Metkem Journal

427

Vo[illegible]. 2 *November, 1955.*

METKEM Journal

Editorial Committee :

S. RAMASWAMY, R. NATARAJAN, K. RAMNATH
T. M. KRISHNA RAO, P. B. SRIRANGAN,
N. SUNDARESAN, T. S SUBBA RAO.

Managing Editor : R. PARTHASARATHY.
Associate Editor : C. S. SRINIVASAN
Editorial Assistant : V. RAMASWAMY

Office of the Managing Editor :
P. O. BOX 67. TIRUCHIRAPALLI.

*

In this Issue

HYDROBIOLOGICAL INVESTIGATIONS IN STANLEY RESERVOIR ● CHAIRMAN'S SPEECH ● THE ELECTRO-CHEMICAL INDUSTRY IN GERMANY, AND OTHER USUAL FEATURES.

*

Cover Photo

A Scene from " Sikander ", a drama staged by the pupils of the Mettur Chemicals School.

OFFICE OF THE REGISTRAR OF BOOKS
20 JAN 1956
MADRAS

Hydrobiological Investigations of the Stanley Reservoir and of the River Cauvery at Mettur Dam

by S. V. GANAPATI, B.A., M.Sc., A. R. I. C.

THE hydrobiology of impounded waters used as sources of water supply and for pisciculture is of great importance not only from the point of view of providing a wholesome supply of drinking water but also for increasing fish productivity. Our knowledge about the hydrobiology of South Indian lakes and reservoirs is very meagre.

The Stanley Reservoir at Mettur Dam was formed when the construction of the Dam across the Cauvery at Mettur was completed in 1934. (*Fig. I*) SundaraRaj (1942) examined how the construction of the dam affected the fisheries of the Cauvery. However, no hydrobiological survey of the reservoir has so far been made and hence no records are available about the conditions existing in the reservoir above the dam and in the river below it. With the progress already on hand for a wider exploitation of the fishery of the reservoir and for augmenting the natural crop of fish, it was considered essential to conduct a thorough survey of the reservoir and of the river. Investigations were made on four occasions during 1947 and 1948 and the results of these investigations are recorded below.

MATERIAL AND METHODS

The investigations can be classified under two heads: (*a*) those pertaining to the reservoir and (*b*) those relating to the river below the dam. Samples from different depths in the reservoir were taken from (1) the surface water, near the Jetty in the reservoir; (2) the leakage water flowing from the high level sluice or from the pipe leading to the garden; (3) the low level sluice and (4) the tail race water. All these spots are fixed at different heights in the dam excepting (1) which fluctuated with the water level.

In the case of the river below the dam, samples of water were collected from fixed points on the two banks to a distance of about half-a-mile down the river. The methods of analysis are the same as those described already (Ganapati, 1943). The turbidity was measured in cm. by viewing a printed paper through a column of water (in a clear glass cylinder measuring 30 cm. in height and 1 inch in diameter) which obscured the printed matter when it was viewed at 3 ft. level by a person standing erect. The results are shown in Graph I and Tables I to III.

LOCATION AND PHYSIOGRAPHY

The Cauvery is one of the larger rivers of South India and takes its rise in the Brahmagiri hills of the Western Ghats near Coorg at an elevation of 4,400 ft. Its course in Coorg is tortuous on a rocky bed with high banks covered with tropical vegetation. Entering the Mysore plateau, the river it passes through a narrow gorge with a

fall of 60 to 80 ft It then widens to an average width of 300 to 400 yards till it receives a tributary called the Kabbani after which it widens considerably. At Sivasamudram in the Mysore State are the celebrated falls with a precipitous descent of about 300 feet where this energy is converted into hydel power by the State.

From Sivasamudram to Hogganikal falls and four miles lower, the river passes through a wild hilly country, often in inaccessible rocky gorges in the Madras State. At Hogganikal Falls, the river descends to 70 ft. in a deep chasm in its rocky bed, where it throws up a column of perpetual spray, resembling smoke,—hence the name "Hogganikal" or "Smoky rock." The height of the falls has, however, been greatly reduced by the formation of the Stanley Reservoir above the Dam at Mettur, which extends right up to the falls. The Mettur Dam in the Madras State has been constructed in the gorge where the river enters the plains. The bed of the river continues to be rocky for more than 25 miles below the Dam until its confluence with the river Bhavani at a place also bearing the same name.

The dam at Mettur is one of the largest in the world. It is 5,300 ft. long, 214 ft. high at the deepest portion of the river, and 171 ft. broad tapering to 20·5 ft. at the top and was built at a cost of nearly Rs. 5 crores, (the equivalent of about £ 4 million at the present rate of exchange). This reservoir, called the Stanley Reservoir, has an area of 60 sq miles impounding 95,660 m.c. ft. of water at its maximum level which is + 796 ft. above mean sea level The normal flood discharge is through the Ellis Surplus to the east of the Dam with a sill level of + 770 ft. The Ellis Surplus has 10 vents of 60 ft. span with liftable iron shutters. The channel from the Ellis surplus is 3½ miles long and joins the river 2·5 miles below the dam. The reservoir normally surplusses for 100 days in a year (Sundara Raj, 1942).

When the level falls below + 774 ft. —that is, 4 ft. above the sill level—the shutters of the Ellis Surplus are let down and the supply for irrigation begins from the high level sluice which has eight vents (each measuring (10½ ft. × 16 ft.) with a sill level at + 720 ft. Normally, the reservoir is not expected to fall below + 735 ft. level. If at any time, however, the water level should fall below + 730 ft. the irrigation supply will be through the low level sluice which has five vents (each measuring 7 ft. × 14 ft.) with a sill level at + 670 ft. The low level sluice is not expected to be used except in very bad years. The high level sluice is designed to operate with a head of water ranging from 54 to 10 ft., though 15 ft. is the lowest expected. Besides these two sluices, a pipe has been inserted in the wall of the dam at + 717 ft. from which water is obtained for feeding the park and the fish ponds constructed near the dam

The dam provides facilities for the generation of electricity. Four pipes at sill level (+ 640 ft.) through the Dam for turbines operating under a maximum head of 150 feet, have been installed for a maximum production of 49,000 h.p. The location of the various sluices with their levels is shown in *Fig. 1*. The maximum

depth at the dam site is 165 ft. from the reservoir bed, 150 ft. from the hydro-electric pipes, 126 ft. above the low level sluice, 73 ft. above the pipe through which water is supplied to the park and fish ponds and 76 ft. above the high level sluice when the water is at its maximum level (+ 796 ft.). The other end of the reservoir extends up to Hogganikal falls; and the catchment area above the dam is 16,300 sq. miles.

METEOROLOGY

The meteorological data during 1946 to 1948 at the dam site are given in Table I from which it will be seen that (1) the temperature is highest (96 to 102 deg. F) during the hot weather months of March, April and May; (2) that it is at its least (73 to 82 deg. F.) during the north–east monsoon season from October to December; and that (3) rainfall is also highest during the same season. (This was especially so during 1946 and 1947.) The year 1948 was marked by a very low rainfall with a consequently high average atmospheric temperature.

The river below the dam is affected by the north-east monsoon and so it is flooded ordinarily in November. While the south-west monsoon supply is fairly dependable, the north-east monsoon is unpredictable and frequently fails as will be seen from the data for 1948. The chief object of the construction of the Mettur Dam is to remedy the unsatisfactory supply of the north-east monsoon rains by storing the flood waters resulting from the south-west monsoon rains in the upper reaches of the Cauvery (near its source) and distributing them evenly throughout the irrigation season up to January.

So, the main supply of water to the Stanley Reservoir is received from the south-west monsoon rains at the source of the river in Coorg and Mysore. The first freshes usually appear about the middle of June. The flew decreases in August, and by October the river sinks to its normal dry weather flow consisting of straggling streams and a succession of deep rocky pools above the dam.

The periods of overflow in the reservoir during 1945 to 1948 are given below :—

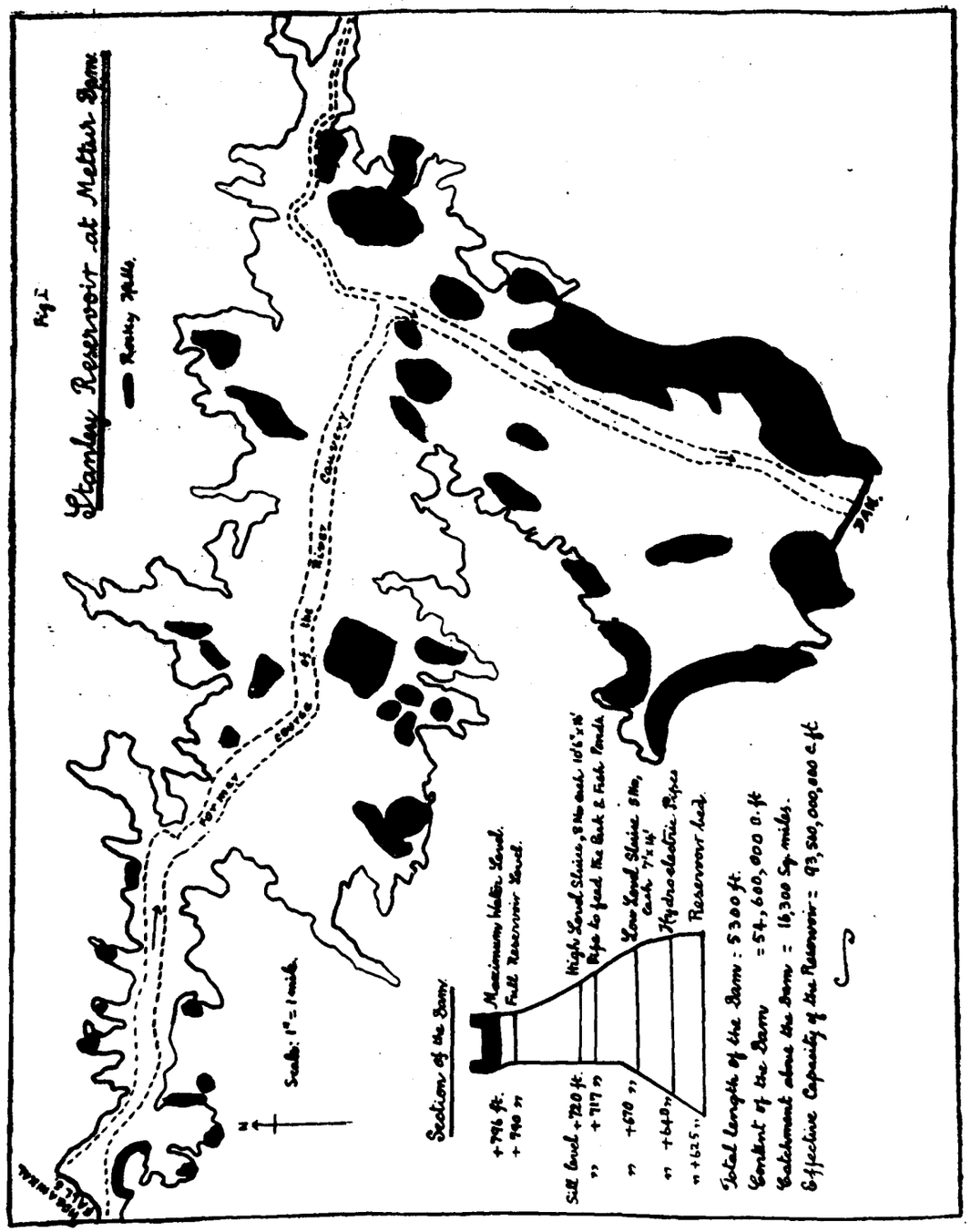
Year.	*Dates on which surplussing began and stopped.*	
1945	1st January	20th January
1946	8th August	31st December
1947	1st January	13th February
	1st June	20th June
	27th August	26th November
1948	26th July	7th November

THE STANLEY RESERVOIR

(*a*) *Physical conditions* :

(1) **Depth**: The depth was recorded from the sill level of the hydro-electric pipes (+ 640 ft.) and not from the bed of the reservoir (+ 625 ft.) So, there is always a depth of 15 ft. of water retained in the reservoir and which is usually not taken into account. So, on the dates of examination the depths were as given below :

Date	*Recorded Level*	*Hydro-electric pipes*	*Depth from Reservoir bed*
25—6—1947	764·4 ft.	124·4 ft.	139·4 ft.
14–11—1947	780·6 ,,	140 6 ,,	155·6 ,,
20—2—1948	721·6 ,,	81·6 ,,	96·6 ,,
17—6—1948	740·0 ,,	100·0 ,,	115·0 ,,



On 20th June 1947 the surplus water stopped flowing through the Ellis Surplus and investigation was started a week or so afterwards. On 14th November, water from the reservoir was surplussing. On the other dates, water was being let out for irrigation either from the high level or low level sluices.

(ii) **Colour**: The colour of the surface and the bottom discharges (tail-race) is noted below against the dates of observation :

Date	*Surface water*	*Tail-race water*
25—6—1947	Green	Black
14–11—1947	Green	Brown
20—2—1948	Green	Green
17—6—1948	Green	Green
18—6—1948	Green	Brownish

(iii) **Turbidity**: The transparency of the water at different depths was found to be generally good at all situations excepting the very bottom where turbidity was noted on one or two occasions during the investigation.

(iv) **Smell**: A distinct smell of H_2S was noticed only at S_3, S_4, S_5 and S_6 on 25th June 1947 in the samples drawn from (1) high level sluice; (2) the pipe; (3) low level sluice and (4) tail-race.

(v) **Temperature**:

(*a*) The temperature of the surface water varied from a minimum of 28·2 deg. C to a maximum of 30·8 deg. C during the period of investigation. The maximum was recorded at 4-30 p.m. and the minimum at 7-20 a.m. on 20th February 1948.

