance to the Government in its development programme and that you would keep that offer in mind. We await your call.

I have now great pleasure in calling upon the Honourable Dudley Senanayake, the Prime Minister of Ceylon, to address the 61st Annual Conference of the Institution of Engineers, Ceylon.

THE INSTITUTION OF ENGINEERS, CEYLON

Address

BY THE HONOURABLE DUDLEY SENANAYAKE M.P.
Prime Minister of Ceylon

Mr. Chairman, Your Excellencies, the one single lady and Gentlemen.

At the outset I owe you an apology. I was to address you the day before yesterday, but sudden unexpected circumstances prevented me from doing so. You are aware of the tremendous damage that has been caused in the Chilaw district and it was essential for me to go to that region and see for myself how the work of rehabilitation and assistance was going on and I had to spend the whole day there and it was these circumstances which prevented me from fulfilling my obligation the day before yesterday.

I thank you for postponing this address, and giving me the opportunity now. I am glad that I have got the opportunity today and not the day before yesterday for the simple reason that I would have had to speak to you somewhere else the day before yesterday. I am told that this is your headquarters for the Annual Sessions and the Irrigation Department headquarters too. I must confess that although I have been in contact at various times with Engineers of the Irrigation Department, this is the first time I have had the opportunity of coming here and I am glad to have been able to avail myself of that opportunity.

I referred to the tremendous damage that was caused in the Chilaw District and I must tell the Engineers that they should take immediate action as is called for, to resuscitate the area once again.

Now, coming to the matters on which I wish to generally speak to you, I am aware of the fact that Engineers belong to that larger category known as Scientists also. They are men of science as opposed to men following the arts and, I myself, find a commoner ground with men of science than the other category, my education also having been on those lines. Therefore, it gives me a special pleasure to speak to you gentlemen.

Before I leave the Scientists, I wish to inform you that the much awaited Scientific Research Council legislation has been just approved by the Cabinet and is to be placed before the Parliament, and then we can have the benefit of the qualified Scientists in the development of this country.

Now, let us for a while look at the vast changes that have taken place around us. I think, if we stop to consider the early period of the long history of mankind and consider the various civilisations that thrived during this long period, I think it would be proper to say that in none of those earlier periods were there such vast changes in so short a period as has happened during the modern period.

Consider the changes started during the advent of this century and how the world in general, as a result of these changes, has vastly changed. I think we can attribute that tremendous change in so short a period to the efforts and contributions made by science and scientific men throughout the world. That is an acknowledged fact. These changes have been tremendous with the advent of this century. If we only take the mode of transport we were accustomed to have and when we think that before the close of this century, Man may have transported himself to other planets as well. I do not know with what consequences—but that tremendous achievement and the potentialities have been developed fully well. During this period, when these vast changes were taking place, we and countries of this region, were unfortunate. We lapsed in servile slumber owing to the fact that we were a subject race and it was not until the turn of the mid century that we got an opportunity of addressing ourselves to the task very seriously of the development of our own country and taking part in the tremendous changes that have been taking place in the world around us.

Countries more fortunate particularly in the Western region, had almost more than 50 years start on us. Well, that was unfortunate but perhaps there are certain other factors which probably would have been useful, because of those circumstances, the paths followed by others, sometimes the mistakes made by others were there available to us in the formulation of our policies and the objectives which we should pursue.

Now, in this new Ceylon, in the context of resurgent Asia, we have tremendous problems to grapple with. Those problems can only be successfully tackled to my mind to a great extent by the contribution that you Engineers could make towards the solution of these.

In this context, I appreciate and welcome the assistance proferred to the Government by your Institution and I thank them very much for that offer they have extended to us.

Now, what is it we have to do? Revolutionary changes have occurred. It is not a time to stand idle or work at a slow pace.

We have adopted the democratic form of life, for very many good reasons. Sometimes those forces may make execution rather delayed but we must not and we will not forsake them because of that different ideal way of life that we have adopted for ourselves. But as a result it may be that totalitarian regimes have an advantage over countries such as ours but, let me assure you, that I am convinced that the achievements of the democratic regimes, although they may be achieved at a slower tempo, are more lasting and are based on secure foundations and that is why in facing the tasks ahead, we have to realise that these forces will have to be speeded up as much as possible. Freedom means nothing if it is not accompanied by a higher standard of living for the common man. After all we have now been free to manage our affairs for the last 19 years. Could we be satisfied with the performances on the economic front in those 19 years? I am afraid we have no cause for satisfaction. Therefore, in the immediate present and future, a great acceleration of the economic development of this country is needed and the Engineers of this country will have to play a foremost part in that attempt.

Now, what happened to this country in the many years of our unfortunate subject era. Then too a tremendous change in the economy took place. According to the needs of the time when we were a free country, we had a satisfactory economy. We were self-supporting to a great extent as regards our needs, and it has been a boast that there was a time when we were able to supply larger countries than ours in the region with food, and then scarcity and nonavailability was not a problem. Food and clothing and many of the needs of those years were available, but, of course, this economy which was based on a self-sufficiency in agriculture, was completely changed. There was a total deterioration in agricultural activities and the emphasis was on a shift from agriculture to the growing of money crops for international markets. Naturally, all the forces of the then government, all the activities of the then Engineers and agriculturalists were harnessed towards that objective. The cultivator was affected; he was fighting against tremendous odds. Those marvellous irrigation schemes were left to go from bad to worse and the accent was placed on the development of money crops. At the outset or the initial stages of this scheme there might have been certain advantages which have disappeared or are fast vanishing now.

Consider the plight of one industry alone. I wonder whether you are aware of this fact, that when these rubber plantations were started, a pound of rubber in the international market fetched Rs. 10/-. or more, and I wonder whether you are aware of the fact that a measure of rice sent from Burma was obtained for about ten cents. Look at the terms of trade then and the terms of trade today. Briefly,

one pound or rubber could then obtain 100 measures of rice. Today, one pound of rubber cannot obtain one measure of rice. So, taking the rubber industry alone, the terms of trade have turned adversely to over a hundred times against us.

Then consider the tea industry. Probably, the plight there is even worse and it is an unfortunate fact that the future as regards these two matters are practically bleak. It is a well known fact in the world, today, the prices of the primary commodities in the international markets are coming down. The trend is there to be seen and the price of the manufactured product in the international market is going up. That is the general trend.

The unfortunate consequences of that trend are that the poor countries are getting poorer while the rich countries are getting richer. That is a stark fact acknowledged even by richer countries. All of us are aware of the fact that international efforts are being made by organisations such as UNCTAD to see what measures,—concerted measures by the developing and developed countries,—are necessary to remedy this unfortunate state of affairs.

The developed countries, must realise that the very developments which have taken place during the course of this century are due to the scientists and engineers who have made and are attempting to make the world one.

Time was when we had the delusion of national sovereignty, and the promise of isolation. Now, any single event in any part of the world, mainly due to the development of communications and other factors have their direct impact right throughout the world. We are only experiencing that today.

We know how our rice supplies have been jeapordised by the Vietnam war. We are aware of the trouble caused to the world by the closure of the Suez Canal, so that even bigger countries cannot rest in satisfaction that all is well with them, and therefore what happens to the rest does not matter. I am glad to say that that is not the spirit, for a good number of advanced countries are addressing themselves to this task. I am glad to see a representative of the Canadian government here. Canada has always had a broader view of these matters and we are beholden to that country for the views they have taken.

Now, how long can we go on like this? With our money crops gradually coming down, there may be temporary ups and downs but they are coming down, and the prices of essential foods that we have to get to stave off hunger and death are increasing. Our staple food is rice, but what is happening in the world market is that rice prices are going up. In the last few years, every year has seen an increase in the price of rice. Well, various factors contribute to a crisis. There are, of course, other factors, such as war I referred to and heavy purchases. Natural disasters such as typhoons and droughts cause price increases. Another factor, which is not of a temporary nature, is the explosive increase of the population of the rice eating countries of the world. That is also a significant factor. I do not know whether it is due to the fact attributed to rice, that the rapid expansion of population takes place. You may find some support for that theory in the fact that I do not eat rice. But, however, that is a significant fact. What is happening is that the exportable surpluses of the countries that exported rice to the rice-eating countries are decreasing. Every year we have seen a decrease in the export of rice from Burma. Other countries too are having that difficulty. Vietnam, which was a big exporter, is a very great importer today, and countries like Indonesia, owing to the instability in the past, from being self-sufficient have become importers of rice and the trend is the rapid increase of prices. What therefore is necessary in those circumstances? The only thing the country can do is to arrest this alarming deterioration in trade. We have to face periodically crisis after crisis. The first thing, we should do is to make ourselves self-sufficient in our basic needs.

We talk of industrialisation. We are aware of the fact that high standards of living have been achieved by certain countries through rapid process of industrialisation. We know that there is no industrialisation here, not of capital goods. We know that we have to obtain our raw material from abroad, and we have to use our foreign exchange, and a great deal of it, and rapidly too, and now, although we are importing only a limited quantity of food, the shouts of scarcity is ample testimony to that limited quantity. That limited quantity of food is actually costing us in foreign exchange—about 800 million rupees.

800 million without the other necessities such as cloth and other things. Food alone costs us as much as 800 million rupees in exchange. Now, that 800 millions will also increase with the increase in population—although I am not personally responsible for it—As I said earlier, the amount of food which could be brought with 800 millions is gradually diminishing with the soaring prices that I referred to. So, before rapid industrialisation we should be self-supporting in those bare necessities, such as food.

Moreover, industrialisation needs an industrial population to buy the products of industry. The large majority of our people composed of 60 to 70 percent follow the pursuit of agriculture, directly or indirectly. If the farmer is poor, you may have to pile up your industrial goods in your godowns without a sale.

To industrialise this country, the farmer must be made prosperous—firstly, to produce the food to save the exchange, to bring the goods necessary for industrialisation, and secondly to create the purchasing power in the country to purchase the industrial goods; so that the two must go hand in hand.

I am aware of the part played by the Engineers of Ceylon in this effort of making the country self-sufficient in food. I come in contat with them for as you are aware, I am spending a good part of my time going to various parts of the country, seeing their work, and seeing to what extent the cultivator is benefited by their services.

It is unfortunate that I have seen on these tours many good things and may be one bad thing, the papers only carry the bad things. But let me assure you, but for a few instances here and there, I am confident and aware of the tremendous efforts that the Engineers are making for the development of the country and for making it self-sufficient.

There are certain matters we should not ignore in the pursuit of our objectives, I have referred to the scarcity of exchange and financial resources. In those circumstances, it is a paramount necessity to use the resources available to us, to the utmost and that is where Engineers and Scientists can play a prominent part.

If exchange is scarce, let us find the material here for most of our activities, by research, and experiments. Buildings are necessary on a vast scale, much of the materials that are imported can be replaced by local materials. It is in your hands to make quick and rapid investigations and bring the satisfactory results of investigations into practice.

We have undertaken schemes of development of fairly large proportions compared to schemes anywhere else. Some contemplated projects like the Mahaweli Ganga Diversion Scheme are very large. Here again, I would like to say—I am not referring to that particular project that generally, comprehensive investigation of a scheme is necessary before the actual launching on it.

If this is done, it will save us millions and millions of rupees in the future. The full potentialities should be entirely investigated, and the various possible alternatives, considered before the most suitable and most beneficial project is chosen.

Of course, this lack of thorough investigations and study in the beginning may be the result of a demand for quick action. Sometimes I find that this demand for quick action results in a certain lack of proper investigation, creating for us, tremendous problems as the work proceeds. Moreover, we have to face another factor. Now it has become a habit after a scheme is inaugurated to revise the original estimate more than four to five times—i.e. the estimate is four to five times the original estimate when the work is finished. I am aware of the factors contributing to this. I am aware of the fact that there are changes in the prices of materials. I am also aware of the fact that most of this has happened through improper investigation of the full financial implications of the scheme. Investigations are sometimes haphazardly carried out. The schemes are not thoroughly investigated and for the purpose of getting a scheme accepted, some rough figures are worked out, resulting in the revision of estimates at a later stage. I think you will realise that it will be very necessary to pay some attention to this aspect. I do not want to delay you very much longer, but I would like to emphasise the fact that the biggest burden for the development of this country rests finally on gentlemen such as the members of your institution. You should remember that all these efforts of yours are not for your benefit, or my benefit, it is for the benefit of the cultivator who is waiting at the end of the canal for the water. That is the man you and I have to serve. Therefore, it is useless making all your calculations of so many thousand cusecs if nothing happens at the other end. I have gone and sometimes seen nothing happening. I have been told about the cusecs that have been let out but I do not know where these cusecs have gone.

So, in the implementation of the tasks ahead, let all of us not forget the man we have to serve, the man to whom cusecs means nothing, until water gets into his field. You have a glorious heritage in Irrigation Engineering. Your forefathers in this country, over the last one thousand, two thousand years have been second to none in the world. That heritage is yours and with this inspiration and knowledge I am convinced that you will deliver the goods.

Thank you.

INSTITUTION OF ENGINEERS, CEYLON

Vote of thanks to the Hon. Prime Minister

By MR. A. N. S. KULASINGHE
Vice President

Mr. President, Your Excellencies and members,

It is indeed a great pleasure and a fortune that I have had the opportunity of proposing a Vote of Thanks to the leader of Ceylon.

I say this not as a flattery but we are all convinced that in you, Sir, we have the necessary leadership to achieve great heights in Ceylon, if only we have not been hampered by our short-comings.

We are, Sir, aware of the tremendous tasks that you had undertaken from the time you took charge as Honourable Minister for Agriculture and Lands. During the past years, a tremendous achievement has been made in those branches of development which had been started by you. The good work is being carried out, specially by our irrigation engineers and in spite of this fact that certain conditions, most of them beyond our control, have prevailed, water reaches the cultivator in spite of some of the cusecs being lost. Achievements have been made that we all can be proud of. We are grateful to you Sir, for having given us an opportunity of taking part in the development of our country without being told what to do and how to do by foreign experts. It was our experience, a long time ago, that we had no freedom of thought at all in getting on with our work in the development of the country, but with the advent of the age of Freedom and by the advice and guidance from people like you, we have been able to make contributions to progress. We are still, Sir, prevented from making our full contribution to progress by preventing us from having an opportunity to have access to those leaders, including you, who make decisions on policy. We have been, on a number of occasions surprised by the fact that opinions and advice given by very competent people in our profession have not even reached you. We are not making a complaint against any body, but for the greater good of Ceylon and for your own good and for the good of all of us, we would request you, Sir, who is the only person who can do this, that the advice that is available from the technologists including the engineers and other scientists to be able to reach you.

We must thank you, Sir, for having spent so much of your time today, giving to us a very interesting and constructive address which has been very inspiring to all.

We are not at all unhappy that you were unable to make it for the first day. We are all aware of the circumstances that led to that inability. We have been ourselves taking part in the flood relief work and therefore, we appreciate your concern in the matter and the necessity for you to be present there in person.

We are, however, happy that you have been able to find the time for us, in the midst of all your busy work, specially at a time when a very great demand is being made on your time.

On behalf of all the Engineers of our profession, we thank you Sir, for gracing this occasion and giving us this talk.

THE INSTITUTION OF ENGINEERS, CEYLON

Address by the
Guest Speaker

Dr. KOICHI AKI, Former Director, Water Resources Development Division, ECAFE, Bangkok.

on

Some Considerations on Development and Conservation of Water Resources.

President's Introduction

Gentlemen, now I would like to call upon Dr. Koichi Aki to deliver his address on the Development and Utilization of Water Resources. Before I ask him to take the mike I would like to give a short biographical sketch of Dr. Aki.

