"HEALTH STATUS OF TEA PLANTATION WORKERS WITH SPECIAL REFERENCE TO THEIR OCCUPATION"

PART I

Joint Study

By

ROSS INSTITUTE UNIT OF OCCUPATIONAL HEALTH

(St. John's Medical College, Bangalore)

&

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PREFACE

This is the first part of the report of the study 'Health Status of Tea Plantation Workers with special reference to their Occupation'. The study conducted in 1979 was jointly undertaken by the Ross Institute Unit of Occupational Health of St. John's Medical College, Bangalore and the Regional Occupational Health Centre of I.C.M.R. Bangalore.

The study was carried out in some plantations and tea factories in South India. It involved investigation of medical histories, physical examination, anthropometry, basic laboratory estimations and some special investigations such as cholinesterase levels of the workers and their families in these estates. Measurements of environmental parameters in the tea factories were also undertaken. A preliminary analysis of sickness absenteeism and medical records has been included.

This is a pilot study and it has been attempted to build up a health profile of the tea plantation workers, determine possible areas of occupational risk and identify areas requiring further detailed investigation.

The preliminary analysis of the data has been limited to the working population in the 18-60 age group. This is being presented in this report.

Analysis of the total study population data including the under 18's and over 60's will be presented in Part II of the Report.

Owing to reasons beyond our control, the reporting of this study has been much delayed. We very much regret this.

We take full responsibility for the data presented and the views expressed in this report.

It is hoped that this report on an area of growing significance will stimulate further research in health in the plantations.

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CHAPTER I

INTRODUCTION

THE REPORT of the 1971 census shows that 72 percent of the working population of India are involved in agriculture, livestock, forestry and plantations. Less than 10 percent are in the manufacturing, repair and processing industries.

REVIEWS OF Occupational Health Research in India (Rao and Lundgren, 1955 and Rao and Chatterjee, 1964) show that most of the research undertaken have been for industry and on industrial workers. Very few studies have been done in the agricultural sector or on agricultural workers. Only in the last decade there is a growing interest in the study of occupational health of agricultural workers of both the organised and unorganised sectors.

THE ROSS Institute Unit of Occupational Health (RIUOH) at St John's Medical College, Bangalore, was established in collaboration with the Ross Institute of Tropical Hygiene (London School of Hygiene and Tropical Medicine) to study plantations and non-industrial occupations as one of its primary objectives (Narayan 1977). Because of the historical connections of the Ross Institute with tea plantations and the interest shown by the Medical Division of the United Planters Association of Southern India (UPASI), it was decided that the first organised study would be undertaken on the health status of tea plantation workers with specific reference to their occupation. The study was conducted from March 1979 in collaboration with the Indian Council of Medical Research (ICMR) through its Regional Occupational Health Centre (ROHC) at Bangalore.

STUDIES ON tea plantation workers have been undertaken earlier. Ramalingaswami and Patwardhan (1949) studied the diet and health status of South Indian plantation labour; Gilroy (1951) surveyed child nutrition on tea estates in Assam; Interns of St John's Medical College have studied various aspects of health, morbidity and occupational hazards during short term elective postings in plantations 1975-79 (Narayan, 1980 & 1982); the morbidity and mortality among plantation workers and 0-6 year olds has been discussed by Rahmathullah (1979) and Unnikrishnan (1979) respectively; Chakravarti (1969) has made an appraisal of health hazards during spraying operations of pesticides in tea plantations.

THE PRESENT study, however, is the first attempt to study the total population of plantation, ie., workers and their families. The study has also attempted to identify those aspects of ill-health and morbidity in which there may be an occupational risk factor. The study involved investigation of history, physical examination, anthropometry, basic laboratory investigations and special investigations such as cholinesterase levels on workers of two plantations and three factories in South India. Measurement of environmental parameters in various sections of four tea factories were included. Preliminary analysis of hospital records and sickness absenteeism records were also done.

THE REPORT is presented in two sections. Section 'A' reviews literature on the health status of agricultural and plantation workers with specific emphasis on India. Apart from general scientific literature the other sources of information were the World Health Organisation, the International Labour Organization, the Government of India, the United Planters' Association of Southern India and the Ross Institute Units in Cinnemara (before 1971) and in Bangalore (after 1974). A review of the reports on hazards of exposure to tea and coffee dust, is also given.

THIS IS followed by an overview of the tea industry in India and some background on the chemistry, nutrition and pharmacological aspects of tea.

A DETAILED description of the occupations on a tea plantation and an outline of the important aspects of the physical, chemical, biological, mechanical and psycho-social environment on the tea plantation are presented.

SECTION 'B' deals with the main study, its scope and objectives, the materials and methods including the organizational aspects of the field work, the plan of analysis, the observations and results, the discussion and conclusions and the suggestions for follow up and research work in the future.

AN EXTENSIVE bibliography of the literature reviewed is also included. Wherever possible, references to these have been given in the main text of the report.

TABLES BASED on important facts from literature and the data collected during the study as well as a series of figures and illustrations have also been included in the hope that this report would stimulate further research in this increasingly important but much neglected field of agricultural and plantation medicine. It is expected that the report may act as a reference material for those embarking on such research.

CHAPTER II

REVIEW OF OCCUPATIONAL HEALTH RESEARCH IN AGRICULTURE WITH SPECIAL REFERENCE TO INDIA, PLANTATIONS AND TEA

(a) Definitions

'Agriculture' has been defined as 'all forms of activities connected with growing, harvesting and primary processing of all types of crops, with the breeding, raising, caring for animals and with tending gardens and nurseries' (WHO, 1962).

An 'agricultural worker' has been defined as 'any person engaged either permanently or temporarily irrespective of his legal status in activities related to agriculture' (WHO, 1962).

The World Health Organisation (WHO) and the International Labour Organisation (ILO) have evinced interest in the health problems of agricultural workers, since their inception. Expert Committees of both these organisations either jointly or separately have reported from time to time, about all aspects of agricultural work and the health and occupational hazards of agricultural workers.

(b) Health of agricultural workers (overview)

The second joint report (WHO, 1953) identified four important occupational health problems associated with agricultural enterprises -these being: (i) infectious diseases transmitted by animals; (ii) poisoning by pesticides; (iii) diseases of the locomotor system; and (iv) conditions more prevalent in rural areas such as malaria and parasitic infections. Some measures for general health protection of workers in places of agricultural employment were also described.

The fourth joint report (WHO, 1962) highlighted the factors responsible for the morbidity patterns seen among agricultural workers. These included:

(i) geographical and ecological characteristics of the area;

(ii) the type of housing and status of environmental sanitation;

(iii) general low income levels;

(iv) inadequate medical and health services;

(v) occupational patterns in farming

(vi) association with plants and animals

(vii) psycho-social features of the environment like isolation, interaction of groups differing in ethnic and other background, paucity of amusement and absence of leisure;

(viii) working conditions including economic and physical factors;

(ix) accidents associated with work;

(x) occupational diseases including poisoning and infectious diseases and those caused by physical environmental factors.

The fifth report (WHO, 1967) reviewed the existing resources available for the protection of workers health in developing countries. It noted the general neglect of agricultural workers even though 'it still remains as the means of subsistence for the majority of the people'. It observed certain features specific to work in developing countries like 'women performing heavy work when they are pregnant and very young children also work'. The increase in health hazards to the agricultural communities because of the introduction of mechanization and the extensive use of synthetic fertilisers and pesticides was also stressed.

Occupational Health problems in agriculture have also been reviewed by I.L.O. (1963 b). Many aspects of safety and health including codes of practice have been discussed in I L O (1963, 1963a, 1965, 1969, 1972). Some aspects of ergonomics in the fields of agriculture and forestry have been described in I.L.O. (1977).

The state of the art in respect of agriculture with special reference to occupational health and safety has been reviewed by different authors in 1971. These include agricultural work by Kundier and Mamsikov (1971), agricultural workers by Baztarrica (1971), agricultural implements by Jain (1971), agricultural machinery by Knapp (1971), agricultural chemicals by Matheson (1971) and occupational health in agriculture by Copplestone (1971). Emara (1971) is also a very comprehensive review.

Agricultural Chemicals

Agricultural chemicals and their extensive use in the field is the most important factors that has revolutionised the occupation of agriculture from its traditional nature to a modern industrial enterprise. Reviews of the chemicals used and their hazards have been attempted by many authors. Pesticides by WHO (1962a) and Copplestone (1971a), organophosphorous pesticides by Medred and Kagan (1971), Halogenated pesticides by Dinman (1971), Fungicides by Hunter (1971) and Rodenticides by Vallet (1971).

Organophosphorous insecticides have been studied in much greater detail than most of the other chemicals because of its effects on blood cholinesterase enzyme levels. These can be studied in the laboratory as well as in the field. Hall et al (1937), Huorga et al (1952) and Bigg et al (1958) and Holmstead (1959) have described cholinesterase activity in normal and pathological sera, the pharmacology of cholinesterase inhibition and described colorimetric methods for measurement of cellular and plasma levels.

Callaway et al (1951) was the first to measure blood cholinesterase levels in healthy adult populations and delineate the range of personal variation. Studies and reviews of studies have been done on factory workers field workers, manufacturing or using organophosphorous pesticides and both acute and chronic toxicity has been well described. These include Barnes et al (1951), Davignon et al (1965), Marjorie Bick (1967), Namba T (1971 and 1971a), Wayland (1971), Kahn (1976) and Conerski et al (1978).

Occupational diseases

1. Respiratory

Respiratory diseasea and their associations with agricultural dusts have been reported in literature for decades. The picture is usually of a condition described as 'extrinsic allergic alveolitis' by Riddle and Grant (1967) and Pepys (1969).

Reviews of these conditions including Farmers Lung (Pepys 1971) vegetable dusts (El Batawi, 1971), Mycoses (Ganor and Sagher, 1971) and agricultural dusts and diffuse pulmonary fibrosis (Rankin et al, 1965) are available.

A very large number of specific case studies and conditions have also been described in agriculture and related occupations (Van Toorn, 1970) including Farmers lung, Pigeon breeders or bird fanciers lung, Bagassosis, wheat weevil disease, Malt workers lung, Maple bark strippers disease, New Guinea Lung disease Paprika splitters lung, Vineyard sprayers lung, and Furriers lung.

2. Animal bites and stings

Problems related to the contact with wild and domestic animals in agricultural work has been reviewed by Rao (1971) and the bites and stings of venomous animals, also an important occupation hazard has been reviewed by Riou and Juminer (1971).

3. Zoonoses

The dangers of diseases transmitted from animal to man in agriculture and related occupations has been reviewed by a Joint FAO/WHO expert committee on zoonoses (WHO, 1967), Abdussalam (1971) and Steele (1975).

4. Dermatological diseases

The first large study of dermatological conditions in agricultural cooperatives has been reported by Karchlik and Nikolasova (1976).

Occupational Hygiene

Identification of occupational hygiene problems in agriculture and hazards during work in farmers has gained interest in the last decade. Zaforski (1972) has reviewed the work environment in modern agricultural plants and Berry (1975) has described industrial hygiene aspects of farm hazards.

Legislation

The diseases related to agricultural work which have now been placed on the prescribed occupational diseases under the National Insurance (Industrial injuries) Act 1965 in U.K. are the following: (Ministry of Social Security, U.K. 1967 & 1972). The method/mode of contact is also described.

(i) Anthrax - Handling of wool, hair, bristles, hides or skins or other animal products and contact with infected animals.

(ii) Glanders - Contact with equine animals and carcases.

(iii) Leptospira icterohaemorrhagica - places infested with rats.

(iv) Leptospira canicola - contact with dog kennels and care of dogs.

(v) Beat knee, hand, elbow - due to manual labour.

(vi) Farmers Lung - exposure to the dust of mouldy hay or other mouldy vegetable produce by reason of employment in

a. agriculture/horticulture or forestry;
b. loading or unloading or handling in storage such hay or other vegetable produce;
c. handling bagasse.

(vii) Brucellosis - contact with bovine animals or carcases as in farm workers, veterinary worker and slaughter house worker.

(viii) Following chemicals used also in agriculture as indicated:

a. Methyl bromide - pesticide
b. Dinitro ortho cresol - insecticide, ovicide, and fungicide
c. Compounds of Mercury - fungicide in seed dressing
d. Compounds of Arsenic - weed killers, insecticide and fungicide
e. Compounds of Phosphorous - rodenticides and insecticides.

(c) Health of Agricultural Workers in India (excluding plantation labour)

Magnitude of problem

An enquiry into the working and living conditions of agricultural labour in India (Labour Ministry, 1957) revealed that in the year 1956-57 there were 16.3 million agricultural labour households in the country of which 57.3 percent were landless labourers. The size of the average family was 4.4 and the annual income per household was Rs.437.00. The average adult male worker had wage employment for 194 days, was self-employed for 40 days and unemployed for 128 days.

The 1961 census showed that 131 million ie., 69 percent of the total working population of India were engaged in agriculture. 16.7 percent of the total work force were landless labourers. The average daily wage of casual labour was 96 paise for adult male, 59 paise for adult female and 53 paise for child respectively.

According to the 1971 census 43.3 percent of the working population are cultivators, 26.3 percent are agricultural labour and 2.4 percent are in plantations, livestock and forestry bringing the total employed in agriculture and related occupations to 72 percent (Narayan 1977).

Classification

The agricultural sector in India is very diverse and though the agricultural workers are often visualised as only working in the field producing food and other crops, they are in reality a group of workers engaged in a diversity of jobs which include primary processing of food and other crops. In the broader sense, it also includes other jobs associated with agrarian culture including rural cottage industry and rural artisans who produce goods mainly recycling agricultural wastes, to be used by agricultural workers and their families. Narayan (1979) suggests a classification shown in Table I.

Overview

Reviews of occupational health research in India, Rao & Lundgren (1955) and Rao & Chatterjee (1964) show that most of the research work has been done even in India, on industrial workers and factories jobs apart from basic research aspects. In occupational research the agricultural worker has not received the emphasis which is his due. In the last decade this trend has shown a change.

Rao & Saha (1962) reviewed the occupation of the agricultural worker in a developing country. Narayan (1979) Natu and Shaikh (1979) and Gupta (1979) have presented broad overviews of the agricultural sector in India, the known problems and the special features.

TABLE I

AGRICULTURAL INDUSTRY IN INDIA
(a suggested classification)

A: PRODUCTION

1. Unorganised sector — Cereals, pulses, oilseeds, cotton, jute, sugarcane, vegetable, fruit, fodder.
2. Organised sector: (plantations) — Tea, Coffee, rubber, spice, cinchona
3. Sericulture
4. Forestry
5. Livestock and animal husbandry
6. Fisheries

B: PROCESSING

I. Food processing

1. Sorting, dehusking, storage
2. Milling, pounding, grinding
3. Oil manufacture
4. Gur manufacture
5. Drying/pickling/preservation
6. Distilling

II. Cottage industry (from agricultural produce & wastes)

1. Weaving, cotton, wool, jute, silk
2. Rope making - jute, hemp, sisal, coir
3. Household items - bamboo, cane, coir
4. Hiding and tanning

C: RURAL ARTISANS AND OTHER OCCUPATIONS OF VILLAGE
(not strictly agriculture but supportive of it)

1. Smithys - iron, tin, silver gold etc.
2. Carpenters
3. Cobbler
4. Potter
5. Brick/tile maker

Nutrition and Energy Expenditure and Occupational Physiology

Rao & Saha (1962) studied energy expenditure in agricultural operations. Three typical agricultural occupations during harvesting were compared with twelve operations in cotton textile industry. The agricultural operations were generally much heavier, mowing required 167 K Cal/M^2/Hr, threshing 205 Kcal/M^2/Hr and carrying 299 K Cal/M^2/Hr (refer Table 2a). Studies on energy expenditure and requirement of agricultural workers were undertaken by Ramamurthy and Belavady (1966) and Belavady (1966). The energy expenditure in eight agricultural workers were measured by them and this is shown in table 2b. Diet surveys showed a deficit of 250 calories/day between intake and expenditure.

Occupational hazards/diseases of specific groups

Mathur (1957) studied 1948 horticultural workers in Delhi and listed out various occupational hazards of gardening. Tuberculosis of lung was radiologically positive in 2.6% of workers. Eye injuries were common. Sen & Khanna (1978) have presented data on Brucellosis and Q fever being occupational health hazards in dairy and livestock workers.

Ghosh et al (1980) studied agricultural workers engaged in tobacco cultivation and found that 88 percent of workers suffered from symptoms like nausea, vomiting, giddiness, head-ache, fatigue, loss of appetite and dyspnoea. These workers showed 3-4 times higher concentration of nicotine and cotinine in their urine as compared to workers not engaged in tobacco cultivation. Nicotine seemed to be responsible for these symptoms.

Jejurikar and Jape (1981) did a preliminary study of 255 fisherfolk to find out their morbidity patterns. The study revealed that though they showed many clinical features common to the general population, the following conditions were significantly commoner:

(i) callosities on the palm;
(ii) scabies and taenia infection;
(iii) lacrymation and redness in eyes;
(iv) cramps in the muscle and muscular fatigue and hypertrophy;
(v) poor personal hygiene;
(vi) change in colour and texture of skin; and
(vii) injuries to skin.

Occupational Accidents

Gordon, Gulati and Wyon (1967) did an epidemiological study of Traumatic accidents in rural Punjab in the year 1959-60. Accidental injuries in 4 villages of Ludhiana district were investigated and followed up.

The study gave epidemiological insight into the accidents related with agricultural work. The rate per 1000 population was 115.6 (Disabling 110,6 and crippling-5 and fatal- nil). In men the percentage at work was much higher. 17 percent were due to agricultural implements, 11.5 due to striking against blunt objects, 9.6 percent due to domestic animals, 9.1 percent each due to falls, and hot liquids, 3.4 percent due to bites and stings and 3.6 percent due to agricultural machinery. Machinery accidents were mainly due to hand powered choppers used to prepare feed for animals.

Sekhon (1968) has discussed certain accidents like : i) head injury peculiar to country cane crusher (Kohlu injury); ii) chaff cutter and wheat thresher injury; iii) hazards of fruit plucking and rural electrification and iv) hazards of insecticides and pesticides. Suggestions for prevention are also given.

Datta and Verma (1969) studied 427 accidents which reported to a rural health centre from 10 villages near Pondicherry. The morbidity and mortality rates were 51.9 and 0.5 per 1000 population. 79 percent of these accidents in both male and female occured at work in the fields. The causes of accidents were - falls and injuries 64 percent, bites and stings 20 percent; foreign bodies 6.8 percent; burns 6.1 percent; accidental poisoning 1.9 percent and electric shock 0.9 percent.

Agricultural Chemicals

Research into the hazards of pesticide spraying have been stimulated in recent years mainly due to the extensive spraying operations in malaria control programmes.

Kashyap (1971) has reviewed the effect of occupational exposure to organo phosphrous pesticides, Naresh Bhu et al (1976) have studied chronic poisoning in pesticide workers using organophorous pesticides, Gupta (1978) has reviewed occupational exposure to pesticides, Gupta (1980) has described health risks in ultra low volume aerial spray of malathion for mosquito control and Kashyap (1980) has reviewed the scope and need of toxicological evaluation of pesticides under field conditions, especially medical surveillance of malaria spraymen exposed to HCH in India.