The surface temperature varied with the changes in the atmospheric temperature (*Vide* Table II–diurnal variations on 14th November 1947).

(*b*) The bottom temperature varied from a minimum of 26·2 deg. C at 6 a.m. on 15th November 1947 to a maximum of 28·9 deg. C at 9-45 a.m. on 17th June 1948.

(*c*) *Thermal stratification :* The differences between the surface and bottom temperatures are shown below :—

Date	*Time*	*Surface*	*Bottom*	*Difference*	*Depth*
		Deg. C	Deg. C	Deg. C	Ft.
25- 6-1947	8-30 a.m.	29·4	26·7	2·7	124 4
14-11-1947	6-00 a.m.	28 6	26·4	2·2	140·6
,,	12 noon	30·0	26·6	3 4	,,
,,	6 p m.	29·4	26·6	2·8	,,
,,	12 midnight	29·0	26·6	2·4	,,
15-11-1947	6-00 a.m.	29·0	26 2	2·8	140·6
20- 2-1948	7-20 a.m.	28·2	26·4	1·8	81·6
	4-30 p.m.	30 8	26·4	4·4	,,
17- 6-1948	9-00 a.m.	29·6	28·9	0·7	100·0
19- 6-1948	9-30 a.m.	29·2	28·2	1·0	,,

It will be seen from the above that the maximum difference of 4·4 deg. C was noticed at 4-30 p.m. on 20th February 1948 and the minimum difference of 0·7 deg. C. at 9-00 a.m. on 17th June 1948. On other occasions the differences fluctuated between these two extremes.

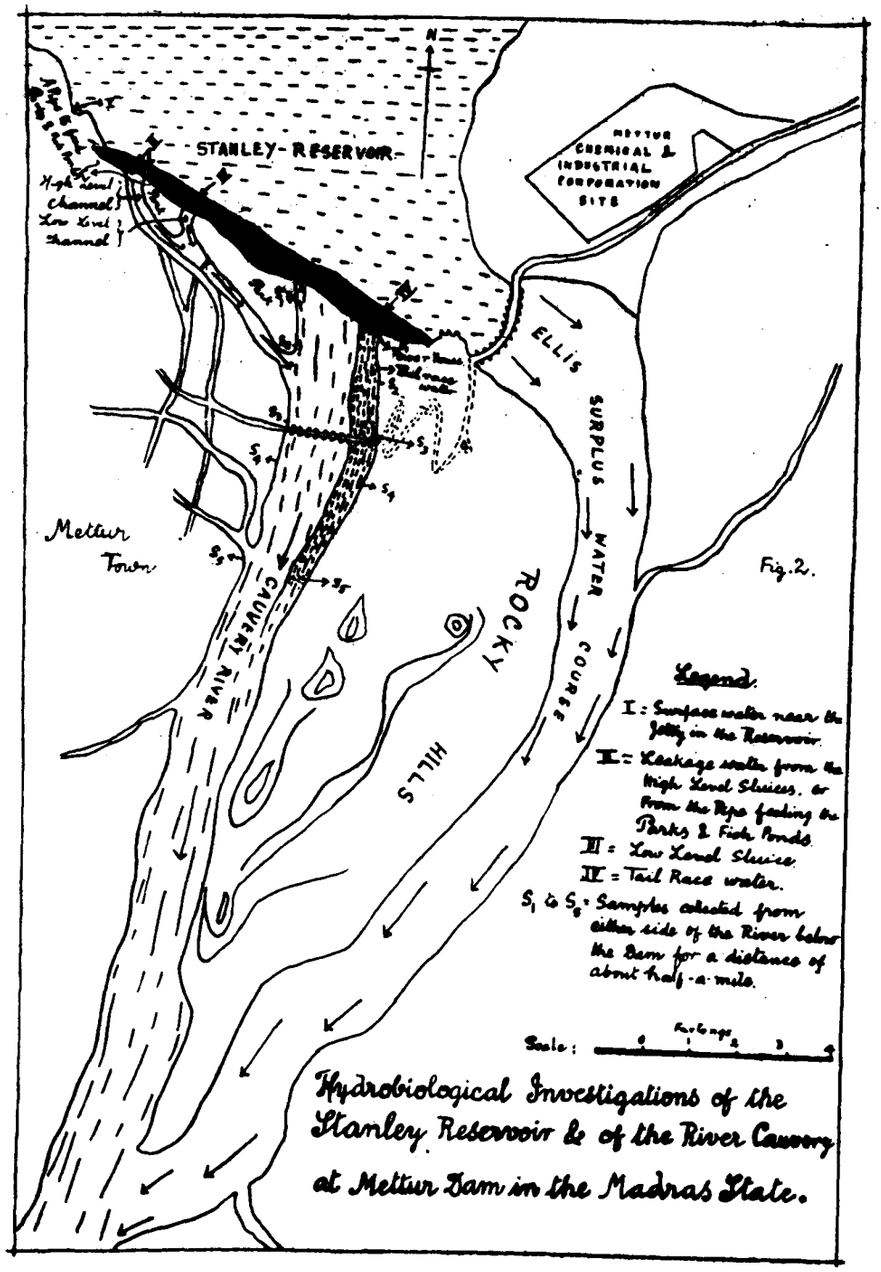


Fig. 2.

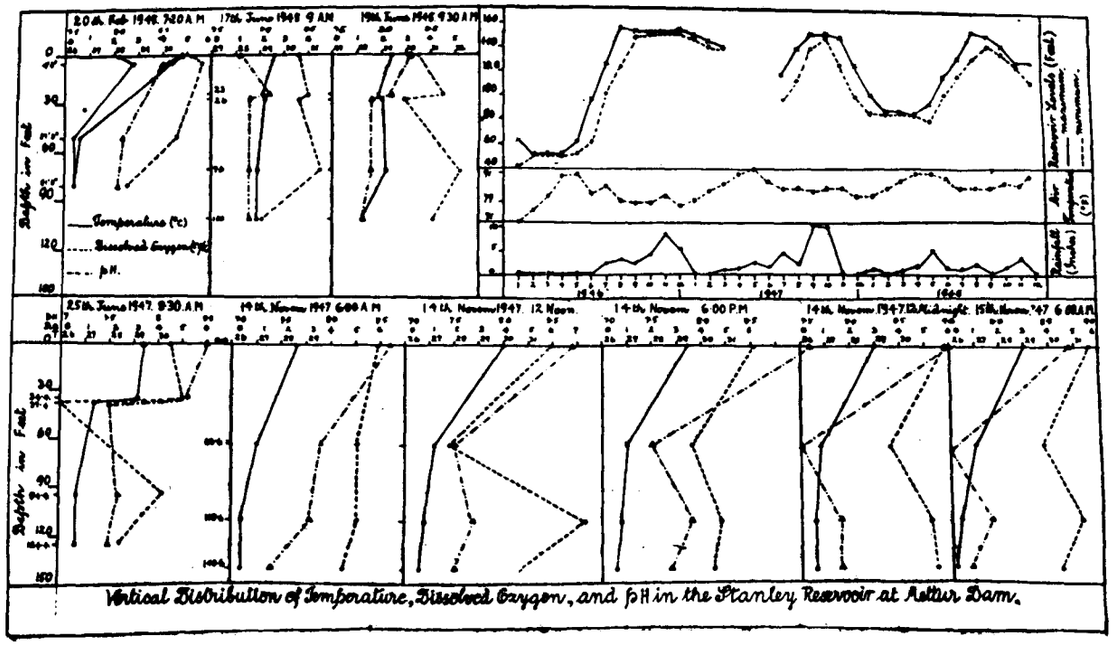
(*d*) *Vertical distribution of temperature*: Chart I and Tabular Statement No II give the data for the vertical distribution of temperature on different dates in the reservoir. A study of the graphs will show that (*a*) on 25th June 1947 at 8-30 a. m. and on 20th February 1948 at 7-20 a. m. there was a pronounced thermal stratification; (*b*) that on 14th November 1947, the water layer below 63.6 ft. depth appeared to be unaffected but above that layer, fluctuations in temperature were noted; (*c*) and that on 17th and 19th June 1948 the curve was almost a straight one indicating minimum differences in temperature between the surface and the bottom layers.

(*b*) *Chemical conditions:*

(1) **Carbon di-oxide:** Free CO_2 was absent at the surface layer, but was present at the other layers and varied from a minimum of 0.15 parts on 14th November 1947 to a maximum of 0.39 parts on 17th June 1948.

Carbonates (CO_3) were present at the surface layer and absent at the other layers indicating the region of photo-synthesis. They varied from a minimum of 0.3 parts on 19th June 1948 to a maximum of 1.95 parts per 100,000 on 25th June 1947.

Bicarbonates (HCO_3) varied from a maximum of 21.04 parts per 100,000 on 25th June at the bottom to a minimum of 6.71 parts at 12 midnight at the surface on 14th November 1947. Free CO_2 and bicarbonates increased with depth.



Vertical Distribution of Temperature, Dissolved Oxygen, and pH in the Stanley Reservoir at Mettur Dam.

(2) **pH:** The pH of the surface layer was always above 8·0 but in the lower layers it was below 8·0. It varied in the present study from a minimum of 8.1 on 17th June 1948 to a maximum of 79.2 at 6 p.m. on 14th November 1947 at the surface; and from a minimum of 7.4 on 14th November 1947 to a maximum of 7.95 on 20th February 1948 at the bottom layer.

In the vertical direction (*Vide* Graph I) the pH decreased with the depth and moved almost parallel to the graphs for dissolved oxygen.

(3) **Dissolved Oxygen:**

The values for the surface and bottom layers on the different dates are given below:

Date	*Time*	*Surface*	*Bottom*	*Difference*
25—6—1947	8-30 a m.	4·467	2·513	1·954
14–11—1947	6-00 a.m.	5·968	4.580	1·388
14–11—1947	12-00 Noon	5·967	4·718	1·249
14–11—1947	6-00 p.m.	6·106	4·580	1·526
14-11—1947	12-00 Midnight	5·829	5·412	0·417
15–11—1947	6-00 a.m.	5·690	4·441	1·249
20—2—1948	7-20 a.m.	5·233	2·616	2·617
17—6—1948	9-00 a.m.	3·643	2.102	1·541
19—6—1948	9-30 a.m.	3·503	4·064	+0·561

It will be seen from the above that at the surface, the oxygen values varied from a minimum of 3·503 cc/l on 19th June 1948 to a maximum of 6·106 cc/l at 6 p.m. on 14th November 1947; and at the bottom from a minimum of 2·102 cc/l on 17th June 1948 to a maximum of 5·412 cc/l at 12 midnight on 14th November 1947.

The surface layer was surpersaturated (100.6 to 108.6 per cent) on 14th and 15th November 1947 indicating vigorous photo-synthesis and the water was also green in colour.

Vertical distribution of oxygen: A study of the charts and Table II shows (*a*) that at S_4 on 25th June 1947 there was no oxygen in the water feeding the Park and Fish Ponds—that is, at a depth of 37.4 ft. from the surface; and at other lower levels though oxygen was found, its presence had to be attributed to aeration; (*b*) that on 14th November 1947 the amount of oxygen decreased with depth; (*c*) and that on 20th February 1948 and 13th June and 19th June 1948 the oxygen curves ran almost parallel to the corresponding temperature curves and

indicated wide fluctuations from the surface to the bottom due to aeration.

(4) **Nitrates:** Varied from a minimum of nil to a maximum 0.010 parts per 100,000 (S_5 on 19th June 1948.) At the surface, it was invariably absent but was present in varying amounts at the lower layers and usually increased with depth.

(5) **Phosphates:** Varied from nil to 0 010 parts per 100,000 (S_5 on 19th June 1948) and were present at all depths, being slightly more at the lower layers than at the surface.

(6) **Silicates:** Varied from a minimum of 0.1 part to a maximum of 1.6 parts per 100,000 and were found to increase with depth.

(7) **Iron:** The quantity varied from nil to 0.34 parts per 100,000. It was invariably absent at the surface, but was present in the under layers and appeared to increase with depth. Thus, it was found in abundance on 25th June 1954 in the black coloured water emerging from the tail-race.

(8) **Hydrogen Sulphide:** This gas found in the samples drawn on the 25th June 1954 from the tail-race and from the pipe leading to the garden and fish ponds; and the quantity varied from a "trace" to 0·14 parts per 100,000. H_2S was not noticed on the other days covered by this investigation.

(9) *Chlorides:* Varied from a minimum of 1·0 part to a maximum of 1·7 parts per 100,000.

THE CAUVERY RIVER BELOW THE DAM

(a) 23rd June 1947:

The vents in the low level sluice (*Fig. 2*) were closed at the time of the investigation on 23rd June 1947, but the vents in the high level sluice were open. So a part of the water supply to the river below the dam came from the high level channel—that is, from the 34 ft. level from the water surface in the reservoir. Under pressure of the above head of water, it rushed out through the narrow vents with tremendous force causing a column of water sprayed to a height of 50 ft. near the bend in the channel. The water rushed and dashed against numerous boulders of rock forming the bed of the channel till it joined the main river.

The tail race water discharging from the turbines operating under a head of 94·4 ft. for the generation of electricity was discoloured black and smelt strongly of sulphuretted hydrogen. Because of the powerful flow of this coloured water, almost a fourth of the river below the dam was black in colour (the water not mixing with the bluish-green water from the high level sluice) for about half-a-mile below the dam. The two distinct streams

flowing side by side gradually got mixed and ultimately the river water became uniform in colour. Samples of the water were taken from five different points along the two banks of the river till the two portions got completely mixed up. The results are shown in Table III.