Dr. Koichi Aki was born in 1902. He was the Director of the Japanese Overseas Ministry of Home Affairs in 1946. He was a member of the Economic Stability Board National Research Committee and the Zone Councillor of Science and Technology in 1946. He was also in charge of the water resources division of the ECAFE for four years and now he has gone home to Japan where he is Professor of Civil Engineering of Kanto University. I now call upon Dr. Aki to deliver his address.

Dr. Koichi Aki's Address

"Water is an indispensable element for living." This sentence is now becoming very popular, everywhere in the world, at this stage of our development. Frankly speaking, this may be clarified by the long successive human effort made for obtaining water and for the prevention of damage due to flooding. The history of the Yellow River shows us details of these matters. Even in Japan, as far as technical matters are concerned, human efforts made to prevent flooding by rivers and to improve drainage etc. were the first to be described in our history.

Probably you know that in 1960, the General Assembly of United Nations adopted the project called "United Nations Development Decade Programme", that is, that the 10 years of the 1960s should be the years when the disparity of living standards between developed and developing countries should be taken away. To promote this Decade Programme, UNESCO proposed the setting up of the

International Hydrological Decade Programme which was later adopted by the U. N. General Assembly and came into operation in 1965. Probably you may also be aware that the following was set up as the major objectives of the IHD programme:

"The rapid advance made in industry and agriculture, accelerating growth of human populations and the desire to secure higher standards of living, have resulted in increased use of water by man, both in agriculture, industry, municipal and domestic purposes, to the extent that the availability of water as well as the control of excessive water, have become a critical factor in the development of many regions of the world".

Of course the nature of the problems that we had to tackle, during the last several thousand years, were somewhat different in different regions. We can understand that this mainly depended on the different nature of the hydrological condition of the region.

For instance, as you are aware in some part of the world we have lots of rainfall, even more than 10 metres in a year, we also have desert areas where the annual rainfall is limited to only 10 millimeters. Even though we have nearly the same amount of annual rainfall in all regions, in some regions the rainy season is limited to half the year where the rainy season and the dry season are clearly divided in two seasons, and in some regions the rain falls throughout the year. And we also have some examples in Japan, where nearly half of the annual rainfall comes in the form of snow and about thirty to forty percent of the annual rainfall falls in ten or fifteen days accompanied by tropical cyclones.

We have some experience in the hydrological condition in monsoon zones. In this area we notice that the variation of annual run-off or peak discharge of the river covers is so wide due to the size of the river basin and its topographical status. Always it gives us some difficulty in fixing the spillway capacity of reservoirs where we try to build dams in this region. Even in regions where we have more than 1,000mm of rainfall in a year, when the rainfall is limited to half the year, it is sometimes called a dry area.

We must appreciate the fact that the availability of water effects the pattern of life in different regions. For example, we can point out some specialized characteristics not only in the pattern of life, but even in the social structure in humid and arid zones. This can be represented as facts we experience in rice cultivated areas and that of upland crops. It can be said that the yields of product in rice zones are far more stable and its productivity in rice zones is also higher than those in upland crops. In upland zones the instability

of the yield of product introduces the need for well balanced distribution of water resources and promotes strongly the co-operative spirit in their lives. We can recognize those facts even through the structure of rural life in both areas, and we notice clearly these facts through the modernization of agricultural production measures in the humid and arid zone areas of the Asian countries.

Since we settled on the earth, we have continued our efforts to bring up more efficient ways of use of water-resources for our living. But following the rising of living standards of the people, requirements of water increase steadily and to meet these requirements we had to face so many problems, the solution of which requires earnest attention. I would like to show you some examples of problems we are facing in Japan. These are typical of rice cultivating countries.

During the last fifteen years Japan made very rapid progress in her economic development. Extension of industrialization and urbanization followed by the rising of living standard of the people required an increasing supply of water for domestic and industrial utilization. In this process there occur troubles between new consumers and traditional old users. New consumers complain that farmers are using too much water for their cultivation but generally speaking it is not easy for new consumers to minimize their requests.

In the case of Japan the quality of irrigation water for rice cultivation varies rather widely from around 15mm to 30mm a day. It is really a little bit more than those of artificially irrigated rice field in other countries, specially that of the United States where rice cultivation made rather fast progress in recent years where it is around 10mm to 15mm a day and it also varies over a smaller range compared with that of Japan. Newly exploited areas for rice cultivation, specially where countries introduced rice cultivation in recent years are somewhat different in their consumption, but in general where traditionally rice has been the main crop for the local people, we can clearly find out some specialized characteristics in rice cultivation. I can say this is the most excellent way of use of its natural environment for their living.

I think this simply depends on the fact that Japan is favoured by water. For instance, if we supply irrigation water continuously we can minimize growth of weeds in the field and can save power for ploughing compared with the case of intermittent irrigation. In general, farmers' houses are built along the distribution canal, therefore irrigation water is also used for domestic use and sometimes used for transportation and moreover I can say the rice field of each family is generally divided in several plots for the sake of well balanced distribution of labour power of each family, therefore there occurs need of supplying water to each plot by order. Therefore

generally speaking I can say that the distribution canal is built up not only to carry water for cultivation, but for the needs of the inhabitants in that plot and for the purpose of carrying water through canals by the cheapest way.

In fact we will be able to decrease the amount of irrigation water for rice cultivation if considered from the view point of rice plantation. In the majorities of these cases, however, there will arise the need for separation of the irrigation and the domestic water supply canal and of land consolidation along the newly built distribution canal. These projects cannot be brought up without the real understanding and co-operation of farmers concerned and it needs some amount of investment for construction. We have some examples like this in Japan. The first step was to separate irrigation and domestic water supply. After long negotiation with local people finally this project was accepted and the water supply system for the village was constructed based on the use of ground water. As for irrigation, there was the need for setting up a new canal because of the difficulty of less water flowing in the old canal and the new canal was constructed lined by concrete to reduce leakage of water and to be able to carry a decreased amount of water merely for irrigation. But in the meantime there appeared the reduction in the ground water level which made it difficult to continue its pumping up for domestic use and there occurred the need for setting up new supply canals directly taking water from streams and rivers. It is really a heavy burden for the local people to finance.

Coming to this stage of development we are faced with new problems of flood control, that is, following the rapid promotion of urbanization there occurred flood damages along the small scale rivers in the original urban area. Changing pattern of land use along the small scale river basin is causing a rapid change in its run-off status which is accelerating flood flow in down stream areas causing difficulties in drainage and flooding. The solution of these problems is becoming urgent today in Japan.

Hydropower generation is also one of the big sectors of water utilization. The role of hydropower in Japan in its course of economic development is highly valued. It is still vividly recalled to my mind, the occasion of the general address prepared by Prof. Mason of Harvard University at the 1st UN Conference on Peaceful Uses of Atomic Energy, the title of which was "World Power requirements in 1975 and 2000" Prof. Mason referred to the consumption of energy per capita in Japan which was somewhat higher compared with its living standard than those of the other industrialized countries.

According to the data of 1955 prepared by UN, consumption of electricity per capita in UK was 1960kwh, in West Germany it was 1730kwh, in France 1230kwh and that of Japan was 830kwh and on that basis the living standard of Japanese was nearly one third or one fourth those of European countries. Also in 1955, the percentage of electricity consumed in industry and mining among the total consumption of electricity in UK was 48.8%, in West Germany 58.0% and in France it was 62.2% and in Japan it was 69.3%. The electricity consumed in producing one US dollar equivalent of Industry and mining product in UK was 2.36kwh, in West Germany it was 2.65kwh, in France it was 5.75kwh and in Japan it was 7.23 kwh.

What does this mean? This merely depends on the structure of industry in the country. In the case of Japan according to the records for 1958, ammonium sulphate, iron and steel, calcium carbide, aluminium and caustic soda, these five industries consumed 23.5% of the total consumption of electricity. This was 30% in the 1930s. I can say during that stage nearly 30% of total electricity produced was consumed through electric furnace and electrolitic furnace. When electricity is utilized as mechanical power, such as in the field of machine manifacturing industry and so on, the share of the cost of electricity in the production cost is one percent or less, but in the case of above mentioned electro-consuming industries the share of the cost of electricity occupies about 15% to 25% of its production cost.

How did Japan build up such a structure of her industries? Simply speaking it is as follows. At the early stage of her industrialization, through the efforts of her Government, textile industry based on cotton and silk was strongly promoted, followed by iron and steel industry. During the stage of 1880s, coal burned power stations were set up at the main cities to supply electricity for domestic use. And coming to the stage of 1890s hydropower stations were taken up following the improvement of transmission of electricity. Before 1913 already 327 hydropower stations were set up and the total installed capacity of those stations was 480,000kw and its firm out put was 320,000kw. And during the years from 1959 to 1963, 86 hydropower stations were constructed and their installed capacity was 3,386,609kw and its firm out put was 718,056kw. Here you can find out in old days the average installed capacity of the stations was 1,470kw and now it is grown up to 39,500kw and the ratio of installed capacity and firm power was 1,50 in its early stage, but it is grown up now to 4.72, this show us the changing status of hydropower development in Japan. Following the development of hydropower, the construction of steam power stations had been promoted in Japan. For example, in 1910 the total installed capacity of power stations were 258,000kw,

of which 44% of hydro and 56% of steam, but it grew up of 4,500,000 kw in 1930, where 65.5% were of hydro and 34.5% of steam. In 1964, the total installed capacity was 34,282,000kw, where 44% were of hydropower and 56% of steam power.

Here we can appreciate, that in this century the construction of hydropower station was promoted rapidly and following the increase of installed capacity, the ratio of installed capacity and firm power has also increased largely. As for its utilisation, that of the hydropower stations was around 60% and that of the steam was limited to 20%. And at the early stage of its development the majority of the hydropower stations were of the so called run-of river type and the out put of those stations were directly due to the natural flow of the river. Therefore by the operation of hydro and thermal plant we could supply electricity to meet the demand. Japanese engineers were quite successful in building up well combined systems of hydro and thermal power generation. In this case, at night or in wet seasons, we always have some marginal power and the above mentioned electric consuming industries were specially set up as consumers for the so called marginal power under special electrical tariffs. It can be said that this built up the base of the industrial structure of Japan and these electric consuming industries were successful in supplying materials for the secondary product industries in Japan.

Today we are facing the changing status of the power producing structure in Japan. Originally hydropower in Japan was developed as run-of river type station as I mentioned and for time being those stations were designed to be based on the minimum flow of the river, but gradually it was extended to be based on the mean flow of river. After this stage small scale reservoirs were constructed with these stations.

Of course during this period some large scale reservoirs were constructed to regulate river flow, but coming to present stage, large scale reservoirs gradually came to be quite popular and these hydropower stations are planned to be operated as peak load stations. As was shown, following the successive increase of installed capacity of the station there was sign of decrease in its capability. For instance, the capability of run-of river type stations were nearly 48% in 1952 and 60% in 1963, but that of the dam type power station was 57% in 1952 and it was reduced to 24% in 1963. Due to the difficulties of obtaining definite alternatives, for the time being hydropower is expected to be operated as peak load stations. Now we have to face the difficulty of operating these stations to be adaptable to the requirements of water users down stream. We are now building re-regulating reservoirs for this requirement. Coming to this stage the system operation of hydro and steam power stations requires the setting up of pumped up storage to the dam type stations.

We have to face the problem of flood control. Specially in the countries like Japan which are located in the tropical cyclone zone, we can expect very heavy rainfall in certain limited small basins and in short periods, and I can say that the forecasting of such rainfall is not so easy for us even today. Nowadays the water level of reservoir is generally drawn down so as to be able to regulate flow to such extent that flash floods can be absorbed. But now the water level of reservoir is designed to be kept as high as possible throughout the year. And the reservoir is operated as soon as rainfall is forecast. The tropical cyclone zone does make it easy to answer this question. We are now promoting research on flood forecating using radar directly attempting to read the density of rainfall and so on. We have ocasionally experienced so called artificial flood due to mishandling of the reservoir. Therefore as was mentioned we are promoting the study of forecasting of rainfall, but at the same time we are coming to the stage that we have to think of the limitation of land use of low land in down stream areas.

These are some of the problems, the solution of which is earnestly required in the course of our economic development.

The fact that we cannot continue living without water means that the availability of water gives strong influence to the living status of the people of the region. Therefore where there is a request for rapid development, in parallel with the precise understanding of natural environment, there is need for full knowledge about the social and economic environment concerned. Administrative problems will also have to be included in this unified approach to solve these problems. We in Japan have been faced with the problem of how to protect our lives and property from damage due to floods and I think topographical conditions and pattern of land use have introduced these concepts in our everyday life. We have to pay keen attention to the methods by which we can solve these difficulties in the near future.

THE INSTITUTION OF ENGINEERS, CEYLON

Vote of thanks to Dr. Koichi Aki

By Mr. E. C. FERNANDO - PAST PRESIDENT

May I say that this task gives me great pleasure in proposing a vote of thanks to a gentleman of Dr. Aki's impressive achievements and the eminence that he has reached in Japan. There is yet another point that I might refer to. All you gentlemen who have had the good fortune of making contact with Dr. Aki in the last few days, would have been impressed by the gracious and charming attitude he has to everybody he associates with.

Dr. Aki, gentlemen, has treated us to a very lengthy discourse on a very wide field of various aspects of water resources development. I believe that it is the first time that an eminent engineer from Japan has graced the Annual General Conference of this Institution. May I hope that this will be the precursor of many other visits from eminent representatives from Japan, because the fact remains, and I would remind you gentlemen that Japan is a member country of the Colombo Plan, that Japan has done much for this country, and has proved a very helpful neighbour.

Japan has gone so far on the road to economic development that we have much to learn from countries like Japan. I know that even today we get a great deal of assistance in the way of technical men and other assistance from Japan, and I hope that in the particular field of water resources development, we would be favoured with the kind of assistance that we require in Ceylon, so that we may make rapid progress in this wide field.

Our President is one of the shining lights of the water Resources Board now in Ceylon. As you know, the Water Resources Board was established in Ceylon about 18 months ago. There is much we have to do. It is a tremendous field that we have to work in. Even in simple things like the provision of the supply of safe potable water to the people of this country, even in a simple elementary requirement like that, we are sadly deficient. In regard to the development of hydro power, as we gathered from the paper that Mr. Somasundaram delivered yesterday, Japan has developed two-thirds of its hydro resources. We are nowhere near that figure here in

Ceylon. I have no doubt that when we do ponder Dr. Koichi's wide-ranging discoveries at leisure, we shall find many matters of much interest as well as benefit to us. Mr. President and gentlemen, I gladly move this vote of thanks to Dr. Aki and now call upon all of you gentlemen present to show your appreciation in the usual manner.

THE PRESIDENT—Mr. S. Arumugam

Dr. Aki, in addition to the sentiments that have been expressed by Mr. E. C. Fernando, on behalf of the members of the Institution, I wish to add my personal thanks to you, Sir, for having come from Japan to Ceylon and given us this lecture.

THE INSTITUTION OF ENGINEERS, CEYLON.

DISCUSSION ON PAPERS

ANNUAL CONFERENCE 1967

THE INSTITUTION OF ENGINEERS, CEYLON.

Some Aspects of Drilling for Groundwater in Ceylon

By L. R. A. THEVATHASAN, A. M. I. E. (Ceylon)

DISCUSSION.