Miscellaneous

Datta and Ramanathan (1971) have compared seven modes of carrying loads on the horizontal plane. These were double pack, head load, rucksack, sherpa type, rice bag, yoke and with hands.

Das et al (1976) have reported case studies of five patients with primary mesothelioma, all belonging to a rural agricultural community working in sugar cane farming on an allied trade. None of them had any exposure to asbestos previously. Whether this observation is coincidental or has any aetiological bearing is being further investigated.

Nag, Sebastian and Malvankar (1980) studied the effective heat load on agricultural workers during summer season and found that the environmental heat load on workers performing light and moderate activities was 40 and 27 percent of total heat load, respectively suggesting that with increased metabolic heat production the relative load due to environmental routes was progressively less.

(d) Health of Plantation Workers (overview)

Plantations have been defied 'as any agricultural undertaking regularly employing hired workers, which is situated in the tropical or sub-tropical regions and which is mainly concerned with the cultivation or production for commercial purposes of coffee, tea, sugarcane, rubber, bananas, cocoa, coconuts, groundnuts, cotton, tobacco, fibres (sisal, jute and hemp), citrus, palm oil, cinchona or pineapple; it does not include family or small scale holdings producing for local consumption and not regularly employing hired workers' (ILO, 1966).

TABLE 2a ENERGY EXPENDITURE LEVELS IN OPERATIONS IN RICE CULTIVATION

Activity	No. of subjects	During work		Pulmonary ventilation L/min/M^2	Oxygen consumption L/min/M^2	Energy expenditure K Cal/Hr/M^2
		Pulse/ Min.	Resp/ Min.			
Mowing	12	137	27	15.9	0.566	167
Carrying	14	154	31	25.5	1.017	299
Threshing	10	129	33	18.8	0.730	205

NB: Average age 26-30. Body surface area - mean 1.49 M^2
Source: Rao and Saha, 1962

TABLE 2b ENERGY EXPENDITURE IN SOME AGRICULTURAL ACTIVITIES

No.	Activity	No. of subjects studied	Average weight (kg)	R.Q.	Cal/kg/Hr	Cal/Min
1	Ploughing	11	44.7	0.89	7.02	5.48
2	Puddling	11	45.5	0.89	8.65	6.45
3	Working push hoe	12	45.7	0.88	5.87	4.66
4	Trimming bunds	10	43.4	0.91	9.30	6.28
5	Making channels for irrigation	6	42.3	0.86	4.56	3.25
6	Harvesting	10	43.2	0.87	5.22	3.8
7	Making of bundles	9	44.7	0.85	4.66	3.48
8	Threshing	9	44.8	0.87	6.97	5.27

NB: Figures given are averages
Ranges were indicated in original article
Source: Ramanamurthy and Belavady, 1966

The definition may be extended to include rice, chicory, cardamom, geranium, pyrethrum or any other crop (ILO, 1966).

In India, the legal definition for plantations adds a clause on size (10.117 hectares or more) and on number of employees (thirty or more persons in addition to limiting it to tea, coffee, rubber and cinchona (PLA, 1951).

Government of India and I.L.O. Sources

Surveys and reports on the health of plantation workers have been undertaken by the Government of India and others like the International Labour Organization, since the 1940's.

(1) A labour investigative committee in 1943 observed that "the health and physique of plantation workers were not too good though it was better than that prevalent in the villages....Common complaints were bowel complaints, worm infestation, respiratory disease and malaria...." (Rege, 1946).

(2) A survey of standards of medical care for tea plantations in India was made by Lloyd Jones (1947). He observed that "vast bulk of morbidity and mortality were due to conditions arising from poor diet, poor sanitation, untreated or inadequately treated water supply and ignorance of workers". The main diseases were malaria, bowel diseases like cholera, typhoid and the dys-enteries, anaemias, hookworm infection, Kala-azar, tuberculosis and leprosy. Comparing the three areas he visited, Assam, North Bengal and South India, he noted that Assam labour were the worst off; in Bengal the state of nutrition was better but tuberculosis, bronchitis and fibrosis were common; in South India the standards of health were better and maternal mortality was relatively low. Kala-azar was unknown but hookworm and other intestinal worms were very common.

(3) The Government of India initiated a study in 1948 into the cost and standard of living of plantation workers in South India. This included a diet survey and medical evaluation of a sample of plantation workers and their families in tea, coffee and rubber estates in South India (Labour Ministry, India, 1948). This study which probably is the only comparable one to our study in the plantations included recording of medical history, measurements of heights and weight and physical examinations and hemoglobin estimation and stool examination (Ramalingaswami and Patwardhan, 1949).

The salient findings/features of this study were:

(i) 1592 individuals were included;
(ii) diets were low in calories and proteins and grossly deficient in calcium, Vitamin A and its precursors and thiamine;
(iii) 79 percent of the adults were under-weight by 10 percent or more as compared with the average for South Indian adults;
(iv) 81.2 percent above 12 and 61.3 percent below 12 showed morphological changes of early Vitamin A deficiency.
(v) 30.8 percent above 12 had evidence of neurological involvement due to thiamine deficiency;
(vi) 12.1 percent showed one or more signs of riboflavin deficiency;
(vii) 291 persons had haemoglobin levels below 13.2 gms and 148 had less than 9.8 gms percent;
(viii) A stool examination in one locality (Coorg) revealed an infestation rate of 40 percent by hook worm;
(ix) Malaria as assessed by palpable spleen was not detected in most of the estates. Splenic index in Coorg was 50 percent and in Malabar 11.1 percent;
(x) Scabies and coccal dermatitis were frequently encountered;
(xi) Upper respiratory tract infections were common but chronic lung disease was rarely seen;
(xii) Histories suggestive of chronic gastro-duodenal ulcer were obtained occasionally;
(xiii) No cases of cirrhosis of liver and infective hepatitis;
(xiv) Diarrhoea was frequently complained of more especially among children and over half of them had blood and mucus;
(xv) Lack of appetite, distension and easy fatigability were frequently complained of.

(4) The Ross Institute Unit in Assam surveyed the nutritional status of 4564 children of tea estate labourers and villages of Assam Valley (Gilroy, 1951). 44 tea estates were included and two subsidiary groups of medically backward estates and villages.
The salient features were that:-

(i) physical development were reasonably satisfactory when compared to weight tables for tea estate children of Wilson and Mitra (1938) and Mitra (1939);
(ii) xerophthalmia was very common, dry skin moderately common and pyoderma absent;
(iii) beriberi, scurvy and rickets were completely absent;
(iv) Vitamin A deficiency was seen in 75 percent, Vitamin B_2 in 0.6 percent, caries in 0.4 percent and discolouration of hair in 19.8 percent;
(v) Assamese village children had poorer physique but less vitamin deficiency signs showing thereby that the diet was qualitatively balanced but quantitatively deficient in comparison to plantation children.

(5) MacDonald (1954) reporting on the health problems of the tea industry noted the changing clinical profile of estate hospital practice with the disappearance of malaria and the reduction in the proportion of dysenteries and pneumonia. Tropical ulcers had become relatively rare and this was attributed to the reduction in the prevalence of leeches due to increased use of chemical fertilizers. The most important causes of invalidism was anemia, either acting uncomplicated or complicated by pregnancy or infectious disease and tuberculosis.

(6) Foy and Kondi (1956) and Misra (1959) have reported on the incidence of anemia based on studies done in Assam at the Labac Central Laboratory. Of the 7155 anemic subjects investigated, 21.43 percent were anemic pregnant females. Macrocytic anemia was seen in 47.88 percent of the total and 54.95 percent of the pregnant females. Macrocytic anemia of pregnancy was 11.78 percent of the total. All these showed marked improvement with folic acid administration.

(7) In 1962 a team of experts from I.L.O surveyed the standard of living and conditions of employment in banana,cocoa, palmoil, rubber, sisal, sugarcane and tea plantations in twelve countries of the Asian, African and Latin American region (ILO, 1966). In India, the enquiry dealt with a dozen tea plantations, the largest of which had 2025 workers. The survey concluded that 'despite substantial progress the health position on plantations was not universally satisfactory. Malaria had been eliminated but bad hygiene, malnutrition and under-nourishment are often responsible for intestinal or pulmonary diseases as well as anemia.

(8) ILO in 1970, reporting on the social consequences of technological development in plantation, observed that technological changes have led to two main spheres of concern in connection with the health and safety of plantation workers. These are the hazards surrounding the use of agricultural chemicals and secondly to the operation of tractors and their equipment.

(9) ILO (1970a) infers from general and epidemiological data that "socio-economic, cultural and environmental conditions and the milieu in which the plantations live and work, which are close to 'nature in the raw' have a specific influence on the morbidity and mortality rates of plantation workers". With regard to occupational health hazards it identifies three major areas:
(i) harmful effects to workers health of new chemical products used for weeding, controlling plant diseases and eradicating insect pests;
(ii) different type of lung affections and bronchial troubles from the inhalation of dust in the work place particularly the factories in the plantations;
(iii) hazards due to insects and poisnous reptiles such as scorpion and snakes.

(10) ILO (1976) reporting on the Housing, Medical and welfare facilities and occupational safety and health on plantations notes that
- plantation communities tend to be exposed to a wide spectrum of communicable diseases, infections acquired through the handling of animals, insect borne infections and diseases associated with low standards of personal and environmental hygiene.

- In Sri Lanka 50 percent of total sickness on plantations is caused by respiratory diseases, and 25 percent by intestinal diseases. Intestinal parasites are common. Hookworm infestation is the main cause of anaemia which is very common among women and children. Malnutrition, Tetanus and epidemics of influenza are also common.

- With regard to work related hazards data available from Sri Lanka showed that falls are the main cause of major field accidents closely followed by cutting and digging implements and falling objects. Number of accidents are due to encounter with reptiles, insects and wild animals. In factories the commonest types of major accidents are due to improper handling of machinery, falls, falling objects and improper handling of

(i) physical development were reasonably satisfactory when compared to weight tables for tea estate children of Wilson and Mitra (1938) and Mitra (1939);
(ii) xerophthalmia was very common, dry skin moderately common and pyoderma absent;
(iii) beriberi, scurvy and rickets were completely absent;
(iv) Vitamin A deficiency was seen in 75 percent, Vitamin B_2 in 0.6 percent, caries in 0.4 percent and discolouration of hair in 19.8 percent;
(v) Assamese village children had poorer physique but less vitamin deficiency signs showing thereby that the diet was qualitatively balanced but quantitatively deficient in comparison to plantation children.

(5) MacDonald (1954) reporting on the health problems of the tea industry noted the changing clinical profile of estate hospital practice with the disappearance of malaria and the reduction in the proportion of dysenteries and pneumonia. Tropical ulcers had become relatively rare and this was attributed to the reduction in the prevalence of leeches due to increased use of chemical fertilizers. The most important causes of invalidism was anemia, either acting uncomplicated or complicated by pregnancy or infectious disease and tuberculosis.

(6) Foy and Kondi (1956) and Misra (1959) have reported on the incidence of anemia based on studies done in Assam at the Labac Central Laboratory. Of the 7155 anemic subjects investigated, 21.43 percent were anemic pregnant females. Macrocytic anemia was seen in 47.88 percent of the total and 54.95 percent of the pregnant females. Macrocytic anemia of pregnancy was 11.78 percent of the total. All these showed marked improvement with folic acid administration.

(7) In 1962 a team of experts from I.L.O surveyed the standard of living and conditions of employment in banana,cocoa, palmoil, rubber, sisal, sugarcane and tea plantations in twelve countries of the Asian, African and Latin American region (ILO, 1966). In India, the enquiry dealt with a dozen tea plantations, the largest of which had 2025 workers. The survey concluded that 'despite substantial progress the health position on plantations was not universally satisfactory. Malaria had been eliminated but bad hygiene, malnutrition and under-nourishment are often responsible for intestinal or pulmonary diseases as well as anemia.

(8) ILO in 1970, reporting on the social consequences of technological development in plantation, observed that technological changes have led to two main spheres of concern in connection with the health and safety of plantation workers. These are the hazards surrounding the use of agricultural chemicals and secondly to the operation of tractors and their equipment.

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loads. The next category of frequent accidents are caused by the use of improperly guarded machines and moving belts.

- Deaths at work were mainly due to falls, snake and insects bites, and exposure to natural hazards including landslides and lightening and due to drowning.

- No reliable data was available on hazards due to pesticides and agricultural chemicals.

11. U.P.A.S.I. Sources

The United Planters Association of Southern India has been collecting data as part of its Comprehensive labour welfare scheme. Some important epidemiological information on the health status of plantation workers and other sections of the plantations have been reported.

(i) A study of the health of 526 women workers registered on a No-birth bonus scheme (UPASI 1971a) found that 85 percent suffered from anemia (hemoglobin less than 60%), 90 percent had non-specific leucorrhoea and 72.2 percent complained of epigastric pain and 5 had pulmonary tuberculosis (1 percent).

(ii) An analysis of major causes of death in Munnar Plantations (UPASI, 1979) revealed that old age and debility were the causes for 21.82 percent, prematurity 18.48 percent bronchopneumonia 14.55 percent, malnutrition 4.5 percent congestive cardiac failure 3.6 percent and suicide 3.0 percent. An analysis of major causes of infant deaths in Munnar (UPASI, 1979) revealed prematurity to be the major cause (52.59 percent) followed by bronchopneumonia (24.14 percent), umbilical sepsis (6.03 percent), malnutrition (5.18 percent) and gastroenteritis (5.18 percent).

(iii) A study on the morbidity and mortality patterns among under six year olds in four tea estates in Munnar (Unnikrishnan, 1979) found that 0-6 year olds formed 13.05 percent of the cases attending estate hospital out patients. Respiratory tract infections, water borne illnesses and fevers accounted for 88.84 percent of the morbidity. Respiratory tract infections were maximum in infants, water borne illnesses in 1-2 year olds and fever increased with age. Among in-patient admission respiratory infections (31.58 percent); fevers (13.68 percent) and diarrhoea (8.52 percent) remained the three major categories. Mortality was mainly due to prematurity and bronchopneumonia.

(iv) A study of water borne illness on 26 estates in Munnar (UPASI, 1979) showed incidence per 1000 population for three years - 1976, 1977 and 1978 to be 400, 376 and 382 respectively (only diarrhoea, dysentery and gastroenteritis was included). Of the 21,097 cases recorded in 1978 gastroenteritis was diagnosed in 12.7 percent, bacillary dysentery 6.8%, amoebic dysentery (13 percent), diarrhoea in 65.7 percent, infective hepatitis (1 percent) and enteric fever in 0.37 percent.

(v) A retrospective study of diarrhoeas in children admitted to the plantation hospital (Basu, 1977) in Munnar showed that it was commonest in the 0-1 and 1-2 age groups (46.9 and 30.4 percent respectively). Stool examination revealed roundworm ova in 23.5 percent, active amoeba in 15.7 percent, giardia in 2.6 percent. Hookworm ova, E.coli and tapeworm ova was also reported. In 54.8 percent of cases no organism was found.

(vi) Rahmathullah (1979) has reported that in the estates under the Comprehensive Labour Welfare Scheme, remarkable improvement in malnutrition in children had been shown. In 1974, the figures for Normal, 1^{o}, 2^{o}, 3^{o} based on the under-five weight chart (Morley card modifed for India) was 27, 46, 16 and 10 percent respectively. In 1978 the figures were 31, 39, 25 and 3 percent respectively. Rahmathullah (1982) also showed a change in crude birth rate, death rate and infant mortality rate from 41.7, 9.5 and 111.80 in 1970 to 24.9, 5.3 and 52.5 in 1980.

12. Ross Institute Unit Sources

The Ross Institute Unit of Occupational Health, Bangalore, undertook over forty short term field projects on various aspects of health of plantation workers including aspects of occupational hazards and safety from 1975-79 as part of an internship training programme in the plantations. These projects include statistical analysis of hospital or health centre records, community survey of a specific health problem and evaluations of a component of the health service. Community surveys were either total family units or specific target populations such as pre-school children, primary school children, factory workers and so on. A review of these projects (Narayan, 1982) highlight the following epidemiological information on health status of tea plantation populations.

(i) A systematic study of 20 percent of the population of 12 estates in Munnar showed that 38% had endemic goitre. Some associated epidemiological features were also studied.

(ii) Over ten nutritional assessment surveys were undertaken - five in samples of creche children, two in primary school children, two in children of estate population (house to house survey) and one in the total estate population. Malnutrition based on weight alone ranged from 42 to 93 percent of the sample (Ist degree and above). Vitamin A deficiency signs from 0.65 to 75 percent, Vitamin B deficiency signs from 3.2 to 25 percent, caries from 22 to 45.5 percent among the children 0-6 and primary school age groups. All assessments were based on clinical signs.

(iii) Hemoglobin estimation was done on 490 subjects representing twenty percent of the total population of an estate. 3.47 percent had less than 8 gms percent, 31.43 percent had between 8.1 to 10 gms percent, 45.92 percent had between 10.1-12.4 gms percent and 19.18 percent had above 12.5 gms percent.

In another house to house survey of three divisions of an estate, anemia was found to be clinically present in 48 percent of the population. In females, it was 60 percent and in females in the 15-45 age group it was 81 percent.

(iv) A study analysing morbidity and mortality patterns among under fives found that the top ten diseases affecting under-fives were bronchopneumonia, gastroenteritis, PCM, primary complex (Tb), amoebic dysentery, acute nephritis, lobar pneumonia, bronchial asthma, infective hepatitis and ascariasis.

(v) In a nutrition survey of the labour population 476 stool examinations were done. 57 percent were positive for amoebic cysts, round worm ova were found in 73 percent, hookworm ova in 9 percent, whipworm ova in 8 percent, threadworm ova in 3 percent and tapeworm ova in 0.42 percent of cases.

(vi) The percentage of cases admitted to the garden hospital attributable to water borne diseases on an estate were 12, 20 and 28 percent in 1975, 1976 and 1977. The diseases included were typhoid, amoebic and bacillary dysentery, diarrhoea, gastro-enteritis and infective hepatitis. More than forty percent of the admissions were below 5 years of age.

(vii) In a study of 101 female subjects above 18 years in an estate in Nilgiris, 19.6 percent complained of one of the following complaints - dysmenorrhoea, menorrhagia, pruritis vulvae, irregular menstruation, and white discharge.

(viii) A house to house survey on one tea estate in the Nilgiris showed 4.02 percent of the population having presence of sugar in the urine (Benedicts test) and 6.32 percent having blood pressure recordings above 140/95 in a single recording in the field.

(ix) A review of accidents in two tea factories in Munnar in the past twenty years showed that (a) 90 percent occured while working at the tea leaf roller; (b) 75% were cases of hand injuries and two thirds of these involved the right hand; (c) 20 percent were cases of fractures and the rest were contusions, lacerations and sprains; (d) males were most often affected.

(x) In a retrospective analysis of cases of accidents at work admitted to a plantation hospital it was found that hand injuries constituted 23.5 percent of the cases. Among factory workers, 70 percent were working in the rolling section and among field workers 80 percent were pruning during the accident.