GENERAL CHARACTERISTICS OF THE TWO SECTIONS OF THE RIVER

The meandering black eastern portion of the river had lower temperature (26·6 to 27 deg. C), lower content of oxygen (2·513 to 3·250 CC/L) and percentage of saturation (42·9 to 55·6), lower pH (7·5), but higher content of phosphates, silicates and nitrates than the water in the western portion of the river, which was flowing at a terrific speed and where the water was bluish green, at a slightly higher temperature (27.0 to 29·8 deg. C), higher oxygen content (4·118 to 5·444 CC/L) and phosphates, silicates and nitrates lower.

The surface water in the reservoir was bluish green in colour, but quite transparent, the greenish tinge being due to the dominance of *Synedra* sp and *Pediastrum* spp. A few copepods and fewer rotifers constituted the Zooplankton. Water issuing from the lower level channel also smelt strongly of sulphuretted hydrogen. There was a thick carpet-like growth of the sulphur bacterium *Thiothrix nivea* which coloured the bottom a dull white. Mixed with it all over the granite steps in the low level sluice, there was an abundant growth of *Spirogyra* sp even in the flowing water. As an adaptation to the fluviatile conditions, the alga had developed rhizoical anchoring organs. Other associated forms were *Scenedesmus* sp. and *chroococcus* sp. Immediately below the sluice gates in the channel, where the water was more or less stagnant, the entire bottom was covered with small slimy cushion-like colonies of *Rivularia*. In association with this growth, there were numerous specimens of *Amphora*, *Navicula*, *Fragillaria*, and *Oscillatoria* and all these organisms were found in the gut contents of fish that frequented this portion.

In the black coloured eastern portion of the river the rocks and stones at the bottom were covered with a luxuriant growth of *Thiothrix nivea* besides an abundance of algal growth. This sulphur organism formed not only a uniform felt-like covering over the rocks, but formed trailing filaments attached to the shoots and leaves of submerged plants as well. Along with it the following organisms were found in association. *Stegioclonium* sp. appearing as specks of bright green, *Scenedesmus*, *Fragilaria* sp., filaments

of *Ulothrix* sp., *Spirogyra* sp. and *Oscillatoria* sp. were inter-woven on the submerged grass and colonies of *Microcystis spp*. It is apparent from the above that several of the common algae and diatoms could thrive in an environment charged with H_2S. Curiously enough, the animal life in the region was rich. In the low level channel, where black coloured water was flowing gastropod shells and *Palaemon* sp. were found to be actually teeming. Insect life was also seen in plenty in the moss and algal encrustations on stones. The common species of fish like *Labeo Kontius*, *Garra* sp., *Barillus* sp., *Danio* sp., *Cirrhins reba*, *Barbus carnaticus* and *Barbus Sarana* were quite common in the area. Examination of the gut contents of a few specimens of fish showed that they had been feeding actively on the algal encrustations and that the sulphur bacterium was also included in their menu. Similarly also in the region where the black coloured water was flowing in the river several fishes were seen feeding on the algal growths. Further down the river before the malodourous water got completely mixed with the ordinary river water, shoals of fish–*Cirrhina reba* were seen feeding. In spite of the presence of H_2S, the conditions of existence were therefore not altogether inimical to fish life below the dam.

(*b*) *14th November 1947*: There was no smell of H_2S in the tail-race water, which was coloured brownish and not black on this occasion but was very turbid. So, the eastern portion of the river was brownish and the western portion greenish. The brownish colour of the tail-race water was obviously due to freshes reaching the river as a result of the local showers in the higher reaches of the river, and also probably due to settlement of the freshes which had reached in June, July, August and September. So the physical, and chemical characteristics (Table II) differed considerably. The eastern portion (S_4) was brownish, more turbid, had a temperature of 26.4 to 26.6 deg. C and contained more phosphates, nitrates, silicates and iron than the western portion (S_1) of the river.

(*c*) *20th February 1948*: On this occasion though the entire river below the dam was coloured greenish, there were slight differences between the eastern (S_4) and western portions (S_1) of the river (Table II). The eastern portion was less warm, but contained more of the nutrient substances of biological significance.

(*d*) *17th and 19th June 1948*: On 17th June the water in the entire stretch resembled that on 20th February 1948, but on 19th June 1948, the tail-race water—that is, the eastern portion of the river became reddish while the western portion continued to be greenish. The characteristics of the two are shown in Table II (S_1 & S_4). This sudden change in colour is attributable to cold freshes reaching the

reservoir from the upper reaches of the river.

DISCUSSION

The important points arising out of this investigation are: (1) Thermal stratification and H_2S formation in the reservoir (ii) Nutrient substances of biological significance occurring in the tail-race water.

(i) *Thermal Stratification and H_2S formation in the reservoir :*

Investigations on four dates only were made during a period of 2 years (1947-1948) from which it is found difficult to draw any definite conclusions about the stability of thermal stratification. On 25th June 1947 there was a pronounced thermal and oxygen stratification accompanied by the production of sulphuretted hydrogen from the 34·4 foot layer down to the bottom. It could not be definitely ascertained from the engineering authorities when the production of H_2S was first noticed in the tail-race and at other depths above and when it stopped. But it is known that surplussing of water through the Ellis Channel was taking place from 8th August 1946 to 20th June 1947 continously and the investigation relating to the vertical distribution of temperature, dissolved gases, etc., was made on 25th June 1947—that is, five days after surplussing had stopped.

Again on 14th November 1947, the second investigation was made. From 26th August 1947 to 26th November 1947, water from the reservoir was surplussing. So, the second investigation was made twelve days before surplussing ceased. On this occasion the nature of the thermal stratification was entirely different from the first. There were changes in temperature from the surface to the 63.6 foot layer, but lower down from 63·6 ft. to the bottom the temperature of water remained the same in the course of twenty-four hours. Further, there was no production of H_2S in the under layers which were fairly well saturated with oxygen.

On the third occasion (20th February 1948), there was no surplussing of water. But the nature of thermal stratification was almost similar to that on 14th and 15th November 1947.

On the last two dates (17th and 19th June 1948) the water level was increasing and there was no surplussing. There was a difference of 0.7 to 1.0 deg. C between the surface and bottom layers and there was also no production of H_2S in the underlayers.

Every year from January to May, the reservoir does not get either freshes from the upper reaches or rainfall in the locality. Lowest level of water is reached in the reservoir. But from the middle of June till September, the reservoir gets water from the source of the river in Coorg where rainfall is maximum. So the water level rises from June until the maximum is reached in August or September ordinarily when Ellis Surplus starts

functioning. From October to December there is unpredictable local rainfall. So, if there is rainfall during this period, the maximum level will be maintained. If not the water level goes down and the high or low level sluice will be opened for irrigation. It seems, therefore, that a pronounced thermal stratification characterised by the absence of oxygen and the presence of H_2S in the under-layers will be possible only under certain conditions and in certain years only. The present series of investigations has not been of help in determining these conditions. More work is indicated for arriving at a definite conclusion as to when and under what conditions H_2S is formed in the under-layers.

On 25th June 1947, even at a depth of 34 feet from the surface, because of the absence of oxygen and the presence of H_2S, conditions below the 34 foot layer were unsuitable for fish life. As a result, a major portion of the water space (nearly two-thirds is rendered waste so far as fish productivity is concerned on account of lacustrine conditions created by the damming up of the Cauvery river. But the lotic conditions created below the dam in the river more or less nullify this effect, and even though the water is still offensive-smelling, it is rendered suitable for fish and plant life.

(ii) *Nutrient substances of biological significance in the tail-race water :—*

It is seen from Table II that phosphates, nitrates and silicates are present in greater amounts in the tail-race water than in the water issuing from the high level sluice. Their presence is due to biological action taking place in the under-layers on account of higher bottom temperature which ranges from 26 to 30 deg. C (Ruttner 1931).

SUMMARY

(1) Ordinarily, there is a difference in temperature between the surface and bottom layers in the Stanley Reservoir. Mixing is confined to a certain depth at the top during certain months, but a thorough mixing from the surface to the bottom at least once a year appears to be possible.

(2) A pronounced thermal stratification accompanied by absence of oxygen and presence of H_2S in the underlayers appears to beformed under certain conditions in certain years only.

(3) The temperature of the bottom layer of water is fairly high and therefore due to increased biological activity, the tail-race water contains greater amounts of nutrient substances than the top water issuing from the high level sluice.

(4) On certain occasions the tail-race water differs physically, chemically and biologically from the top water issuing from the high level sluice and the river below the dam presents a strange appearance.

REFERENCES

1 GANAPATHI, S. V. (1943) :
'An Ecological Study of a Garden Pond containing abundant Zoo-Plankton' Proc. Ind. *Acad. Sc., Vol.* XVII, *No.* 2, *Sec., B*, *pp.* 41-48. (1943)

2. RUTTNER, F. (1931) :
Hydrographischc and Hydrochemische Beobachlungen auf Java Sumatra und Bali. Arch. f. Hydrob. Suppl. B., VIII, *pp.* 197-454, (1931)

3. SUNDARA RAJ (1942) :
Dams and Fisheries ; Mettur and its lessons for India. Proc. Ind. *Acad. Sc. Vol.* XIV, *Sect. B*,, *pp.* 341-358.

Table No. 1 SHOWING THE RAINFALL, AIR TEMPERATURE AND WATER

Months	Total Rainfall in inches				Temperature of air—					
					1945			1946		
	1945	1946	1947	1948	Max.	Min.	Mean.	Max.	Min.	Mean.
January	..	0·63	0·11	1·06	..	..	..	85	68	71
February	..	Nil	Nil	Nil	..	..	..	90	73	76
March	..	0·60	1·07	0·85	..	..	..	95	80	82
April	..	0·35	1·42	1·88	..	..	..	95	85	90
May	..	0·50	2·88	5·19	96	86	91	96	87	91
June	..	0·40	1·75	1·32	93	84	88	94	80	83
July	..	2·89	4·97	1·33	90	80	85	93	80	86
August	..	3·15	2·32	2·12	89	81	85	9?	79	80
September	..	2·64	10·69	0·19	90	82	86	91	78	79
October	4·88	4·15	10·02	1·76	85	81	83	91	78	79
November	3·89	8·85	0·65	3·68	83	77	80	87	77	82
December	Nil	6.09	0.10	0·15	84	73	78	84	73	78
Total	..	30·25	35·98	19·53						

* Reckoned from – 640 ft.

LEVEL IN THE STANLEY RESERVOIR DURING 1945 to 1948.

Monthly averages (°F)								Reservoir Levels (in Feet)*					
1947			1948			1945		1946		1947		1948	
Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
87	74	80	86	78	82	..	..	63·75	41·55	151·75	146·05	101·05	86·25
92	79	85	91	80	85	..	.	51·25	49 4	146·15	141·25	84·4	86·35
96	80	88	94	82	88	..	..	51·30	51·15	141·25	141·2	88·4	87 20
100	83	91	101	82	91	..	..	53·75	51·15	..	..	87·05	86·90
102	84	93	100	83	91	..	..	62·35	52·7	..	..	95·95	80·95
95	81	88	99	80	89	..	..	97·4	62·4	..	..	118·75	103·00
92	79	85	94	78	85	88·3	77·8	126·25	102·1	119·0	98·75	133·85	119·10
92	79	85	93	78	85	106·15	91·0	156·0	124·7	140·1	113·15	156·00	134·2
91	78	84	91	79	85	103·15	74·8	153·45	148·6	153·2	141·95	153·3	145·8
93	78	85	96	79	87	88·35	76·0	152·50	149·3	153·2	150·3	145·0	137·2
94	76	85	96	77	86	94 9	80·9	152·70	151·9	150·9	127·85	136·6	128·6
87	78	82	95	82	88	87 9	66·29	153·75	151·7	127·85	100·55	131·35	114·85

— the sill level of the Hydro-electric pipes.

Table No. II ... Shewing the Physical & Chemical

Sl. No.	SOURCE	PHYSICAL Depth (Ft.)	Time A.M.	Colour	Turb. Smell (Cm·)	Temp. (°C)
	DATE OF COLLECTION				*25th June 1947*—	
S_1	From the reservoir near the Jetty-Surface, reservoir ...	0.0	8·30	Gr.	>20 Nil	29.4
S_2	Leakage from the first vent in the High Level Channel ...	34.4	8·45	Nil	>30 H_2S	29.2
S_3	Water gushing from the 2nd vent in the High Level Channel ...	34.4	8·50	...	>30 Nil	29.2
S_4	From the main feeding the circular basin in the Park and Fish Ponds	37.4	9·00	...	>30 H_2S	27.4
S_5	Leakage water from the vent in the Low Level Sluice ...	94.4	9·30	Nil	>30 H_2S	26.7
S_6	From the Tail-race water near the Power House ...	124.4	10·20	Black	>30 H_2S	26.7
	DATE OF COLLECTION				*14th November 1947*—	
S_1	From the reservoir near the Jetty-Surface water ...	0.0	6.00	Gr.	>30 Nil	28.6
S_4	From the main feeding the circular basin in the Park and Fish Ponds	63.6	,,	Wh.	18.5 ,,	27.0
S_2	Leakage water from the Low Level Sluice ...	110.6	,,	Br.	13.0 ,,	26.4
S_4	Tail-race water from the Power House ...	140.6	,,	Br.	14.0 ,,	26.4
S_1	From the reservoir near the Jetty-Surface water ...	0.0	12 Noon	Gr.	>30 Nil	30.0
S_2	From the main feeding the Park and Fish Ponds ...	63.6	,,	Wh.	18.5 ,,	27.2
S_3	Leakage water from Low Level Sluice ...	110.6	,,	Br.	14.0 ,,	26.8
S_4	Tail-race water from Power House	140.6	,,	Br	14.0 ,,	26.6
S_1	From the reservoir near the Jetty-Surface water ...	0.0	6 p.m.	Gr.	30 Nil	29.4
S_2	From the main feeding the Park ...	63.6	,,	Wh.	18.5 ,,	27.0
S_3	Leakage water from low Level Sluice ...	110.6	,,	Br.	14.0 ,,	26.8
S_4	Tail-race water from Power House	140.6	,,	Br.	14.0 ,,	26.6
S_1	From the reservoir near the Jetty-Surface water ...	0.0	12 Mid-Night	Gr.	... Nil	29.0
S_2	From the main feeding the Park	63.6	,,	Wh.	... Nil	26.8
S_3	Leakage water from Low Level Sluice ...	110.6	,,	Br.	... Nil	26.6
S_4	Tail-race water from Power House	140.6	,,	Br.	... Nil	26.6

Conditions in the Stanley Reservoir, Mettur Dam, Madras State.