Introduction

Mr. Thevathasan in introducing the paper said that Ceylon had a rich heritage of Irrigation works. He referred to the Presidential address delivered that morning in which the President traced the history of ancient irrigation works. He said that he was deeply grateful to the President, Mr. S. Arumugam, for having taken so much interest in the obtaining of historical facts of ancient irrigation works and that we had now on record valuable data concerning them.

Until the year 1940, the accent was in the restoration of ancient irrigation works. It was in 1944 that a commencement was made in the investigation of the multipurpose reservoirs that would be possible on the river systems in Ceylon. For this purpose large dams had to be constructed and it was necessary to carry out foundation investigations. Hence core drilling came into its own in Ceylon. In relation to most countries Ceylon had been richly blessed by rainfall, and an adequate system of rivers had been distributed to most parts of the Island. Appendix II showed the distribution of rivers in Ceylon. People were satisfied with the surface water available and the hand dug wells which were predominent in the Island and people were settled in areas where water was readily available. As such the need for ground water had not been realised. There were areas where at least for 4 to 5 months in the year surface water faded out and people had to go for miles for even a pot of water. Man if he were to habitate these areas had to look for ground water for cultivation of his land, let alone living in such areas. The quest for ground water actually started only about an year and a half ago, and in this respect he mentioned that our President Mr. S. Arumugam—when he was in the Irrigation Department—took the initial step in the investigations for ground water. Many people had doubts of there being any ground water worth speaking of in Ceylon. Mr. Thevathasan said that he certainly knew of one who had great interest in this subject and had been actually working on it for several years. This he said was Mr. Sirimanne, who formerly worked in the Geo-

logical Survey and was now working in the Irrigation Department aiding them in their programme.

It would be interesting to know that surface water in streams and lakes was only about 3 per cent while the balance 97 per cent was underground. Actually surface and under ground sources were not always separate. What was surface water at one point, might become ground water at another, then might emerge as surface water at another point. Hydraulic interconnections made this possible. To picture the possibilities of ground water of an area, mapping and classifying its production aquifers, its ground water potential had to be done. Locating ground water, however, meant determining where the water occurred under conditions that permitted it to flow into a well fast enough to be useful. Practical ways of doing this, included application of scientific knowledge, drilling experience and common sense.

Mr. Thevathasan next referred to the areas of investigation and drew attention to Appendix I where the geological formation as is known at present was shown. He also drew attention to Appendix II where the likely hydrogeological regions were indicated. Then the question could be asked—Where was ground water likely to be found in Ceylon? It could be found in sedimentary rocks, gravel and sand deposits and in fractures in the igneous and metamorphic rocks. Next he referred to the purpose of which a well was drilled. In the case of small farms and domestic supplies, small diameters up to 6" would suffice. Large diameters from 6" to 12" would serve for irrigation, large farms, industry, municipal works and such like. Mr. Thevathasan next briefly went through his paper. He explained the two basic methods of well drilling, viz: rotary and percussion or cable tool, the components of the percussion rig and rotary rig, the equipment used with them and the manner of operation. He further compared the advantages and disadvantages of the percussion and rotary drilling. He said that the advantages of one may sometimes be the disadvantages of the other. Briefly, rotary for speed and percussion for versatality. He drew attention to the picture of the tricone rock bit used for rotary drilling and said one could imagine how big the bit was, considering the size of the man's foot. He also drew attention to the drawing of the truck mounted rotary cum percussion rig (WW 1 Converti drill) and said that from that drawing one could have a fair idea of what the drill looked like and know what the components of the machine and the drilling equipment were that went to drill the hole.

Mr. Thevathasan laid stress on formation recognition—sampling and coring played a very important part in water well drilling.

Successful well drilling, whether for water or for geological information, depended upon the ability of the driller to recognise

formations and changes in formations as the drill penetrated them. He should keep a written log of the formations noting their characteristics as to texture, colour, etc. To be able to do this, the driller should study the characteristics of all the formations in the area of operation. An experienced driller—according to him—recognised changes in the formation by the action or sound of the equipment, the movement of the drill pipe and the behaviour of the circulating pump.

An examination of the drill cuttings deposited in the channel flowing to the slush pit, indicated more definitely the character of the formation.

He said that if samples were correctly taken it would be possible to identify water bearing formations. Those samples were taken usually every five feet or more often, if the occasion demanded it. The samples taken were placed in polythene, plastic or canvas bags or in core boxes. The surest way to learn the character of the formations beneath the earths' surface was to drill through them, obtain samples while drilling and record a log of the borehole.

He referred to the well log, which was a written record of the geologic formations met with as the well was being drilled, recording depth, thickness, and chief characteristics, such as texture, colour, hardness and whether they appear to be water bearing.

Mr. Thevathasan said that the geolograph was an instrument attached to the drill stem and recorded automatically the penetration time or time taken for any action on the rig. This gave very valuable information of the behaviour of the rock bit in the hole, and helped to supervise the work done by the driller.

He next referred to the drilling time log which was very helpful in evaluating information from a hole drilled by the rotary method. It gave an accurate record of the time taken to drill each foot of depth and also supplied useful information about the formations, because the character of the material being penetrated by the bit, largely determined the rate at which penetration proceeded.

Well screens were necessary when wells were installed in an aquifer of sandy materials. Swabbing was to clean the hole of sand and fine grained material after screening. Swabbing and bailing were continued until clear water entered the screen freely.

In regard to test hole drilling, he enumerated the various objectives and said that the installation of observation wells was necessary to carry out yield tests on a prospective well. Pumping tests had to be

carried out for various time periods, draw down noted, and how much water level was lowered at a given rate of pumping.

He next dealt with coring and said that it could be resorted to when it was necessary to obtain a more complete picture of the formation being penetrated. He explained the various types of core barrels in use. He gave reference to his paper on "Foundation Exploration Work by Core Drilling" which he read in 1948 and further said that in core drilling the size of the hole could vary from $1\frac{1}{2}$" to 3". In exceptional circumstances and at a prohibitive cost, hole diameters up to 6" or a little more could be drilled if desired. In well drilling, holes could be drilled from any diameter varying from 6" to 16" or even nore with heavier machines. He said that it was necessary to do well drilling, if one were to insert a tube well pump of 6" or larger, capable of pumping 50 gallons per minute to a wide range up to even 1500 gallons per minute.

Mr. Thevathasan said that since the writing of this paper two flowing wells had been drilled in the Vanathavillu area and indicated the location on a plan that he produced. P. 14 discharged about 100 gallons per minute and P-8 about 10 to 15 gallons per minute. These two cases were said to be under artesian conditions. When a well was drilled through an upper confining layer into a artesian aquifer, water rose in the well to some level, above the top of the aquifer. In these two instances P-14 was located in the north of the area and P-8 in the western limits. These confirmed the two major components of the flow directions. He elaborated on what was meant by an artesian well and explained in detail how it occurred.

He further went on to say that the Irrigation Department had in the course of investigation installed three production wells at the 11th 14th and 18th miles on the Puttalam-Mannar road where water was being pumped twice a day into tanks of 1400, 1000 and 800 gallons capacity, respectively. This had been a great boon to the people of the area chiefly in the months of May to September when people had to go for water several miles or pay at the rate of Rs. 8/- for a 45 gallon drum of water that was transported by vendors in carts. At Vanathavillu it had been possible to find good water. A good part of the area was below 500 ppm chlorides and a small portion was even below 100 ppm. Investigations were still proceeding.

Mr. Thevathasan at this stage said that the time allotted to him was up and he had to conclude his introduction. Before he concluded he wished to express his thanks to the President for all the interest he had taken in ground water investigations. He also thanked the past and present Directors of Irrigation who kindly granted him permission to read this paper and permitted him to use the data and information available in the Department. His thanks were also due

to the members of the Israeli Team that worked on the Ground Water programme, the Deputy Directors, Messrs. Manamperi and Anghie, Mr. Sirimanne, Specialist Officer (Geology), and Mr. Rajendram, Irrigation Engineer, for all the help given him in his work.

The President said that they had had a most interesting paper. In fact Mr. Thevathasan had recorded a most momentous event, namely, the discovery of what he called "flowing wells" and what we call artesian wells, from where the water was just pouring out in areas where fresh water was so difficult. The subject was open to remarks and discussion.

Comments by Members

Mr. Kulasinghe said that there were one or two practical points he wished to refer to. Mr. Thevathasan had been using sludge in fairly large quantities for the drilling work. In some of their work on piles, they had had to face the necessity of using drilling mud like bentonite but there appeared to be nothing available in Ceylon like bentonite. Unfortunately bentonite had to be imported and at a fair cost. Could he tell us whether he had investigated and found whether any local material that had the properties of bentonite, even to a lesser degree, so that they could use it without importing bentonite.

The other point was the question of reverse circulation. It might interest the members present to know that the reverse circulation process of drilling was used by them 15 years ago in Ceylon for drilling. The circulation had to be by an air lift process and not by pumping so that it did not have some of the drawbacks of pumping. He wondered whether Mr. Thevathasan had any experience of that application, and what was the sort of process used for drilling, and what he thought were its advantages and disadvantages.

Mr. A. T. G. A. Wickremasuriya whilst congratulating the author, Mr. Thevathasan for his interesting talk on the various aspects of drilling for ground water, based on a number of years of experience, made special reference to the aspect of underground flow of water. Mr. Wickremasuriya referred to Badagiriya Tank, situated about 7 miles inland from the sea in the Hambantota District. Although that tank had a sufficiently large catchment to fill it, according to what could be estimated from calculations of area, yield and capacity, it seldom filled up. It would appear he said that losses from the tank by evaporation alone was probably not the only major factor responsible for the situation. There was probably an abnormal loss by seepage of water from the tank. He suggested that when the proposed pumping operations in that region were carried out it would be a good thing to observe the drop in ground water in the area. The extent to which the tapping of underground water would affect

the storage in the tank should be gone into in evaluating the net benefits of a lift irrigation scheme for the area.

Mr. Kumarasuriyar said that they were addressed on a very interesting and documented lecture on a subject which was very specialised. It was an unfair comment which he would like to make at that stage, namely, what the real purpose of all those investigations were going to be. As they had heard that morning and as they knew even before, the total population in this country was so large but only a very small fraction of the water requirements were being utilised. They had now reached a stage where they had to look for water underground, and appropos to that, was there water underground? Finding water alone was not enough. They must know how much water there was. For instance there were competing demands in any growing country. Really, they were now worried and rightly so, of irrigation, agriculture and so on, but they largely forgot industry. They set up factories where there was not a drop of water to drink. They built factories like textile mills where water was not found. If anybody cared to study that problem in its totality, one should say where storage underground was concerned, it seemed to be almost nil. Of the rainfall precipitation, the portion that got underground and stayed underground was very small. If then they were going to investigate for water, wasn't it better for all concerned and for all who were accountable for the future generations that they did it on a proper geological survey rather than piecemeal; or one particular agency do this, because if somebody wants to design overall water schemes, for domestic purposes alone, there were ten million of them and they should have fifty times that amount. They couldn't postpone that problem much longer. Even the question of the 1400 gallon tank mentioned by Mr. Thevathasan as installed at Puttalam would meet marginal needs. They had to think in terms of a large usage. He would like to make a suggestion that consideration should be given to start a geological survey with Mr. Thevathasan at its head and that be under an organisation like the Water Resources Board or the Geological Department or something like that, but he suggested that that data be documented and made available. If somebody wanted to put down a foundation, he knew what type of soil there was and so forth.

The other point was that as Professor Wolman pointed out at a meeting when he was in Ceylon when he described the geology of this country—said that the central hills of Ceylon were like a woman's breast, and that the water flowed from the mother's breast downwards. But the central hills did not seem to absorb much water and retain it. He did not know much about the absorbing powers of a woman's breast, but the central hills did not seem to absorb and retain water. Therefore, there was not much of storage. Down below they got to the sedimentary rock formations. If this was so, then the

water seemed to run from a part of it into this sedimentary basin and that part of it, if they examined it carefully, would be along the coastal area—Puttalam, Mannar, possibly up to Jaffna. The crystalline limestone formation was in the Matale areas. If we attempted to draw water from the sedimentary rocks, would we run the risk of destroying the water quality by raising the salt water from underneath. He said he would like these, if possible, answered.

Mr. P. M. Sithamparapillai said that he would like to associate himself with the various views expressed and also thank Mr. Thevathasan for his interesting paper. In the Irrigation Department when they talked of drilling, they thought of Mr. Thevathasan, and when they talked of Mr. Thevathasan, they thought of drilling. It was Mr. Thevathasan who had built up the Drilling Branch from scratch to its present position, and our thanks were due to him for presenting this paper.

Regarding ground water it would not be correct to say that investigations were started only about one and a half years ago. Years back, one of their Ministers had stated in Anuradhapura that instead of raising the irrigation tank bunds, the tank beds should be dredged. That might not be feasible in the central areas of Ceylon where ground water storage facilities in the subsurface were comparatively small. In the Jaffna Peninsula or some of the coastal regions, there were many excavated tanks, and deepening these would encourage recharge of ground water and greater storage in the subsurface. The more there were such excavated tanks in these regions, the greater would be the facilities for recharge.

Investigations for ground water and the construction of wells had gone on from time immemorial. They were told of Moses who hit on a rock causing the opening up of a spring.

Geological science was very important in this respect and its study was being given more and more importance in the Irrigation Department. Mr. Thevathasan had emphasised that Mr. Sirimanne's work there had helped the investigations greatly.

A previous speaker had mentioned that their present surface reservoirs could be depleted in some areas, if ground water were drawn out in the neighbourhood. This was not the only problem. Subsisdence of the earth's surface materials might also be caused in areas where ground water was pumped out. In California, where drilling was being done for oil, subsidence had occurred in some areas. Water was therefore pumped in, after removing the oil. This problem had been noticed in several countries. It was therefore essential to bear in mind the highly porous nature of the rocks in the area

from Puttalam to Jaffna, because such areas could be succeptible to subsidence.

Mr. Thevathasan had discussed the drilling and pumping work that was going on and also stressed on the logging of the cores, the well records, and the data regarding the depths of the wells being drilled, the characteristics of the rocks such as texture colour, hardness and whether they appeared to be water beaing. Much experience was needed to put everything on record. Because designers had to depend later on the information found in such records. It was therefore very necessary to have a good log, and the training of drillers in this respect was very important.

He believed that in a Paper of that type, if comparative costs could be given, it would be very helpful, because many people did not know the costs involved. He said that he would be thankful if Mr. Thevathasan could discuss this aspect also.

Mr. G. S. Sinnetamby stated hat he wished to ask whether Mr. Thevathasan could tell him whether there was water in Kalladi in the Puttalam area. His branch of the Electrical Department about four years ago, had completed a primary grid Substation at Puttalam about four miles from Kurunegala road from the town. The construction of the quarters attached to the substation had not been commenced because the P.W.D. felt that potable water was not available in that area. He further stated that the neighbour across the road, the Cement Corporation had succeeded, by obtaining water from the Mi Oya. He inquired whether Mr. Thevathasan could say whether he could assist in carrying out an investigation of that area to ascertain sources of ground water.

Mr. G. M. Yoganandan said that the author deserved to be congratulated for the paper he had presented and he stated that he understood that in some cases a bore hole had to be abandoned if the supply of water was inadequate. He wished to inquire from the author whether it was not feasible to determine by a preliminary survey using a seismographic instrument whether there was water or not. This instrument might be used to give a rough indication of the stratification underground and whether water occurred or not. In cases where the quantity of water was inadequate, he asked whether it was not possible to increase the yield by electrosmosis—i.e. by using a charged electrode to attract the positively charged water particles.