(xi) A survey of 238 permanent workers of five tea factories in Munnar region showed that 74.4 percent of the workers had signs and symptoms of respiratory disease. In males (205 subjects) it was 75.1 percent and in females (33 subjects) it was 69.7 percent. Prevalence was higher in older age groups and those with longer years of experience. 79.4 percent of the smokers and 68.8 percent of non-smokers in the sample had positive signs. 66.8 percent had clinical signs of emphysema but in the absence of chest x-ray and respiratory function tests further classification was not attempted. The two other surveys carried out later in 159 workers in five factories and 78 workers of two factories in Munnar showed a much lower prevalence.

(xii) A pilot study undertaken to identify health related difference in women pluckers belonging to two groups of low and high productivity (based on mean plucking performance) showed that low pluckers and greater experience of disease especially anemia with corresponding effect on their absenteeism rates.

Many other studies done on retrospective analysis of burns, acute nephritis, bronchtis, bronchopneumonia and others admitted to estate hospitals as well as health practice research on family planning programme, creche services and others had no direct relevance to the current study.

Other Sources

(1) Fernando (1971) has reviewed the processes involved in tea cultivation and the tea industry highlighting some of the known hazards.

(2) Reviews of the state of the art and related hazards associated with the cultivation of various plantation crops have been compiled by the International Labour Organisation and shown in Table 3 & 4. A comprehensive overview of plantations themselves has been given by Cabrera (1971).

(3) Mackay (1977) attempts to ascertain the health patterns in a Bangladesh tea garden population using three parameters derived from crude data ie., causes of loss of working time, causes of death and ages at death. He found that intestinal and respiratory disease account for half of the total loss of working time. Traditional tropical diseases such as malaria, tuberculosis and venereal diseases contribute hardly at all. Intestinal infections are a major cause of death; respiratory infections are not. The other principal cause of death is cardiovascular disease.

(4) Mackay (1979a) in a clinically descriptive and taxonomic paper based on twenty years of personal experience in rural industries in the tropics highlights the effects of stress on indigenous and expatriate executives in plantations and describes the psychosomatic illness and social maladjustment resulting from unsuccessful adaptation to stress. He describes behaviour patterns classified into manifestations such as the alcoholic, the agressive, the hermit and the transgressor of cultural barriers.

TABLE 3 OCCUPATIONAL HAZARDS REPORTED IN CULTIVATION OF SPECIFIC CROPS

Types of crop	Hazards reported	Source/authority
Bamboo	Venomous snakes, falls, cuts, tetanus, skin punctures, hyper keratosis	Ko Yuanching (1971)
Bananas	Pesticide poisoning, snakes, venomous insects, harvesting injuries with machetes	Ko Yuanching (1971)
Coconut	Falls, injuries from cutting and digging implements, snake bites	Fernando (1971)
Coffee	Coffee workers lung, skin & respiratory allergy, snake bites, falls from trees, burns, minor cuts and abrasions, electrical hazard and crush/amputation injuries from unguarded drying machinery	Bedrikow (1971)
Cocoa	Cuts from saws/machetes, snake bites, elephants and other dangerous animal, pesticide poisoning, diseases of low socio-economic standards	SoFuluwe (1971)
Cotton	Animal and plant diseases, snake bites, eye/skin infections, insect borne diseases, pesticides, accidents due to agricultural machinery and implements.	Gupta (1971)
Hemp	Cannabosis, toxicomania, obstrutive arteritis, machine accidents, fire hazard	Barbero-Carnicero (1971)
Jute	Accidents, fire hazard, pesticides, non-specific lung disease, mill fever	Khin Maung Nyint (1971)

Source: Encyclopedia of Occupational Health and Safety, I.L.O (1971)

TABLE 4 OCCUPATIONAL HAZARDS REPORTED IN CULTIVATION OF SPECIFIC CROPS

Type of crop	Hazards reported	Source/authority
Oil palms	Snake bites, dangerous animals, falls, cuts from implements, skin punctures, pesticides and herbicides	Sofoluwe (1971)
Pineapples	Pesticides, heat stress, accidents due to machines and tools, skin pricks from thorns	Ko Yuanching (1971)
Rubber	Falls, cuts from implements, snake/insect bites, pesticides and herbicides, acids and chemicals, unguarded machinery, fire and heat hazard	Dunlop Co Ltd (1971)
Rice	Uncomfortable posture, heat stress, fertilizers and pesticides, stigmata, raynauds phenomena, cyanosis of extremities, dermatitis, bites/stings, psycho-social stress	Wongpanich (1971)
Sisal	Cutting implements, airborne dusts, injury from processing plants	Arreguin Velez (1971)
Sugarcane	Cutting implements, accidents from tractors and machines, cuts and abrasions from plant, bites/stings, weils disease from rats, pesticides	Munoz & Suchman (1971)
Tobacco	Pesticides and weedicides, skin disease, conjunctivitis, laryngitis, knife injuries, tetanus, lifting/handling accidents, transport accidents	Sangroy Torres (1971)
Tea	Falls, cutting implements, bites/stings pesticides and herbicides, caterpillar allergy	Fernando (1971)

Source: Encyclopedia of Occupational Health and Safety - I.L.O (1971)

(5) Kroeger and Fernando (1974) have presented data on the incidence of diseases among plantation labourers in Ceylon.

(6) Tarigan et al (1977) have studied health status of pre-school children in some settlements of tobacco plantation labourers in North Sumatra.

(7) Fenwick and Figenschou (1972) and Collins et al (1976) studied productivity in cane cutters in Tanzania and physiological performance and work capacity in cane cutters in Sudan respectively. Both these studies were done primarily to determine the effects of schistosoma mansoni infection on work performance but are very well planned studies particularly the latter on occupational physiological measurements of plantation workers.

(8) Roy Chowdhury (1959) presents statistical data in a review of sickness absenteeism in a tea factory at Calcutta. Each worker was losing 12.6 man days on medical grounds and in addition 1.5 man days on account of accidents. The average daily absenteeism was 1.1 percent. Introduction of mechanisation increased the man days lost by 31 percent but number of injuries were reduced by 49 percent.

(9) Chakravarti (1969) has presented an appraisal of health hazards during spraying of pesticides in tea plantations for the first time in Indian literature.

(e) Review of Literature of hazards from exposure to tea and coffee dust

Tea dust

Hazards associated with the inhalation of tea dust has been reported in literature since the 1770's and well documented by Pinnagoda (1971).

Lettsom (1979) describes that some tea blenders are "seized with sudden bleeding from nostrils, and others attacked with violent coughs ending in consumption". He, however, was doubtful whether they were caused by tea dust.

Thackrah (1832) reports that "Tea men, in removing tea from chests, are much affected by the dust especially by that from the green. But as this annoyance is occasional only, we can scarcely suppose it capable of producing permanent injury either to the nervous system or the lungs".

Johnstone (1855) mentions "the headache and giddiness to which tea tasters are subject, the attacks of paralysis to which, after a few years, those who are employed in packing and unpacking chests of tea are found to be liable".

Morton (1879) described what he called 'Tea Drinkers disorder', an 'occupational disease' occuring among "tea brokers or tea tasters on the lines of painters colic or glass grinders disease". He described acute and chronic effects of nervous and systemic poisoning. These were due to tasting of infusions of tea and not smelling the leaves and hence were thought to be due to ingestion of tea and not inhalation of dust.

Castellani (1920) mentions 'tea tasters cough' and 'tea factory cough' which, after a guinea pig experiment he concludes, are types of fungal infections of the upper respiratory tract caused by inhalation of dust during a tea tasters occupation.

Doig (1949) reports pulmonary fibrosis and dyspnoea in a worker engaged in tea blending in a grocers ware house for five years. No other dust exposure was discovered.

Wegeman (1968) has reported conditions similar to asthmatic bronchitis among tea packers in Hungary. His study on this occupational lung disease showed that sputum and blood were highly eosinophilic. X-rays showed condensed hili and prominent bronchial markings. Candida was collected from the patients sputum and the effected workers responded to intracutaneous administration of thrush antigen. He, therefore, concluded that this condition was also a fungal disease (form of bronchomoniliasis).

Uragoda (1970) reported a case of asthma in a tea maker as a result of inhalation of tea fluff in the atmosphere of the factory. Provocative inhalation of the fluff produced an attack within a few minutes. A positive reaction was obtained on skin testing with tea fluff antigen. He called it 'tea maker's asthma'.

Pinnagoda (1971) in a very comprehensive study of the health hazards from exposure to tea fluff in the blending and packing industries in U.K., found that workers were not exposed to a major risk of developing respiratory disease at the dust levels prevailing in the two factories surveyed. The main findings were:

(i) in the dusty areas the average total dust concentration was in the region of 2 $\mu g/M^3$;

(ii) after correcting for the differences in sex and smoking habits and comparing tea workers with controls, a significantly higher proportion of tea workers were shown to suffer from persistent cough and breathlessness (Grade II). Tea workers and controls did not show significant differences in prevalence of other chronic symptoms;

(iii) Respiratory function tests showed that FEV, decreased among groups exposed to dusty environments but the change was not statistically significant;

(iv) Male workers with heavy dust exposures complained more of symptoms of irritation in eyes skin and nose. Females complained less of symptoms of irritation;

(v) Radiological examination did not show any gross abnormalities attributable to fluff;

(vi) None of the workers examined showed any positive reaction to tea fluff antigen or chlorogenic acid.

(vii) Chemical analysis by liquid chromatography has shown that tea fluff chemical composition in similar to that in black leaf tea. Microscopical examination of air borne tea fluff revealed the presence of the four identifying components found in the tea dust.

To summarise:

There is evidence in literature that workers in tea factories with high dust concentrations are at a greater risk of respiratory infections than others. The symptomatology may be due to the direct effects of inhalation of tea dust by the irritation of the upper respiratory passages. Hypersensitivity mechanisms probably also occur. Fungal contamination of tea leaf has been observed and hence the possibility of bronchomycosis should also be kept in mind.

Coffee dust

i) Figley and Rawling in 1950, Bruun in 1957 and Gronmeyer and Fuchs in 1958 have reported that workers in coffee industry frequently develop asthma, rhinitis and dermatitis (Freedman et al 1962).

ii) Figley in 1950 showed that patients who are allergic to coffee dust showed positive intra-dermal reactions to castor bean in the absence of any known exposure to castor bean (Figley and Rawling, 1950). Coulson in 1950 suggested that this cross reactivity may be explained by the facts that bags of coffee and bags of castor bean come in contact with each other in the holds of ships coming from South America since both are imported from there. He also reported sufficient contamination of the burlap coffee sacks with castor bean to sensitise the coffee workers to castor bean (Freedman et al 1962).

iii) Kaye and Freedman (1961) showed that a small percentage of coffee workers were allergic to coffee dusts which fill the air of the factory during coffee manufacturing process. Large positive intradermal tests were obtained in allergic workers with extracts of green coffee, whereas roasted coffee produced only small reactions. Heating or roasting the coffee bean appeared to destroy its allergenicity. Thus the workers who were allergic to inhaled green coffee dust were able to drink ordinary coffee which is prepared from the roasted bean without adverse reactions. Previous family history or past history of allergy increased the response clinically. Allergic reactions were generally in the form of coryza, dermatitis, lacrimation and bronchial obstruction.

iv) Freedman et al (1961 and 1962) found that among the substances present in green coffee, phenolic compounds particularly chlorogenic acid has been reported to be responsible for allergic reactions. Chlorogenic acid has been found to be capable of inducing the formation of circulating antibodies in animal species. Layton et al (1964) from studies done by them suggested that the antigenic effect may not be chlorogenic acid but by trace amounts of protein impurities in it. Bariana et al, (1965) after further investigations have found evidence for the antigenic and allergenic activity of chlorogenic acid.

v) Turula (1966) studied the incidence of coffee allergy in a Helisinki roastery. Of 102 subjects who were studied, 35 workers were identified with history of allergic symptoms to raw coffee including rhinitis, dermatitis, conjunctivitis, headache, dyspnoea and asthma. The investigation included skin scratch tests, nose provocation tests, and x-rays of chest and maxillary cavities. Raw coffee allergy showed all the signs of occupational disease; ie.,

(a) intensity decreases with continuous exposure;
(b) symptoms disappearing with change of job or vocation;
(c) symptoms intense on returning;
(d) symptoms intense during working hours;
(e) symptoms failing to occur when a gas mask is used;
(f) skin scratch tests and nose provocation tests were positive in subjects and not controls. X-rays of maxillary sinuses showed thickening of mucous membranes in some subjects.

vi) Van Toorn (1970) reported a case of a man who worked for more than twenty years in a coffee roastery factory and developed lung lesions. By immunological investigations the presence of circulating antibodies against coffee bean dust in the patients serum was demonstrated. Immunofluorescence of the lung biopsy demonstrated deposits of IgG and complement among alveolar capillaries. He therefore felt justified to call the condition coffee workers lung - an extrinsic allergic alveolitis analogous to farmer's lung.

vii) BedriKow (1971) in review articles on coffee cultivation and coffee industry mentions the allergic reactions of skin, mucous membranes and respiratory symptoms encountered in some persons handling green coffee. Symptoms observed include nasal discharge with mucous congestion, skin eruptions, dyspnoea, asthma and lacrimation often with headaches. Severe reactions follow first time exposure or return to work after absence and mild symptoms are encountered in persons who have a long history of exposure. Allergy testing with fungal and other impurities found in coffee proved negative. Chlorogenic acid has been identified as a possible allergen. This acid derives from coffeic and quinic acid and is found not only in coffee but also in castor bean, oranges and various other plants. Further studies are required to establish the exact nature of this coffee allergy.

CHAPTER III — TEA CULTIVATION AND TEA INDUSTRY IN INDIA

Tea is grown in India as an organised agro-industrial undertaking. It is one of the most important plantation crops in India. The others are coffee, rubber, spices and cinchona.

Tea plantations are located in the States of Assam, West Bengal (North) Tamil Nadu, Kerala and Karnataka (South). In 1978, it was estimated that the total acreage under tea was 363,303 hectares. South Indian tea plantations account for 20.3 percent of tea acreage and 23.4 percent of tea production in India. In South India, the tea is grown on the slopes of the Western Ghats, principally on the Kanan Devan Hills of Kerala and the Nilgiris and Anamallai hills of Tamilnadu (UPASI, 1978).

History

Tea is the name given to both the Shrub Camellia Sinensis, and the beverage brewed from the leaves of this shrub. The word tea comes from the Chinese Fukien dialect word 'te' pronounced tay (Ukers, 1935 quoted in Pinnagoda, 1971).

The orgin of tea has its roots in Chinese mythology and the first use of this beverage is attributed to Emperor Shen Nung in 2737 B.C. (Ukers, 1935 quoted in Pinnagoda, 1971). Another myth which tries to explain the effects of tea relates to a Buddhist monk, Dharuma, who came to China in the 5th century A.D. It is said that during a period of meditation he became drowsy and seizing his offending eyelids, he cut them off and cast them from him. A plant grew where they fell the tea plant, from whose leaves can be prepared a drink that drives away sleep (Harler, 1973). Between 5th century A.D and 19th century, tea spread all over the world and began to be cultivated in many countries.

In India, the indigenous tea shrub had been known for centuries. The locals used it as a vegetable in the form of mang. It was discovered by Robert Bruce in Upper Assam in 1823. Chinese tea plants were first imported from Canton and planted in Calcutta in 1780. After some experiments, it was decided that Assam was the best area for growing it commercially using the wild Assam type of tea. The East India Company which had lost its monopoly on Canton tea trade turned to India to establish a rival source of supply under its control. By 1838, it began producing tea in Assam by employing villagers and processing it with the help of imported Chinese labour. Assam tea was first auctioned in London in 1840. In the following years, the Assam Tea Company was formed with 2636 acres of tea. By 1860, the total north-east Indian tea was 284,470 acres yielding 86 million pounds (Pinnagoda, 1971).

Tea was first introduced in Nilgiris in 1834. Plants were brought Kew garden, London, unaware that the plant was indigenous in Assam. Commercial tea planting started in 1853 and was well-established by 1880. Anamallais was the last planting district to be opened at the end of the century (Rahmathullah, 1977).

By 1970, 881,000 acres was under tea in India and the annual production was 926 million pounds. In the same year, the tea acreage in the world was 3,258,000 acres and the production was 2790 million pounds (Harler, 1973).

Characteristic features

The tea industry occupies an important position in the national economy. It provides employment to over 8 lakh workers. Of these, 56 percent are women. The family ratner than the individual is unit of recruitment. Most of the labour force in the South Indian plantations were recruited from the plains of Tamilnadu under the traditional Kangani or 'labour contract' system.

Tea is the largest earner of foreign exchange in the country. 75 percent of tea plantations are under corporate ownership and a large proportion of the remaining 25 percent is in the small grower sector. The other important economic features are participation of large equity capital, system of industrial management, considerable amount of foreign capital, crop specialization and very low average labour/land ratio (Cabrera, 1971).

The labourers in a tea plantation are widely dispersed because only by having them so can they be within economic reach of their working area. This is in very marked contrast to a factory oriented industry or mining where workers are concentrated around the factory or mine-shaft (Mackay, 1974).

Health and Welfare

The Plantation Labour Act, 1951 is one of the most comprehensive labour welfare legislation in the statute books and makes detailed provisions for health, welfare and social security benefits (PLA, 1951). The Act covers all plantations measuring 10.117 hectares or more and employing 30 or more persons. It provides for: i. drinking water; ii. sanitation; iii. medical aid; iv. creche; v. recreational facilities; vi. educational facilities; vii. housing; viii. protective clothing; ix. hours of work; x. leave with wages and xi. sick leave.

Other statutory benefits applicable through various enactments are: i. full employment; ii. maternity benefit; iii. Employment injury benefit; iv. Provident fund and family pension; v. Gratuity; vi. Festival holidays (UPASI, 1978).

Other non-statutory benefits for the labour include:

(i) annual leave and travelling expenses to home and back;
(ii) cattle keeping and grazing facility;
iii) facilities of free collection of fire wood;
(iv) ex-gratia payment in cases of non-occupational chronic disease;
(v) issue of free liquid tea/coffee at work spots;
(vi) kitchen gardens;
(vii) ex-gratia payment for promotion of family planning;
(viii) uniforms for certain categories of employees;
(ix) arrangement for issue of food grains in some areas on a no-profit no-loss basis (UPASI, 1978).

Wages and Bonus

The tea industry is covered by the Minimum Wages Act and in addition also pays an annual bonus to the workers.

Unions

Plantation labour are among the best organised sections of workers in the country. All the central trade union organisations are represented in the plantations. For white collar workers there is a separate union.

UPASI and Comprehensive Labour Welfare Scheme

The United Planters Association of Southern India represents employers and has organised a number of important services for its members including information and advise on tea research, planting techniques, modern management techniques, labour legislation, labour welfare and health. It also acts as a liaison agency for the industry with government and international organisations. In the seventies it initiated a Comprehensive Labour Welfare Scheme to improve the health and living standards of plantation workers and their families. The components of the scheme are:

(i) Maternal and child Health;
(ii) Child development;
(iii) Education on personal Hygiene;
(iv) Environmental sanitation;
(v) Nutrition;
(vi) Planning of Leisure; and
(vii) Family Planning (Rahmathullah, 1982).