CHEMICAL—Parts per 100,000											
Carbon dioxide Free	Co_3	HCO_3	pH	D. O. CC/L	D. O. %Sat	NO_3 N	P_2O_5	SiO_2	Fe	H_2S	Chloride
—*Water Level 764, 4 Ft.*											
Nil	1·95	13·88	8·5	4·467	79·4	·002	·001	0·3	Nil	Nil	1·7
,,	1·50	14·94	8·3	5·095	91·2	·004	·004	0·3	0·04	·08	1·7
,,	1·80	14·03	8·3	5·026	90·7	·002	·003	0·4	·01	Nil	1·7
·27	Nil	19·21	7·5	0·0	0·0	Tr.	·006	0·4	·08	0·14	1·7
·21	Nil	20·59	7·6	4·258	72·5	·005	·006	0·4	·09	0·10	1·7
·31	Nil	21·04	7·5	2·513	43·0	·005	·005	0·1	·34	Tr.	1·7
—*Water Level 780.6 Ft.*											
Nil	1·2	7·32	8·6	5·968	104·7	Nil	·002	1·1	Nil	Nil	1·1
·15	Nil	10·37	7·9	5·135	87·9	Tr.	·002	1·2	Tr.	,,	1·1
·15	Nil	10·67	7·8	5·135	87·0	,,	·003	1·4	·01	,,	1·2
·26	,,	10·06	7.4	4·580	77·6	·006	·005	1·4	·04	,,	1·2
Nil	0·60	7·93	8·7	5·967	107·1	Nil	·002	1·0	Nil	Nil	1·2
·25	Nil	9·76	7·5	1·804	31·0	·005	·002	1·2	·01	,,	1·1
·22	,,	9.76	7·7	7·355	125·5	·005	·003	1·4	·06	,,	1·2
·33	,,	11·59	7·5	4·718	80·2	·006	·003	1·4	·08	,,	1·2
Nil	1·2	7·01	>9·2	6·106	108·6	Nil	·002	1·2	Nil	Nil	1·1
·20	Nil	9·45	7·5	3·608	61·8	·004	·003	1·2	·01	,,	1·1
·18	,,	10·06	7·9	4·857	82·9	·005	·004	1·5	·06	,,	1·2
·18	,,	12·50	7·7	4·580	77·9	·005	·004	1·4	·08	,,	1·2
Nil	1·5	6·71	9·0	5·829	103·0	Nil	·002	1·1	Nil	,,	1·1
·20	Nil	8·84	7·5	3·608	61·6	·005	·002	1·2	·02	,,	1·1
·17	,,	11·59	7·9	5·274	89·7	·005	·004	1·5	·08	,,	1·2
·20	,,	11·89	7·9	5·412	92·0	.005	·005	1·4	·10	,,	1·2

Table No. II (ctd.) **Showing the Physico – Chemical**

Sl. No.	SOURCE	PHYSICAL				
		Depth (Ft.)	Time A.M.	Colour	Turb. Smell (Cm.)	Temp. (°C.)
	DATE OF COLLECTION				*15th November 1947*—	
S_1	From the Jetty-Surface water ...	0.0	6-00 A. M.	Gr.	... Nil	29.0
S_2	From the main feeding the Park ...	63.6	,,	Wh,	... ,,	27.2
S_3	Leakage water from Low Level Sluice ...	110.6	,,	Br.	... ,,	26.4
S_4	Tail-Race water from the Power House ...	140.6	,,	Br.	... ,.	26.2
	DATE OF COLLECTION				*20th February 1948*—	
S_1	From the reservoir, near the Jetty-Surface ...	0.0	A. M. 7.20	Gr.	25 Nil	28.2
S_2	From the main feeding the Park	4'6"	7.30	Gr.	25 ,,	28.8
S_3	Leakage water from Low Level	51'6"	7,40	Grey	13.6 ,,	26.4
S_4	Sluice From the Tail-race water near the Power House ...	81'6"	8-40	Grey	12.0 ,,	26.4
	DATE OF COLLECTION				*20th February 1948*—	
S_1	From the reservoir near the Jetty-Surface ...	0.0	P.M. 4.30	Gr.	... Nil	30.8
S_2	From the main feeding the Park and Fish Ponds ...	4'6"	4.40	,,	... ,,	30.2
S_3	Leakage water from Low Level Sluice ...	51'6"	4.50	,,	... ,,	26.6
S_4	From the Tail-race near the Power House ...	81'6"	5.10	,,	... ,,	26.4
	DATE OF COLLECTION				*17th June 1948*—	
S_1	From the reservoir near the Jetty-Surface water ...	0.0	A.M. 9.00	Gr.	>30 Nil	29.6
S_2	Leakage water from High Level Sluice ...	23.0	9.05	,,	>30 ,,	29.1
S_3	From the main feeding the Park and Fish Ponds ...	26.8	9.15	,,	>30 ,,	29.2
S_4	Leakage water from the Low Level Sluice ...	70.0	9.25	,,	>30 ,,	28.9
S_5	Tail-race water from the Power House ...	100.0	9.45	,,	>30 ,,	28.9
	DATE OF COLLECTION				*19th June 1948*—	
S_1	From the reservoir near the Jetty-Surface water ...	0.0	A.M. 9.30	Gr.	>30 Nil	29.2
S_2	Leakage water from the High Level Sluice ...	22.8	9.40	,,	>30 ,,	28.9
S_3	From the main feeding the Park and Fish Ponds ...	25.8	9.50	,,	>30 ,,	29.0
S_4	Low Level Sluice open ...	72.8	10.00	,,	>30 ,,	29.2
S_5	Tail-race water from the Power House ...	102.8	10.00	Red	13.0 ,,	28.2

Conditions in the Stanley Reservoir, Mettur Dam, Madras State.

CHEMICAL—Parts per 100,000											
Carbon dioxide Free	CO_3	HCO_3	pH	D. O. CC/L	D. O. %Sat	NO_3 N	P_2O_5	SiO_2	Fe	H_2S	Chloride
Water Level 721·6 ft.											
Nil	1·2	7·01	8·7	5·690	100·6	Nil	·002	..	..	,,	..
·20	Nil	9·15	7·5	3·747	64·7	·005	·002	..	..	,,	..
·18	,,	10·67	7·9	5·274	89·4	·005	·003	..	..	,,	..
·18	,,	11·28	7·7	4·441	75·0	·005	·004	..	..	,,	..
—*Water Level 721·6 ft.*											
Nil	1·80	15·15	8·7	5·233	91·3	Nil	·002	0·1	Nil	,,	1·5
,,	1·65	16·32	8·5	5·645	99·4	,,	·002	0·1	,,	,,	,,
,,	0·60	17·69	8·11	4·613	78·2	Pre.	·004	1·0	,,	,,	,,
,,	0·30	18·00	7·95	2·616	44·4	,,	·004	1·0	,,	,,	,,
—*Water Level 721.6 ft.*											
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	.	..	..	..	..	..	..	...	..
—*Water Level 740.0 ft.*											
Nil	0·6	16·16	8·1	3·643	64·9	Nil	Nil	1·4	Nil	Nil	1.3
Nil	0·6	15·55	8·1	4·064	70·9	·002	.002	1·4	,,	,,	,,
·39	Nil	16·47	7.7	3·643	64·6	·004	·006	1·4	,,	,,	,,
·29	,,	16·77	7·9	4·084	79·1	·004	·008	1·6	.04	,,	,,
·39	,,	16·16	7·9	2·102	37·1	·006	·008	1·6	.04	,,	,,
—*Water Level 742.8 ft.*											
Nil	0·3	16·16	8·3	3·503	62·1	Tr.	·001	1·4	Nil	Nil	1.3
,,	0·3	16·47	8·1	4·484	79·1	,,	,,	1·4	Nil	Nil	,,
·34	Nil	16·77	7·9	2·943	51·9	·004	·004	1·6	,,	,,	,,
·22	,,	17·38	7·9	5·185	91·9	·008	·008	1·6	,,	,,	,,
·25	,,	16·16	7·8	4·064	70·9	·010	.010	1·6	.14	,,	1·0

Table No. III — **Showing the Results of Analysis of Samples of Water collected from the two banks of the river Cauvery to a distance of about ½ mile Below the Dam on 23rd June 1947**

Stations	I		II	III		IV		V	
Description	E	W	E	W	E	W	E	W	E	W
A. *Physical:*			*Water Level*	*94.4 Ft. in the reservoir*						
1. Time of collection A.M.	9.30	9.40	9.45	12.00	9.55	12.10	10.20	10.20	10.30	10.35
2. Meteorology			Bright Sunshine	Clear blue sky—no wind						
3. Depth of water (Ft.)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
4. Smell	H_2S	Nil	H_2S	Nil	H_2S	Nil	H_2S	Nil	Nil	Nil
5. Colour	Inky	Green	Inky	Green	Inky	Green	Inky	Green	Green	Green
6. Turbidity (Cm.)	.....			.....	> 30 Cm.					.....
7. Temperature (°C.)	27.0	28.8	26.8	29.7	26.6	29.8	26.9	27.0	27.0	27.0
B. *Chemical:* (Expressed in parts per 100,000)										
8. Free CO_2	.308	Nil	.286	Nil	.198	Nil	.242	Nil	.110	Nil
9. CO_3	Nil	1.35	Nil	1.80	Nil	1.50	Nil	1.80	Nil	1.80
10. HCO_3	21.04	18.91	21.20	17.69	21.20	18.30	21.04	17.99	21.04	18.91
11. pH	7.5	8.4	7.5	8.5	7.5	8.5	7.5	8.3	7.5	8.3
12. D. O. (CC/L)	2.513	4.467	2.513	5.444	2.932	5.026	2.932	4.467	3.250	4.118
13. % Sat.	43.0	78.7	42.9	97.3	49.8	89.9	50.1	76.4	55.6	70.5
14. P_2O_5	.005	.002	.005	.002	.004	.001	.004	.002	.003	.002
15. SiO_2	3.8	3.0	3.8	3.2	3.8	3.1	3.9	3.3	3.8	3.1
16. NO_3N	0.005	0.001	0.004	0.004	0.004	0.002	0.005	0.002	0.006	0.002
17. Chlorides	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7

E = Eastern black portion of the river.

W = Western colourless portion of the river.

*The German Electro-Chemical Industry**

S. RAMASWAMY, B. Sc. Hons.,
Production Superintendent, M. C. & I. C. Ltd., Mettur Dam R. S.

IT is well-known that energy in the form of electricity causes chemical reactions in the electrolytic or the electro-chemical industry. This is a wide field, embracing the manufacture of metals like aluminium, magnesium, sodium, copper, iron, lead and others; non-metals like phosphorus, graphite, etc., or chemicals like carbon disulphide, caustic soda, chlorine, phosphoric acid, hydrogen peroxide, calcium carbide, etc. Relatively of recent origin, the electro-chemical process developed only in the last thirty years, but it has already brought about a revolution in the manufacturing costs of many products, the most outstanding of which are chlorine, sodium, hydrogen peroxide and aluminium.

The ramifications of the German chemical and electro-chemical industry are very wide. The development of the industry was controlled by the powerful I. G. Farben-industries, since almost all the electro-chemical plants in the country were merged with this group before the war. The huge resources of this combine, both financial and technical, enabled the German electro-chemical industry to attain a state of high productivity and contribute greatly to the German war effort. With the defeat of the Germans, however, the first step taken by the allies was to break up this big combine into several individual groups and to lay down the condition that they do not re-form again. Thus while formerly the powerful units of BASE at Ludwigshafen Hoechst near Frankfurt and Bayer Leverkusen near Koln were all in one in the I. G. Farben group, they are to-day separate, and in a sense, rival units.

During my sojourn, in West Germany early in 1954, I had opportunities of visiting some of the factories carrying on electro-chemical operations—chiefly, in the manufacture of chlorine and caustic soda, calcium carbide, graphite, etc. A vigorous rebuilding activity in the industry was evident everywhere, and many units are to-day at well over the peak war and pre-war production levels. It is my intention to discuss only two lines of production in this paper, these being of more direct interest to us in the chlorine-caustic soda field—namely, caustic soda and chlorine, and calcium carbide.

* Paper presented before a meeting of the Electro-chemical Society, Inc. India Section, at Mettur Dam.

Chlorine-Caustic Soda: Historically, the electrolytic chlorine industry began in Germany in 1892, with the first plant at Greisheim. Substantial increase in production came when in 1935, I. G. Farben launched a four-year chlorine plan, with the mercury cells as the basis. In mercury cells, plants had either the short horizontal cells up to 7 metres length as in Hoechst or the long horizontal cells up to 14 metres length as in Leverkusen or the rotary disc cells as in Rheinfelden and Huels. By 1943, I. G. Farben controlled about 70 per cent of chlorine production in Germany. Nearly 80 per cent of their capacity was mercury cell.

Many of the units suffered severe bomb damage, particularly during the closing stages of the war. But, chlorine production has continually been on the increase as the following production figures will show. (War-time figures of production are also given.)

Year:	*West Germany:*
1949	187,034 Tons.
1950	239,301 ,,
1951	280,913 ,,
1952	292,733 ,,
1953	337,233 ,,
1954 (1st half).	181,590 ,,

War time production for all Germany (inclusive of East Germany.)