Mr. G. M. Anghie, whilst congratulating the author on his excellent paper said that as the discussions seemed to centre on ground water distinct from drilling, it was necessary to have a clear concept what ground water was. He defined ground water as water in the deep zone of saturation overlaid by water in the upper zone of aeration.

In reply to questions—

(1) From Mr. Kumarasooriyar, he said that unlike in the past systematic large scale exploration was being done by the Irrigation Department with Israeli Technical Assistance since 1965. However, Mr. C. H. L. Sirimanne, Hydrogeologist, had certainly contributed the most valuable work on the geological aspect of ground water investigations in Ceylon.

(2) From Mr. Yoganandan, he said that the Irrigation Department was using resistivity methods in preference to seismic methods for surface investigations.

(3) From Mr. Wickremasuriya, he said that before a well field could be developed, it was necessary to work out well spacing which could result in minimum interference during pumping. This was being done. He also said that pumping from test wells was being done to supply drinking water to the people of Vanathavillu.

Mr. A. S. de Silva said that he had the occasion to associate himself with the work of Mr. Thevathasan when he had come to Kurunegala with a Drilling Party about one and half years ago. Two drill holes were put in, round the periphery of Kurunegala Tank which was a mile or two from town. However they were unable to find any water for use on commercial lines.

The general feeling of the people of Kurunegala was that water was found in the centre of the tank. The ancient kings had built this tank, but the Irrigation Department with all its modern equipment could not trace from where the water came. The people of this area felt that there was something wanting. The achievements were not good enough. He wished to know why the drilling here was a failure.

Mr. T. N. Wynne Jones said that since listening to our learned speaker on the matter of tube well drilling, it had occurred to him that a few observations upon another aspect of it might be of interest.

He was in the Army in France in the First World War, and he saw a great deal of well drilling, it may not have been upon very scientific lines, there were no surveys, only immediate action, the method was applied without delay and the water obtained almost immediately.

The advance of the British Army depended largely upon the supply of water; there were no other sources, than very deep wells, 100 ft. and more, no pumps, only buckets on the end of long ropes,

the swaying bucket bumped repeatedly and was usually about empty by the time it was hauled to the surface.

Water for countless thousands of men and horses could not be obtained by this means, time did not permit.

Certain units of the Royal Engineers were hastily formed and equipped with well drilling equipment mounted upon lorries; they arrived, they set to work, and in hours there was a deep tube well.

There were lorry mounted air compressors which blew a well to fill the low height surface erected canvas tanks—and immediately moved on to blow up another tube well—up to a dozen or more before returning to re-commence the series over again—and again.

The method may not have been mathematically efficient, but it was practical—it worked and could be extended as quickly as the Army could advance.

There were other methods of quick lift of water from deep wells, when the diameter permitted;—the belt lift, and the chain helice; again not highly efficient, but amazingly effective; but these constitute yet other methods of obtaining water, in large quantities very quickly from deep wells.

Author's Reply

Mr. Thevathasan in reply to Mr. Kulasinghe said that bentonite was one of the best of drilling muds for use in drilling. However, ant hill earth would form a good substitute provided a percentage of bentonite was mixed with it. In core drilling, when casing had to be set, ant hill earth made into a slurry could be poured to set around the casing at the bottom, to make it easy to withdraw the casing when drilling was completed. In regard to the reverse circulation method, it was advantageous to use this method when drilling large diameter holes.

In thanking Mr. Wickremasuriya for his kind remarks, Mr. Thevathasan said that losses could occur due to seepage from a tank. Where there are fissures, joints and rocks of a porous nature, water could leak out. As is the practice, a net work of observation wells were put down when drilling wells. They were spaced at intervals and observations made. He said that he would certainly remember to observe the drop in the water level of Badagiriya Tank when investigations and pumping tests were carried out.

Mr. Thevathasan said that he was grateful to Mr. Anghie for his comments and for answering some of the questions raised by M/s. Kumarasuriyar, Yoganandan and Wickremasuriya.

Mr. Thevathasan further stated in reply to Mr. Kumarasuriyar's question, that the Irrigation Department were the pioneers in core drilling in Ceylon, and that there was a fair amount of information available in the Department from all the drillings carried out in the Island so far. As for as coordination and the information being made available it was up to the Government to take steps in this matter. At the time of writing this paper it was felt that the underground flow in the Vanathavillu area would be East-West, due to the dip of the basement rocks. But with further investigations, it was observed that the flow was not only East-West, but also in the northerly direction. The fissuring and jointing of rocks in the Tabbowa area might contribute to this in part. They were still in the investigation stage and a forecast of the quantity of water that would be available in that area could not still be made.

Referring to Mr. Sithamparapillai, Mr. Thevathasan said that he was thankful to him for his kind remarks. He appreciated the assistance that Mr. Sithamparapillai had given in the investigation of the Mahaweli Basin. He also stated that Mr. Sithamparapillai was responsible for all the geological studies, while drilling was carried out for the Mahaweli Project, and was thankful to him for all the help that he had given in carrying out the programme and hoped that would be of further help whether it was on core drilling or tube well drilling in the future. In regard to cost, core drilling had been done in the 'A', 'B' and 'N' sizes and although diamond bits were used, the cost had worked out to be between Rs. 20/- to Rs. 30/- per foot, while in the case of tube well drilling the cost had been from Rs. 35/- to-about Rs. 60/- a foot. The overheads by way of hire charges on ancillary plant made the cost of tube well drilling high.

Mr. George Sinnathamby referred to the question of availability of ground water in the Kallady area. He was not certain where exactly that area was, but if it fell in the miocene belt, ground water should be available. If it was out of it, small quantities should be available, if the depth of overburden was sufficient. As for the Irrigation Department investigating that area, if Mr. Sinnathamby would apply to the Head of his Department, he was certain that he would approve the investigation of that area, before the investigation party moved out of the Vanathavillu area.

In reply to Mr. Yoganandan's questions, the Engineering seismograph could be used to interpolate the data between drill holes the results of which were already known. Resistivity surveys had been done to ascertain the nature of the sub surface and whether water was available. The general methods used for well development were—back washing, surging and air lifting. Electrosmosis might not be a practical or economical method though it might be used for analysis of salt content in the ground water.

In reply to Mr. A. S. de Silva's question, on the sufficient availability of ground water in the Kurunegala area, Mr. Thevathasan said that Kurunegala had very little ground water to speak of, due to the geological nature of the area. Small quantities of about 25 to 30 gallons per minute might be available. The drillings were done on Ministerial orders to ease the situation of the supply of water to Kurunegala town, on account of the severe drought that prevailed at that time. The rains had set in fortunately and the water scarcity problem had been solved. In regard to springs and the possibility of ground water, that question had to be explored by carrying out a systematic drilling investigation.

In conclusion Mr. Thevathasan thanked all the members who participated in the discussion.

The President in closing the business of the day thanked Mr. Thevathasan for having presented such an interesting paper and said that it had also been a very painstaking paper.

He remarked that members should not forget that the accent of the paper was on drilling and not on ground water, although the discussion gradually drifted down to ground water and said however that Mr. Thevathasan answered all the points that arose with regard to ground water.

Experimental Concrete Road at Chunnakam, Jaffna

By Mr. G. M. YOGANANDAN, B.Sc. (Eng.) Cey., A.M.I.C.E., A.M.I.E. (Cey.,)
and
Mr. A. K. V. P. GOONEWARDENA, B.Sc. (Spl.) Hons. Physicist P.W.D.

DISCUSSION

Introduction

Mr. G. M. Yoganandan thanked the Institution for giving him and his co-author the honour of presenting the paper.

He said that a well designed and well constructed concrete road required little or no maintenance and was therefore more economical than flexible pavements in the long run.

The project amply demonstrated that it was not impossible to achieve high quality control even without sophisticated equipment and skills.

His plea was that the Public Works Department should construct at least a few stretches of concrete road using conventional equipment.

The President thanked the Authors for presenting an excellent paper and then said that the subject was open for discussion.

Comments by Members

Mr. A. N. S. Kulasinghe said that whilst congratulating the authors of the paper on the very fine attempt they had made to present an interesting subject, he was only sorry that this interesting topic had not come from the P.W.D. ten years ago, in which case a little more progress could have been shown.

It might be interesting to know that an experimental concrete road had been done in this country about 12 years ago and that it was the Marine Drive. The experiments were based on stretches of 400 feet each of reinforced concrete, pretensioned prestressed concrete and post-tensioned prestressed concrete.

He thought that in a country like Ceylon concrete roads should be given a little more consideration than they have been before.

It was a pity he said that even when the P.W.D. did try to carry out these experiments on concrete road construction, the equipment available were inadequate.

He said that there was one little point more he wished to make. He thought that there was a little error in the text. The Rebound Hammer was referred to as the Smith Hammer. It should be Schmidt, he said and was developed in Switzerland.

Mr. T. Wijesinghe stated that he was indeed happy as an engineer in the first instance, and a P.W.D. Engineer in the second instance, to take part in the discussion. He was grateful to the co-authors and to the organisation to which they belonged for the efforts taken in this matter inspite of the very meagre and very inadequate equipment. It is indeed ironical that the authors have even had to be charitable in printing a word of thanks for the simple matter of borrowing a vibrator. It just shows the difficulties our engineers are working under and I do hope that the Hon. Ministers who are themselves concerned about this matter will understand how we are carrying out construction works.

Concrete roads have so far not made as much an impact as bitumen roads. There is the question of maintenance costs.

A second reason why the concrete road has not made such an impact as the bituminous road is due to the problem of transverse joints. The bituminous road has always given a smoother ride In concrete roads the joints fall at regular intervals. Now, the designers have been able to space out these joints at larger intervals. In more than one country long slabs have been laid to lengths as much as two miles without joints.

A third reason which he would say the concrete road is not very popular is as mentioned by another speaker earlier, due to what can be celled the well organised campaign on the part of the bitumen manufacturers. Mr. Wijesinghe reminded the audience of the paper presented before this Institution several years ago. The author did a very good job and also did justice to the Bitumen manufacturing organisation he represented. Whether it is Shell, Caltex or Stanvac. they have all played a very leading role in promoting their product,

It would be relevant to mention here that an important investigation was conducted by an organisation known as AASHO only a few years ago. They embarked on a Multi-million dollar project investigating various stresses in a concrete slab and a significant finding made in that work is the overall efficiency of the concrete road.

In almost every investigation carried out under controlled conditions, they came out overwhelmingly in support of the concrete road is an engineering success.

Mr. Wijesinghe stated that the future was very promising. In Asian countries there is the problem of bullock cart traffic, but he did not think it a serious problem as the bullock cart was on the way out. It has been found in India, where bullock carts are much rampant than here, that concrete roads fare much better than expected against bullock cart danger, when protected against the adverse effects of the wobbly steel tyre which cut the concrete.

Mr. A. A. D. O. P. Saparamado thanked the authors for the very interesting paper they had submitted.

He said he would wish to point out two important findings of the AASHO road tests. The road test was the biggest project of its kind ever undertaken and had cost about Rs. 25 million.

One of the findings of the test, that had a bearing on concrete road construction in this country was that there were no significant differences in the performance of those sections having 40 ft. joints and mesh reinforcement, and those sections having 15 ft. joint spacing and no reinforcement. This removes the concept that reinforced slabs would be structurally more sound than non-reinforced slabs.

In the experiment undertaken by the P.W.D., cost was one of the primary considerations.

One of the objects of a concrete mix design was to cut down the quantity of cement which has a great influence on the cost of the mix.

The experience gained from the experiment already conducted would help to advise the department in regard to design mixes etc. for these projects, including the type of equipment that has to be used. Further experience and data would be available once these sections are built.

Mr. J. R. V. Seneviratne congratulated the authors of this paper for having promoted a subject which, judging from the discussions, seemed to have created much interest and much confusion too. He said he wished to discuss some aspects of the paper and clarify a few minor points.

Mr. Seneviratne said that it would be observed on page 140 that the authors had worked out the stress due to wheel loads adopt-

ing the modification by Teller and Sutherland as in Appendix I of Westergaards original formula. Westergaard's original formula was almost similar to that indicated in Appendix I but with the exponent $(a_1/e)^{0.6}$ instead of $(a_1/e)^{1.2}$

From certain tests carried out by the Bureau of Public Roads in Arlington, U.S.A., a man named Kelly, who worked out the theoretical stresses from Westergaards analysis as against the actual observed stresses at the site, proposed that the exponent 0.6 in Westergaards analysis be increased to 1.2 as the stresses in the corner formula computed from the Westergaards equation were considerably lower than the actual observed stresses computed from observed strains. Two others namely Teller and Sutherland who worked independently in comparing the theoretical corner stresses according to the Westergaard equation with the maximum observed stresses at Arlington for three conditions of warping found that the observed stresses were higher, the theoretical values being 40 to 50 per cent higher when the corner was warped upwards. This was found to be in close agreement with the stresses obtained using the modified formula proposed by Kelly as against values computed from Westergaard equation. The above would indicate that in adopting the formula in Appendix I the influence of warping on corner stresses is amply taken care of. Adding the Temperature warping stresses at paragraph 9 (3) to the load stresses at para 9 (2) toobtain the maximum combined stresses at para 9 (4) would therefore appear incorrect. The observations of the authors in this respect would be appreciated.

Although the maximum single wheel load according to the traffic study was 5000 lbs., a load of 7000 lbs. was used in the design. Mr. Seneviratne wished to know the reason for the adoption of a load nearly 40 per cent in excess of that actually observed stating that this being an experimental project he would have confined himself to the minimum weight so as to permit failure as a slab that did not fail could have been over-designed and thereby uneconomic.

To accommodate this situation, the Portland Cement Association adopts a method of design based on a "Controlling wheel load" worked out from the possible traffic loads that would use the pavement during the life span.

Mr. Seneviratne inquired whether the authors had introduced any form of strain guages in the experiment. On the subject of expansion joints, he stated that this type of joint is now not encouraged or advocated very much as most of the problems leading to failure of concrete slabs were observed to originate at the expansion joints. There is a school of thought in the United States that feels it unnecessary to introduce expansion joints as these would be naturally

formed when the concrete shrinks initially immediately after the laying. Mr. Seneviratne inquired from the authors whether the 3/4" transfer dowels provided were calculated or arbitrarily provided as the spacing appeared rather excessive.

Mr. V. C. de Silva said that he wished to join in the congratulations that had been offered to the authors.

He said that when the estimate for the experiment was put up for his sanction, he had just returned from China. In China he did not see a single pot hole and the roads were mostly concrete and for long distance travel what they had there was not good.

They were taken to see the Great Wall of China at their request. It was a fair distance, he said, and it would have been a very pleasant trip, but for the fact that they were travelling on concrete roads. The joints set up a vibration which was very unpleasant and in view of that when the experiment in question was put up to him, he thought it was not justified and he reduced the distance by half. It was up to the authors to show him he was wrong.

He said that the author had mentioned that roads were one type of structure. He thought that it was underestimating the case as the road was a much more complex structure.

One of the things done during the experiment, he was told, was that the traffic was clearly inconvenienced.

The site selected for the purpose was too narrow.

The surface of a concrete road is definitely superior to anything else. There is one place where in Ceylon the bitumen surface has failed; that is at the roundabouts and curves. The premix cannot stand up to the stresses on the curves. He said that they should think of concrete roads at least in those places.

With the oil refinery in the offing, he said, that there will be competition for persuading them to use bitumen and cement so that the future of the roads in this country will get more and more economic road soon.

Mr. M. R. Fernando thanked the authors for the information given in their paper.