The scheme was initially funded by USAID, later extended and supported by the Government of India and is now being gradually taken over by the managements.

From the point of view of working conditions and welfare measures the workers in the plantations are in a much better position than the farmers in the rural areas and are relatively on par with urban industrial workers. However, the presence of organised health services do not necessarily mean a better health status and the present study proposes to look into this matter in greater depth.

CHAPTER IV

CHEMISTRY OF TEA

The chemistry of the tea leaf and the composition of black tea has been studied and the constituents estimated by Millin & Rustige, 1967 and Millin, Crispin and Swaine, 1969.

The green tea shoots contain - i) Caffeine; ii) Catechins - the colourless compounds contained in the vacuoles of the leaf cells; iii) Flavanols like kaempferol; iv) Leucoanthocyanins mainly as leucocyanins; v) Phenolic acids like theogallin, chlorogenic acid and gallic acid; vi) Free Amino acids eighteen of them of which theanine is the most abundant; vii) Minor amounts of B group of vitamins and Vitamin C (Das, Ghosh and Guha, 1964) and Inositol and biotin. (viii) The approximate chemical composition of green tea shoot is shown in Table V. Soluble carbohydrates including mono and polysaccharides;

During the processing of tea leaves the leaf cells are ruptured bringing catechins in contact with polyphenol oxidase enzyme in the cell chloroplasts. Aerial oxidation catalysed by the enzyme and subsequent dimerization produces theaflavins and derivatives. Furthur oxidation produces dull brown pigment called thearubigins. Flavanols undergo little or no change during processing. Leucocyanins are completely oxidised during enzymic action and therefore are not found in black tea.

The composition of the soluble components of black tea is shown in Table VI. It reflects the above mentioned changes. Theaflavin imparts the bright golden colour and gives astringency to the beverage. Thearubigins also add to the colour. Caffeine is responsible for the stimulant action.

TABLE 5

Approximate composition of green tea shoots

Substances soluble in water	Dry weight(%)
Flavanols	
(-) epigallocatechin gallate	9-13
(-) epicatechin gallate	3-6
(-) epigallocatechin	3-6
(-) epicatechin	1-3
other flavanols	1-2
Flavonols and Flavonol glycosides	3-4
Leucoanthocyanins	2-3
Acid depsides	5
Total polyphenols	30
Caffeine	3-4
Amino acids	4
Simple carbohydrates	4
Organic acids	0.5

Approximate composition of green tea shoots

Substances partially soluble in hot water	
Polysaccharides - starch	1-2
pectin substances etc	12
Proteins	15
Ash	5
Substances insoluble in water	
Cellulose	7
Lignin	6
Lipids	3
Pigments	0.5
Volatile substances	0.01-0.02

(Millin and Rustidge, 1967 included in Pinnagoda, 1971)

TABLE 6 Estimated composition of black tea components soluble in water

	% Dry weight of leaf			% Dry weight of leaf
Flavanols (mainly epigallocatechin gallate)	1-3	Partially soluble substances		
Flavonols and flavonol glycosides,	2-3	Proteins	Ca.	15
Phenolic acids and depsides	4	Polysaccharides		14
Theaflavin	1-2	Nucleic acids		0.09
Non-dialyzable phenolic substances	1-5	Mineral salts (ash)	Ca.	5
Other phenolic substances (bisflavanols, dialyzable thearubigins and other fermentation products)	2-4			
Caffeine	3-4			
Amino acids and peptides	5			
Simple carbohydrates	4			
Organic acids	0.5			

(Millin Grispin and Swaine, 1969 included in Pinnagoda, 1971)

CHAPTER IV (B) NUTRITIONAL ASPECTS OF TEA

Das et al, 1964 has presented a detailed review of the nutritional values of tea based on studies undertaken in India and abroad. Table 7 presents the main findings or ranges of findings on the protein, sugar, caffeine, vitamin B, C, A, copper and fluorine content of green and black teas in India. Since tea is a very popular beverage in India and is drunk extensively especially in the North, the nutritional value of the brew gains some significance.

Processing of tea, use of certain fertilizers, season and other environmental factors change the levels of these constituents in the sample of teas used for brewing.

It is an established fact that tea has no calorific value exclusive of any accessories like milk and sugar that may be added to it. It is also established that there is no sodium in tea. Hence it is a beverage that can be freely prescribed in all obesity diets and 'salt poor' or 'salt free' diets.

It has been estimated that many Indians take upto 5-6 cups of tea in a day. Based on this pattern of consumption it has been further estimated that 5-6 cups of tea can supply an adult 9-14% of daily requirement of thiamine, 5% of daily requirement of niacin, 6% of folic acid requirement, 6% of pantothenic acid requirement, entire requirement of Vitamin E and K and 155 ug of copper and 1 mg of fluorine. These are small but not insignificant amounts.

Cohen & Mclendon (1954) have recommended more tea drinking - beginning on a small scale at the age of one as a possible preventive measure against tooth decay since tea is an auxiliary source of fluorine. The high copper value of tea may help in hemoglobin formation though this has not yet been adequately studied.

TABLE 7 NUTRITIONAL ASPECTS OF TEA (INDIAN) (per 100 gm)

Nutrients	Green	Black	Nutrients	Green	Black
1. Protein (g/)	25.55	22.60	8. B.Vitamins (ug/)		
2. Sugar (g/)	4.67	4.90	a) Thiamine--B_1*	164-207	148-311
3. Caffeine(g/)	3.06	3.51	b) Riboflavin *	940-2048	1652-2048
4. Copper *	31-34 ppm		c) Niacin	7400-8400	6400-7300
5. Fluorine	180 ppm		d) Folic acid	4500-5900	7800-9300
6. B Carotene (ug/)	6300-13800	4200-11100	e) Pantothenic acid	966-2510	1323-1967
7. Vitamin K** (biological units)	300-500		9. Vitamin C (mg/g) (ascorbic acid)	0.07	0.02-0.03

Extracted from Tables presented in Das et al, 1964

* = Dry weight base. Samples from various parts of India ** = Russian processed tea

CHAPTER IV (C) PHARMACOLOGICAL ASPECTS OF TEA

Das et al 1965, have presented a detailed review of the distribution of caffeine, theobromine, theophylline and of tea tannin's which are flavonoid compounds in different varieties of tea. They have also outlined their pharmacological and physiological effects.

It has been reported that a cup of tea contains 40-100 mg of caffeine depending on whether it is weak, medium or a strong brew. It also contains 130 mgm of tannins and 30 mgm of flavanols. The pharmacological and physiological effects of these compounds have been studied in the laboratory as chemical solutions on both animals and man. Studies have also been reported on the effects of a brew of tea on human subjects-these effects being attributed to the above constituents.

Table 8 summarises the main effects and the clinical significance of some of these effects. The range of effects reported in literature are very wide in their scope. It is important to remember, however, that green leaf infusions show the above effects and some of these are reduced or lost by the tea during processing.

TABLE 8 PHARMACOLOGY OF TEA

Constituent	Effects reported in literature	Clinical significance or potential
1. Xanthines mainly Caffeine	i. Stimulation of central nervous system	Alleviation of fatigue
	ii. Increased ease of muscular activity	? Contra-indication in labile autonomous nervous system
	iii. Diuresis	
	iv. Stimulation of cardiac muscle	? Contra-indication in hypertension
	v. Augmentation of gastric secretion, tone and motility	Contra-indicated in peptic ulcer
	vi. Effects on thyroid gland	? Contra-indicated in hyperthyroidism
	vii. Hypocholestrolemia	Use in hypercholestrolemia
	viii. Decreases blood sugar	
	ix. Role in brain metabolism	
2. Tannins including flavonols	i. Demonstrable Vitamin P activity ie., reduces capillary fragility and permeability.	Treatment of haemorrhagic disorders
	ii. Increases storage of Vitamin C and reduces excretion	Use for bleeding gums, Wound healing
	iii. Effects on haemopoiesis	Treatment of anemia
	iv. Antibacterial effect on salmonella, shigella, eltor vibrio and staph. aureus	Treatment of plague, typhoid bacillary dysentry and intestinal infection
	v. Reduces fluid loss in intestine	Useful in treatment of cholera
	vi. Normalises thyroid hyperfunction	Therapy of toxic goitre
	vii. Inhibits growth of virus in embryonated egg.	

Extracted from Das et al, 1965.

Das et al 1965 sum it up very well by stating that "our age-old idea about the food value of tea which was so long in a rather conflicting state is prone to change in view of the rapidly accumulating scientific data about tea and its products. The knowledge gained about the vitamin contents of tea, nutritional, physiological and pharmacological importance of tannins and caffeine, the important constituents and lastly though not the least, its most important role in maintaining intestinal hygiene either by killing or preventing growth of harmful microflora present there, reveal tremendous possibilities for popularising the adequate use of tea in human dietaries. In view of the shortage of vitamins and minerals in the principal diets of India and other under-developed countries, the regular and adequate consumption of tea as a supplement to the diet, may contribute significantly to our dietary requirements".

CHAPTER V — OCCUPATIONS IN A TEA PLANTATION

The occupations in a tea plantation may be classified broadly into:

A. Field work
B. Factory work
C. Supportive services
D. Administrative including supervisory and managerial.

Most of the working population, if not all, reside in the plantations in labour lines and accommodation provided by the management. The work and home environment especially for the field workers are not as clearly distinguishable as in industrial workers. The work is varied as in most agricultural operations and the load varies with season, production demands and other factors. Workers are shifted from job to job and distinct job appointments are not always given. Workers may move from field to factory and vice versa. During a life-time a worker may have been involved with different types of work for carying periods of time. An occupational history therefore requires patience and insight. Clear cut division for epidemiological analysis are not always possible.

A. Field Work

As in the rest of agriculture field jobs are very varied and could be described under the following headings

(a) Plucking
(b) Clearing
(c) Planting
(d) Manuring
(e) Weeding
(f) Pruning
(g) Lopping
(h) Pesticide spraying
(i) Other miscellaneous manual jobs including transportation

(a) Plucking

This job has been described in great detail by Rahmathullah and Pothi (1981) in their preliminary report on Productivity of women pluckers. The manual removal of the tender green tea shoots - 'the two leaves and a bud' using the thumb and fingers of both hands is done mainly by women workers though additional male workers may be allotted the job during the 'flush' season.

The skilled hand movements consist of:-

i) Automatic finger movements using a differential group of movements with the ten fingers;

ii) The thumb and forefinger of both the hands are used to pluck two different units of the 'two leaves and a bud and then transferred to her two palms held by the other six fingers. When one of the two palms is full the right one in the right handed women and the left one in the left-handed woman--the collection is thrown on to the basket on the back strapped to her forehead. (Figure-1)

iii) These movements are further complicated by the responsibility for selective plucking, ie., avoiding over-mature or immature leavels and maintaining the surface configuration of the bush of either the horizontal normalcy or convex shape as in 'dome plucking'. This requires good finger-eye-brain coordination.

iv) This work is done for eight hours in the open with constant mobility along the gradients of the field.

v) The most skilled workers pluck upto 100 kilograms in a working day, which is about 4.9 lakhs--half a million units of two leaves and a bud in a single workingday.

Though plucking is classified as manual labour in actual fact it is a highly skilled, incredibly taxing job requiring the further interest of the applied physiologist, psychologist and ergonomist.

(b) Clearing

This includes felling of trees, uprooting stumps, burning undergrowth and removing old tea plants. It also includes other land preparatory work such as ditch and irrigation channel digging, bunding, levelling and sloping.

(c) Planting

This includes soil preparation, care of the nursery, planting of vegetatively propaged cuttings, interculitivation with shade trees and early care including watering.

(d) Manuring

This includes application of both organic and sophisticated chemical fertilisers in powder or spray form. The types of compounds used are nitrogenous, phosphatic, compound or mixed and trace element fertilizers.

(e) Weeding

This is done manually using a hoe or by the hand pulling method which is traditional. A wide range of chemicals weedicides and herbicides are being used currently. They are applied or sprayed around the tea bushes.

(f) Pruning

This is an operation done once in 3-5 years of a cycle of plucking. Using pruning shears the whole bush is pruned fairly drastically. The older leaves and matured wood are removed by this method and the tea bush is thus maintained as a constant leaf producer.

(g) Lopping

This involves the lopping of branches of the shade trees usually silver oak, that are cultivated in between the tea bushes. The worker 'shins' up the tree or climbs up sometimes using a ladder and 'lops' of the extra branches using an axe, lopping sickle or other sharp cutting implements.

(h) Pesticide spraying

This includes formulation, mixing, transportation, dusting and spraying of a large number of chemicals used to destroy insects and other biological pests that attack tea bushes. The chemical may be an insecticide, rodenticide, fungicide, bactericide, miticide or nematocide. The details of the chemical nature of these products are described elsewhere in the report.

The transportation is mainly done using a Bak-pak sprayer, ie., a motor operated sprayer strapped to the back of the sprayer. The load may be upto 25 kilograms since the machine weighs 12.5 kilograms and about 10 litres of insecticide and about 2 litres of fuel are usually carried. The operation is carried out for 5-7 minutes at a time followed by a gap for some time. A session may last for about 5 hours depending on the demands of the cycle of spraying. (Figure 6)

(i) Other manual jobs

The plucked tea is usually kept in baskets or sacking carried on the backs of the pluckers or workers and supported by shoulder straps or head hands. These have to be carried, when full to centrally located weighing sheds for weighment. From here they are transported to the factories for processing.

Being an agricultural operation, there are many other miscellaneous manual jobs in the field apart from those described above. These include building of roads and rail tracks, digging wells, maintaining irrigation trenches and spring outlets, construction repair and maintenance of buildings and sheds, keeping of cattle, grazing raising of other live stock including poultry, maintenance of gardens and landscaping and other such related agricultural work. (Figure 5)

Epidemiological features

1. Sex distribution:

Field jobs on a tea plantation have a distinct sex distribution. While plucking in most plantations is almost exclusively done by female workers all other manual agricultural work is done by male workers.

2. Work distribution

Most of the agricultural work described are done by the male workers in rotation or according to the cycle/seasonal demands. 'Sprayers' tend once again to be specially trained, skilled agricultural workers.

They are trained on the job and during the spraying season they carry out the required spraying. In the field they are assisted by other workers who help them with transportation and formulation. In check rolls often these helpers are not indicated as 'sprayer assistants' since this is a changing responsibility. Occupationally speaking they are as much at risk as the sprayers. Epidemiologically field workers in tea plantations can be divided into three groups:-

i. Pluckers (mostly female)
ii. Field workers (mostly male)
iii. Sprayers (always male)

B. Factory Work

After weighment of the freshly plucked, tender, green tea leaves, they are transported to tea factories situated on the estate or in one of the neighbouring estates. They are then dried through a special process to obtain the dried 'black tea' that is packed and commercially sold. Black tea may be divided into various grades consisting of the leaf and the 'broken tea'. The latter is further sub-divided into pekoes, broken orange pekoes, fannings and dusts (Fernando, 1971). Tea processing consists of five stages:

1. Withering (Figure 7)

The green leaves are spread manually on large withering lofts (60 ft x 6 ft) located on the upper floors of the factories. They consist of wooden frames with a nylon or wire mesh netting. The workers spread upto 1000 kilograms of leaf per day. The leaf density may be 1-4 kilograms per square foot.

Air at a controlled temperature of 80 deg. F and humidity 60-70% (wet and dry bulb difference must be atleast 6 deg for this process) is blown over and under the leaves. Once in eight hours the air blowing is stopped and the leaves in the loft are manually turned.

The withered leaf is then scraped from the mesh and collected in sacks. These are then weighed and dumped into the chute leading to the roller. A full sack may weight from 25 to 30 kilograms.

Withering takes out upto 50% of the moisture in the leaf. By this process the cell membranes in the tea leaf are made more permeable and the enzymes in the nucleus mix with the cell contents starting the fermentation process.

2. Rolling (Figure 8)

Withered leaves are passed through rolling machines which twist the leaf causing cells to rupture further. Rollers are used in the 'orthodox' method of manufacture but in some of the newer factories-the use of retorvanes or CTC machines (cutting, tearing and curling) are common.

Leaves are pushed into rollers manually and the opening and closing of the roller table door and its locking is also done manually. The temperature maintained is 70-80 Deg. F and the machine usually has a speed of 36-45 r.p.m. From rollers the tea is collected in trolleys manually by workers. A full trolley weighs 150 kilograms.

After crushing the leaves are passed over roll breakers which are sieves which separate the broken sections of the leaf from those that need furthur reduction in the rollers. Leaves are fed into roll breakers by hand though sometimes a wooden board is used like a tray. Roll breakers vibrate at 310-320 r.p.m.

3. Fermentation

This is an oxidation process. From the rolling section the crushed leaves are carried in trays, 1½ feet square to the fermentation trough. Each tray when full weighs 10 kilograms. A fan blower and a humidifier maintain the temperature at 70 deg. F and the humidity at 90-100 percent (the wet and dry bulb difference being less then 1°-2°F.

4. Drying/Firing (Figure 9)

Following fermentation the leaf is then manually fed onto a dryer on a continous belt over which a forced draft of hot air drawn from a furnace is blown. The temperature is about 200 deg. F and the process takes about 20-21 minutes per batch. The dry tea produced by this process has only 2-3 percent moisture. Apart from removing the moisture the process also stops further fermentation.

5. Sifting/stalk extraction (Figure 10)

The dried leaves from the drier are collected in boxes and taken to the sifter. Coarse stalk is extracted by hand or by the use of electrostatic extractors working at 210 r.p.m. and separating brown and black tea. Sifting into various grades and categories is done on mechanically agitated bays filled with wire mesh of various gradations. (Figure 11)

6. Packing (Figure 12)

The sifted tea is then packed in wooden tea chests lined with paper and foil. Often a 'tea-chest maker' is appointed specially for this purpose. The chests are filled, nailed, sealed and labelled. Each box weighs 40 kilograms. Sometimes sacks reinforced with foil are used. These weigh about 25-30 kilograms, when full. Tea chests are loaded onto trucks manually and transported to the auctions.

Furnace operation

In addition to the above operations a furnace is kept continously operative at 250 deg. F. Coal is fed once in 10-15 minutes using a shovel and the slag is removed periodically.

Epidemiological features

1. Sex distribution

The factory workers are mostly if not exclusively male. In some factories women are employed in the sifting section.

2. Work distribution

Workers are not strictly allotted or confined to specific sections in the factory. They may work in different sections of the factory during the year or even during a specific quarter. They may be shifted from one section to another according to work load and experience.

3. Type of work

In most sections the work is manual labour--mainly consisting of feeding various machines and collecting the finished products. Work in the withering loft is the most strenous of all. The environmental parameters of temperature, humidity, illumination, noise and dust levels vary greatly between the sections.