1940	...	367,000 Tons.
1941	...	416,000 ,,
1942	...	463,000 ,,
1943	...	492,000 ,,
1944	...	499,000 ,,

The main chlorine plants are situated in Gendorf, Burghausen, Hoechst, Rheinfelden, Huels, Knapsack, Luelsdorf and Leverkusen in West Germany. Of these, I visited the plants at Hoechst, Rheinfelden, Knapsack and Leverkusen. The Germans have been largely responsible for the development and large-scale use of mercury cells in the manufacture of chlorine-caustic soda and practically all their entire production is by this process. A very small proportion is produced by the diaphragm process, and the Billiter type of cells is employed in two or three small plants. Hoechst and Leverkusen are the two big plants producing chlorine by the mercury cells, and one of these plants—Leverkusen, will now be briefly described.

Leverkusen has 204 cells operating at 20,000 to 30,000 amps.—some of the cells are 12 metres long and 60 cm. wide while others are 14 meters long and 80 cm. wide. Direct current for the cells is supplied by the familiar types of conversion equipment—Rotary convertors, M. G. Sets and mercury arc rectifiers. The rotary convertors and M. G. sets are older equipment, the new additions being mercury arc rectifiers.

The brine cell consists of an H—girder web 30 mm. thick, 732 mm. wide, sides 312 mm. high and 14 meters long. The sides are ebonite-covered, and the edge of the ebonite,

which is under mercury, is anchored under a steel strip screwed into the bottom. The cell is set to slope 20 to 25 mm. At the low end are an ebonite covered end-box, water-luted lid, and side issue lute for amalgam.

The decomposer is a single 8-inch bore, mild-steel pipe with graphite elements shaped to the curvature. Given high load on the cells and good heat insulation, it is possible to make 70 per cent caustic in them. Leverkusen has set apart a few cells for this purpose, the liquor going directly to a flaker placed in a cell below. The tops are sandstone covers said to last for about four years. Anodes are set 9 mm. from the cell bottoms. Mercury charge for the 20,000 amp. cell is 800 kgm/cell. The following are typical performance data:

12 M 60 Cm

Rated Gurrent	20,000 Amps.
Cathode Area M^2	5 M^2
Cathode Current Density	4000 A/m^2
Brine Inlet Concn.	300 g/l.
Temperature	60°C.
Outlet Concn.	250 g/l.
Tem.	75°C.
Cell Gas	94/96% Cl_2 0·9% H_2
Amalgam	0·1% Na.
Voltage	4·3-4·8 V.
Current Efficiency-	94%

Usages/ton Cl_2

Salt	1·785 tons.
H_2SO_4	69·4 kilos.
Hg	0·411 kilos.
Electrode	6·72 kgs.

In the brine plant, salt is discharged from wagons with a 1000-ton salt bunker below ground level. The dechlorinated brine runs into this heap from hand-manipulated hose pipes, and brine and some salt crystals flow through a gutter into three dissolvers of 30-40 cubic metres capacity, which are brick-lined concrete pits fitted with agitators. The brine is pumped from here by cast-iorn pumps to 13 ebonite and tile-lined tanks of 50 cu. metres for treatment with $BaCO_3$, Na_2CO_3 and caustic and bisulphite. The brine is then filtered by Kelly-type pressure filters (5 numbers) and stored finally. The discharge liquor from the cells is dechlorinated by adding HCl boiled *in vacuo* (400 mm. vac. provided by three stone-ware Elmo pumps) blown with air and treated finally with caustic before pumping on to the salt heap.

A typical analysis of the salt used in the plant is NaCl—98·4 per cent, $CaSO_4$—0·87 per cent, Na_2SO_4—0·20 per cent, MgO—0·04 per cent.

The caustic liquor from the cells has the following analysis:

NaOH-50 per cent, Cl - 0·1 per cent, CO_3—0·1; SO_4 - 0·01 per cent, Fe_2O_3 Al_2O_3-0·0005 SiO_2 - 0 002 per cent Hg - 40-80 mg/m^3

The chlorine gas is drawn from the cells by chlorine compressors at the liquid chlorine plant. It passes through two mild - steel, tile-lined towers in series, packed with rings.

A8809

The towers have Oppenol between the iron and the tile lining Water is sprayed in to remove the salt carry-over in the chlorine and also to cool the gases down. The washed gas is dried in a two-stage conventional acid drying system, three towers being in parallel in each stage. The towers are of 1·5 meters dia., 7 metres high, and packed with 2-inch rings. For the strong acid, cast-iron towers are used and for the weak acid, iron towers, tile-lined on Oppenol are used

At Leverkusen, a wide variety of operations is covered and a whole range of chemicals produced. The plant employs around 14,000 people, of whom 1,600 are technical men, 1400 are on the administrative side and 11,000 are plant operatives. In the first category of technical skilled men, nearly 600 are engaged on research. Among the plant operatives, about 2200 are skilled and the rest un-skilled labour. The plant produces barium compounds, activated charcoal, chlorine, sodium hydroxide, hydrogen, hydrochloric acid, oxygen, chromium compounds, fluorine and fluorine compounds, sodium compounds, sulphur and chlorine compounds, carbon and chlorine compounds, titanium compounds, vanadium pentoxide, zinc and zirconium compounds, and on the organic side, phenol, dipehnyls, isocyanates, tanning gas and tanning agents, amines, chlorinated hydrocarbons, piperidine, rubber accelerators, rubber antioxidants, resins, etc.

The Leverkusen plant consumes over 300 million kWh of power (33,000—36,000 kW), about 50 percent of which is purchased power. They generate nearly 140 million units in their own power stations. Over 18,000 kWh of power is for their chlorine and caustic soda.

An interesting development in Germany has been that different products have been made from the sodium amalgam of the chlorine cell, apart from making caustic soda. At Hoechst for instance, a few cells are set apart to make pure, nearly water-white sodium sulphide. This is done by reducing the slope of the secondary cell from the normal 13 cms. for the 7 metres to a slope of 6 cms. only and introducing sodium poly-sulphide (Na_2S_4) in parallel current with the flow of the amalgam. At the discharge end, Na_2S_4 is converted to Na_2S completely. Two types of products are made:

	I.	II.
Na_2S	-29-30 percent	58–60 percent
$Na_2S_2O_3$	-0·2-0.3 percent	0·2-0.4 percent
Hg	-0·1 percent	0·1 percent
Free S	...	0·1-0· 5 percent

For the above two types the entrant liquor has a composition of

	(*a*)	(*b*)
Na_2S	- 10–11 percent	20–21 percent
Free S	- 11–12 percent	22–23 percent

At Leverkusen, the sodium amalgam is used to hydrogenate nitrobenzene finely suspended in water. The temperature is controlled around 80 deg.C and by the reduction about 80 percent of benzidine is formed. Another use of the amalgam in BASF is the manufacture of sodium hydrosulphite by reaction with sulphur-di-oxide in preference to the conventional zinc dust-sulphur-di-oxide method.

Calcium Carbide:

The carbide industry had its origin in Germany at Hart in the period 1900—1910. Then came Knapsack in the early 1910's, followed by Burghasen

in 1920 and Ludwigshafen in 1940-42. All plants follow the same process—namely, the electric furnace fed with lime and anthracite and coke. There have been developments and improvements in the handling of raw materials and finished products, in the electrode design and also in working conditions. Consumption of electricity in the modern furnaces is about 3100 kWh per ton of calcium carbide of 290 litres per kgm. quality.

The reaction of lime and carbon to form calcium carbide is well-known.

$CaO + 3C = CaC_2 + CO - 125{,}000$ Cals. This means that 2280 kWh is the theoretical heat requirement per ton of calcium carbide. Allowing for the heating of the charge from cold, an additional 500 kWh will be used up, totalling to 2780 kWh minimum. Material requirements are 0·84 ton of raw lime (90 per cent) and 0·547 ton of carbon per ton of carbide.

Total installed capacity for carbide in Germany in nine plants is over 1,250,000 tons annually, with a furnace capacity of 670,000 kW. One of the biggest is Knapsack with a capacity of 300,000 tons and a furnace capacity of 150,000 kW. The installed power per ton capacity, based on 8000 hours' operation per year for the German plants is around 4000 kWh. A few plants work on hydro-power, and these plants also face, as we do here in our part of the country, shortages of power supply due to lack of water in the off-seasons. Most other plants operate on steam power with their own power plants.

I, also, paid a visit to the big unit of Knapsack. This is one of the fortunate factories, practically undamaged during the war. The carbide plant lies alongside the large power plant of Knapsack with a generating capacity of 500,000 kW from steam, the fuel being brown coal, obtained from a rich deposit in the immediate neighbourhood.

Knapsack operates eleven furnaces with capacities ranging from 10,000 kW — 24,000 kW. The furnaces are equipped with Soderberg type of continuous plastic electrode. The electrodes are of circular sections set in triangular fashion. The transformers are symmetrically arranged, above the upper platform. The big 24,000 kW furnaces are of the closed type following the Union Carbide design.

Operating data per ton of Carbide :

Lime	...	982·1 kilos.
Coke	...	533·1 kilos.
Anthracite	...	105·0 kilos.
Electrodes	...	32·9 kilos.
Power	...	3531·1 kWh.

Carbide is, for the most part, converted in the plant itself to calcium cyanamide and the little balance left to acetylene which in turn is transformed to other chemical products.

Electro-chemical operations have in recent years been revived on a large scale in Germany. Though the Germans had to divulge practically all their important processes and know-how and patents of their plants and companies, they are working at a fast pace now, and are taking hundreds of new patents, and developing newer and better processes. The old factories in West Germany have been revived to full productivity already. Also, there is a large and frequent exchange of visits by technical personnel between German and American industrial plants which is also aiding the rebuilding and consolidation of the German chemical industry.

EIGHTEENTH ORDINARY GENERAL MEETING

Plea for withdrawal of salt levy

CHAIRMAN'S SPEECH

THE eighteenth ordinary General Meeting of the Company was held at Mettur Dam on August 27, with Mr. S. Vaidyanatha Iyer, Chairman, in the chair.

Welcoming the gathering present, the Chairman said that considering the adverse factors to which a reference had already been made in the Directors' Report, the year's working results might be considered to be satisfactory. He stated further: "For the first time since the extensions to our caustic soda - chlorine plant were completed, we were able to operate the plant at near full capacity. With the production of stabilised bleaching powder, there will be better utilisation of our output of chlorine and this will result in an improvement on our economy which will progressively be reflected in the accounts. We are simultaneously exploring other profitable methods for the utilisation of chlorine which would in turn help us to expand further our caustic soda production. Demand for caustic soda in the country is far in excess of current production and with the new tempo of industrial progress set, a most promising vista seems to be opening out to us".

The Chairman also welcomed the appointment of a Development Council for Alkalis and referred to the nomination of Mr. K. K. Raman, Director, as a Member of the Council.

Continuing, Mr. Vaidyanatha Iyer observed: "Due recognition to the importance to national economy of the industry, which produced nearly 30,000 tons of caustic soda in 1954 as against a mere 2,900 tons in 1946, came from the Government of India by their acceptance in January 1955 of the Tariff Commission's recommendations for the conversion of the revenue duty on caustic soda into a protective duty and the levy for the first time of a protective duty on bleaching powder. It may be recalled here that similar recommendations made by the Tariff Board in 1950 were not accepted by Government. It is my earnest hope that the other recommendations of the Tariff Commission, now a statutory body, cautiously made after a thorough

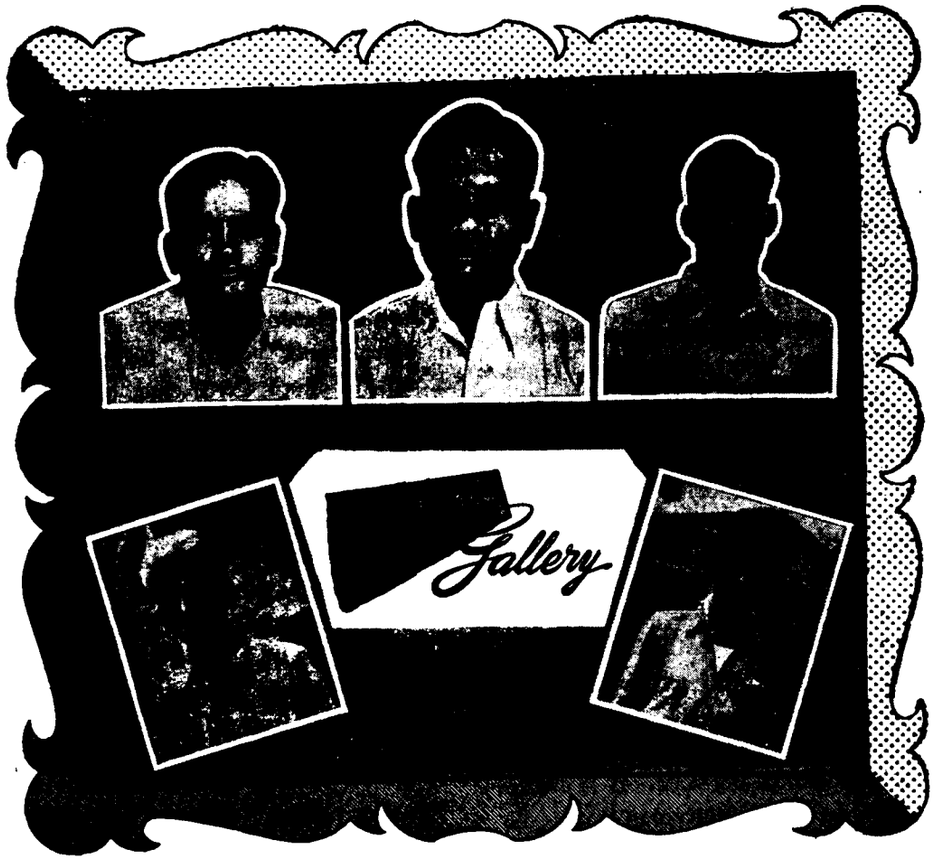
investigation of the industry will be implemented in full by the Government Departments concerned.