He pointed out that as far back as 1960, the P.W.D. had constructed a small stretch of concrete roadway of length nearly 150 ft. on the Walasmulla Middening-Talawa-Hingama Road in Hambantota District and that had been used below the spill of an Irrigation

tank near Alutwewa near about the 26th mile of the above road. He said that it would be worthwhile to investigate how this section was at present.

He also stated Mr. Kulasinghe had mentioned that the P.W.D. should have concentrated on concrete roads a few years ago. He said that he may not be far wrong if he pointed out that the main reason why the P.W.D. could not concentrate on concrete road was due to the fact that was so difficult for the department to obtain 3/4" metal at the departmental rates. Nearly 500 cubes of 3/4" metal were needed for a mile and that was really a problem when the department found it so difficult to obtain even 25 cubes of 3/4" metal per month.

In order to overcome that situation, he inquired from the authors whether it was not possible to use a larger size of metal below, restricting the 3/4" metal a minimum thickness.

Mr. T. Sivaprakasapillai wished to mention that in the 1930's, the Colombo Municipality had concrete surfaces on both sides of the Galle Road.

In India, he said, the cost of the concrete road was very low because they were making 1:8 mix and rolling the concrete with the normal road roller before the initial set and they were able to get very good results. He said that he understood that those roads have lasted 30 years and more with no maintenance though subject to bullock cart and all other traffic.

Author's reply

Mr. Yoganandan in reply said that he was pleased at the interest shown in their paper.

He was associated with Mr. Kulasinghe in the design of the prestressed concrete road slab at the Marine Drive. The Rebound Hammer is a device of Mr. Ernst Schmidt of Switzerland and he was sorry that the name was spelt wrong.

He would like to tell Mr. Wijesinghe that there was hardly any damage to the concrete surface as a result of steel rimmed cart traffic and this was probably due to the high strength of concrete.

The modification to Westergaard's equation for stresses due to wheel loads referred to by Mr. Seneviratne does not include any temperature effects. Temperature stresses are worked out in accordance with Thomlinson's equation.

The original plan was to have one mile of road in which there were to be lengths of slab varying in thickness from 6" to 2". The stress in a 6" slab due to wheel load at corner and a temperature gradient of 3° F/in is 515 lbs/sq. in; the corresponding value for a 4" thick slab is 895 lbs/sq. in. The slabs were therefore not over-designed. In any case, there is no rigid method of design available for road slabs and the method adopted was only a guide to assess very roughly the stresses that might occur.

Fatigue in concrete in road slab is not important unless there is loss of subgrade support and the stresses are near the ultimate strength of concrete. Performance of the road slab was determined by watching out for cracks, settlement and other signs of damage.

Neither cracks nor settlement has occurred and a study will be made for as long as possible. The only damage that has occurred is the scaling of the concrete surface after a shower of rain which is effectively stopped by a single coating of bitument.

Mr. V. C. de Silva had stated that the estimate length of the road was halved; but in actual fact it was quartered. This was the reason why the construction of the road consisted of 1/8th. mile of 6" thick slabs and another 1/8th. mile of 4" thick slabs. He believed that the cost of the concrete produced for the road was the cheapest in the P.W.D.

Regarding Mr. M. R. Fernando's question, it was not necessary to use $\frac{3}{4}$" coarse aggregate for the concrete. In the experiment maximum size of 2" was used. It is possible to design gap graded concrete to give the requisite strengths. Aggregates in Ceylon were quite easily obtained and of high strengths and should not present a problem. He was unable to help Mr. T. Sivapragasapillai as he had not known of the concrete haunches to Galle Road.

In India cement is cheaper than in Ceylon and so is labour. Very dry mixes of concrete even as weak as 1:8 could be compacted with normal road rolling equipment to give strong base courses. The surface would of course not be very even.

The President stated that he wished that more papers of the type just read were presented as they would create a great deal of interest.

THE INSTITUTION OF ENGINEERS, CEYLON

Planning by Network for Construction of Uda Walawe Headworks

By Mr. D. L. O. MENDIS, B. Sc. (Eng.) Cey., A. M. I. C. E., M. ASCE., M. I. E. (Cey.)

DISCUSSION

Introduction

The author introduced the paper with a few remarks outlining the mode of presentation of the paper in two Parts further sub-divided into nine Sections.

He apologised for the omission of Fig. 3 from the annexures, which was the Lay Out Plan of Uda Walawe Headworks. He had set up the original Lay out on a blackboard and introduced the audience to the Scheme with the aid of this plan.

Mr. Mendis, referred the audience to the STOP PRESS on page 67, where he had saluted the workers of the Equipment Branch for their achievement on the river closure. He emphasised that the outstanding characteristic of these workers had been their **determination to succeed.** He said that if a similar emotional response could be obtained from other categories of workers—including Engineers—we would reach self sufficiency in a much shorter time than otherwise.

Mr. Mendis said that this river closure operation had attracted attention by its very magnitude. Thousands upon thousands of visitors had flocked to Uda Walawe to marvel at the spectacle of man battling for time and space to harness a mighty river.

However, it was only a very, very few of those visitors who had known that another far less spectacular but nevertheless as real struggle was going on in the construction of the Left Bank Power Plant. This struggle had been to complete the Structure up to at least full supply elevation of the Reservoir before the end of September. In this, we had to give all credit to the Contractor and the Sub-contractor, who had made up the delay of about two months and succeeded in bringing the L. B. Power Plant up to a safe level by the end of September. The Right Bank Power Plant Civil Works had been virtually completed by this date. The delay of two months had been due to cracks in the concrete, about which mention was made in Section 6 of the paper.

Continuing, Mr. Mendis stated that in Part II of the paper, Section 6 dealt with quality control of concrete. This Section described the plant used and the procedures adopted for quality control in manufacture, transport and placement of concrete. This Section was written from the view point of the Engineer's representative, planning Construction via the medium of the Daily Meeting. Mr. Mendis stated that he was not entitled to speak of the Contractors view point on these matters. He said that this job had been a team effort, and Mr. Munasinghe, Resident Engineer, Head works, had been the Captain of the team.

Coming to Section 9—Post Script, Mr. Mendis said that this was the most important part of his paper. Here, he had presented the case for commencing construction of Samanala Wewa Headworks, as soon as the construction of the Uda Walawe Headworks is completed. Referring to Page 58, he quoted:

"When the construction of Uda Walawe Headworks is over, a very large number of experienced Ceylonese personnel, from the lowest semi-skilled workers to the engineers themselves, will be available for further construction work. These personnel are the employees of the River Valleys Development Board, as well as the Contractor.

The proper utilization of this valuable asset-trained personnel—will depend on the availability of mechanical equipment and materials for construction. It is possible that the assessment of the availability of men, machines and materials to undertake construction of another Headworks, will be done at non-engineering levels, whilst engineering opinion may even be solicited from non-Ceylonese authorities.

This opportunity is therefore being taken to present the case for Samanala Wewa from two standpoints."

Continuing, Mr. Mendis stated that the examination of the Financial Analysis of the Consultants lead to the conclusion that the estimates of cost drawn up for an American Construction Co., were one fourth more than the cost of construction by a non American Agency. This may have represented the American overheads abroad.

The view point of the Ceylonese Construction Engineer may be described without malice, as a "worm's eye view". Here, the justification for construction had been assumed and the task itself was examined in terms of its physical components.

The eight and a half million cubic yards of rammed earth fill, it was stated, could be done in twenty five thousand hours. This gave an average performance of three hundred and forty cubic yards per hour. The maximum potential of the equipment had been given as one thousand cubic yards per hour.

The serviceability or availability of equipment for the Samanala Wewa job was thus thirty four per cent. In comparison during the river closure at Uda Walawe, the average out put had been about five hundred cubic yards per hour, in spite of restriction of space, and the corresponding serviceability was about fifty per cent.

Mr. Mendis stated that he had not gone into detail about the men and machines required for construction of the Samanala Tunnels. The work that was now being done at Maskeliya gave assurance that construction of Samanala Tunnels would be chicken feed to the team now tunnelling at Maskeliya.

He stated that no special problems would arise about concrete construction. Indeed, in some respects, the natives of this country had the advantage of possessing special knowledge of local conditions which a foreign Contractor would not possess.

He added that since writing this paper, he had been informed that there was no reason why construction of the Pen stocks and Power House also should not be taken up because there was no shortage of manufacturing countries ready to sell technological equipment necessary for this work on favourable, deferred payment terms. However, he could not state whether this was definitely correct.

Mr. Mendis further stated that having thus simplified in words a very big construction Project, he wished to draw attention to page 66, where he had stated—

"This viewpoint of our ability to undertake construction of Samanala Wewa Headworks may appear optismistic. It is agreed that in the conventional setting of traditional procedures such a viewpoint may be so described. But if construction is to be undertaken in this fashion there must be a reorientation of attitudes and a re-distribution of the controls, so that the project may proceed without hindrance from administrative hurdles".

In conclusion, Mr. Mendis stated that a request had been made to the Chairman of the River Valleys Development Board to obtain the approval of the Hon. Prime Minister and Hon. Minister of Land, Irrigation and Power, to name the two Reservoir Power Plants at Uda Walawe after them, i.e. the Senanayake Power Plant and the De Silva Power Plant. He said that the Chairman had mentioned

that it would be appropriate to name the Reservoir itself after the Hon. Leader of the Opposition, who had inaugurated the Uda Walawe Project when she was the Prime Minister. If this was done, it would surely be symbolic of an united effort towards the development of our country.

Comments by Members

Mr. A. C. H. Pereira confined his observations to the material of the Post Script. He inquired whether Samanala Wewa had been scrapped because there was a short fall of land actually available between Samanala Wewa and Uda Walawe, the extent being only ten thousand acres instead of the thirty five thousand acres expected.

He said that there was enough water for irrigating hundred thousand acres in the Walawe Basin and that the Uda Walawe Dam should have been sited higher up. His contention was that the storage of Uda Walawe should have been only sixty thousand acre feet, and that of Samanala Wewa 200,000 acre feet.

He suggested the formation of a National Development Committee to assign priority for Development Schemes.

Mr. W. T. I. Alagaratnam thanked Mr. Mendis for his very valuable paper, and stated that normally when a valley was planned, it was usual to start from the top and go down, but in the case of the Walawe Scheme, the start had been made from the middle. That might be the reason why Samanala Wewa was not taken up. Therefore the total acreage Which the Samalala Wewa could have irrigated had been reduced. Regarding Samanala Wewa he understood that a Technical Committee was appointed to look into this and they recommended that it should be taken up, but the World Bank or somebody had stated that due to insufficient funds, work could not be taken up. Mr. Alagaratnam felt that Ceylon depended too much on foreign aid, and as such we have to suffer.

Continuing, Mr. Alagaratnam remarked that Mr. Mendis had said that the earlier design was for earth banks on either side of the concrete spill. But the Gal-oya Board was of opinion that it was not the cheapest solution for the scheme, and the Minister himself had suggested that it should be looked into.

When the scheme was taken up, the Gal-oya Board felt that there may be an alternative solution and suggested that instead of asking the Contractor only to tender as suggested by the E.C.I., they could also give alternative proposals. The Contractor had sent a tender with a change in the site with an estimated saving of five million rupees and about two thousand acres of additional land.

Regarding Samanala Wewa, Mr. Alagaratnam thought that even now the scheme was almost ready to be taken up, when other schemes have yet to be designed and as he had stated, the Technical Committee had recommended that the scheme be taken up. It would also help Uda Walawe with a regulated storage higher up, so that the cultivation might be made more reliable. He further said that most of the members had gone and seen the river closure, which was a very great achievement, he said, taking the risk, which even the Contractors did not want to take.

Mr. P. H. Perera claimed that it was the Irrigation Department and not the Gal-Oya Board that suggested locating the Spill on the Left Bank extremity rather than in the concrete structure of the river closure. Thus he said, it was the Irrigation Department and not the Gal-Oya Board that allowed for an alternative proposal when calling for tenders.

Mr. Perera stated that the use of the spillway excavation material on the Bund was a contributory factor in making the Contractor's proposal cheaper than that of the Consultants. He asked the author what savings had been effected by having the Spillway on the Left Bank.

Mr. Perera concluded by stating that Samanala Wewa would be ideal for a Peaking Power Station with Uda Walawe for storage.

Mr. Perera inquired whether the networks had been amended as construction proceeded.

Mr. Alagaratnam in reply said that it did not matter who had made the suggestions for an alternative proposal, but the Gal-Oya Board too was composed of engineers from the Irrigation Department, because the General Manager of the Gal-Oya Board, when the Board had called for tenders and prepared the tender documents had been Mr. Manamperi who had come from the Irrigation Department to the Gal-Oya Board, and who was now back in the Irrigation Department—whether the Board took the credit or the Irrigation Department took the credit, most of the Engineers of the Board were engineers of the Irrigation Department. Mr. Alagaratnam added that he was not on the Board now.

Mr. S. A. D. A. Subasinghe referred to page 41, and inquired why arrears of earthwork were allowed to accumulate. Had the networks been used properly? He referred to page 43—where the author had stated that logistics were not considered in drawing up networks—and wondered why?

In regard to figure 11, where five hours dry weather had been predicted, Mr. Subasinghe inquired whether the network had been drawn up after the job was completed. He requested the D.I.E., Planning to speak on PERT.

Mr. U. Ranasinghe asked how the cost of a Reservoir Power Plant compared with the cost of the conventional Downstream Power Plant. In regard to the river sluice, which had a capacity of four thousand cusecs, he inquired what the water level was during the rains from October 17th to the 22nd in the Reservoir.

He asked whether the author could state that this design of Power Plants should be adopted for future construction. Has it been used widely abroad?

Mr. Muthubalasuriyar congratulated the author for the pains taken in preparing this paper. Regarding Networks, he stated that mistakes in estimating time as mentioned by the author, will be corrected with experience. There was no doubt that Network Planning should be adopted in industry. In regard to Mr. Perera's remarks, Mr. Muthubalasuriya stated that it did not matter whether the Gal-Oya Board or the Irrigation Department was given the credit, so long as the nation benefited from such a scheme.

Mr. Mutubalasuriyar said that Samanala Wewa, Maskeliya Oya, Mahaweli Diversion and other Schemes were all necessary. Priority has to be given from the viewpoint of national benefit. The present crisis is a shortage of rice. The Mahaweli Project will give the maximum benefit in rice production. This is why the Mahaweli Project has been given top priority.

Mr. A. Maheswaran (Irrigation Department), while thanking Mr. Mendis for his excellent paper said that he wished to speak a few words on the Samanala Wewa Project, about which some discussion had already taken place. As far as he was aware, the Walawe Ganga Reservoir Project, which was planned by the Irrigation Department in 1948 with the assistance of the American Consultant, was not taken up for implementation due to shortage of investment capital. Subsequently, in 1958, investigations were commenced on the Samanala Wewa Project and a Feasibility Report was released in 1960—long before Uda Walawe investigations were initiated. The Government, after study of the Samanala Wewa Feasibility Report, called for certain modifications. Finances, again proved an obstacle, and further progress was not made. Then, it was thought, that a short term project in the Uda Walawe area could be the answer to meet the development needs of the nation. That resulted in the initiation of investigations into the Uda Walawe Reservoir Project during early 1961. Though the Uda Walawe Reservoir Project was implemented,

Samanala Wewa Project was not lost sight of. The Consultants were instructed to prepare detail plans and specifications after studying the integrated operation of the Uda Walawe and Samanala Wewa Reservoirs. The Consultants concluded that 23,000 acres of land could be irrigated directly by Samanala Wewa after allowing for the cultivation of 40,000 acres of new lands and 16,000 acres of existing lands below Uda Walawe Reservoir. The project was found to be economically feasible. However, it was not possible to get "lending agencies" to provide the necessary financial assistance.