4. For epidemiological studies

Factory workers may be classified into five groups taking environmental parameters, type of work and usual number of work into account. These are

a) Withering loft workers or 'witherers'
b) Rolling/roll breaking section or 'rollers'
c) Fermentation/firing/drying section or 'fermenters'
d) Sifting section or 'sifters'
e) Packing section or 'packers'

C. Supportive services

Sections A and B have outlined the occupations which are characteristic of a tea plantation and a tea factory. Being an agro-industrial undertaking, there are a wide range of supportive services/jobs done by skilled workers which need to be listed here for the sake of completeness. The nature of these jobs are similar to those done by individuals with the same job description in any organised agricultural or industrial enterprise. Most, if not all of them, live on the estate and though they share the same home environment and quite a bit of the work environment, they are not in direct contact with the tea bush or products of tea in the factory for long hours. Epidemiologically speaking they form a good internal control group on a plantation. Sometimes many of these jobs may be allotted to field or factory workers when their active, productive life is over.

1. Sweepers
2. Gardeners
3. Helpers or attenders in office, creche, water supply, hospital and bungalows
4. Watchmen
5. Drivers of trucks, jeeps and other vehicles
6. Storekeepers
7. Electrician/s
8. Mechanic/s
9. Plumber/s
10. Medical staff - including doctors, compounders, nurses and midwives
11. Welfare staff - personnel officers, social workers, school teachers etc.
12. Office staff - including accountants and clerks

D. Administrative staff

As in all industrial enterprises tea plantations have an important component of supervisory and managerial staff. These are usually people with many years of experience. They not only share the general and occupational environment of the labour population, but also have the added factor of stress which is now accepted as an important and unavoidable factor of jobs requiring supervision or responsibility over large numbers of people and processes. They may be classified as -

1. Manager/Deputy Manager/Asst. Managers
2. Field supervisors or conductors (Figure 3)
3. Factory supervisors or tea makers

Though these could also be included as internal controls in an epidemiological study, they represent a higher income group which is reflected in a better home environment and nutritional status and these must be taken into account during interpretation.

CHAPTER VI THE TEA PLANTATION ENVIRONMENT

Environment may be defined as 'the aggregate of all external conditions and influences affecting the life and development of an organism, human behaviour or society.'

The tea plantation environment is a complex blend of agricultural work in a rural setting with the organised dynamics of an industrial undertaking. In addition to the environmental factors operating in any rural area it has its own distinctive features.

The environment of the tea plantation worker may be considered under five broad groups:

A. Physical
B. Chemical
C. Biological
D. Mechanical
E. Psychosocial

Tea plantation workers reside on the plantations with their families. These environmental factors can effect their health and living both in the home and work situation. A rigid demarcation between residential and occupational environment is not always possible except for the factory workers.

A. Physical Environment

1. Altitude

Tea plantations are usually situated at altitudes between 1000 m to 2000 m above sea level and though they experience changes of seasons and fluctuations in temperature and humidity, they do not have the extremes of climate conditions experienced in the plains.

2. Geography

The terrain is also very hilly and all distances involve gradient changes. Most plantations are nestled in the valleys or slopes of hill ranges and are usually at some distance from traditional conglomeration of people in villages on the hills.

3. Temperature

Because of the altitude the temperatures on plantations are ambient most of the year. During summer months, it never gets higher than 30°C (96°F) and during winter months it gets as low as 6°C (43°F).

4. Humidity

The humidity varies from 54-70% in the summer months to 80-95% in the colder seasons. Monsoons are heavy especially in the months of June to September. The South India tea plantations also experience the winter monsoon. The maximum rainfall per year has been as high as 10-11 inches.

5. Air velocity

A cool breeze is present most of the year. Stronger winds occur in some of the months.

6. Water supply

The source of water in most plantations are mountain springs. In many, wells and tube wells have also been provided. The springs are usually protected at the point of intake. Water is stored, treated and distributed to the labour lines and points near the fields, and the factory. The water has all the characteristics of spring water (physical and chemical) but may be polluted to various degrees depending on encroachment in and around the spring by the human population.

7. Housing

In the past, housing on plantations was of a very poorstandard-not being very different from the thatched 'kutcha' dwellings of the rural areas. Due to the recommendations of various inspection committee supported by legislation a very large proportion of the labour population and all the other categories of staff have now been provided by a 'pucca' construction with damp-proof floor and tile, concrete or asbestos roof. These are distributed in small groups of labour lines situated close to their respective fields.

8. Sanitation

Labour lines now-a-days have sanitary latrines attached to each unit of housing or of houses. These may be, dug well, bore-hole or the septic tank latrines.

Drains are provided to carry away sullage from kitchens and wash rooms. These usually lead into gulleys and streams in the field. Soakage pits are not very common.

Indiscriminate excreta disposal in and around the lines especially by the children and in the fields is still not uncommon.

Garbage and household wastes are also disposed of rather indiscriminately though in many plantations manure pits are becoming popular. Animal wastes are used as fuel or manure as in most rural areas. In the absence of these practices they add greatly to the insanitary conditions and facilitate rodent and fly breeding.

Popularisation of vegetable plots, gardens and small plots for food crops, in recent years, have resulted in greater recycling of wastes and have helped remarkably in improving sanitation in areas where they have been accepted in larger numbers.

9. Factory environment

Though the tea factories are usually situated on the top of hills and are well ventilated, there are sections of the factory which have high temperatures and humidity like the firing/drying section, the fermentation room and the furnace room. Dust levels are high in the sifting rooms. Noise levels as well as vibration levels of most of the machinery are high.

B. Chemical Environment

A few decades ago tea plantations, like most agricultural operations were relatively free of chemicals. However, reporting on the social consequences of technological development in plantations, I.L.O. (1971) observes that "the technological changes which have taken place in connection with plantation work have led to two main spheres of concern in connection with the health and safety of workers. These relate firstly to the hazards surrounding the use of agricultural chemicals..... Agricultural chemicals which could constitute a hazard to the health of the workers are those disseminated as insecticides, fungicides, herbicides, rodenticides and similar products. There is a pressing need to assess more accurately than has been possible so far the real incidence of ill-effects of occupational exposure to toxic chemicals used on plantations..... Enough is known however to indicate that what are generally referred to as pesticides do cause occupational illness in calculable measures....".

Agricultural chemicals used in tea plantations can be divided into three broad groups:

1. Fertilisers;
2. Pesticides;
3. Herbicides or Weedicides

1. Fertilisers

These are substances added to the soil to ensure a high and stable crop yield. They are classified as organic and mineral. Organic fertilisers are manure from farm animals, bone meal, peat and composts. Mineral fertilisers are produced by the chemical industry either synthetically or by the treatment of naturally occuring minerals. The essential nutritive elements are nitrogen, phosphorous, pottassium and trace elements (Ersov, 1971). Table 10 shows some of the common fertilisers used in tea plantations classified into nitrogenous, phosphatic potash, trace and compound fertilisers (UPASI, 1979a).

2. Pesticides

A 'pesticide' has been defined as "a chemical substance used for the destruction of an organism detrimental to man or his interests". (Copplestone, 1971). Pesticides used in tea plantations may be classified into the following groups depending on the organism which they are designed to kill.

i) Insecticide;
ii) Miticide;
iii) Rodenticide;
iv) Fungicide;
v) Bactericide
vi) Nematocide

Table 11 shows the common pesticides used in South Indian tea plantations and the organism against which they are used (UPASI, 1979a).

Based on their chemical nature, the pesticides used in tea plantations can be classified into the following groups (UPASI, 1979a).

(a) Pesticides, halogenated: These are further divided into 3 groups.

i) Olefin derivatives
ii) Diolefin derivatives, eg., Heptachlor, Endosulphan
iii) Aromatic derivatives, eg., Kelthane, DDT, BHC

(b) Pesticides, organophosphorous, eg., Malathion, Formothion, Dimethoate, Dimeton.

(c) Rodenticides: These are toxic chemicals used for destruction of harmful rodents such as rats, mice and other destructive vertebrates (Voilet, 1971). Those used in the plantations include:

i) Toxic and vesicant gases like hydrocyanic acid, hydrogen sulphide and phosphine.
ii) Inorganic poisons - metallic phosphides like zinc phosphide.

TABLE 10 FERTILISERS USED IN TEA PLANTATIONS

Nutritive element/type	Common examples	Nutritive element/type	Common examples
1. Nitrogenous	Ammonium sulphate, Urea, Calcium Ammonium Nitrate	3. Trace ion	Zinc
		4. Compound Formulations	NPK Fertilizers
2. Phosphatic/Potash	Rock phospate Muriate of potash		

TABLE 11 PESTICIDES USED IN TEA PLANTATIONS
(classified by use)
(Refer Text for Chemical Classification)

Type	Organisms	Common products	Type	Organisms	Common products
1. Pesticide	Red spider Aphids etc.	Formothion, Acarthane EC, Dinobuton, Phosphamiden Quinalphos, Nialate Heptachlor, Dicofol Malathion Oxythioquinox Dimethoate, Monocrotophos Endosulphan, Phasolone	4. Fungicide	Blister blight Black rot Cercospora leaf spot Root disease Red rust and others	Copper oxychloride, Methyl Bromide, Oxythioquinox, nickel chloride, Metham-sodium, Zineb
			5. Weedicides and Herbicides	Annuals and Perennials Grasses, Dicots Ferns, Lichens Mosses, Shrubs	Dalapon, Diuron 2,4-D salt, MSMA 2,4,5-T salt, DNOC Paraquat, Triazine Simazine
2. Rodenticides	Rats, Mice	HCN, H_2S, PH_3 Zinc phosphide			
3. Nematicide	Nematodes	Methyl bromide, Oxythioquinox Metham sodium			

Source: UPASI, 1979a

(d) Fungicides

Are chemicals used to destroy fungi by killing mycelium and spores or by preventing germination of spores (Hunter, 1971). Fungicides used commonly in tea plantations can be chemically classified into:

i. Copper salts; eg, copper oxychloride
ii. Bromomethane; eg, methyl bromide
iii. Nickel salts; eg, nickel chloride
iv. Zinc ethylenebis dithiocarbamate, eg, zineb
v. Sodium-N-methydithiocarbamate; eg, vapam
vi. 6-methyl-2 3-quinoxaline dithiol cyclic carbonate eg, oxythioquinox

(e) Miticides

The common chemicals used against mites infesting the tea bushes are:-

i. Nialate: O.O.O'O tetraethyl 5.5' methylene tisphosphorodithioate
ii. Dicofol: 1.1. bis (chlorophenyl) 2. 2. 2-trichloroethanol
iii. Monocrotophos--cir (2 methylcarbamoyl-1-methyl vinyl) dimethyl phosphate
iv. Phasolone

(f) Nematicides:

The common chemicals used against nematodes infecting tea bushes are:-

i. Methyl bromide
ii. Metham sodium-(Vapam, ref d (v)
iii. Oxythioquinox (ref d(vi)

3. Herbicides

These are chemicals used for weed control (Hammond, 1971). Herbicides commonly used on tea plantations include:-

i. Dalapon: 2,2-Dichloropropionic acid
ii. 2,4-D: 2,4-Dichlorophenoxyacetic acid
iii. DNOC: 2,4-Dinitro-O-Cressol
iv. Paraquat: 1,1'Dimethyl-4,4'-bipyridinium salt
v. Simazine: 2-chloro-4.6-Bis(ethylamino)-S-triazine
vi. 2,4,5-T: 2,4,5-Trichlorophenoxyacetic acid
vii. Diuron: N'-(3-4-Dichlorophenyl)-N-N-Dimethylures
viii. MSMA: Monosodium methane arsonate
ix. Glyophosate formulation: N-(Phosphonomethyl) glycine

C. Biological Environment

The biological environment of the tea plantation is a very complex one and includes the flora and fauna of the hills in which they are situated, the wild game of the neighbouring forests, the domestic animals in the labour lines and the insects and biological pests of the tea bush. From the point of view of hazards these can be broadly classified into:

(a) Wild animals/Game

These include elephants, bear, wild pigs, wolves, foxes, jackals, porcupines and so on. Normally they do not seek out human victims or attack them unprovoked. They usually attack when they are surprised, sense danger or there is accidental invasion of the privacy of their lairs. Scratching, bites, severe mauling and infections with animal disease particularly rabies can be the result of such encounters (Rao, 1971).

(b) Domestic animals/livestock

These include animals in the service of man like transport animals such as horses, bullocks, donkeys and elephants; productive animals such as cattle, goats, sheep, pigs, chicken, ducks and geese; pets such as dogs, cats, rabbits and monkeys. The risk to the worker and his family members are mainly when tending any of these animals. Aggressive reactions like kicking, biting, goring, butting, trampling and scratching are not uncommon (Rao, 1971).

(c) Snakes

Highly venemous snakes are not as common at the high altitudes where tea is grown but most of the common species are present and snake bites are rather common.

(d) Biting/stinging insects

These occur as anywhere else in the residential and work setting. Hives are not uncommon on tea bushes, shade trees and dwellings. These include bees, wasps, scorpions, hornets, spiders, butterflies and caterpillars. Injury caused by caterpillars have been reported by Mackay (1967)a) in tea garden workers in East Pakistan.

(e) Stinging and allergy producing plants

Thorny shrubs and stinging plants such as nettle occur in the undergrowth of the tea plantations. A detailed study has not been done.

(f) Pests of tea bush

A very large number of insect pests of tea have been reported. The medical importance of these arthropods have not been studied especially from the point of view of stings, injury or allergy. These can be classified into ten groups (Cranham —).

i. Shot hole borer - xyleborus fornicatus
ii. Tea tortix - Homona coffearia
iii. Mites - Tea red spider mite (oligonychus coffeae), Scarlet mite (Brevipalpis californicus) Yellow mite (Hemitarsonemus latus), Purple mite (Calacarius carius carinatus)
iv. Defoliating caterpillars:
Nettle grubs, gelatine grubs, geometrid caterpillars, Twig caterpillar (E. bhurmitra)
Loopercaterpillar (B. strigaria)
Begworms, faggot worms
Red slug (Eterusia sedea cingala)
Lobster caterpillar (stauropus alternas)
Cutworms (Noctoidae), Army worms (Spodoptera litura) Tea leaf roller (Gracilaria theivora)
Tea leaf skeletoniser (Piermopoda rufi margine)
v. Sucking insect pests.
Lygus bug (Lygus viridanus) Tea aphis (toxoptera auranti) Tea mosquito bug (Helopeltis spp)
Mealybugs (Pseducoccidae) Scaly insects (family coccidae and Diaspididae) Thrips (Thysanoptera)
vi. White grups - cockchafer larvae, Holotrichia disparilis.
vii. Red ants - Oecophylla smaragdina
ix. Crickets - Brachytrupes partentotus
x. Miscellaneous - Red borer (Zaurera coffeae)
Tea leaf miner (Melanagromyza theae)
Leaf eating weevils

(g) Diseases of the tea bush

V.Agnihothrudu has described many diseases of the tea bush. These are primarily fungal infections. No information is available whether they can affect human beings who come in constant touch with them. The following are common:

i. Black root rot (Rosellinia arcuata)
ii. Brown root disease (Fomes noxius)
iii. Red root disease (Poria hypoteteritia)
iv. Branch Canker (Macrophoma theicola)
v. Collar canker (Phomopsis theae)
vi. Charcoal stump rot (Ustulina zonata)
vii. Root splitting disease (Azmillaria melleu)
viii. Diplodia root disease (Botryodiplodia theobromae)
ix. Thorny stem blight (Tunstallia aculeatta)
x. Blister blight (Exobasidium vexans)
xi. Red rust (Cephaleuros parasiticus)
xii. Brown blight (Glomerella cingulata)
xiii. Grey blight (Pestalotia theae)
xiv. Leaf spot (Cercospora theae)
xv. Thread blight (Pellicularia Koleriga)
xvi. Copper blight (Guignardia camelliae)

(h) Soil transmitted helminths

It has been reported that due to insanitary conditions in labour lines and habit of indiscriminate excreta disposal around the lines and in the fields that hookworm larave (Filariform) abound in the soil of the plantations.

(i) Other helminths

Round worm, thread worm and pin worm infections are rather common in labour population and because of the insanitary habits their cycle of transmission is maintained in the environment from man to man.

(j) Insect vectors of disease

Mosquitoes and flies are common insect vectors found in plantations and hence malaria and gastro-intestinal diseases are rather common. Other insect vectors like fleas, ticks and mites have not been identified commonly and this may probably be due to the climatic conditions.

Mechanical Environment

Mechanization of work on tea plantations has been proceeding very slowly as newer and newer technological developments are introduc .. As in all agricultural operations implements have been used from earliest times. The factory was always mechanised through innovations decreasing manual handling of tea or feeding of machinery which were being introduced from time to time.

The mechanical environment of the worker, taking into account potential hazards may be described as having the following components.

1. Plucking

This involves walking up and down a gradient in between the tea bushes with a basket on the back, which when full, can weight upto 15 kilograms. This can lead to accidental falls. (Figure 13)

Though plucking is done by hand all over India, mechanical plucking has been attempted in Japan and USSR. However, this requires a flat terrain and the growing of bushes in a set pattern (Fernando, 1971). Since this is a very recent innovation the hazard due to this machinery if at all has not yet been reported.

2. Agricultural work

The field work done in the plantations, described earlier require the use of various forms of digging and cutting implements which include:

i. Axes and pick axes
ii. Shovels
iii. Hogs
iv. Pitch forks and reves
v. Sickles and scythes
vi. pruning shears
vii. Cutlasses and machetes
viii. Digging forks and blade harrows
ix. Knives of various sorts
x. Ropes, chains and pulley mechanisms

The mechanical hazards are two fold: (a) Physical injuries due to cutting edges of the implements when they are carelessly used; and (b) Fatigue due to improperly designed tools resulting in excessive physical exertion and awkward positions during use (Jain, 1971).

'Loppers' have a double risk of using cutting equipments as well as climbing trees. For the latter, they may shin up trees or use ladders, both of which if done carelessly increases the risk of falls.

3. Sprayers

With the increasing amounts of agricultural chemicals being applied or sprayed on the tea bushes, sprayers have additional mechanical hazards associated with carriage of large bulky containers of chemicals and motor or battery operated spraying equipment. The fire hazard because of the carriage of fuels is another important factor. (Figure 14)

4. Load Carriage

Lifting, carriage and loading of full tea baskets, sacks or tea chests go on continously in the tea plantations. Most of this is done up and down gradients in the fields. In the factory these may be done, up and down spiral staircases to the tea loft. In the absence of proper lifting and carrying techniques the workers are at great risk of accidents, falls and physical and muscular strain.

5. Factory work

The sections of the factory and the processes have been described earlier. The mechanical hazards include (Fernando, 1971):

i. Machinery: Unfenced transmission machinery or unprotected rotating and pressing parts and sharp edges of cutting knives and rotor vanes can increase hazard of injuries to hands and fingers.
ii. Furnace: The main hazard is that of a 'blow back' explosion when relighting a dryer furnace. Mechanical hazards are also present when the furnace is stoked, charged or slag is removed.
iii. Hazards of open stair ways and unguarded leaf chutes. Accidental falls are not uncommon.
iv. Load handling especially in the absence of good housekeeping.

6. Tractors and agricultural machinery

I.L.O (1971) has identified the operation of tractors, bull dozers and their associated equipment as one of two main sphere of concern in connection with the health and safety of workers. "Tractors in particular are responsible for a high proportion of all serious accidents in mechanised agriculture. Many of these are caused by overturning....".