The Chairman also referred to two of the recommendations of the Tariff Commission — one relating to salt cess and the other relating to rail transport. "It is most disheartening to find that Government have not yielded to the industry's request to withdraw this levy on such a basic industrial raw material as salt which is essentially a low-cost item, despite the industry's protest and the recommendations of the Salt Experts Committee, the Planning Commission, the Salt Advisory Committee, the Tariff Board in 1950 and the Tariff Commission in 1954. I feel that there is no justification whatever for the retention of this levy and I appeal to Government once again to remove it without delay."

Referring to rail transport, the Chairman said that although the Tariff Board had repeatedly recommended the grant of concession freight rates both for raw materials and finished products of the industry and the grant of other transport facilities, there had been no response from the Railways. Although the manipulation of rates to subserve foreign interests was now a thing of the past, the manipulation for railway reserves continued he said. He also referred to the delays in the return of empty chlorine containers by consumers because of inadequate rail transport facilities.

Continuing, Mr. Vaidyanatha Iyer observed: "The need for the co-existence of the private sector with the public sector in industry has by now come to be well-recognised and in the context of the more accelerated development and the emphasis on larger employment contemplated in the Second-Five Year plan, I need not reiterate that the private sector can thrive only with the free and wholehearted co-operation of Government".

In closing, the Chairman thanked the staff and labour for their uniform and enthusiastic co-operation.



(Left to Right) *Top row*: *T. K. Sitaraman, V. Sitaraman, D. Sethuraman.*
Below : *K. Pasupathi Pillai, A. Thomas Pillai.*

Academy Award Winner :

There is music in all things if men had ears,
Their earth is but an echo of the spheres,

so sang Byron in *Don Juan*. T.K. Sitaraman, Chemist, fully concurs with this sentiment of the poet. There's music in the sighing of a reed; so there's in the wailing of a factory siren. There's music in the gushing of a rill; so there is in the hum of motors, compressors and engines. After treating himself to the latter kind of music for the best part of a day, Sitaraman relaxes for a change...with music! He often forgets himself (and his neighbours!) as he pours out his heart in the profuse strains of his *alapana* art.

Sitaraman is a first-rate musician, and holds a diploma in music from the Madras University. Back in 1938, he was awarded a gold medal in an

open music competition for men held under the auspices of the Music Academy, Madras. Before obtaining his music diploma, Sitaraman did his B.A. with Chemistry as his subject at Loyola, Madras. Later, he also underwent a one-year course in Textile Technology at the Madras Government Textile Institute.

As one that hath music in him Sitaraman joined the All-India Radio after leaving College, but soon chemistry called him and since 1943 he has been with us. Nostalgic memories are revived for him as he now and then goes on the AIR, but basically he remains a Chemist. A blithe spirit, his approach to his vocation is always that of an artist. Sitaraman is also our local chess champion.

Psalm singer :

We have another Sitaraman who, also, sings. He sings, however, only to the greater g l o r y of God. To V. Sitaraman, Operator, Bleaching Powder Section, goes the credit of organising the *Bhajana Samaj* in our colony, and he organised it in 1942—a true pioneer. And although for some months together, as one local wit put it, he was his own audience for his song-hits from Purandhardas and other bards, he went about this *bhajana* business with such devotion and sincerity that those who came to his parties determined to scoff remained later to pray.

As an operator, Sitaraman is quite an able hand. After taking his Secondary School Certificate, he took a course in surveying For brief periods, he worked as a teacher and a *karnam* (village accountant) in his own place, Thillaiyadi In 1942, he joined MCIC as an Operator in the B.P. Section, and has since been thoroughly devoted to it. Probably as an answer to his prayers our bleaching powder is now getting stabilised !

Auditors count *on him :*

Another active member of the *Bhajana Samaj* is D. Sethuraman of our Accounts Section. He joined MCIC in 1945 as an office boy, but by dint of hard work has risen to the position of a clerk in the Cost Accounts Section. To transients who come to Mettur, Sethuram is a tremendous source of help. For example, our Auditors cannot get on without Sethuraman not (only) because he is in the Accounts Section, but because auditors are also human (Hath not an auditor eyes ? He certainly has, whatever else he may not have !) and they have their inner men to be satisfied, and they would jolly well have to go hungry if they did not have Sethuraman around.

The large attendance at Sethuraman's wedding which took place in Coimbatore recently testifies to his wide popularily with all *cadres* of staff. Sethuraman is a good badminton and volleyball player and has been knocking off one prize or another in these events year after year. Judges also fancy him in " Fancy Dress."

Doctor in the plant :

Meet K. Pasupathi Pillai, a fitter with us, to whose soothing touch, there is always an answering echo in engines, pumps, compressors and such ancillary things. He can dismantle any bit of machinery with an ease and expedition bordering on the uncanny ; he can also " enmantle " the pieces with equal ease and expedition. Pillai has behind him an experience of nearly thirty years and knows machinery in all its quiet and sullen moods. He joined us in 1948, but had worked as a mechanic for over 14 years on the rubber plantations of Malaya, as a fitter for another four years with the Singapore Municipality and as a Charge Mechanic for three years in the Army.

Annie, get your gun–we will repair it ! Another fitter whom you would be delighted to know is A. Thomas Pillai. If Pasupathi Pillai's *forte* is heavy equipment, Thomas Pillai's is light equipment. The moment he is set a task, he is " in " it, in right earnest. And he does his allotted task or tries his honest best to do it correct to schedule.

After school, Thomas Pillai joined the Army as a mechanic. His job was to repair and look after guns and rifles. Pillai came to us in 1940

—

Society of Technologist: On April 29, Dr. C. V. S. Ratnam, PH. D., Senior Chemist, Lignite Mining, Neyveli, addressed the Society on the " Neyveli Project." He said that the present operations were intended mainly to investigate the various methods of quarrying and to collect data for future large-scale operations. The quantity of lignite available in the area was estimated to be about two thousand million tons. Industries in South India would get a great fillip when large-scale operations were commenced, thanks to the availability of this cheap fuel, he added. Dr. Ratnam also said that the installation of a thermal power station nearby with a capacity of 200,000 kW was also contemplated.

Mr. M. Padmanabhan, Senior Chemist, MCIC, read a paper before the Society on "Statistical Quality Control" on May 31.

Dr. Taguchi, Quality Control Specialist from Japan and Mr. G.V. Srikrishna Desikan and Mr. S. M. Sundararaju of the Quality Control Unit, Southern Regional Centre, Bangalore, addressed the Society on July 7, 1955. Dr. Taguchi spoke on "the role of design of experiments for application of statistical quality control methods to chemical process industries". He

From left : Mr. R. Natarajan, Mr. T.A. Thathachariar, Mr. N. Krishnamurthy Iyer and Mr. Ramamurthy Sarma.

described R. A. Fisher's "Randomization Technique," which arrived at getting an idea of various combinations of variable factors within a limited number of experiments. Mr. Krishna Desikan and Mr. Sundararaju supplemented the chief speaker. There was a lively discussion at the end of the lecture.

Staff Association : The Staff Association organized three lectures on Ramayana by Mr. T. A. Thathachariar, Advocate, Kallakurichi on May 1-3. Mr. N. Krishnamurthi Iyer, Advocate, Chidambaram, delivered two lectures, one on 'The Essence of the Ramayana" and the other on "The existence of God." He asked the audience to visualise God as a prisoner at bar and then advanced arguments both as prosecuting counsel and later as defence counsel. The defence counsel of course won the case amidst thunderous cheers.

The lectures were largely attended.

On June 20, Swami Avinashnandaji of Sri Ramakrishna Mutt, Belur, addressed members of staff on "Bhagavad Gita." He said that the Gita was very popular with the peoples of the world because of its universal truth and the message that it contained and its usefulness as a guide to every day life.

Weddings : To the following newly weds, go our hearty congrats. :

Radha K. Raman (son of Mr. K. K. Raman) with Miss Saroja.

A. P. S. Mani (Watch & Ward) with Miss Kamakshi.

K. Subramanian (Weldermate) with Miss Sulochana.

V. Rajaram (Watch & Ward) with Miss Lakshmi.

Periyaswami (Caustic Soda Section) with Miss Pappayee Ammal.

D. Sethuraman (Accounts Section) with Miss Parvatham.

C. P. Saranathan (Govt. Apprentice) with Miss Rajalakshmi.

S. Muniyappan (Attender) with Miss Palaniammal.

* * *

Mr. V. Ramachandra Rao, Purchase Officer celebrated the *Shashtiabdapurthi* of his brother Sri V. Srinivasa Rao, on May 1.

Mr. B. S. Srinivasan, Accounts Section, celebrated the wedding of his daughter Miss. Muthulakshmi, with Mr. C. Gopalan and the Upanayanam of his sons, Vaidyanathan and Raman, on June 27.

Mr. V. Srinivasan, Head Clerk, celebrated the marriage of his sister-in-law, Miss Bhama with Mr. T. V. Viswanathan, on July 8.

Mr. R. Narasimha Rao, Boiler Engineer, celebrated the wedding of his sister-in-law, Miss Nagamani Bai with Mr. G. Gururaja Rao, and the upanayanam of his son, Mr. Narayanan, our star cricketeer, on August 8.

Other upanayanams in recent months were those of K. Srinivasan, son of Mr. S. Krishnaswamy Iyengar and K. Rajagopalan, son of Mr. R. Krishnamurthy.

Pictures : Films screened in recent months included—

Excuse my dust, Plymouth Adventure, Valentine, An American in Paris, Jeopardy, Magic Carpet, Royal Wedding, Duchess of Idaho, Thief of Damascus, Annie Get your Gun, When in Rome, Rogues of Sherwood forest, Textiles unlimited and *Industrial Production Control.*

Return of the U. N. Fellow :

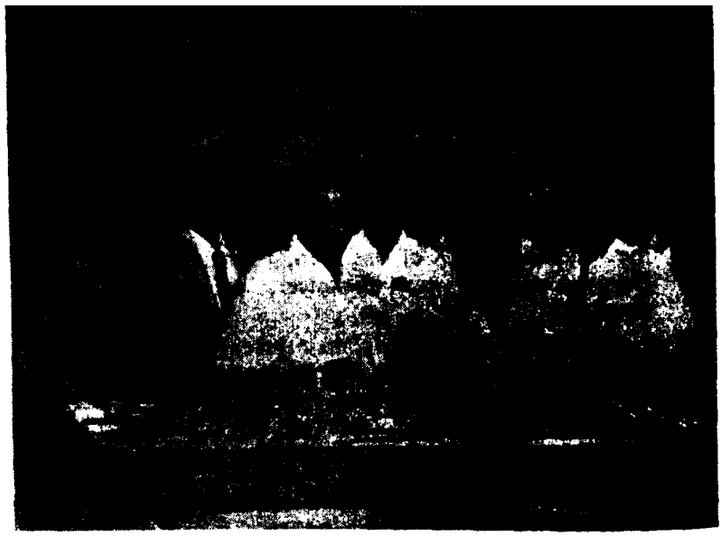
Mr. K. Ramanathan, Works Manager, MCIC, returned to Mettur on June 20, 1955, after completing a six-month-study tour in West Germany under the auspices of the United Nations Economic Development Scheme-Technical Assistance Administration Programme for India. The U. N. Fellowship awarded to him was intended mainly for observation and training in the manufacture of heavy chemicals and for a study of the manufacture of equipment and machinery for use in chemical industries. Messrs. Friedrich Uhde GMBH, Dortmund, the well-known German chemical engineering firm, assisted Mr. Ramanathan greatly in planning out his programme.

Mr. Ramanathan's programme included visits to various chemical factories and manufacturers of equipment and machinery, and to the ACHEMA Chemical Industries Exhibition in Frankfurt, training in manufacture of stable bleaching powder, studying of mechanical rectifiers, indicating and recording instruments, and of gasification of coal, and hazards in chemical industries.

Miss Saroja—Mr. Radha K. Raman.

Miss Parvatham—Mr. D. Sethuraman.

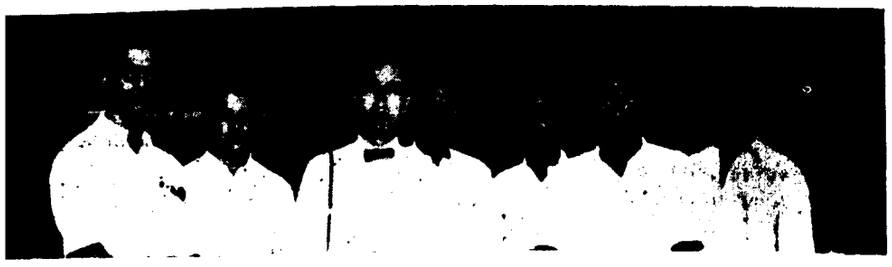
THEY WERE *Welcome!*



The Hon. Corea, Minister, Government of Ceylon and party examining the Factory model.

Among those who paid us the honour of a visit in recent months were: Dr. C. V. S. Ratnam, PH. D., Chief Chemist, Neyveli Lignite Mining Project, the Hon. Corea, Minister for Commerce, Government of Ceylon, Mr. R. Balasubramanian, I. A. S., Collector of Salem, and Dr. Taguchi, Quality Control Specialist from Japan.

Mr. R. Balasubramanian, I. A. S., Collector of Salem (Centre). with Mr. R. Natarajan.