Mr. Maheswaran, continuing further, said that in his opinion Samanala Wewa was an excellent reservoir which would serve the power grid in meeting peak load demands. As the country was not industrially developed, there was a large fluctuation in energy demands. The peak load occurred between 6.00 p.m. and 9.00 p.m. The existence of Uda Walawe Reservoir for regulation made it possible for the Samanala Wewa to operate as a peaking station. The Samanala Wewa also had the benefit of both monsoons. It was unwise to depend on one valley like Kelani Valley for all the Hydro-Power needs. It was a pity that Maskeli Oya Stages II and III were preferred to Samanalawewa. Even if the Irrigation Component of Samanala Wewa were to be left out, the Samanala Wewa Project could have been justified as a pure Hydro-Power Project.

In advancing the construction programme of Uda Walawe Project, the R.V.D.B. authorities and employees have displayed courage and foresight. The large fleet of construction equipment had been released for work on other projects. The nation would benefit immensely, if the construction organisation at Uda Walawe, were shifted to Samanala Wewa than if they were dispersed on several smaller projects.

Referring to the comments made by Mr. A. C. H. Pereira on the National Development Committee, Mr. Maheswaran said there were several obstacles that prevented the National Development Committee from making an effective contribution. It was difficult for the recommendations of the National Development Committee to outweigh political and financial considerations.

Mr. S. Arumugam, President, wound up the discussion with an explanation regarding the origins of the Uda Walawe Project. He said that Dr. Savage had been invited by the Government to recommend the construction of a Multi-Purpose Project somewhere in 1947. Dr. Savage had been shown the Embilipitiya site by Mr. Arumugam himself and the Inginiyagala site on the Gal-Oya by Mr. M. C. Abraham.

Dr. Savage had recommended that the Gal-Oya Project be taken up for construction. Later the E.C.I. had suggested the construction of a Reservoir at Uda Walawe. The United States Operations Mission had also taken a part in some discussions regarding the Uda Walawe Project, and Mr. Phillips, a water expert attached to U.S. O.M. had one day rung up the Irrigation Department and said that he had located a site for a reservoir for power production in the upper Walawe region, and this was the birth of the Samanala Wewa scheme. The question of developing power in the Walawe Basin thus came later.

Author's Reply

Mr. Mendis thanked Mr. Arumugam, The President, for having clarified many of the controversial points raised inthe discussion. He said that most of Mr. A. C. H. Pereira's questions had been answered in the discussion itself. The question of acreage under Samanala Wewa remained.

The present position said the author, was that thirty five thousand acres of land was available below Samanala Wewa and above Uda Walawe which had been provisionally blocked out for subsidiary crops—fifteen thousand acres for chillies, ten thousand acres for onions and ten thousand acres for sugar cane.

The author thanked Mr. Alagaratnam for his remarks. In regard to Mr. P. H. Pereira's question, the author stated that he very much liked to know the answer to that question.

It was difficult to separate costs of the Reservoir Power Plant and allocate part to power and the remainder to irrigation. However, this was being done at Walawe, and the author would try to have the answer available of the comparative cost of a Reservoir Power Plant and a conventional Power Plant for future reference.

This also answered Mr. Upali Ranasinghe's first question. In regard to Mr. Ranasinghe's second question, the author stated that the hydrological calculations had been made by him on the 21st of October. Assuming a one hundred and fifty hour base, which was the base of the designed hydrographs for all, except the one thousand year flood, and observing the actual rise in water level up to the 21st instant, it had been predicted that the Reservoir would fill up to an elevation of two hundred and forty five with the River Sluice open and discharging four thousand cusecs. The actual maximum water level had been two hundred and forty seven M.S.L. on October 23rd evening. Further calculations based on actual rainfall figures in the catchment would be done if these figures were available.

The author thanked Mr. Mutubalasuriya for his kind remarks. He thanked Mr. Maheswaran for his remarks, and also stated that he had been informed by Mr. Maheswaran that the cost of one kilowatt of installed power was about Rs. 1,500/- for Hydro Projects in Ceylon. At Uda Walawe, the Reservoir Power Plants cost about Rs. 3,000/- per installed kilowatt. If power costs were half the total, this would work out to Rs. 1,500/-. It was this separation of costs that had still not been finalised.

In reply to Mr. Subasinghe, the author stated that the Field Officer who had prepared the twenty four hour Network on Figure 11 and had used it for construction, was present at this meeting. He would introduce this Officer, Mr. V. J. I. Sovis to Mr. Subasinghe, so that he could answer all his questions, and be assured that the Network was not drawn after the event.

The author described how observations of temperature, pressure and humidity had been made every fifteen minutes in the Uda Walawe laboratory, and how the Field Officer in charge, Mr. K. S. K. de Abrew had plotted these readings and used them for forecasting rain. After reading up about weather forecasts, including Mr. Ismail's papers on similar work in Gal-oya, Mr. de Abrew had become quite competent in making short term predictions. Then one day, he had tried a long term forecast, when he stated that it would not rain for two days. That very evening, it poured! So they had told this Officer that he had achieved professional status!

In regard to arrears accumulated and why Time Estimates were given without regard to logistics, the author stated that the job was planned on the basis that it would be completed by the end of this year, and that the necessary equipment would be found. As a matter of fact, during the river closure operations, some equipment had been loaned by the Irrigation Department.

THE INSTITUTION OF ENGINEERS, CEYLON

Operation and Interesting Features of Treatment at the Towns South of Colombo Water Supply Scheme Treatment Station

By Mr. A. VAIRAVAMOORTHY, B. Sc. (Eng.) Hons. (Cey.), A.M.I.C.E., A.M.I.E. (Cey.)
and
Mr. S. K. RASARATNAM, B. Sc. (Eng.) Hons. (Cey.), Grade. I.E. (Cey.)

DISCUSSION

Introduction

Mr. S. K. Rasaratnam said that it was his pleasure to present the paper before the institution. In the ordinary course of events this paper he said, would have been presented by Mr. Vairavamoorthy with whom he was associated in writing it. Mr. Vairavamoorthy had however gone abroad on study leave. The paper dealt mainly with the treatment of water and the plant used for such treatment at the Towns South of Colombo Water Supply Scheme. The present rate of consumption of water in the five towns mentioned in the paper was an average of about 9.5 million gallons a day increasing to 10 to 10.5 million gallons on pre poya and poya days. He then went on to summarise the paper emphasising the main points and hoped that information provided in the paper would help those interested in the Design and Operation of water treatment plants.

Comments by Members

Mr. R. V. Perumainar congratulated Mr. S. K. Rasaratnam on the presentation of the Paper—Mr. Rasaratnam being the youngest Engineer of the Team that was engaged on the Towns South of Colombo, Water Supply Scheme.

As part of the training of young Engineers, Mr. C. Rasiah Director of Water Supply & Drainage was keen that junior officers should write Papers on the work they have been engaged on. This effort compels them to search for and obtain a more intimate knowledge of the work and also gain more confidence in themselves. Mr. Perumainar added that he hoped that other Heads of Departments would also follow this commendable example.

He further added that in the development of water purification in Ceylon, a number of unusual problems had been encountered as a result of high temperature and nutritional materials found in river and tank water and, therefore, research and experiments on an advanced stage had become necessary. With this in view, four different types of Plants were installed at the following schemes:-

1. Towns South of Colombo, W.S.S. & University, Peradeniya
2. Matara
3. Kandy
4. Negombo

A fair amount of data had been collected, but this had to be scheduled and put into an useful form. A great deal more work had to be done on this.

The design of the Peradeniya Plant was according to the wishes of Prof. E. O. E. Perera. This Plant was provided with modern equipment such as P. H. Recorders, Residual Chlorine Recorders, etc. so that this would be helpful to the students following Courses of Study in the Faculty of Engineering.

The W. H. O. standard leaves a permissible limit of 5 p. p.m. for turbidity on the Silica Scale, but the Department maintains a standard for filtered water not exceeding 1 p. p.m.

For those who wish to know more about the Plant in Towns South of Colombo and other Plants on water treatment, he was happy to state that there are a number of senior Engineers in the Department of Water Supply and Drainage, present at the meeting who would assist Mr. Rasaratnam to furnish additional information.

Mr. S. E. J. Mather whilst congratulating the Co-authors on the excellent and most useful paper thanked the Chairman for the opportunity given him to clarify a few points on the paper.

He said that it was very fortunate for them to discuss the paper after the introduction of the paper and the visit to the Treatment Works.

(1) Mr. Mather enquired that the scheme appeared to have only post chlorination and whether it was not considered that Pre-chlorination would be advantageous in view of the presence of Algae in water. He said that it would certainly improve the quality of water having of course in mind the extra cost involved as the dosage may be twice or four times that for post-chlorination.

(2) Mr. Mather enquired whether the Drinking Standards referred to at page 121 was any specific standard of the Department of Water Supply, Drainage and Local Government Works or whether it is according to the International Standards for Drinking Water (1958) as published by the W.H.O. He also enquired whether the author is aware that the W.H.O. are at present preparing a revised standards for Drinking Water—one for the European countries and another for the South East Asian countries.

(3) He next enquired from the author about the chloride content in water referred to at page 121. He observed that the International Standards for Drinking Water allows 200 parts per million as permissible and 400 parts per million as excessive. It was observed by him in the paper that the Departmental standard for chloride content was not to exceed 10 parts per million and he would therefore like this to be clarified by the author.

(4) Mr. Mather further enquired from the author about the problem of settled sludge coming up due to the movement of the scraper if the scraper is worked from the time the clarifier was put into operation as is the case in this scheme. Would it not be better if the scraper is started after a fair amount of sludge has settled—say once or twice a day?

(5) Mr. Mather said that while at the site he had observed that there was only one Alum Pump installed for the dosage of same into the raw water. He was surprised that there was no stand-by pump as these Alum Pumps very often get choked. On enquiry at site Mr. Mather said that one of the Engineers had informed him that this discrepancy was noticed by them and a second pump has since been obtained for installation. He observed that a second pump should be fixed as a standby without delay.

Mr. C. Rasiah congratulated the Authors on writing a most interesting paper. He further added that great pains had been taken by them in studying and collecting relevent data before writing it.

On the question of pre chlorination he said that it was being considered, taking into account at the same time the increased expenditure in the production of water.

On the question of the standard adopted by the department he said that the standard given was only for this particular scheme and not a general standard.

With regard to the staff requirements he said that there was at present an engineer and a senior inspector in addition to 4 officers trained and designated purification plant operators. There were also electrical and mechanical foreman to maintain the plant and equipment. It is also proposed to appoint a laboratory assistant and Bacteriologist.

He further mentioned that an article written in connection with the Colombo Municipality Centenary Celebration had mentioned that the water from this scheme would be expensive and would cost three times the Colombo municipality's price for the production of water. Before the completion of the scheme, water was bought from the Municipality at 40 cts./1000 gals. The water produced at T.S.C. scheme which was up to International standards costs only 42 cts/ 1000 gals, although it was a pumping scheme. The quality was better than the Colombo Municipality Water.

Author's Reply

As regards pre chlorination Mr. Rasaratnam said that he was not aware as to how far this question had been studied. As Mr. Mather pointed out the cost of pre chlorination would be higher than that of post chlorination. Although there was a fair amount of algae formation on filters and clarifiers labour requirements were not excessive to clean it. With problems of unemployment he felt it would be advisable to continue this method of cleaning.

There were other problems like silting in the Aerator. At the initial stages of operation 3 to 4 cubes of sand had to be removed about once a week. The piping system to remove silt could not cope with the sand. Thus pumping had to be interrupted and the sand removed manually. This problem was not so acute at present. Perhaps conditions at the mouth of the intake had been upset during construction and may have settled down by now.

Mr. Rasaratnam also mentioned problems in the clarifier such as sludge coming up during operation. The exact reason was not known. One suggestion was that this was due to temperature differences in the water. This problem has not yet been studied in great detail. The filter runs had however not been affected to any great extent.

As regards standards he said that there seemed to be some misunderstanding. The standard mentioned was only for this particular scheme. The chloride content in the raw water had been low in this instance. Control of the chloride content was not possible and would depend on the source of supply chosen.

In reply to Mr. Mather's question as to whether the sludge coming up could be prevented by stopping the scraper Mr. Rasaratnam said that this had been tried out but without success.

In answer to Mr. Mather's question as to why only 1 alum pump was available Mr. Rasaratnam said that initially the contractors had intended using only 1 pump but when it was pointed out that this was unsatisfactory another pump has been supplied and this would be coupled with the other pump with stopcocks so that continuous dosing was assured.

Mr. Rasaratnam said that there was clogging of the lime waste line, lime being insoluble in water. This choked the drainage system. This line has now been diverted and more make up water added to prevent recurrence. He also pointed out that there were misprints in the texts. The iron content should have read as 0.2 p. p.m. The main supply as 33 K.V. instead of 35 K.V. and voltage 400 volts instead of 440 volts.

In conclusion he thanked the institution for having given his colleague and himself the privilege of presenting this paper.

The President thanked the authors for their very interesting paper and the members who contributed to the very useful discussion.

THE INSTITUTION OF ENGINEERS, CEYLON

Power Development Planning in Japan

By Mr. A. J. SOMASUNDARAM, B.Sc. (Eng.) Lond., C. Eng., M.I.E.E., A.M.I.E. (Cey.)

DISCUSSION

Introduction

Mr. A. J. Somasundaram in presenting his Paper said that he hoped that his Paper would serve as a guide to those Engineers who are involved in the Power Development Planning in this country. As the time was short he touched on certain aspects of his Paper, which he thought were too brief. Regarding the rate of increase in the Annual energy production in Japan, he said that the average rate of increase during the last 10 years was over 13%, which he said was quite large for an Industrially advanced country like Japan.

He said that the long range forecast of electric power demand in Japan was periodically made on the 1st of October each year for the duration of six years including the year of survey and then amended in April the following year.

Regarding the estimation of the capability of plant, he said that the stream flow records for a period of twenty years is used as the basis for all calculations.

He said that in Japan the economic hydro ratio is about 40% He said that this was due to the fact that though Japan was endowed with abundant rainfall and dashing rivers, the availability of economical Hydro resources has decreased considerably and the economics of Thermal generation was improving with the introduction of larger and more efficient Steam Turbines.

Comments by Members

Mr. E. C. Fernando while congratulating the author, wished that the author could give some more information about the Power Development in Japan. He said, the author must have good reason for confining his paper to the particular sector of the Electricity Supply Industry in Japan, that he had commented on. He thought he was right in saying that Japan is the most industrially developed country in the East. Electrically, Japan, particularly as regards power supply, is far ahead of the other countries in this region. Japan had been completely self-sufficient electrically for the past two decades or so. This should be the background for the particular interest in the paper that had just been presented.

In so far as the paper is concerned, its particular angle is with regard to power development planning. Indeed, Mr. Fernando felt that the approach to that problem is a very complex one, particularly in the case of countries with very heavy power demands like Japan and United Kingdom, so that the task of forecasting the requirements of power can be one attended with many difficulties. The approach of having a six year forecast supplemented by another one year forecast, is fairly well-known, and this is adopted in the United Kingdom also. He mentioned the U.K., because he knew that Electrical Engineers here are familar with the Electrical Power situation of that country.