7. Transportation

In addition to tractors, transport of tea by trucks and wagons are very common. Rope ways and rail roads and in some plantations animal drawn vehicles are not uncommon. Loading, unloading and transporting of goods in these vehicles along steep slopes, narrow roads, narrow culverts and bridges have their own associated hazard.

8. Miscellaneous

As in all agricultural work there are many associated jobs which have their own mechanical hazards. In the plantations these include:

i. Construction, repair and maintenance of buildings;
ii. Storage/stacking of materials;
iii. Vehicle and implement their workshops;
iv. Use of welding equipment, generators, internal combustion engines
v. Water collection, storage and purification operation and so on.

9. Working hours

Most work operations on the tea plantations with or without mechanical implements entails hard physical labour. Because of the seasonal nature of crop yields, the hour of work vary. Though legislation and regulations have attempted to fix the working hours and over time hours, these are often exceeded during peak production months or other contingencies of the work. Long hours of physical work often in inclement weather, increases fatigue which in turn increases the risk of accidents associated with factors described in 1 to 8.

Psycho-social Environment

The importance of psycho-social factors in any occupational environment are being recognised only in recent years. Emphasis in occupational health has all along been on physical, chemical, biological and mechanical factors.

The tea plantation workers and their families are a relatively closed population separated from the rural population by geography and terrain. Historically because of the 'kangani' or labour contract system they were transplanted from the plains of Tamil Nadu and were settled on the interior and relatively inaccessible hills where the tea plantations were being developed by the pioneer British planters.

In the absence of a detailed study of psycho-social factors operating in the tea plantation environment, some tentative suggestions are offered based on personal observations of the local population. The factors described may possibly affect life styles, relationships and attitudes both at work and at home among this population.

1. Isolation

Geographical isolation from village or town life because of seting of estates in the hills is an important reality. This is associated with factors like long distance travel, lack of market and other amenities and severance of ties with the socio-cultural aspects of village life. This engenders loneliness, boredom and stress. Alcoholism which is rather common may be related.

2. Status of women

Women working is a traditional pattern of agricultural work in rural areas of India. In the plantation however they have a better status since plucking which is an important aspect of plantation work is mainly done by them. They are seen as wage-earners and employment is both continous and has the added associated security of bonus and welfare benefits. This factor must have its own effects on the dynamics of the home, family life, child rearing practices and field and factory work environment.

3. Dependence

The historical development of plantations has necessitated the plantation management having to provide all types of amenities to the working population. Because of the geographical isolation this has not only meant facilities in the working environment but also basic amenities of living such as housing, food rations, water supply, sanitation, clothing, medical care, schooling, creche for under fives, recreational facilities, transportation and so on. Being cut off from village life there has been little contact with the ideas of local self-government or community organisation to provide for community needs. This situation has resulted

in a great sense of dependence. Plantation legislation has put the complete onus of such services on the management. Government responsibility is minimal and predominantly supervisory. This has further isolated the population from the general socio-political changes in the country.

Managements have thus traditionally been authoritarian or paternalistic. Trade unionism is, therefore, weak and has not been seen by managements as progressive involvement of workers and their representatives in solving common problems.

4. Social Stratification

A distinctive feature of plantation life is the clear cut social stratification of the plantation population into:

i. Labour population
ii. Staff
iii. Management

There are distinct entities well separated through differing standards of housing, life style, social relationships, work patterns and amenities. There was not much social interaction between these entities traditionally and the relationships were rather feudal. In recent years, this situation is changing. Social mobility has also been practically impossible in this artificial society because of the stratification.

5. Diversity of population

Historically plantations had only labour from the Tamilnadu plains and managements, who were predominantly expatriate. In the last decade or two, there has been a very significant change in this matter.

Labour have migrated from the plains of Kerala and Karnataka into the plantations of their own respective States. Tribal populations common in the hills, who had kept aloof for years, have now been increasingly seeking employment in the plantations. A very massive rehabilitation programme is also afoot, wholly sponsored by Government, involving the Tamil, repatriates from Sri Lanka.

Staff have been increasingly drawn from the State of Kerala.

Management cadre has been drawn from the educated upper classes all over India. Of late many of them are professionally trained agricultural graduates. Such a diversity, not uncommon in the urban conglomerations of India have their own disadvantages and advantages which can affect work relationships.

All health problems of tea plantations, including those that may be work-related must, therefore, be studied against the background of this psycho-social ethos--characterised by an isolated migrant labour population in a markedly stratified social setting, lacking traditional cultural supports and working in an occupation in which the entire adult members of the family may be wage earning and fully dependent on the employer for all their needs.

Health in the Plantation Environment

Having considered some of the important aspects of the physical, chemical, biological, mechanical and psycho social factors in the tea plantation environment one has to conclude that the plantation workers will suffer from health problems common to other agricultural labour and also experience some of the hazards and stresses that are becoming increasingly common among industrial workers.

The ecology of health in such a situation is very complex and studies on health status will have to include among other things health problems related to inclement weather, poor environmental sanitation, chronic effects of handling of agricultural chemicals, hazards of close proximity to animal, insect and plant life, accident hazards related to increasing mechanisation, dust problems especially in the factory as well as stress related problems caused by isolation and stratification of plantation society.

CHAPTER VII — SCOPE AND OBJECTIVES OF THE STUDY

Introduction

Occupational Health Research in Agriculture and related occupations has not been very extensive in the past because agriculture by and large is predominantly an unorganised sector. W.H.O (1962) outlined ten areas of research which would be of direct benefit to the agricultural worker. These were:

i. Definition of safe working conditions on a scientific basis;
ii. Safety in farm equipments;
iii. Physiological studies on agricultural operations and work studies;
iv. Toxicology of agricultural chemicals;
v. Epidemiology of farm accidents;
vi. Problems of mental health and psychology;
vii. Survey of home environment;
viii. Problems of working women and child labour;
ix. Veterinary problems in relation to man;
x. Hygiene and public health with special reference to occupational diseases from animals, plants and micro-organisms.

W.H.O (1973) has stressed the need for environment and health monitoring of occupations as an important public health measure and an epidemiological research tool. The aims of such monitoring should be:-

i. to strengthen preventive action against occupational health hazards;
ii. to identify unrecognised health risks at the work place;
iii. to identify variations in individual susceptibility and tolerance;
iv. to identify the interactions between work and the general health of the gainfully employed.

Some suggestions for preliminary survey, observational survey, hygiene survey and medical survey are also given.

W.H.O. (1975) in a study group report on the Early detection of health impairment in occupational exposure to health hazards has clearly defined four categories of criteria of health impairment. These are:

i. Changes in biochemical and morphological parameters to be measured by laboratory analysis;
ii. Changes in physical state and functions of physiological systems to be evaluated by physical examinations and loading tests;
iii. Changes in well being to be evaluated by medical history taking and questionnaires;
iv. Integrative changes that may result from effects on several physiological systems: These are not specific and could be affected by factors unrelated to work such as nutrition and communicable diseases. These include studies of subjective states, behaviour patterns, anthropometry, employee records and medical service statistics.

The report goes on to stress that the epidemiological methods must always be used in interpretation of occupational health evaluation efforts. These include:

i. Comparison of parameters established in exposed workers with those in workers not exposed to the work factors under study;
ii. Keeping in mind endogenous factors such as age, sex, genotype and exogenous factors such as nutrition, past or present disease status, previous or concomitent exposure and social conditions, which could influence variability.

Keeping these guidelines in view and the findings of the review of literature a preliminary study of the total estate population of a tea plantation was planned by the Ross Institute of Occupational Health and Regional Occupational Health Centre with the following general and specific objectives.

General Objectives

1. To study the health status of the workers on a tea plantation with specific reference to the physical, chemical and biological factors in the occupational environment.

2. To study the parameter of the occupational environment of tea plantation workers in:

(a) the field; and (b) the factory

Specific Objectives

1. To observe and describe the occupations on a tea plantation as a preliminary step to further occupational health, physiological and ergonomic assesment (Refer Chapter V).

2. To outline the physical, chemical, biological, mechanical and other factors in the field environment (Refer Chapter VI).

3. To outline the physical, chemical, biological and mechanical factors in the factory environment and to monitor -

i. temperature;
ii. humidity;
iii. light;
iv. noise; and
v. dust levels in different sections of tea factories.

4. To study the health status of tea plantation population particularly workers by assessing -

(a) historical experience and morbidity;
(b) occupational history and symptom review;
(c) physical examination and anthropometry;
(d) basic laboratory investigation of blood, urine, stool in all and special investigation like chest x-ray, ECG and sputum for AFB, and vaginal smear whenever indicated.

5. To assess the factors in the home environment of plantation workers that contribute to their ill health.

6. To monitor the exposure of the plantation population to organophosphorous insecticides by measurement of cholinesterase levels in their blood samples.

7. To analyse some of the medical and sickness absenteeism records to get additional evidence of occupational factors that determine these patterns.

8. Finally to study and analyse all of the above data with a view to separating out the effects of the home environment and the influences of the work environment. By so doing, the study will attempt to:

(a) identify the areas of health impairment which are related to occupational hazards;
(b) identify aspects of health status which need further assessment with reference to occupation.

CHAPTER VIII — MATERIALS AND METHODS

a. Sample estates/Factories

Three medium sized tea estates and four tea factories in the Nilgiris around Coonoor were selected for the study because of the following factors:

i. willingness of the management to participate in the study;
ii. proximity to the UPASI headquarters where a central diagnostic laboratory was set up by the Ross Institute of Occupational Health/ Regional Occupational Health Centre team;
iii. presence of dependents and family members in the working age group on these estates who lived on the estates but worked in jobs outside the estates so that this group could form a control group;
iv. comparability in size and operation and medical services.

b. Sample population

The family was the unit of investigation. The total population of estate 'A' was investigated in the study. Since the field workers outnumber factory workers by 20 to 1 factory workers of estates 'B' and 'C' were included to increase the number of factory workers in the sample. These were neighbouring estates and showed very similar features as seen in Tables 9a and 9b.

c. Methods

The following were undertaken during the study:

(1) Preliminary survey of Estate

This baseline information to dermine comparibility of the estates was done on a proforma (Appendix -a) which included:

(a) Identification data;
(b) Size of estate;
(c) Number of workers: Total, and classified by sex, residential status, service conditions (temporary/permanent), occupational status;
(d) Welfare facilities and medical services provided to labour;
(e) Fertilisers, pesticides and weedicides used.

TABLE 9a CHARACTERISTICS OF THE TEA ESTATES IN THE SAMPLE

Chracteristics	A	B	C	characteristics	A	B	C
1. Planted area (in hectares)	157.38	65	356.87	6. Administrative staff	13	9	29
2. Total number of workers	458	183	1067	7. Medical team	1 MO (visiting 1 compounder 1 staff nurse 1 midwife	1 MO (visiting) 1 compounder	1 MO 1 compounder 1 staff nurse
M	271	66	435				
F	187	117	632				
3. Factory workers	30	35	52				
4. Field workers	403	143	918	8. Distance from Coonoor	12 km	7 km	5 km
5. Skilled workers	13	5	14				

Source: Estate offices

TABLE 9b CHARACTERISTICS OF TEA FACTORIES IN THE SAMPLE

Characteristics	A	B	C	D	Characteristics	A	B	C	D
1. Workers by Section	7	5	13	1	2. Method (orthodox or CTC)	CTC	CTC	CTC	Orthodox
i. Collection/ Spreaders					3. No. of workers	30	35	52	10
ii. Rollers	12	10	15	4					
iii. Driers	5	6	6	1					
iv. Sifters	6	7	8	3					
v. Packers	-	3	8	1					
vi. Others	-	5	2	-					

Source: Estate Officer

2. Family Data

(a) A Family Card (Appendix-e) was completed for each family unit included in the investigation. This included data on:

i. Age;
ii. Sex;
iii. Marital status
iv. Place of birth
v. Education
vi. Occupation
vii. Duration of stay in estate; and
viii. Vital events for previous year.

(b) Home visits: The residential accommodation of the families were visited and the living conditions were assessed especially:

i. room space
ii. illumination
iii. ventilation
iv. water supply
v. sanitary facilities, latrines and waste disposal
vi. possessions in house

(c) Map of lines: Each labour line was mapped out in detail and numbers of houses clearly indicated.

3. Individual data

For each person adult or child included in the investigation a special individual data sheet (Appendix-b) was filled which included:

i. identification data;
ii. Occupational History - present, additional and previous occupations with durations;
iii. Personal history including-

(a) Appetite; (b) Sleep; (c) Micturition; (d) Bowel movements; (e) Smoking and tobacco habits; (f) Alcohol; (g) Chewing habits; (h) Drug habits

iv. Past History - for eight specific conditions:

(a) Asthma; (b) Tuberculosis; (c) Chronic dermatitis; (d) Peripheral neuritis; (e) Diabetes; (f) Hypertension; (g) Allergies; (h) Mental illnesses and any others.

v. Family History for the same eight conditions outlined above and any others.

vi. Assessment of working conditions and relation to any other health conditions-subjective assessment by the worker.

vii. Symptom review of previous or presenting illness including:

(a) Cardio-respiratory system; (b) Gastro-intestinal; (c) Neurological; (d) Skeletal; (e) Skin; (f) Miscellaneous

For women workers and controls

viii. Menstrual, obstetrical and gynaecological history were recorded (Appendix - e)

For children under 12 (Appendix - c)

ix. Additional information was recorded on:

(a) Past history of 16 child-hood illnesses; (b) Immunization status

For children under 2

x. Additional information on feeding habits was recorded

4. General Clinical Examination

A standardised proforma was used on the reverse of the individual card (Appendix-b) and every subject on the study was examined for:

(a) Pulse; (b) B.P.; (c) Lymphadenopathy; (d) Pallor; (e) Cyanosis; (f) Jaundice; (g) bone deformities; (h) Odema; (i) Hernia; (j) Glossitis/cheilosis/angular stomatitis; (k) Hydrocele; (l) varicose veins; (m) Elephantiasis; (n) Cardio-vascular system; (o) respiratory system; (p) per abdominal examination; (q) Assessment of nervous system.

For children under 12

(r) Assessment for nutritional deficiency signs was done.

5. Anthropometric measurements

On all the subjects of investigation the following measurements were recorded:

(a) standing height; (b) weight; (c) sitting height; (d) waist height; (e) total arm span; (f) chest circumference in inspiration and expiration.

For children under 2

The following were also recorded:

(g) head circumference; (h) mid arm circumference

6. Laboratory investigations

The following investigations were done on all the subjects included in the investigation;

(a) Urine examination - for albumin, sugar and microscopic deposits
(b) Stool examination for ova and cysts
(c) Blood examination for
  i. leucocyte count-total and differential
  ii. erythrocyte sedimentation rate
(d) Plasma cholinesterase levels

The following additional investigations were done when indicated by symptom review or the findings of clinical examination:

(e) X-ray of the chest - done by the assistance of the District TB Control Programme at the District Hospital, Coonoor.
(f) Sputum for acid fast bacillus
(g) Vaginal/cervical smear for monilia, trichomonas or G.C infection
(h) Electro-cardiogram

For children

Examination of blood was done whenever sample was easily available, for children 2-12 age group. No samples were collected in infants under 2.

7. Environmental Monitoring of factories

The following were undertaken in each of the four factories included in the study:

i. Mapping: A detailed mapping of factory indicating sections, ventilation outlets, exits and entrances and distribution of machinery was done.

ii. Environmental parameters measured:
At specific pre-determined points eight hourly (working shift) samples were monitored for:
a. humidity - wet bulb;
b. air cooling - kata thermometer reading;
c. noise levels;
d. dust levels by collecting dust in midget impingers (Appendix-d)

Determination of indices

iii. The indices of thermal stress namely WBGT, CET were computed for each department.

iv. The total dust in 'million particles per cubic foot' and the frequency distribution of the particle size was done for each department.

8. Miscellaneous

Description of occupations on tea estate

i) The workers undertaking different occupations in the field and various sections of the factory were observed in the field. Photographs were taken wherever possible. Descriptions based on these observations were noted (refer Chapter V).

ii) Information was collected on the following additional aspects from planters, managers and the scientific department of UPASI.

a. List of pesticides, fungicides, herbicides and weedicides and fertilisers used in the tea estates (Chapter VI)
b. Diseases of the tea bush:
i. entomological; ii. microbiological (Chapter VI)
c. Other observations of:
i. general environment, ii. psycho-social factors; iii. life styles; iv. attitudes by informal interview with Link Workers, field and factory workers and estate staff and management (Chapter VI).

iii) Records Analysis:

The following records and registers were perused and analysed wherever possible for a year's duration previous to the month of beginning the study.

a. Work register of estate: Mandays worked classified by different occupations and available on a monthly basis.
b. Absenteeism records: Monthly/Quarterly basis available from estate office.
c. Estate Hospital Birth Register
d. Estate Hospital Death Register
e. Estate Hospital Out patient Records and Register
f. Sickness absence Register.

Organizational Aspects of Field Study

A study such as this even though it may be considered a preliminary or pilot study requires adequate preparation because of the nature of data collection. Family based investigations, involving history taking and examination of all members of the family and including a home visiting give rise to many field problems. Laboratory investigations involving collection of urine blood and stool samples especially from a rural agricultural population, in our experience in the field, has been not very successful. However, in the plantation study we received great support and cooperation and we were able to undertake most of what we had planned to do. Though we attribute this mainly to the enthusiasm of the Link Workers, we have outlined all the stages in our planning and field work to place on record our experience.

Planning of the project, preparation and standardisation of forms and procedures, mid-course evaluation and corrections and concurrent and terminal checks on reliability of data collected and laboratory investigations done were undertaken as in any research programme.

Planning and organization of the field work, however, consisted of the following steps:

1. Meeting with Managers and Medical Officers of all the selected estates. During these meetings the objectives and methodology of the study was explained. The limitations of the study were also explained to

prevent any undue expectations regarding the immediate value of the findings to the estate. It was decided that all positive laboratory investigations and or clinical findings would be listed out and given to the medical officer for follow up within the resources and constraints of the estate health services. No treatment would be given as part of the study though advise on possible management would be given by the team if required or requested. Administrative problems regarding getting field workers off work on day of examination and so on were discussed.

2. Meeting with Link Workers

As part of the UPASI-Comprehensive Labour Welfare Scheme, plantation estate workers have been selected by the workers themselves and trained by the Medical Advisor and the team as Link Workers. As the term signifies, the Link Worker acts as a link between the estate health service and the labour population in the lines. These workers inform the health team about vital events and health problems of the workers and their families. The health team in turn take the assistance of these workers to organise preventive and promotive programmes. This concept has greatly improved the participation of the labour in health decision making as well as taking responsibility in health matters.

In all the 3 estates in which we worked, the Link Worker scheme was in operation. A meeting was held with them and all aspects of the field study was discussed. Since they were expected to act as links between the research team and the families, they were requested and encouraged to bring up all the common fears and doubts that such a study may generate. Very interesting discussions were held on matters included in our proformas such as:

(a) occupational history and its significance;

(b) reasons for enquiry on religion/caste;

(c) confidentiality of findings;

(d) follow up of positive laboratory investigations;

(e) significance of testing of blood, and so on. Methodology of collection of urine, stool in all cases and sputum (whenever required) was explained in detail. The detailed role of the link worker was outlined and they were made wholly responsible for;

i) meeting the families;
ii) distributing urine bottles and stool cups the day before the examination;
iii) Explaining to them the mode of collection;
iv) labelling the samples;
v) accompanying workers and families to the health centre for examination;
vi) assisting with blood collection, anthropometry history taking and examination;
vii) following up defaulters;
viii) following up those that require further examination;
ix) accompanying doctors on line visiting, and assisting with mapping of lines and home visiting.