Dr. Taguchi, (from left-third) Mr. S. M. Sundararaju (second) and Mr. G. V. Krishna Desikan. (fifth)

Briefs

New Steel Project

An integrated iron and steel plant with an initial capacity of 1 million ton of ingots to be rolled into about 760,000 tons of rolled products is to be set up in the Bhilai region of Madhya Pradesh following an agreement arrived at between the Governments of India and the Union of Socialist Soviet Russia.

According to the terms of the agreement, Russia will have to supply the plant and equipment, which will be paid for in twelve annual instalments. Indian technicians will be trained both in India and the Union of Socialist Soviet Russia so that Indian personnel may man the plant to the maximum extent possible from the beginning. The whole plant is expected to be commissioned by the end of 1959. This agreement marks a great step towards attaining a production capacity of 6 million tons of steel by the end of the Second Five-Year Plan.

Development Council for Heavy Chemicals (Alkalis)

The Government of India have set up a Development Council for heavy chemicals. The Council will recommend targets for production, co-ordinate output programmes and review progress from time to time. It will also suggest methods for efficiency and promote arrangements for marketing and standardisation of products Further it will endeavour to promote industrial labour conditions.

Mr. K. K. Raman, Director, has been nominated a member of this Council.

New Soda Ash Plant

Birlas have registered a company under the name of Sourashtra Chemicals Ltd., for the manufacture of soda ash. The plant will be installed in Porbunder with an initial capacity of 100 tons per day which is expected finally to be stepped up to 200 tons per day.

Pyrogallol indicator for titration of ferrous iron solution

It is reported that a method has been evolved suggesting the use of pyrogallol as an internal indicator in titrating ferrous iron with standard dichromate solutions. The method is based on the fact that pyrogallol produces no colour with a pure ferrous salt, but a brownish-red colour with pure ferric salt. Further, pyrogallol when present in a solution containing ferrous iron is not oxidised. A trace of the oxidised product of pyrogallol imparts a red coloration to the solution. A two-percent aqueous solution of pyrogallol is used as an indicator. The end point in the dichromate titration is the appearance of a pale brown-red tinge which intensifies into a brownish red colour with the addition of a drop of the titrant. The titration has to be

conducted in a medium of orthophosphoric acid — sulphuric acid. The method is said to be applicable in the presence of hydrochloric acid, gluconate and stannic chloride.

Domestic Water Treatment
Improved Chemical Method

It is reported that sodium silicate in a "modified" form aids coagulation of water by aluminium sulphate. The standard dosage is 30 parts per million of aluminium sulphate and 2 parts per million of modified sodium silicate. The modified silicate solution is made by mixing a dilute solution of sodium silicate and sodium bicarbonate solution in a certain proportion.

It is claimed that the effect of the treatment of water would be the more pronounced, the worse the condition of the water to be treated.

Marketing of Soda Ash and Caustic Soda

The Government of India have formulated a scheme for the marketing of soda ash and caustic soda through a system of controlled monopoly. Under the system, Messrs. Tatas and the Imperial Chemical Industries Ltd., will secure exclusive rights to market these chemicals at prices to be fixed by Government. These firms would be paid for their services. To meet any additional requirements of these chemicals, Government will also import from the cheapest possible foreign sources.

New cure for warts

According to recent work done in the United States, methionine can be used to treat warts. This use was found accidentally when a patient with warts was treated with methionine for some other ailment. Oral administration of this chemical at the rate of 1 to 2 grams per day resulted in the disappearance of the warts within ten days.

New Ammonium Chloride Plant

A ten-lakh rupee ammonium chloride plant erected in the factory of the Fertilisers and Chemicals (Travancore), Limited, (FACT) at Alwaye, was declared open on June 4, by Mr. Panampilli Govinda Menon, Chief Minister, T. C. State.

With a capacity of eight thousand tons a year, this plant will not only be able to meet all the country's current requirements of this industrial chemical, (4,000 to 5,000 tons) but can also meet potential, increased future demands.

The method employed by FACT for ammonium chloride manufacture is the neutralisation of hydrochloric acid with ammonia. Hydrochloric acid is obtained from the neighbouring factory of the Travancore-Cochin Chemicals and ammonia is available in FACT's own plant. The two gases are continuously fed into saturators where they react to form ammonium chloride.

The "dry-cells" industry is a major consumer of this chemical, accounting for about 1,500 tons a year. Ammonium chloride is used as a cleaning agent and a flux in the galvanizing of steel sheets and structures, and in tinning and soldering

jobs. It is also used in textile dyeing, tanning of leathers, fermentation, ice manufacture, urea formal dehyde resins, etc.

Quality Control Course

The Quality Control Association, Bangalore, conducted a 10-day training course in "Quality Control" at Bangalore from May 8. Mr. William P. Walker, Regional Industrial Adviser, Technical-Co-operation Mission, Madras inaugurated the course. Thirty-one trainees deputed by various industries took part in this course.

Mr. M. Padmanabhan, B. Sc., was the trainee deputed by Mettur Chemical & Industrial Corporation Ltd. for this course.

Ferric Chloride (Flores Martis).

Ferric chloride anhydrous is made by the reaction of gaseous chlorine on pre-heated scrap iron. The reaction is carried out in a brick-lined shaft furnace provided with a cooling jacket and in which the scrap iron after initial ignition is burned in an atmosphere of chlorine gas.

It can also be made by the action of hydrochloric acid on iron oxides or ferrous carbonate and subsequent crystallisation. Hydrated ferric chloride is produced by passing chlorine through ferrous chloride or by oxidising a solution of ferrous chloride with nitric acid.

Ferric chloride has wide applications in industry. It is employed as an oxidising agent in dye manufacture, dye intermediates, in detecting blowholes and blisters in castings, as a coagulant in the treatment of water and sewage. It is used to a limited extent in etching and engraving. It is also largely employed in glycerine recovery plants.

Despite its extensive uses, there is no commercial production of this chemical on any regular scale in India. There is appreciable demand in the market both for solid ferric chloride and ferric chloride solution. The latter is commercially sold as 40-per cent solution.

The Mettur Chemical & Industrial Corporation is at present producing and marketing on a small scale ferric chloride liquid. It has plans for setting up a plant for large-scale production of anhydrous ferric chloride.

REPUBLIC DAY TOURNAMENTS (1955)
CONDUCTED BY
METTUR RECREATION CLUB,
METTUR DAM.

We participated in the above tournaments and succeeded in becoming joint winners (with MRC club) of the handsome shield donated by Mr. K. M. Kuruvilla, being bracketed with MRC for maximum points in the various games. Here's a brief report of the matches.

Tennis : P. B. Srirangan of our club covered himself with glory by annexing the doubles crown and becoming the All-Mettur Tennis champion for the year. Giving an exhibition of calm and intelligent game, he made up for lack of power by his quick foot-work and fine anticipation and did not concede a single set to his opponents throughout the tournament.

In the Singles, after eliminating A. K. V. Madhavan and T. A. Balu (both of MRC) in straight sets, he beat his club-mate N. Sundaresan also in straight sets in an all-chemical final, which was a well-contested match. The runner-up, who also disposed of two MRC players and beat his club-mate S. Ramaswamy in the semi-final, commited mistakes at crucial moments. Srirangan, partnering S. Ramasamy went on to complete a grand double by beating Mohamad Ali and Madhavan (MRC) in an interesting and well-fought out final, in straight sets. For the winners, Ramasamy served a few aces while Srirangan played his usual steady game. Mohamad Ali, for the losers, played quite a brainy game while his aggressive partner Madhavan was often erratic. The doubles winners annexed a shield presented by Mr. Chandappa Iyer of Mettur Dam.

Our second pair N. Sundaresan and K. R. Ramakrishnan lost in the semi-finals to the Ali-Madhavan combination.

Volleyball : Our team consisting of A. P. S. Mani, J. George and S. Muniyappan beat a strong MRC team (led by the veteran Nachi) by two games to one in a match jam-packed with thrills and excitement. Being down by 4–12 in the third game, our team revealed excellent retrieving powers to annex the game and the match. It might be invidious to single out individuals for praise, but nevertheless it should be mentioned, that teen-ager George of our team played the game of his life. His stinging services and cunning placements were a treat for tired eyes. In the finals, they lost to a definitely superior MRC Team which included Ponnan, the ace player from Jalakantapuram. Though beaten, they were not disgraced.

Badminton : One of the biggest debacles in our club's badminton history was witnessed when our formidable (?) first team consisting of S. Sambandam, R. Krishnasamy, K. Rathnam, P. B. Srirangan and K. Rajagopal was well and truly thrashed in straight games by Sitapati's team (MRC) in the finals. Our discomfiture was complete in that our winning the toss on the windy evening of that final could not help us get a single game ! Nothing appeared to go right for our players from the beginning to the end.

But our team has only itself to blame for its crushing defeat. As indicated in the previous columns of this journal, our players had not been practising and even the best players cannot possibly reproduce a match-winning form overnight.

The criticism of our players does not detract a whit from the credit due to the MRC Team for its victory, which was, indeed, well-earned.

Still, the doubles event, was an all-chemical final, Sambandam and Sampath beating Srirangan and Krishnasamy by two games to one, though the latter team spent some anxious moments in beating Sitapati and Balu (MRC) in the semi-finals.

Table Tennis – (Singles) : Four of our players entered for the event —N S. Parameswaran, T.S. Subba Rao, K. R. Ramakrishnan and V. Vaidyanathasamy. Parameswaran went down in the first round ; Vaidyanathaswamy turned the tables on his club-mate and rival, Subba Rao, by beating him 3–2 in the second round, while Ramakrishnan was beaten by T. A. Balu (MRC) in a good match by 1-3 in the semi-finals. Vaidyanathaswamy reached the final by beating Jayachandran (MRC) in the semi-finals by 3-2.

In the final, Sami was leading by two games to one when lights failed ! The re-played final saw Balu beating Sami by 3-2.

Table Tennis – (Doubles) : Our first team, Subba Rao and Ramakrishnan lost to Balu and G. Subramanian (MRC) by 2-3 in the first round. The second team V. V. Samy and Sambandam was beaten by another MRC team in the semi-finals.

Contract Bridge : Our team T. M. Krishna Rao and P. A. Raghupathi Iyer lost in the first round, while our second team, K. Rajagopal and S. Ramasamy lost in the semi-finals.

Field Events : Arumugham (of our Watch and Ward staff) won the slow-cycle event.

OUR OWN ACTIVITIES

Cricket : The sequence of defeats continued.

Swaraj Cricket Club, Madras, defeated our team by 132 runs in a match played on our grounds in the first match of the season.

Useful innings by Subbaratnam (56), Natarajan (50 retired) and Gopal (43) enabled the visitors to amass 219 runs, though young Raju of our team got the best bowling figures of his career by taking 8 wickets for 37 runs, including a hat-trick.

Our team floundered on some good bowling by our visitors, for only 87. K. R. Ramakrishnan was the top scorer with 17 runs. S. Krishnan took 4 wickets for 11 runs.

Again, in the last match of the season, played on our grounds, Sowrashtra Cricket Club, Salem, won by 5 wickets.

Our team hit up 123 runs, thanks mainly to a fighting innings of 52 not out by K. Sampath. S. Bashyam, their pace-bowler got 7 wickets for 39 runs. (5 of them clean bowled.)

The Salem Club hit off the necessary runs for the loss of only 5 wickets. T. M. Srinivasan (40), Bashyam (32) and P. V. Narasimhan (21) were the chief scorers.

And so our worst season ended with the final score-board showing, played 9, won nil, drawn one and lost 8.

Badminton: Two of our teams participated in the Young Men's Recreation Club Third Annual District Doubles Tournament held at Iddappadi in May last.

Sambandam and Sampath of our team reached the finals after three rounds and lost there to "Noor, Attur" by 1-2. The second team K. Rathnam and R. Krishnasamy (changing their usual positions) lost to the Noor Team in the semi-finals. Though these performances have some what mitigated the severity of our earlier defeat at the hands of MRC, the fact remains that out-of-practice players cannot expect to go far in any competitive event—sometimes they might go as far as the finals, but only thus far, and no farther.

Volleyball: We participated in the Mettur Industries Operatives Club Second Annual District Triples Tournament played at the Salem camp grounds, Mettur Dam, in April last.

Our team which gave such a memorable display in the MRC tournament, inexplicably failed even to give a fight to the strong Jalakantapuram team (of Ponnan and Co., and eventual winners of the final) whom they were unfortunate enough to meet in the very first round Going down in straight games, it looked as though the big reputation of their opponents had made our men lose their nerve. The second team (N. Subramanian, G. Jayaraman and D. T. Vincent) did not also do anything of note and lost to a Dharmapuri Team again in the first round.

Table Tennis: We played a number of friendly matches with MRC players at our club in April last.

Tennikoit: Some of our apprentice trainees have shot oxygen into a moribund game, and it is showing signs of revival.

Tennis: At a pleasant function got up on June 1, Mr. R. Natarajan presiding, Mr. K K. Raman, declared open a second tennis court. Both the courts are now operating in full swing.

The budget meeting of the Staff Association held on February 17 was made lively by an interesting debate. Subjects were (1) reduction of the grant to the cricket club from Rs. 900/- to Rs. 500/- and (2) the starting of a second tennis court. Arguments, for and against, were ably made by both sides. The reason put forward for the proposal to cut the cricket grant—namely, that the standard of our cricket had gone down was countered by the argument that, if this was a

Mr. K. K. Raman (fourth from left) declared open a second. tennis court in June.

indeed a reason steps should have been taken in Australia to withdraw support to cricket after the crushing defeat that the country had suffered at the hands of England in the last season. After prolonged discussions, repeated calls for quorum and demands for polls, the General Body voted Rs. 100/- more to cricket.