In regard to the approach to power demand forecasting that Mr. Somasundaram out-lined, it would be interesting to know how the impact of national growth and the economy, are inter-woven into the Electrical Power development of that country. Mr. Somasundaram had not made any reference to this aspect in the course of his paper. It is noted that the Electrical Council in Japan works out the actual figure of forecast, but Mr. Fernando would be grateful, if Mr. Somasundaram would kindly let the audience know, a little more in detail with regard to the links between the Power forecast and the national economy.

Mr. Fernando would also like to enquire whether the Electrical Council of Japan in finalising its figures of development, took into account any other sources of power. In England for instance, there was natural gas. They had recently discovered sources of natural gas in the North Sea, which have obviously made a big impact on electricity power production.

Mr. Fernando next requested the author's indulgence to go beyond the confines of his paper. As the author had visited Japan recently, Mr. Fernando thought that Mr. Somasundaram would be able to answer some questions on the power situation in Japan, generally, although he had not dealt with them specifically in his power. Mr. Fernando considered that a comparison of the Power Development in Japan with, say the United Kingdom, would be an interesting exercise. Japan would seem to be more industrially developed; Japan has a population of about a 100 million compared with some 55 million in the United Kingdom. If an attempt were made to extend that comparsion to a small country like Ceylon, it would be remembered that Japan is about 4½ times in extent and something like 10 times in population. The figure for Japan for power for 1966 quoted by Mr. Somasundaram was two hundred billion units. It has also being stated that Japan has a generating capacity of 45,000 M.W. It would be interesting to know that the corresponding figures for the United Kingdom were 33,358 M.W., bearing in mind the differences in population and extent. The figure in units generated is 145,000 million for United Kingdom, as compared with 200,000 million units for Japan for the same year.

Mr. Fernando pointed out that England is a country having coal and iron, and these are two of the most important factors that had made England a leading industrial country, and also enabled her to stage her industrial revolution years ago. Japan unfortunately, has neither. On the other hand, there is no doubt that Japan is the most industrially advanced country in the East, and has been so for a number of years. If one tried to compare the figures of power output of Japan, with those for Ceylon, it is found that our output was some 400 million units, i.e. about 1/5 of 1% of Japan's figure. Even allowing for the fact that Japan has 10 times the population and 4 times the area of Ceylon, the difference is staggering.

Continuing Mr. Fernando requested Mr. Somasundaram to be good enough to inform the audience how the 45,000 MW in the case of Japan is made up. How much was hydro and how much was thermal? In the case of thermal power; how is Japan meeting the fuel requirements despite the absence of both coal and oil in the country.

Mr. Fernando further enquired what the respective capital costs are in Japan for thermal power per kilowatt, installed and for hydro power. He requested that a rough idea be given of the O & M costs for both the thermal and hydro power. Mr. Fernando rather expected that to have 45,000 MW of installed capacity, Japan would have the largest size machines in the world today for thermal power. He enquired what capacities of machines Japan had to hydro power? What proportion of the available hydro power potential has now been developed in that country? He also requested that some general information be given on the types of thermal and hydro power plant that Mr. Somasundaram must have seen there. What type of construction has been adopted for the main and subsidiary transmission?

Turning to finance, Mr. Fernando pointed out that in terms of 45,000 MW and 200 billion units, the capital outlay on the system must be enormous. The annual capital required to be injected into such a power industry would be about Rs. 4,000 million, big money by any standard. But that would be the size of capital required annually to progress a power system of that size. Not only that, the industry must also be expanding. They are going from strength to strength; how is this capital financed? Soon after the war, it was common knowledge that Japan's economy followed American lines by and large, but we also know that the Japanese nation has for many years stood firmly on its own feet, so that it would be interesting to know how this vast financial outlay was made possible. Mr. Fernando pointed out that according to Mr. Somasundaram there were 9 separate Power Companies handling the demand of 45,000 MW.

These commercial set ups must be very big concerns. It would be, interesting to know details of their general and, particularly financial structure.

With a country like Japan, which has no reserves of fossil fuel, he enquired what part nuclear power is being designed to play. It is known that Japan has a nuclear Power Station which was recently completed, but that was only a take-off point more than anything else.

Do these 9 Power Companies effect their own retailing, or do the Municipalities do this and also final distribution?

Mr. Fernando wished to know something about the electrical tariffs in Japan? He inquired how they compared with ours and those out-side Ceylon, say with our neighbours like India and Malayasia. We have heard it said by people who should have known better, that Ceylon has the highest electricity tariffs in the world. That ofcourse, is fanciful thinking. It was said years ago, that the poorest house in Japan was lit with electricity. That shows the amount of electricity supplied in Japan. The position would now be much better. Japan's genious for industry is well known.

Mr. Fernando next enquired how rural electrification is organised and financed in Japan. He said it would be very interesting to have details of Ceylon's own difficult position in regard to rural electrification.

Some two years ago, for the first time in the East, a Computor was used in Japan for starting up a large Steam Turbo Generating Set. As Japan is one of the pioneers of electronics and computors, it would be interesting to know what progress Japan has made in the application of electronic devices and computors to power station operation.

As a final point, Mr. Fernando pointed out that there must be an organization in Japan corresponding to the Electrical Development Association in England; it would be interesting to know some details regarding the Japanese set-up because, the Ceylonese counterpart could get into touch with them no doubt benefit thereby. Mr. Fernando added that, as Mr. Somasundaram was a Distribution Engineer himself, these questions would definitely be of interest to him also.

Mr. Fernando thanked the audience for their kind attention.

Mr. A. C. H. Pereira addressing the President, Dr. Aki, and Members said that the Electrical Section of the Institution, though small in number, packed a lot of Power up its sleeves. He said that Mr. Somasundaram's Paper, though short, does pack a lot of power as was obvious from the interest it had aroused He hoped that Dr. Aki would supplement Mr. Somasundaram's reply by supplying the missing links.

Speaking of the Hydro development in Ceylon, as compared with that in Japan, he said that we have hardly developed 10% of the available Hydro resources. He said that, unlike Japan, where there is ample thermal back up, we in Ceylon have to take special precautions about the manner in which we meet our demands as we are Hydro based.

Referring to the load curves given in the Paper, he said that planners in Japan do not have to worry much about FIRM power as they have enough thermal. But, in Ceylon, where we are dependent on Hydro power as our base load, it is necessary to arrive at what we call FIRM energy. He said that the Government and other reports do not give the FIRM energy available from a source, for units of periods less than a year. He was of opinion that FIRM energy should be defined for smaller units.

Mr. Pereira said that as Ceylon was a poor country, we cannot base our planning on minimum stream flow conditions. as we would be wasting water during heavy rains. He said that much had been mentioned about peaking power in an earlier paper. He believed that peaking power in the Ceylon scene was stuff and nonsense.

Author's Reply

Mr. Somasundaram replying to Mr. E. C. Fernando, said that the statistics regarding future development are published annually by the Government of Japan in the "Economic Prospect" and the "Prospect of Production of Staple Articles".

He said that the ratio of Units generated by Steam to that generated by Hydro was of the order of 60:40 at present.

He said that the annual Funds required for the construction and debt repayment was in the region of 550 million Yen (1 Yen 1.33 cents) Of this, 350 million Yen was used for construction and 200 million Yen for debt repayment. 34% of this 550 million Yen was obtained from internal funds, 8% from increased capital funds, 24% from floating bond, and 34% from outside loan. He added that recent statistics showed that the position of internal reserves was improving as a result of better management.

Regarding Thermal Plant, the author said that although Japan produces Coal of low calorific value, most of the Steam plants use Heavy Oil imported from the Persian Gulf as it is found to be cheaper. Japan also imports a large quantity of high grade coal from the United States. Although the tendency is towards the use of Heavy oil, 25% of Steam is still being produced by coal. Regarding the type of Steam Turbines, he said that the most recent ones were of 600 MW. capacity, operating at super critical steam pressures of 246 kg/sq. c.m.

and having thermal efficiencies of over 40%. As for large Hydro Plants, he believed that the Kansai Electric Power Company had a 500 MW pumped storage station with 250 MW units. He said that the trend was towards the development of multi-purpose schemes and pumped storage plants to meet the peak load. He said that this was due to the decrease in availability of economical Hydro resources and the improvement in the economics of thermal power generation.

Regarding "Firm Power", he said that it depended on several factors such as the stream flow, whether the plant is of the run-of-river type with or without regulating pond or of the reservoir type, the load curve, etc. He said that in Japan, stream flow records extending over a period of 20 years is used as a basis for calculating the capability of a plant.

As regards the development of Nuclear Power, the author said that a 166 MW natural Uranium, gas cooled Power Plant was in commission and that three more plants were under construction.

Then about tarriffs, he said that he was not in a position to give the figures off hand.

Coming to the question of spill, the author said that he believed that it was a question of economics whether it is worth installing additional plant to exploit the energy lost due to spilling, mentioned by Mr. Pereira. As the time was limited the author concluded his talk by thanking the President and Members for their cooperation.

THE INSTITUTION OF ENGINEERS, CEYLON

A TALK ON

"Factory Accidents—how they happen and how to prevent them"

By Mr. B. R. P. GOONEWARDENE, A.M.I.Mech.E., A.M.I.Loco.E., M.I.E. (Cey.)

Deputy Commissioner of Labour (Technical) and Chief Inspector of Factories

Mr. Goonewardene gave a brief description of the need to adopt various safety measures in industrial establishments and other work places. He stated that where safety measures are not adopted and workers are exposed to dangers and risks they meet with accidents. An industrial accident was defined by him as an unplanned, unexpected occurrence, which interferes with or interrupts the normal progress of work in an industrial establishment. The fact that accidents just do not happen and that they are caused was stressed. Accidents are caused either due to unsafe conditions in work places or due to unsafe acts of workers; in some cases they are due to a combination of the two. The unsafe conditions which generally cause accidents are unguarded or inadequately guarded machinery, defective equipment, unsafe electrical installations or unsafe use of electricity, slippery floors, unsafe storage of materials, overcrowding and overloading, improper ventilation, use of harmful materials without adequate protection, badly designed buildings and incorrectly planned layouts, unsafe use of construction equipment and unsafe practices at works of engineering construction and building operations.

He explained the vital need to prevent accidents as workers involved in accidents can get killed or seriously injured with possible permanent disablement and that such accidents have to be prevented for humanitarian, economic and legal reasons. He then went on to explain how accidents have happened in the past and how to prevent them by showing several slides made from photographs taken at actual scenes of accidents in this country. These slides highlighted the fact that several accidents have been caused by electrocutions, unsafe machinery, falls, fires and explosions. Special mention was made of the electrical accidents which have been the cause of the greatest number of deaths in recent times. Defective electric motors,

portable electrical tools without proper earth connections, the use of defective electrical fittings, unsafe operations in the vicinity of overhead power lines, faulty wiring by inexperienced workmen and failure to adopt safe systems of work, have been responsible for the majority of deaths.

Mr. Goonewardene ended his talk by saying that industrial employment is on the increase. As more people have to work together their exposure to various industrial hazards and accident risks must necessarily increase. Accidents resulting in disablements and deaths lead to loss of production. The position is aggravated when the industries use skilled workers who are scarce and have to be trained over long periods at great cost and that the engineers who have a vital role to play in the industrialisation of this country must realise the need to promote safety to prevent accidents if we are to increase productivity for the benefit of the employer, employee and the nation.

THE INSTITUTION OF ENGINEERS, CEYLON

MINUTES OF THE ANNUAL GENERAL MEETING, 1967

Minutes of the sixty first Annual General Meeting of the Institution of Engineers, Ceylon, held at the Irrigation Department Conference Room on 27th October, 1967.

Mr. S. Arumugam, B.Sc. (Gen.) Lond., B.Sc. (Eng.) Lond., M.I.C.E., M.I.W.E., M.I.E. (Cey.) President, occupied the Chair.

The Minutes of the Annual General Meeting held on 27th October, 1966 which had been printed and circulated were considered as read.

In the absence of any comments, Mr. B. R. P. Goonewardena proposed the adoption of the Minutes.

Mr. S. E. J. Mather seconded, and this was passed by the House.

The President stated that it was his sad duty to inform the House. of the deaths of the following members during the Year:—

Mr. K. Roswadowski
Mr. C. L. Unamboowe
Mr. D. M. Wijesinghe
Mr. C. Wijeyanathan

The House then observed two minutes silence as a mark of respect in the usual manner.

Report of the Council for 1966-67—Before presenting the Report the Honorary Secretary Mr. C. Rasiah, said that he would first deal with verbal complaints regarding the delay in sending the Transactions to the membership. He said that this was due to delays in the receipt of 'Papers' after 25th August from some of the authors. For the past 60 years, the Transactions were printed by M/s Colombo Apothecaries Co. Ltd., but this year after inviting quotations for printing, the work was entrusted to M/s. Times of Ceylon whose quotation was cheaper by one thousand rupees. This being their first attempt, the Printers had to be assisted and

therefore it took a longer time. Their printing was quite satisfactory although the Transactions were received only on the 24th of October for distribution.

The Honorary Secretary then gave a brief resumè and the present position of the following matters in the Annual Report:—

Membership—Despite the fact that 115 members were reluctantly struck off the Roll by the Council for being in arrears of subscriptions for 4 years and over, there was an increase in membership—the total now stood at 661.

Committee Meetings—The number of meetings held by the various committees during the year were indicated in the Report. Continuing, the Honorary Secretary said that last year the general body authorised the Council to form a 'National Development Committee". Accordingly the Council appointed a Committee of 14 members during the year. This Committee after some meetings and discussions sent a memorandum to the Honourable Prime Minister.

The Council received a reply that the Honourable Prime Minister would bear the submissions made by the Committee in mind. The Committee met again and decided to forward more specific proposals. For that purpose, detailed information was required regarding the Indian Development Planning Organisation and Mr. A. Maheswaran the Convenor was requested to collect material on this subject.

Headquarters—In regard to the Headquarters Project, no further progress could be made as re-allocation of Crown Land within the City of Colombo was being made by a Sub-Committee of the Cabinet. The Institution was recently allocated a new and bigger site which is about 90 perches at the former Colombo Race Course, the old site being only 60 perches.

Examinations—For the first time, the history of the Institution, it had been possible to hold the joint Part I Examination, in April 1967 with the collaboration of the London Institutions. Out of a total of over 500 applications for the Examination, the Examinations Committee decided that only 179 applicants were eligible to sit the examination and applicants were so informed. Of these, only 34 candidates finally sent in their applications and fees for the examinations. The results were very disappointing.

Recognition—This matter was recommended by the Committee on the Establishment of a Unified Engineering Service. The Committee which was appointed by the Government had also sent a copy of their recommendation to the Public Service Commission. The Public Service Commission had however informed the Institution that they are awaiting Treasury observations on the matter.

Increased Grant—Action had been pursued with the Government, and it was likely that the Cabinet would approve an Increased Grant of Rs. 26,000/- per year.

Bulletin—The publication of the bulletin, had been suspended due to insufficient literary contributions from the members.

Library—Due to scarcity of Foreign Exchange, books on recent advances in Engineering and Management fields were not freely available locally. The Library Committee would be grateful if members who possessed personal copies of new publications, suitable for the library, would send them for reference and return.

Visits—A number of interesting visits were arranged during the course of the year, but the organisers were disappointed to note that the attendance was poor. Moreover, the Council incurred losses in this respect.

To give an instance, for the trip to Uda Walawe, buses were arranged for the number of members who gave in their names, but finally as some did not turn up, the Council incurred a loss of Rs. 170/- on the trip.

The President then stated that the Report was open for discussion.