All instructions were in local language and list of defaultors and other matters of follow up were also given or written down in Tamil.

During the actual field study the enthusiasm, sense of responsibility and interest in the project of all the Link Workers was an unusually effective help in data collection.

Meetings were held with them as and when necessary during the period of field study and a final meeting was also held at the end of the study.

3. Language fluency

In a country such as ours, this can often be an important problem in the field. Of the eight medical officers involved in the project four were fluent in the language. All history taking was undertaken by them. All the details in the individual data form including points regarding examination were translated into local language and all medical officers were informed about these terms.

4. Review of Investigation Load

The number of individuals covered as well as laboratory samples processed/investigated in a day were reviewed from time to time to ensure that the work went on efficiently and at the same time the load was not too heavy on the staff. Too much pressure of work often means that field staff begin to take short cut procedures and methods, that grossly affect the reliability of the readings. Factors such as climatic conditions, transport breakdowns, illnesses of staff made additional demands on the work. All these were, however, responded to by suitable and realistic adjustments in the work schedule.

CHAPTER IX PLAN OF ANALYSIS

1. Data

To summarise, the data collected in this field study included:

A. Personal data

i) Family data on family units in two plantations in the Nilgiris. This included family details and assessment of home environment.

ii) Individual health data - both history and findings of clinical examination of subjects of three plantations in the Nilgiris. These subjects represented the total population of estate 'A', the factory workers and their families of estate 'B' and the factory workers of estate 'C'.

iii) Laboratory investigations including haemoglobin estimation; total and differential WBC count; erythrocyte sedimentation rate; urine for albumin, sugar and microscopy; stool test for ova and cysts; plasma cholinesterase levels on all the adults and a large percentage of the children.

iv) Special investigations like chest x-ray and FVC on some of the factory workers.

v) Anthropometric measurements including weight, height, chest inspiration and expiration, arm length, bisacromial, sitting height and leg length.

B. Environmental Parameters

i) Measurement of temperature (wet and dry bulb and globe thermometer), humidity, noise and illumination and dust concentration in the withering, rolling, sifting, firing and packing sections of 4 tea factories in the Nilgiris.

C. Records Analysis

i) Preliminary analysis of hospital records, sickness absenteeism and work records on one estate in the Nilgiris.

2. Coding

As a preliminary to statistical analysis all the personal data 1A and environmental data 1B above was coded in consultation with the statisticians of Institute of Research in Medical Statistics in Madras. The code was on a scale of 1 to 9 and wherever numbers were involved these were recorded as such in two or three columns allotted for the purpose. Points of history and groups of symptoms were often clubbed together taking into account possible combinations and mutually exclusive categories.

(a) The family data information was put on a separate card.
(b) The individual data was divided into three groups to be punched on three different cards and a punch code was developed for all the three. A method of linkage of cards was also devised.

Card No.1

Identification data, occupational history, personal history, past history and family history for all and menstrual, gynaecological and obstetrical history for women workers.

Card No.2

Symptom review and clinical examination. Also additional information including history and examination for under 12's and under 2's.

Card No.3

Anthropometric measurements, Pulse, blood pressure and laboratory investigations.

(c) The environmental survey data was also coded and put on a separate card.

3. Plan of Analysis

The analysis of the data was planned in two stages:

Ist stage: Analysis of data of individuals in the age group 18-60 since the study was primarily interested in occupational history and this age group may be designated as the working age group. Main purpose would be to identify important associations between health status and work.

2nd stage: Analysis of data on individuals below 18 and above 60 to get a complete picutre of general health status of the whole population.

4. Method of 1st Stage Analysis

The following were the guidelines used for the 1st stage analysis of 18-60 age group.

i) the total sample in this age group were divided into six groups;

a) male field workers;
b) male factory workers;
c) male controls;
d) female field workers;
e) female factory workers;
f) female controls.

ii) The male groups and the female groups were compared for all points of occupational history, personal, past and family history, symptom review and clinical examination and laboratory investigations.

iii) All items were selected out for which there was a suggestive difference between groups at the 10 percent levels of significance. The statistical significance of the contrasts was t, worked out and given as probability values.

5. Working population of study

Table 12 shows the registered working population of the three estates ie., 18 to 60 age group, classified by field, factory and other occupations.

Controls were taken as persons who had never worked in field or factory previously, were of the same income level and shared the same home environment. It was found that some people had worked in one or other capacity in the past in the field or factory. They were excluded from the study and the final population used in the analysis is shown in Table 13.

In Table 13, it is seen that female factory workers were only 17 in number. Being a very small number they were excluded from further analysis. The final categories were:

(a) Males - field and factory workers and controls (b) Females - field workers and controls

TABLE 12 WORKING POPULATION OF ESTATES A, B, & C (18-60 AGE GROUP)

	Male	Female	Total		Male	Female	Total
A. Field				C. Other jobs			
Pluckers	-	277	277	Others within/ without estate	76	9	85
Agr. labour	90	--	90	Students	12	12	24
Conductor/Supervisor	20	--	20	Housewives	--	33	33
Sprayer	14	--	14	Retired/unemployed	63	44	107
Total	124	277	401	Total	151	98	249
B. Factory work							
Processes	115	18	133	Grant Total A+B+C)	420	393	813
Other jobs	30	--	30				
Total	145	18	163				

TABLE 13 WORKING POPULATION USED IN ANALYSIS BY AGE AND SEX

Age (years)	Males			Females			Both sexes		
	Field	Factory	Control	Field	Factory	Control	Field	Factory	Control
18-34	31	50	53	112	5	41	143	55	94
35-44	44	46	5	84	3	5	128	49	10
45-60	48	37	6	69	9	7	117	46	13
Total	123	133	64	265	17	53	388	150	117

CHAPTER X OBSERVATIONS AND RESULTS

This pilot study has attempted to build up a holistic picture of the health status of the tea plantation workers by looking at a wide range of measurements of indicators of health status as well as quantitative and qualitative observations on various environmental parameters. In a preliminary study such as this it may not always be possible to link all the findings but taken together they do help in building up a more complete picture of the community health situation.

The observations are presented in eight sub-sections:

1. Demographic profile of an estate
2. Status of Home environment of plantation workers including sanitation
3. Health Status - current and historical experience
4. Basic Laboratory investigations for anemia, gut infestations and urine chemistry.
5. Anthropometry of working population
6. Cholesterase levels in the working population as an indicator of pesticide toxicity.
7. Occupational environmental parameters in the tea factory
8. Miscellaneous data from hospital and absenteeism records.

CHAPTER X(A) DEMOGRAPHIC PROFILE OF AN ESTATE

To develop a demographic profile the data on Estate 'A' was analysed since it represented a total population data. 261 families were registered and investigated and these included all the families resident on the estate (Field and factory workers and their families, and all other involved in supportive, administrative and supervisory services and their families). Estates 'B' and 'C' were included mainly to increase the number of factory workers in the sample since field to factory worker ratio was 20 : 1.

i) Geographical Distribution of Residence

Estate 'A' may be said to be representative of a medium sized tea estate in the Nilgiris. 261 families were spread out over 8 groups of labour lines A to H. Thirteen families were of the management/administrative/staff category who lived in bungalows scattered over the estate. Forty one families were resident in a village nestled in the hills adjacent to the estate.

ii) Family characteristic

The total population was 1189 and the average household size was 4.55. Both joint and nuclear families were present in the sample. Aged parents who had worked previously on the estates as well as adult unmarried sons and daughters and in some cases unmarried brothers and sisters were also present. Most of the families were second or third generation plantation families.

iii) Age and sex characteristics

Table 14A shows the age and sex distribution of the population in standard five year class intervals. Though the percentage distribution is similar to other agricultural communities in most age groups, there are some interesting differences to be noted.

a) The 0-4 age group constitute 9.5 percent of the total population which is much lower than similar rural communities probably indicative of the effects of the family planning programmes in the estate. There were only 8 infants in the sample.

b) Females are more than males in 0-4, 30-44 and 50-59 age groups which is a little unusual though considering the small numbers this may be a chance difference. Employment is much more among women and is relatively stable and permanent. Hence this improves their economic status probably reflected in lower mortality. Less number of pregnancies may be an additional factor. It must be kept in mind however that unemployment among males is higher and many seek employment outside the estate including in the plains. They may not have been registered in the census thus affecting the totals in the working age group.

c) The population is a young population with 46.7 percent under nineteens constituting a large dependent population.

d) The population in the 15-44 age group are 49 percent.

e) 1.8 percent are above 60 - very similar to other areas.

f) The dependency percentage is 58.32.

TABLE 14A — AGE AND SEX DISTRIBUTION (ESTATE A)

AGE GROUP	% MALE	% FEMALE	% TOTAL	CUMULATIVE PERCENT	% OF MALES	% OF FEMALES	AGE GROUP	% MALE	% FEMALE	% TOTAL	CUMULATIVE PERCENT	% OF MALES	% OF FEMALES
0-4	4.37	5.04	9.41	9.41	8.69	10.15	35-39	3.02	3.70	6.72	76.56	6.02	7.44
5-9	6.56	5.04	11.60	21.01	13.04	10.15	40-44	3.01	4.20	7.82	84.38	7.19	8.46
10-14	7.06	6.98	14.04	35.05	14.04	14.04	45-49	3.28	2.77	6.05	90.43	6.52	5.58
15-19	6.05	5.55	11.60	46.65	12.04	11.60	50-54	1.93	2.35	4.28	94.70	3.84	4.73
20-24	4.79	4.20	8.99	55.64	9.53	8.46	55-59	1.93	1.51	3.44	98.15	3.84	3.04
25-29	4.12	3.86	7.98	63.62	8.19	7.78	60 +	1.00	0.75	1.76	99.91	2.00	1.52
30-34	2.52	3.70	6.22	69.84	5.01	7.44	TOTAL IN SAMPLE	598	591	1189			

TABLE 14E — RELIGION AND CASTE (ESTATE-A)

RELIGION	FAMILIES	NO.OF PEOPLE	%	SC/ST FAMILIES	%
HINDU	202	903	75.94	145	71.78
CHRISTIAN	59	286	24.05	48	81.35
MUSLIM	-	-	-	-	-
	261	1189		193	73.94

TABLE 14D — DISTRIBUTION BY INCOME

INCOME GROUP	NUMBER OF FAMILIES	PERCENT
LOW INCOME	62	23.75
LOWER MIDDLE	181	69.34
UPPER MIDDLE	15	5.74
UPPER	3	1.14
	261	99.97

TABLE 14B — EDUCATIONAL STATUS OF 5-60(+) AGE GROUP (ESTATE-A)

LEVEL	% IN MALE	% IN FEMALE	% OF TOTAL	AGE GROUPS (in %) 15-19	20-34	35-44	45-59
ILLITERATE	21.5	52.0	36.5	13.1	33.8	56.1	74.5
PRIMARY	31.9	21.8	26.9	8.7	17.4	19.3	11.6
MIDDLE	22.8	12.6	17.7	27.0	15.9	14.0	6.8
HIGH	12.2	6.8	9.6	31.4	15.5	4.2	-
POST-SCHOOL (P.U.C./DIPLOMA/ GRADUATION)	11.5	6.8	9.1	19.7	17.4	6.4	6.8
TOTAL IN SAMPLE	539	523	1062	137	269	171	163

b) Females are more than males in 0-4, 30-44 and 50-59 age groups which is a little unusual though considering the small numbers this may be a chance difference. Employment is much more among women and is relatively stable and permanent. Hence this improves their economic status probably reflected in lower mortality. Less number of pregnancies may be an additional factor. It must be kept in mind however that unemployment among males is higher and many seek employment outside the estate including in the plains. They may not have been registered in the census thus affecting the totals in the working age group.

c) The population is a young population with 46.7 percent under nineteens constituting a large dependent population.

d) The population in the 15-44 age group are 49 percent.

e) 1.8 percent are above 60 - very similar to other areas.

f) The dependency percentage is 58.32.

TABLE 14A AGE AND SEX DISTRIBUTION (ESTATE A)

AGE GROUP	% MALE	% FEMALE	% TOTAL	CUMULATIVE PERCENT	% OF MALES	% OF FEMALES	AGE GROUP	% MALE	% FEMALE	% TOTAL	CUMULATIVE PERCENT	% OF MALES	% OF FEMALES
0-4	4.37	5.04	9.41	9.41	8.69	10.15	35-39	3.02	3.70	6.72	76.56	6.02	7.44
5-9	6.56	5.04	11.60	21.01	13.04	10.15	40-44	3.01	4.20	7.82	84.38	7.19	8.46
10-14	7.06	6.98	14.04	35.05	14.04	14.04	45-49	3.28	2.77	6.05	90.43	6.52	5.58
15-19	6.05	5.55	11.60	46.65	12.04	11.60	50-54	1.93	2.35	4.28	94.70	3.84	4.73
20-24	4.79	4.20	8.99	55.64	9.53	8.46	55-59	1.93	1.51	3.44	98.15	3.84	3.04
25-29	4.12	3.86	7.98	63.62	8.19	7.78	60 +	1.00	0.75	1.76	99.91	2.00	1.52
30-34	2.52	3.70	6.22	69.84	5.01	7.44	TOTAL IN SAMPLE	598	591	1189			

TABLE 14E RELIGION AND CASTE (ESTATE-A)

RELIGION	FAMILIES	NO.OF PEOPLE	%	SC/ST FAMILIES	%
HINDU	202	903	75.94	145	71.78
CHRISTIAN	59	286	24.05	48	81.35
MUSLIM	-	-	-	-	-
	261	1189		193	73.94

TABLE 14D DISTRIBUTION BY INCOME

INCOME GROUP	NUMBER OF FAMILIES	PERCENT
LOW INCOME	62	23.75
LOWER MIDDLE	181	69.34
UPPER MIDDLE	15	5.74
UPPER	3	1.14
	261	99.97

TABLE 14B EDUCATIONAL STATUS OF 5-60(+) AGE GROUP (ESTATE-A)

LEVEL	% IN MALE	% IN FEMALE	% OF TOTAL	AGE GROUPS (in %) 15-19	20-34	35-44	45-59
ILLITERATE	21.5	52.0	36.5	13.1	33.8	56.1	74.5
PRIMARY	31.9	21.8	26.9	8.7	17.4	19.3	11.6
MIDDLE	22.8	12.6	17.7	27.0	15.9	14.0	6.8
HIGH	12.2	6.8	9.6	31.4	15.5	4.2	-
POST-SCHOOL (P.U.C./DIPLOMA/ GRADUATION)	11.5	6.8	9.1	19.7	17.4	6.4	6.8
TOTAL IN SAMPLE	539	523	1062	137	269	171	163

TABLE 14C

OCCUPATIONAL STATUS OF 18-60 AGE GROUP
(ESTATE - A)

GROUP	MALE	%	FE-MALE	%	To-tal	%	GROUP	MALE	%	FE-MALE	%	To-tal	%
FIELD WORKER	130	39.75	255	71.62	385	56.36	ENEMPLOYED REGD	54	16.51	38	10.67	92	13.46
FACTORY WORKER	44	13.45	5	1.40	49	7.17	STUDENTS	11	3.36	12	3.37	23	3.36
OTHER JOBS (inside + outside estates)	76	23.45	7	1.96	83	12.15	HOUSE WIVES	-	-	26	7.30	26	3.80
							RETIRED	12	3.66	13	3.65	25	3.66
TOTAL EMPLOYED	250	76.45	267	75.0	517	75.69	TOTAL NUMBER (Sample)	327	47.87	356	52.12	683	

iv) Educational Status (Table 14B and Figure 20a)

The literacy rate is as high as 63.5 percent. Males show a literacy of 78.5 percent and females 48 percent both of which are well above the national average. Because of the provision of schools by estate managements the educational status is improving rapidly as seen in the later half of the table. Though females show lower rates in every category, the rates are indicative of much better educational level among females than in comparative rural situations. Interestingly 23.7 percent of males and 13.6 percent of females have completed high school and many have goneon to PUC, Diploma courses and graduation. The higher educational status of the staff families especially among wives has slightly biased the sample. All the same the labour population is found to be rapidly becoming an educated group with possible affect on their health status.

v) Occupational Status (Table 14C and Figure b)

Out of 660 people in the 18-60 age group in the population only 24.31 percent are unemployed. These include students, housewives, retired individuals and those registered as unemployed. Of the 75.69 percent who are unemployed 56.3 percent work in field jobs, 7.1 percent in factory jobs and 12 percent in other jobs inside and outside the estate. These other jobs include the following:

Among males there were coolies, tailors, cooks, drivers, office assistants, watchmen, mason, postman, store keeper, hospital staff, gardeners, peons, sweepers, carpenters, a baker, a wireman, a trade apprentice, a pharmacist, a scientific assistant, bus conductors and factory workers (other than tea factories). Among females the other jobs included sweeper, creche attendants, a nurse and a typist. Most of these were included in the control group in the study. (Refer Table 12 and 13). Field workers included agricultural workers sprayers, pluckers, conductors and supervisors. These occupations have been described in Chapter V.

Factory workers included those working in withering, rolling, drying, sifting and packing sections and skilled factory staff including supervisors, tea makers, electrician, mechanics, carpenter and fitter (described in Chapter V).

vi) Distribution by religion (Table 14E)

Of the 261 families in the estate 202 were Hindus (75.04 percent) and 59 were christian families (24.05 percent). There were no Muslim families in Estate 'A' but in some of the neighbouring estates there were a few Muslim families. The percentage of christian families was much higher than usual (National average 2%). The christian families consisted mainly of Catholics and Protestant denominations. One family each belonged to the Marthomite and Pentecost denominations.

vii) Distribution by Caste/Region (Table 14E)

Majority of the families were second or third generation plantation labour from the Tamilnadu plains. The castes mentioned on enquiry included Pallar; 'Parayar', 'Adidravida', 'Gounder', 'Madari', 'Eshuvan', 'Eluvar', 'Cobbler', 'Nair', 'Boyan', 'Chakkilian', 'Devar', 'Vanan', 'Kamalan', 'Barber', 'Pullaimar', 'Thandan', 'Ezhutachan and Brahmin.Of the 201 Hindu families 72.1 percent belonged to scheduled castes and tribes. Of these 20 were Badagar families - a local tribe. Interestingly even the christian families identified themselves with certain castes-probably those previous to their conversion. Forty nine out of fifty nine families mentioned the following castes as identification - Parayar, Pallar, Adidravida, Nadar, Badagar and Cobbler.

viii) Social Class (Table 14D)

This is always a difficult parameter to assess in an agricultural community since agricultural economy is usually a subsistence economy. In the plantations as in industry, the workers are mostly wage labour the assessment is made easier. However, because of the varying numbers of family members employed we found a much greater variation than expected. The opportunity presented by the home visit was made use of to assess the income level based on possessions, type of cooking vessels (alumnimum or stainless steel) and other such criteria.