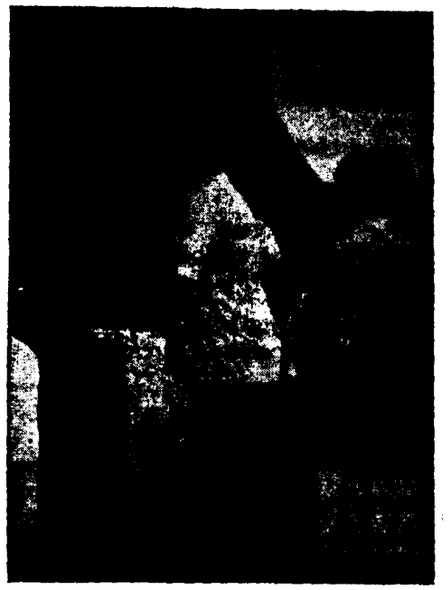
At a meeting held on February 25, the following office-bearers were elected to the various clubs :

Games	*Captain*	*Vice-Captain.*
Tennis	N. Sundaresan	S. K. Chakrapani
Badminton	R. Krishnasamy	K. Rathnam
Volleyball	A. P. S Mani	N. Subramanian
Table Tennis	V. Vaidyanathasamy	N. S. Parameswaran
Cards	T. V. Krishnamurti	—
Cricket	N. Kalyanam	K. Sampath
Net – Secretary:	T. G. Rangan.	
Committee Member :	P. B. Srirangan.	

மெட்கம் செய்திகள்

பள்ளி விழாக்கள் :

கெமிகல்ஸ் ஆரம்பப்பள்ளிக் கூடத்தின் ஆண்டு விழா ஏப்ரல் மீ 24-ம் தேதியன்று ஸ்ரீ R. நடராஜன், தலைமையில் நடைபெற்றது. விளையாட்டுப் போட்டிகளில் வெற்றிபெற்ற



ஸ்ரீ R. நடராஜன், செக்ரடரி, MCIC.
உயர்தரப்பள்ளியின் புதிய கட்டிடத்தையும் புதிய வகுப்பையும் திறந்து வைத்தல்.

மாணவர்களுக்கு ஸ்ரீ S. ராமஸ்வாமி பரிசுகள் வழங்கினர். தலைமை ஆசிரியர் ஸ்ரீ R. V. வெங்கடராசன் ஆண்டறிக் கையை படித்தார். பின் மாணவ மாண வியர் 'ஏக்கந்தர்' என்னும் சரித்திர நாடகத்தை நன்கு நடித்தனர்.

ஜூன் மீ 10-ம் தேதியன்று கெமி கல்ஸ் மத்தியதரப் பள்ளிக்கூடம் உயர் தரப் பள்ளிக்கூடமாகியது. அன்று காலை ஸ்ரீ R. நடராஜன் புதிய கட்டிடங்களை யும் ஏழாம் படிவத்தையும் திறந்து வைத்துப் பேசுகையில் இப்பள்ளி மென்மேலும் வளர்ச்சியுற்றுச் சிக்கிரத் திலேயே உயர்தரநிலையை வகிக்கும் என்று தாம் நம்புவதாகக் குறிப்பிட் டார்.

கெமிகல்ஸ் உயர்தரப்பள்ளிக் கூடத் தலைமை ஆசிரியர் ஸ்ரீ A. ஸ்ரீனி வாசராகவன் ஜூலை மாத இறுதியில் வேலையிலிருந்து விலகினர். அவருக்கு பதிலாக முன்னாள் மேட்டூர் அரசியலார் போதனமுறை உயர்நிலைப் பள்ளிக் கூடத்தில் தலைமை ஆசிரியராகப் பணி யாற்றிய ஸ்ரீ S. K. வெங்கட்ராமன் பதவி ஏற்றார்.

பஜனை சமாஜம் :

மேட்டூரிலிருந்து கோயம்புத்தூ ருக்கு மாற்றலாகிச் சென்ற ஸ்ரீ துரை சாமி பாகவதர் அவர்களுக்கும் ஸ்ரீ வேம்பு அவர்களுக்கும் மே 15-ம் தேதி ஒரு பிரிவுபசார தேநீர் விருந்து நமது பஜனை சமாஜத்தினரால் அளிக் கப்பட்டது. அது சமயம் ஸ்ரீ O. S. நட ராஜன், ஸ்ரீ S. கிருஷ்ணஸ்வாமி ஐயங் கார், ஸ்ரீ V. சிதாராமன் முதலியோர் பேசினார்கள். ஸ்ரீ. துரைசாமி பாகவதர் கெமிகல்ஸ் பஜனை சமாஜத்தினர்

ஸ்ரீ துரைசாமி பாகவதருக்குப் பிரிவுபசார நிகழ்ச்சியின்போது எடுத்த படம்.

பொரியும் அன்புக்கும் நட்புக்கும் நன்றி செலுத்திய பின்னர், அவரு டைய வேண்டுகோளுக்கும் இணங்கி சில பஜனைக் கீதங்கள் பாடினர்.

ஸ்ரீ. துரைசாமி பாகவதர் பஜனை யில் மிகவும் சிரத்தையும் பக்தியும் காண்பித்து வந்ததோடு, தம் இனிமை யான குரலினாலும் சிறந்த இசையினா லும் மேட்டூரில் யாவரையும் பக்தி வெள்ளத்தில் மூழ்கும்படிச் செய்து வந் தார். ஸ்ரீ. வேம்புவும் பஜனைகளில் மிக்க சிரத்தை காண்பித்து வந்தார். இவ்வரிய நண்பர்கள் வெளியூருக்குச் சென்றபோதிலும், இவ்வூர் பஜனை சமாஜத்தினர் வேண்டுதலுக்கு இணங்க பன்முறை இங்குவந்து பஜனை நிகழ்ச்சி களில் பங்கு கொள்வார்கள் என்று நம்புகிறோம்.

உபன்யாசங்கள் :

உத்தியோகஸ்தர் சங்க ஆதரவில் மே. 1 முதல் 3-ம் தேதிவரை கள்ளக் குறிச்சி வழக்கறிஞர் ஸ்ரீ T. A. தாத் தாச்சாரியார் ராமாயண உபன்யாசங் கள் நிகழ்த்தினர்.

சிதம்பரம் அட்வகேட் ஸ்ரீ N. கிருஷ்ணமூர்த்தி ஐயர் மே 2-ம் தேதி ராமாயண சாரத்தைப் பற்றியும், மே 3-ம் தேதி ஆங்கிலத்தில் "கடவுட் தன்மை என்பதென்ன ?" என்பது பற்றி யும் பிரசங்கங்கள் புரிந்தார்.

ஸ்ரீ முத்துகிருஷ்ண சாஸ்திரிகள்.

ஜூலை 21 முதல் 27 வரை தஞ்சை 'ஹரிதபாஷிணி' ஆசிரியர் ஸ்ரீ முத்து கிருஷ்ண சாஸ்திரிகள் 'ஸ்ரீமத் ஸ்காந் தம்' என்னும் கந்தபுராணத்தை விரி வாக உபன்யாசம் செய்தார்.

POWER ENGINEERS in our country are a jealous community... they are rightly jealous of the high repute of their calling. Not only do they know all that they need to know about

Reading between the lines...

aluminium conductors but they know something more... when the lines are built of **ALIND** aluminium. They know, for example, that **ALIND** conductors are made from high-purity rods rolled under the same roof; that these rods are drawn into wires on most modern equipment; that these wires are stranded into cables by highly-skilled crews; that these cables have been tested at every turn by modern methods and equipment; and that Aluminium Industries can be depended upon for deliveries on time.

THE ALUMINIUM INDUSTRIES LTD

KUNDARA — T.C. STATE

Managing Agents SESHASAYEE BROS. (TRAV) LTD

The interests of the public whom it is our privilege to serve are our best interests.

As in the past, so in the future too, consumer interest will continue to be our operating philosophy.

Secret of Success

THE SOUTH MADRAS ELECTRIC SUPPLY CORPN. LTD.,

POWER HOUSE, TIRUCHIRAPALLI.

Managing Agents & Engineers

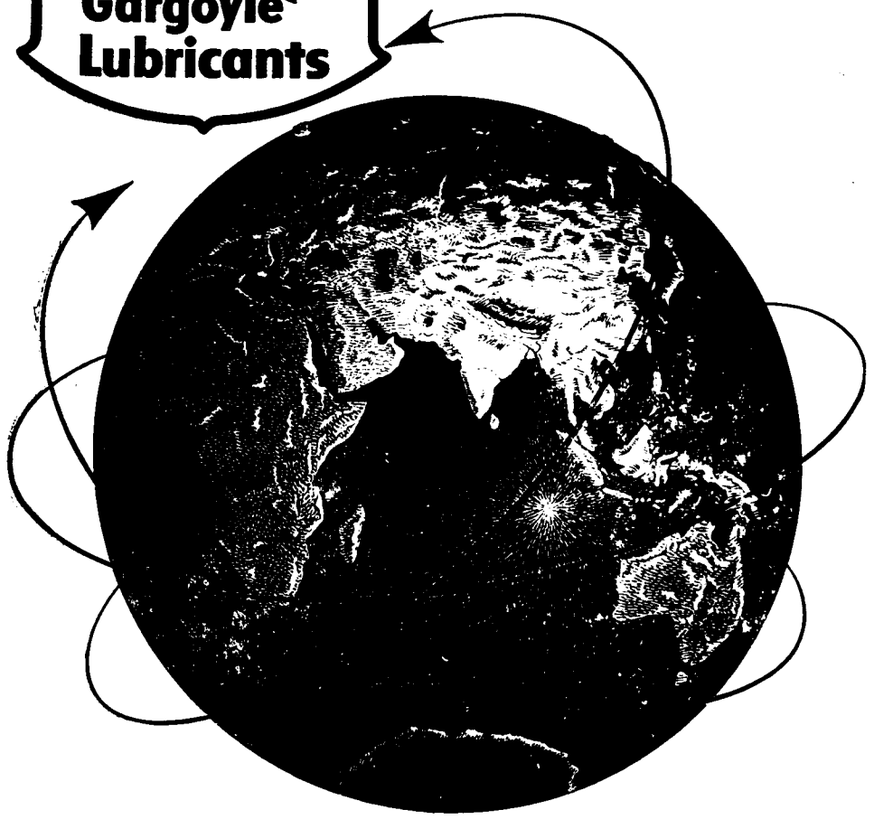
SESHASAYEE BROTHERS LTD., TIRUCHIRAPALLI.

The Symbol of Quality Around the World!

WHEREVER machines run, the name *Gargoyle* stands for outstanding products and service in the lubrication field.

Over the past 89 years, the makers of Gargoyle Industrial Lubricants have developed the *correct* lubricant for every industrial need. Let us show you how this valuable experience can help to reduce costs and improve operations in *your* plant. Get in touch with Standard-Vacuum Oil Company ... Bombay, Ahmedabad, New Delhi, Lucknow, Calcutta, Ranchi, Madras, Secunderabad.

Gargoyle Lubricants



STANDARD-VACUUM OIL COMPANY (The Liability of the Members of the Company is Limited)

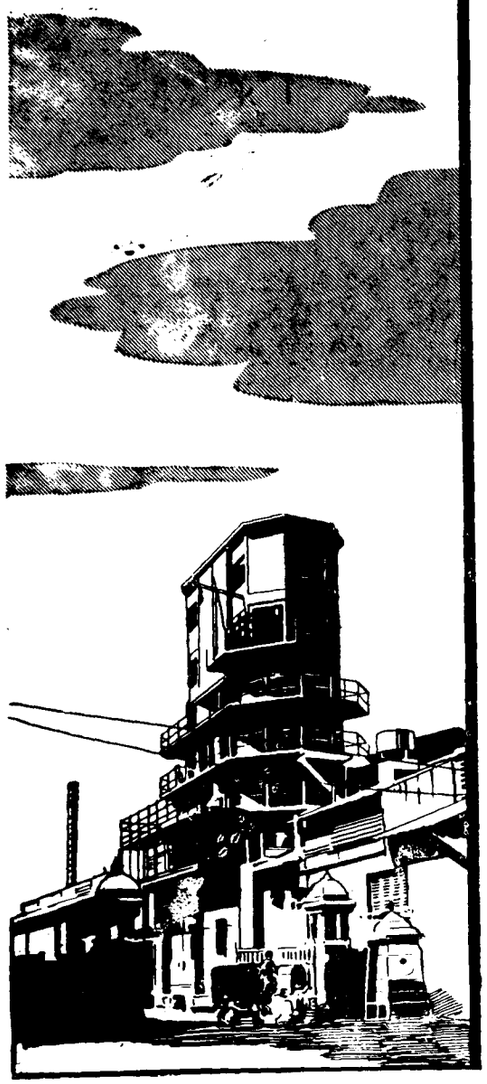
You have any chemical or chemical engineering problems do let us know. We may be in a position to solve them, for we have behind us, a wealth of experience as consultants on plant layout, equipment design and product formulation.

SINGMASTER & BREYER

METALLURGISTS AND CHEMICAL ENGINEERS,

GRAYBAR BUILDING

420, LEXINGTON AVENUE—NEW YORK 17 N.Y.



HIGHEST *Quality*
ATTRACTIVE *Prices*
PROMPT *Deliveries*

CAUSTIC SODA
LIQUID CHLORINE
BLEACHING POWDER
HYDROCHLORIC ACID
FERRIC CHLORIDE

CAUVERY
BRAND
Chemicals

A Product of:

THE METTUR CHEMICAL & INDUSTRIAL CORPN. LTD.

METTUR DAM R.S. :: SALEM DT.

Managing Agents: SESHASAYEE BROTHERS LTD.

METKEM: Printed by T. Sivaprakasam Pillai at The Trichinopoly United Printers Ltd., Tiruchirapalli
Edited and Published by R. Parthasarathy, M. A., for the South Madras Agencies Ltd. Tiruchi
on behalf of The Mettur Chemical & Industrial Corporation, Ltd.