Mr. S. E. J. Mather suggested that the Institution could follow the London Institutions' practice of obtaining Gifts of Books from members transferred from one Grade to another, with a view to adding books to the Library.

He also raised the following questions:—

(a) Of the 24 candidates who took up the Joint Part I Institution Examination, how many passed?
(b) If the members who were struck off the Roll were persuaded to re-join, would the Institution insist on the payment of arrears before re-admission?

Mr. T. D. G. Amarasinghe wished to know the Grades of the Members who were struck off the Roll and whether Income Tax was being paid on their arrears, as this was potential revenue.

Prof. R. H. Paul stated that for the conducting of the examinations in a proper manner, a full time Register was necessary. He also inquired why the Institution which had earlier asked for a grant of about Rs. 80,000/- now asked for a reduced grant from Government. He wished to know whether the Institution had given up the idea of a full set up for conducting the examinations.

Mr. T. Wijesinghe commented on the progress made so far by the National Development Committee and hoped that in the ensuing year a more positive contribution in the development work of this country would be made by Engineers. In regard to the publication of the Bulletin, he suggested the material for its publication be obtained on the following subjects:—

i. Major works in Ceylon.
ii. Major works of interest outside Ceylon.
iii. Certain specific technical subjects of interest to Civil Electrical and Mechanical Engineers.
iv. Research material from Laboratories in Ceylon.
v. Research material from Foreign laboratories.
vi. Relevant matters connected with membership in Journals obtained from Foreign countries.

In regard to the Transactions, Mr. G. S. Sinnatamby congratulated the Institution for effecting a saving in the printing of Transactions by calling for quotations and also for the high standard maintained. He also wished to know whether the Government would recognise the membership of the Institution as a qualification to enter the Public Service.

Regarding membership of the Institution, Mr. Sinnatamby congratulated the Council for having taken the courageous step of striking off the Roll members who were in arrears of subscriptions. It was not possible to run an Institution of this nature without such action. This was a professional body and it should have professional ethics. Under the heading 'Finance' it was stated that "there has been some response in the payment of arrears of subscriptions from members". Immediately after that there is a table of subscriptions received for the years 1963, 1964, 1965 and 1966 and below that a statement that "however the payments received have not appreciably affected the amount outstanding as arrears as on 1-3-67". Mr. Sinnatamby said that there appeared to be some contradiction. He wished to know why Mr. A. C. Wickramasinghe signed his name as Honorary Secretary at the bottom of the Statement.

Mr. L. R. L. Perera made the following suggestions:—

i. To request every new member enrolled to gift a Library book in order to build up the Library.
ii. That a 'Paper' or two combined with a Social be arranged during the middle of the year.

In regard to the points raised by Mr. Wijesinghe in connection with the Bulletin, the Editor, Mr. J. R. V. Seneviratne explained that

there was a lack of literary contributions from members, even though several personal appeals were made. He further said, he was not asking too much to have only eight articles a year from a membership of 600 or more.

The Honorary Secretary in replying to Mr. Mather's remarks regarding examinations said that only one candidate was referred and the others had failed, but one of the Institution's Student members who had made a direct application to London had passed the examination. Regarding the arrears of members who wished to re-join, he said that it was not possible nor desirable to write off the arrears. If anyone wished to re-join, all arrears had to be settled.

In regard to the question of grades of members struck off the Roll, raised by Mr. Amarasinghe, the Honorary Secretary stated as follows:—

28	Members
2	Retired members
27	Associate members
1	Retired Associate member
2	Associates
5	Graduates
50	Students
115	Total

Regarding the Income Tax payable on the arrears, the Honorary Secretary said that the Institution was in correspondence with the Income Tax Department. It was, however, understood that the arrears had to be written off before it was possible to get the Income Tax Department to reconsider the matter.

In regard to the suggestions made by Messrs. Mather and L. R. L. Perera to obtain gift books from new members or, when a member is transferred from one grade to another, the Hony. Secretary stated that the suggestions are very good, however he doubted whether such books could be obtained in practice as it was found difficult to get the subscriptions regularly from a number of members. The matter will however receive due consideration by the new Council.

In regard to Prof. Paul's question about the Grant, the Hony. Secretary stated that the original request of the Council was for a Grant of Rs. 26,000/- for the first year, Rs. 50,000/- for the second year and Rs. 85,000/- for the third and subsequent years. There was absolutely no response from the authorities for this request and the Council therefore decided to request the Government for a Grant

of Rs. 26,000/- and follow up the matter later. The Permanent Secretary to the Ministry of Public Works, Posts and Telecommunications was addressed accordingly, and it is understood that favourable consideration is being given by the Cabinet and that the Honourable Minister of Finance had been requested to send in his observations.

Regarding the next point raised by Prof. Paul about the apointment of a full time Registrar for examinations, the Honorary Secretary said that the Institution did not have sufficient funds to engage the services of a paid Registrar. The matter will be considered at the appropriate time and when the necessity arises.

To Mr. Sinnatamby's inquiry about recognition, the Honorary Secretary said that once the Incorporation Act was passed, it as very likely that the membership of the Institution will be recognised.

Regarding the query on the accounts, the Honorary Secretary said that there was nothing contradictory, as it would be noted that although there has been an increase in the receipt of Subscriptions, the amount still due from members is Rs. 25,971/50—vide the "Current Assets" on the Balance Sheet.

He also regretted the printing error in the Statement of Accounts where the words "Honorary Secretary" had been printed instead of "Honorary Treasurer".

Regarding Mr. L. R. L. Perera's suggestion to have a Social and a paper during the middle of the year, the Honorary Secretary said that according to previous experience, there may not be a good response from the membership, particularly so, as no duty leave could be obtained for the members in the Public Service. However, he said that he would try to obtain leave from the Treasury and if successful, necessary steps will be taken as suggested.

In conclusion, he thanked the Honorary Treasurer, Mr. A. C. Wickramasinghe and the Clerk to Council, Mr. W. I. M. C. Fernando for the able assistance they had given him during the year.

Mr. E. C. Fernando proposed the adoption of the Annual Report and this was seconded by Mr. G. S. Sinnatamby and unanimously adopted by the general body.

The President then called upon the Honorary Treasurer to present the Accounts. The Honorary Treasurer Mr. A. C. Wickramasinghe in presenting the Annual Statement of Accounts stated that he would deal with the important aspects of this document which was available with all members. He stated that he would first deal with the statement of Income and Expenditure.

The Item 'Contributions to the Mercantile Service Provident Society' (M.S.P.S.) which did not appear in last year's statement represented the 6% contribution by the Institution to the Institution's Clerk who is a mercantile employee.

Regarding the item 'Depreciation', the auditors had stated that this was not calculated to any accurate percentum, but that it was in "rounded off" figures. The Auditors had also informed that the practice was not to depreciate when there was an excess of expenditure over income. On the request for more details they had informed that in the Institution of Civil Engineers, London, the buildings were valued at £100, although they were worth millions of £ sterling today.

The Honorary Treasurer then proceeded to comment on the "Balance Sheet". The amount of Rs. 1489/90 appearing under the "Headquarters—Preliminary Expenses on Site, Survey Plans etc." was indicated as an asset, because when the building was completed this amount would form part of the capital value of the building. In fact at the moment this amount represented the actual amount spent on the Headquarters Project.

Under "Accumulated Funds and Liabilities", there was an amount of Rs. 212/50 indicated as "subscriptions received in advance." This represented monies received as subscriptions at full rates mainly through Bankers Orders, from some members who were overseas, whereas such members were entitled to pay subscriptions at half rates. The amount paid in excess had been treated as a payment in advance to be set off against subscriptions due when these members return to Ceylon.

An amount of Rs. 1214/10 indicated as "Building fund, Headquarters" had been shown as a current liability. The Council decided that the Building Fund should be a separate account and until it was so deposited, it has been shown as a liability in the Balance Sheet. Negotiations had already taken place with the Bank of Ceylon regarding the opening of the separate Account and this would be finalised shortly.

The amount of Rs. 272/40 indicated under current liabilities in the Balance Sheet as "M.S.P.S. contributions" comprised of the 6% provident fund contribution from the Institution and the 4% from the employee—our Clerk. Normally such contributions were deposited in the E.P.F. but the E.P.F. office informed that contributions are accepted only when there are three or more employees. Hence this amount of Provident Fund contributions is shown as a liability as this amount is included in the general account with our Bankers. The Council decided that the Examination Accounts

should also be kept in a separate account. The position is exactly the same as indicated for the Headquarters building fund and hence the reason for this being shown as a liability.

The President then announced that the Statement of Accounts were open for discussion.

Mr. G. S. Sinnatamby stated that under "Current Assets" there was a note regarding a "Schedule", and that he wished to see this document. The Honorary Treasurer stated that the Schedule was available with him and that this could be shown to Mr. Sinnatamby after the meeting or, at any time.

As there were no further comments, Mr. A. S. de Silva proposed the adoption of the statement of Accounts for 1966-67. This was seconded by Mr. N. Arunasalam and adopted unanimously.

List of Office Bearers—The names of the Office Bearers for 1967-68 were then announced by the President as follows:—

Prof. R. H. Paul	—	President
Mr. L. C. Williams	—	Vice President
Mr. A. N. S. Kulasinghe	—	—do—
Mr. A. MacNeil Wilson	—	—do—
Mr. V. N. Rajaratnam	—	—do—
Mr. T. Sivaprakasapillai	—	Member of Council
Mr. B. R. P. Goonewardena	—	—do—
Mr. M. S. J. Akbar	—	—do—
Mr. J. P. Senaratne	—	—do—
Mr. T. W. Mendis	—	—do—
Dr. S. L. de Silva	—	—do—
Mr. S. A. D. A. Subasinghe	—	Associate Member of Council
Mr. P. T. Madawela	—	—do—
Mr. K. B. E. de S. Karunaratne		—do—
Mr. S. H. C. de Silva	—	—do—
Mr. A. A. C. W. Jayasekera	—	—do—
Mr. Sena Attygalle	—	—do—
Mr. C. Rasiah	—	Honorary Secretary
Mr. A. C. Wickramasinghe	—	Honorary Treasurer
Mr. A. F. Deane	—	Hony. Asst. Secy & Treasurer

The President then said that it was his pleasant duty to thank the members of the Council for the assistance and co-operation given to him during his term of office. He said that the work was so well

organised that the President's task was made very simple. He also stated that the affairs of the Institution were well managed by the Honorary Secretary and the Honorary Treasurer and most of all by Mr. W. I. M. C. Fernando, the Clerk to Council. He then thanked the Press Supplement Committee and Mr. Abeysundara of the State Engineering Corporation for arranging the Hall and also the Engineers who presented Papers at the Annual Sessions.

His thanks, he said, were also due to the Chairman of the State Engineering Corporation, the Director of Water Supply and Drainage and the Chairman of the Ceylon Tyre Corporation who granted permission to visit the work sites and the hospitality extended to the members of the Institution. He also thanked the Ceylon Broadcasting Corporation and the Press for the publicity given to the Annual Sessions.

He finally offered the thanks of the Institution to the Director of Irrigation for the use of the Hall and all his officers who assisted in the arrangements and in particular Mr. P. H. Perera. He then called upon Prof. R. H. Paul the new President to take the Chair.

Prof. Paul whilst thanking the membership for having elected him President for the ensuing year said that he hoped he would live up to their expectations. Before the commencement of the rest of the business in the Agenda, he said that he wished to thank the retiring President for the very efficient manner he had conducted the affairs of the Institution during his term of office.

Election of Auditors.

Mr. T. D. G. Amarasinghe proposed the re-election of the present Auditors—M/s. Satchithanandan, Schokman, Wijeratne & Co. for the ensuing year and this was seconded by Mr. S. Arumugam and accepted by the House.

Amendments to Regulations

The Honorary Secretary stated that certain members possessing the professional qualifications still cotinue as Graduates and Students of this Institution. In order to overcome this situation, he was proposing the following amendments to the Regulations 3 (f) to be replaced by the following:—

1. "**Students** shall comprise every person who has been admitted into the class of Students so long as his name is on the Roll as such. every candidate for election to the class of Student shall have attained the age of sixteen years but not the age of Twenty-six years, and shall satisfy the Council:

(a) that he has passed such qualifying examinations/or sections of an examination as may from time to time be prescribed by the Council,

and

(b) that he is undergoing a regular course of further education approved by the Council for the purpose of this By-law, or has indentured himself as an apprentice under the supervision of a Corporate Member of the Institution."

2. New Regulation 3 (h) to read as follows:—

"No person shall remain as a Student or Graduate on the Roll as such of the Institution at the end of the calendar year in which he attains the age of 30 years or 40 years respectively."

Mr. A. C. Wickramasinghe seconded this motion.

The amendments were accepted unanimously.

Before moving the 2nd Resolution, the Honorary Secretary stated that last year too a resolution was passed regarding the Board of Trustees. Under Regulation 9 (ii) (e), he explained that there was no need for a Vice Chairman and proposed the replacement of the term Vice Chairman by the words "a Member of the Board of Trustees". He then formally proposed the following amendment to Regulation 9 (ii) (e):—

"The Vice-Chairman" in Rule 9 (ii) (e) to be substituted by the words "a Member of the Board of Trustees".

Rule 9 (ii) (e) will read as follows:—

"The Board of Trustees is authorised to open up an Account called the "I.E.C. Headquarters Building Fund Account" with a Bank and all cheques drawn on this Account shall be signed by the Chairman or in his absence by a Member of the Board of Trustees and countersigned by the Secretary-cum-Treasurer."

This was seconded by Mr. A. C. Wickramasinghe and the amendment was adopted unanimously.

Any other business

Mr. T. Wijesinghe raised the question once again regarding representation in the Senate. The Engineering profession, he said, had been continously ignored. The profession has not been represented in the proper Councils of the country to voice the considered view point from the Engineering aspect on various matters of national importance.

There was one exception made very recently he said. Therefore he wished to formally move the suspension of the standing orders to permit him to move the following resolution:—

> "I propose that this House empower the Council to pursue this matter with regard to the representation of the engineers, by appointing at least one engineer to the Senate."

Mr. A. C. H. Pereira seconding the motion enquired the position regarding this same motion which was proposed last year.

The Honorary Secretary stated that this matter was taken up with the Government before the appointment of the new Senators but without success.

The President then undertook on behalf of the new Council to pursue this matter further.

Mr. G. S. Sinnatamby pointed out that a resolution could not be taken up unless due notice was given. Mr. Wijesinghe said that with the consent of the House there was nothing to prevent the House from agreeing to the suspension of the Standing Orders.

Mr. A. C. Wickramasinghe replied that all the members were aware that there was another item in the programme namely the talk by the Guest Lecturer. It was not fair to delay the Guest Lecturer. The President had given an undertaking to pursue the matter raised by Mr. Wijesinghe and Mr. Wickramasinghe therefore requested Mr. Wijesinghe not to press for the suspension of Standing Orders. Mr. Wijesinghe then withdrew his request for suspending the standing Orders.

Mr. M. Mathurunayagam said that unless due publicity is given in the press to the Engineers demand for representation in the Senate nothing would materialise. The President again guaranteed that the new Council would take up this matter with the Government and do its best to obtain some results.

Mr. A. S. de Silva then referred to the President's remark regarding the good work done by the clerk of the Institution of Engineers and suggested that the Council make a payment of an additional allowance to the Clerk.

Mr. A. C. Wickramasinghe stated that the Institution had already taken action in this regard. The Council had on the Completion of one year's service by the Clerk given him three (3) increments and promoted him from Grade 1 to II.

The President then declared the Annual General Meeting closed.