23.7 percent were low income; 69.3 percent were lower middle income; 5.7 percent were upper middle income and 1.3 were upper income group. The latter two groups were constituted by the administrative/supervisory and technical staff of the estate.

CHAPTER X (B) HOME ENVIRONMENT

Tea plantations are required by legislation to provide residential accommodation for their workers and their families.

Figure 23 is a schematic diagram of the type of house including its measurements which was provided for the workers and their families in Estate 'A'. This is fairly typical of the accommodation provided in the estates in the Nilgiris area.

Depending on the number of permanent workers in a family, one or two units may be provided to a family. Many workers enclose additional portions and thereby extend the accmodation. Some of the families had not been provided accommodation on the estate and had taken up accommodation in the village adjacent to the estate. Many resident in the village had temporary accomodation of poor quality.

i) Lighting

Lighting was good only in 45.6 percent of the houses. In 54.4 percent of cases it was average to poor. This was mainly because of the houses being wall to wall and the absence of windows on the side walls. In some houses the lighting had been improved by the use of skylights or glass tiles.

ii) Ventilation

Ventilation was good only in 46.8 percent of the houses. Windows provided in the front and back walls were often blocked by shelves thus reducing further the little cross ventilation that was available.

TABLE-15 STATUS OF HOME ENVIRONMENT (in percentages)

Sl No	Parameter	Qualitative Indicator			Total No. of Units (IA)
		Poor	Average	Good	
1.	Lighting	12.4	42.0	45.6	250
2.	Ventilation	7.9	45.1	46.8	226
3.	Water supply:				
	a. Source	Spring	Well		
		75.4	24.6		
	b. Supply	Tap			
		91.5%			
	c. Protected Source	91.5			
4.	Electricity	Present	Absent		
		48.8	51.2		250
5.	Flooring	Mud plaster	Cement & tiles		
		80.4	19.6		250
6.	Kitchen	Separate	Part of living room		
		90.8	9.2		250
7.	Bathroom	Separate enclosure	Nil		250
		94.4	5.6		
8.	Lavatory	Present	Absent	Attached to house	
		90.8	9.2	24.5	261

iii) Electricity:

Only 48.8 percent of the houses had an electrical connection.

iv) Kitchen:

90.8 percent had a separate kitchen at the back of the living room (see figure 23). 9.2 percent used a part of the living room separated by a low wall. Chimney arrangements were inadequate and the kitchen was thereby rather smoky.

v) Bathroom:

94.4 percent had a small separate enclosure for bathing purposes. This was often open to the sky.

vi) Latrines:

90.8 percent had been provided separate latrines and of these 24.5 percent had them attached to the main housing unit. Otherwise they were provided singly or in groups at a short distance and usually lower level than the housing units. 9.2 percent had no latrines and used the fields. Latrine units at a distance from the main housing units were often not maintained well and became unfit for use (refer plate 25). Children especially under five, often defecated along the open drains provided causing some fly nuisance.

vii) Refuse disposal:

Both garbage and sullage were disposed off indiscriminately. Open drains provided usually led sullage into the nullahs without any treatment. Garbage was thrown at some distance from the houses, in heaps and not always in a manure pit or trench dug for the purposes. Fly and mosquito nuisance was evident.

viii) Domestic Animals:

Chickens, cattle and pet dogs were kept by families though not always in separate enclosures.

ix) Water supply:

The main source of supply was tapping springs. 24.6 percent also had water from a well The spring water was pumped to large tanks for storage and then supplied through pipes to common tap points in the labour lines. Shunt feed Chlorinaters were being tested out in some of these tanks. (Figure 22 & 24)

x) Vegetable gardens

Of more recent origin is the popularisation of small vegetable gardens and little plots used for cultivation which were evident during house visits.

Though the overall home environmental status was found to be better than the average rural situation, it was found that facilities provided were often modified or improperly used or inadequately maintained, thus increasing the potential for water borne illnesses, infestation by soil transmitted helminths and respiratory illnesses.

CHAPTER X (C) HEALTH STATUS

The data available on various aspects of health status of the sample are presented in the following tables:

Tables 18 shows the main morbidity conditions and their prevalence in the total population.

Table 16 shows past history of eight medical conditions in the population.

Table 17 shows past history of bites and stings and accidents which are both specific groups of occupational and environmental hazards.

Table 18(a) to 18(f) show the percentage prevalence of general signs and symptoms, and those of cardio-respiratory system, gastro-intestinal system, neurological system, eye/ear/and skin conditions and certain other miscellaneous conditions.

Table 18(g) shows the percentage prevalence of obstetrical and gynaecological conditions in females.

In all these Tables - 18(a) to 18(f) - the data has been grouped into five groups, which are male field workers, male factory workers and controls and female field workers and controls. This was done to determi those conditions in which there is a statistically significant difference between workers and control groups suggesting a possible occupational risk factor.

Tables 18(h) and 18(i) show conditions in earlier tables (18(a) to 18(g)) in which there are suggestive differences between workers and controls, field and factory respectively (P - 0.1). The findings are presented for all subjects, as well as by age and sex. The statistical significance of contrasts is also given in the tables in the form of probability values.

Table 18(j) and 18(k) are additional tables for some conditions that we had expected to find difference but in actual study did not find statistically significant differences. Taken together they show a significant trend.

From all the above tables, the following important observations can be made:

GENERAL MOREIDITY

1. The signs and symptoms which are commonest in all the population and its sub-groups (we have taken 20 percent prevalence as an arbitrary cut off point indicating common experience).

i) Leech bite in all groups;
ii) Factory workers male: Joint pains and back aches chest pain and cough with or without sputum, usual disturbances and accidents;
iii) Field worker male: Joint pains and back-ache, head-ache, vertigo and convulsion, insect stings, visual disturbances, chest pain with cough with or without sputum, worms in stool, abdominal pain, disturbed sleep, accidents.
iv) Field worker female: Joint pains and backache, headache and vertigo, pallor, pedal odema, chest pain with cough with or without sputum, palpitation, breathlessness, dysmenorrhoea, and leucorrhoea;
v) Control males: Reduced appetite, chest pain with cough with or without sputum, abdominal pain, headache and vertigo;
vi) Control females: Pallor, pedal oedema, joint pains and backache, palpitation, breathlessness, headache, vertigo, dysmenorrhoea and leucorrhoea.

From the above profiles we can conclude that the commonest morbidity experience of the plantation population are (top ten diseases):

i) Leech bite;
ii) Back ache and joint pains;
iii) Respiratory infections;
iv) Signs and symptoms of anemia;
v) Headaches;
vi) Insect stings;
vii) Reduced appetite;
viii) Accidents in men;
ix) Dysmenorrhoea and leucorrhoea in women;
x) Worms infestations.

Field Workers and Controls Comparison

2. The conditions in which there are suggestive difference between field workers and controls are:

i) History of worms in stool;
ii) Pallor;
iii) Joint pains and backache;
iv) History of peripheral neuritis symptoms;
v) Insect stings;
vi) Snake and scorpion bite;
vii) Leech bite;
ix) Disturbed sleep;
x) Reduced appetite;
xi) Varicose veins.

If we take P value of .01 as an arbitrary cut off point for statistically significant difference then the following conditions become significant.

i) Joint pains and back ache: In all field worker and especially in males and in younger age group.
ii) Pallor: In all field workers and especially in females and in younger age groups.
iii) Worms in stool: In all and particularly in males.
iv) Leech bite in all field workers, both male and female in all age groups.
v) Insect stings in all field workers, both male and females no age difference.
vi) History of peripheral neuritis in all field workers (total), no age difference but more in females.

Factory Workers and Control Comparisons

3. The conditions in which there are suggestive differences between factory workers and control groups were:

i) History of worms in stool;
ii) Joint pains and back ache;
iii) Infective lesions of skin;
iv) Signs of Vitamin B deficiency;
v) Cervical lymph nodes; and
vi) Varicose veins.

However, only infective lesions of skin in young factory workers showed probability or p value of 0.Ci.

Uncommon Conditions

4. The following conditions were very rare or totally absent in the population sample. These were:

Absent:

i) Hydrocele;
ii) Elephantiasis;
iii) Jaundice;
iv) Palpable spleen;
v) Ascites;
vi) Abnormalities of cranial nerves, gait or coordination;
vii) Mental retardation.

Rare:

i) Hernia; (1 case);
ii) Lumps in the abdomen (2 cases);
iii) Abnormality of muscle tone (1 case);
iv) Sensory loss (1 case)
v) Cyanosis (1 case)

TABLE-16 PAST HISTORY (Medical Conditions) (Percentage)

Criteria/ condition	Males			Females		Criteria/ condition	Males			Females	
	Field	Factory	Control	Field	Control		Field	Factory	Control	Field	Control
Asthma	1.7	1.5	1.6	0.4	1.9	Allergies	1.6	1.5	0.0	1.1	1.9
Diabetes	0.8	0.0	0.0	0.0	1.9	Peripheral Neuritis	0.8	3.0	0.0	12.1	1.9
Tuberculosis	0.0	1.5	3.1	0.4	1.9	Mental illness	0.0	0.0	0.0	0.4	0.0
Hypertension	2.4	0.0	0.0	0.8	0.0	Total range	119-123	130-133	60-64	254-264	51-53
Chronic Dermatitis	4.1	6.8	3.1	2.3	3.8						

TABLE-17 HISTORY OF BITES/STINGS/ACCIDENTS (Percentage)

Criteria/ condition	Males			Females		Criteria/ condition	Males			Females	
	Field	Factory	Control	Field	Control		Field	Factory	Control	Field	Control
Snake bite	7.6	5.4	1.6	3.1	0.0	Scorpion bite	15.1	13.8	4.9	7.1	0.0
Dog bite	5.9	10.0	13.1	0.0	0.0	Accidents	20.2	20.0	10.0	4.7	3.9
Stings/ insect	30.3	19.2	11.7	20.5	3.9	Total range	119-123	130-133	60-64	254-264	51-53
Leech bite	79.0	51.5	45.0	76.8	19.6						

TABLE 18(a) GENERAL SIGNS AND SYMPTOMS

Criteria/ condition	Male			Female		Criteria/ condition	Male			Female	
	Field	Factory	Control	Field	Control		Field	Factory	Control	Field	Control
Weakness/ loss of weight	13.9	9.8	17.5	6.9	15.1	Lymph node- upper	9.8	18.5	8.1	2.3	0.0
Pallor	11.5	6.0	6.3	54.7	28.3	Lymph node- lower	4.1	0.0	6.5	0.0	0.0
Pedal odema	6.6	2.3	4.8	26.4	26.4	Reduced appetite	19.5	15.9	23.4	26.6	11.5
Joint pains/ back ache	38.2	33.3	17.2	51.3	41.5	Disturbed sleep	22.1	15.4	9.5	12.2	7.7
Bone deformi- ties	0.0	0.8	0.0	3.4	1.9	Total range	121-123	130-133	62-64	256-265	52-53
Varicose veins	5.0	8.3	0.0	1.5	1.9						
Glossitis/ Cheilosis angular stomatitis	1.7	8.3	1.6	4.9	9.4						

TABLE 18(b) CARDIO-RESPIRATORY SYSTEM (Percentage)

Criteria/ condition	Male			Female		Criteria/ condition	Male			Female	
	Field	Factory	Control	Field	Control		Field	Factory	Control	Field	Control
Cyanosis	0.0	(1)	0.0	0.0	0.0	Haemoptysis	2.4	2.3	1.6	0.4	1.9
Palpitation Breathlessness Sweeling of feet	18.7	12.0	9.4	29.3	22.6	Intermittent claudication	4.1	2.3	1.6	0.4	1.9
						Cardiac disease	2.5	0.0	0.9	1.9	0.0
Chest pain Cough with or without sputum	35.8	33.1	32.8	25.9	26.4	Total range	121-123	130-133	62-64	256-265	52-53

TABLE 18(c) GASTRO INTESTINAL SYSTEM (Percentage)

Criteria/ condition	Male			Female			Male			Female	
	Field	Factory	Control	Field	Control		Field	Factory	Control	Field	Control
Nausea/ vomiting feeling of fullness	15.4	13.6	15.6	16.3	13.2	Tarry stools	2.4	0.0	0.0	0.0	1.9
Abdominal pain	22.8	16.7	21.9	23.1	18.9	Abdominal tenderness	5.7	3.0	4.7	8.3	3.8
Diarrhoea	8.9	3.8	12.5	10.2	13.2	Liver palpable	2.5	2.3	0.0	0.0	0.0
Worms in stool	27.6	18.9	7.8	13.3	1.9	Spleen palpable	0.0	0.0	0.0	0.0	0.0
Constipation	4.9	6.8	6.2	4.5	5.7	Fluid	0.0	0.0	0.0	0.0	0.0
Bleeding per rectum	12.2	12.1	7.8	7.2	7.5	Total range	121-123	130-133	62-64	256-265	52-53

TABLE 18(d) NEUROLOGICAL SYSTEM (Percentage)

Criteria/ condition	Male			Female		Criteria/ condition	Male			Female	
	Field	Factory	Control	Field	control		Field	Factory	Control	Field	Control
Head ache convulsion Vertigo	39.8	30.1	28.1	41.1	45.3	Babinski's	0.0	(1)	0.0	(1)	0.0
Incoordination	0.8	1.5	0.0	0.0	0.0	Higher functions abnormal	0.0	0.0	0.0	0.0	0.0
Neuritis/ Paraesthesis Loss of power	2.4	3.0	3.1	14.4	7.5	Cranial nerves	0.0	0.0	0.0	0.0	0.0
Reflexes abnormal	2.5	4.5	1.6	3.8	0.0	Gait	0.0	0.0	0.0	0.0	0.0
Muscle tone/ power abnormalities	(1)	0.0	0.0	0.0	0.0	Romberg's sign	0.0	0.0	0.0	0.0	0.0
Sensations	0.0	(1)	0.0	(1)	0.0	Total range	121-123	130-133	62-64	256-265	52-53

TABLE 18(e) EYE/EAR/SKIN CONDITIONS (Percentage)

Criteria/ condition	Male			Female		Criteria condition	Male			Female	
	Field	Factory	Control	Field	Control		Field	Factory	Control	Field	Control
Visual disturbances	29.3	24.1	20.3	9.8	13.2	Ear infection	8.1	9.1	7.8	11.7	5.7
Eye infections	1.6	1.5	1.6	0.0	0.0	Skin changes colour/ sensation	10.7	16.7	10.9	12.6	9.4
Pterygium	3.3	9.8	4.7	3.0	3.8	Infective lesions	7.4	14.4	3.1	7.3	7.5
Hearing disturbances/Tinnitus	4.9	14.4	12.5	11.0	11.3						

TABLE 18(f) MISCELLANEOUS CONDITIONS (percentage)

Criteria/ condition	Male			Female		Criteria/ condition	Male			Female	
	Field	Factory	Control	Field	Control		Field	Factory	Control	Field	Control
Jaundice	0.0	0.0	0.0	0.0	0.0	Micturition: Volume abnormality	0.8	3.0	1.6	0.4	0.0
Elephantiasis	0.0	0.0	0.0	0.0	0.0						
Hydrocole	0.0	0.0	0.0	0.0	0.0	Micturition: Pain/burn/ blood	8.9	14.4	9.4	5.7	3.8
Hernia	(1)	0.0	0.0	0.0	0.0						
Micturition: frequency abnormality	2.4	2.3	3.1	0.8	0.0						

TABLE 18(g) OBSTETRICS AND GYNAECOLOGICAL CONDITIONS IN FIELD WORKERS AND A CONTROL GROUP

Obstetrics and Gynaecological condition	Prevalence (%) in females		Obstetrics and Gynaecological condition	Prevalence (%) in females	
	Field workers	Control group		Field workers	Control group
Menstrual cycle irregular	13.9 (194)	12.5 (48)	3-5 Abortions	2.0 (239)	3.6 (28)
Menstrual duration irregular	4.6 (194)	2.1 (48)	One premature baby	1.7 (233)	0.0 (28)
Less quantity of flow	3.2 (194)	4.2 (48)	2 to 7 premature babies	1.2 (233)	0.0 (28)
Excessive quantity of flow	5.2 (194)	2.1 (48)	One still birth	5.0 (240)	3.7 (27)
Menstrual pain	37.9 (190)	40.4 (47)	2 to 7 still births	1.2 (240)	3.7 (27)
Amenorrhoea-gestational	6.6 (259)	7.8 (51)	Leucorrhoea	23.7 (262)	22.6 (53)
Amenorrhoea-lactation	3.9 (259)	3.9 (51)	Pruritis	4.6 (262)	3.8 (53)
Amenorrhoea-monopause	27.0 (239)	7.8 (31)	Prolapse	0.0 (262)	0.0 (53)
1-2 Abortions	5.9 (239)	7.2 (28)			

TABLE 18(h) SELECTED CONDITIONS IN WHICH THERE ARE SUGGESTIVE DIFFERENCES BETWEEN FIELD WORKERS AND THE CONTROL GROUP

Morbidity condition	Prevalence (%) of morbidity condition														
	All subjects			According to sex						According to Age					
				Males			Females			18-34 yrs.			35-60 yrs.		
	F*	C*	P*	F*	C*	P*	F*	C*	P*	F*	C*	P*	F*	C*	P*
1 Worms in stool	18	5	0.001	28	8	0.01	13	2	0.03	14	5	0.06	20	4	0.09
2 Joint pains and back-ache	47	28	0.001	38	17	0.01	51	42	0.2	36	22	0.04	54	52	0.2
3 Pallor	41	16	0.001	11	6	0.2	55	28	0.001	47	16	0.001	38	17	0.09
4 Varicose veins	3	1	0.2	5	0	0.1	2	2	0.2	2	1	0.2	3	0	0.2
Total	388	117		123	64		265	53		143	94		245	23	
1 Reduced appetite	24	18	0.20	20	23	0.20	27	12	0.03	21	15	0.20	26	30	0.20
2 Disturbed sleep	15	9	0.10	22	10	0.05	12	8	0.20	6	7	0.2	21	17	0.2
3 Peripheral Neuritis	9	1	0.01	1	0	0.2	12	2	0.05	3	0	0.20	11	4	0.2
4 Bee/Wasp/ insect sting	24	8	0.01	30	12	0.01	20	4	0.01	15	7	0.09	29	14	0.2
5 Snake Bite	5	1	0.09	8	2	0.2	3	0	0.2	2	0	0.02	6	4	0.2
6 Scorpion bite	10	3	0.03	15	5	0.08	7	0	0.05	5	0	0.04	12	13	0.2
7 Leech bite	77	33	0.01	79	45	0.01	77	20	0.01	72	35	0.01	81	27	0.01
Total	386	117		123	64		264	53		143	94		244	23	

Note: F* = Field
C* = Control
P* = Probability that the observed difference or a larger one, could have arisen due to change

TABLE 18(i) SELECTED CONDITIONS IN WHICH THERE ARE SUGGESTIVE DIFFERENCES BETWEEN FACTORY WORKERS AND THE CONTROL GROUP (Males only)

Morbidity condition	Prevalance (%) of morbidity condition								
	All subjects			According to age					
				18-34 years			35-60 years		
	Factory	Control	P*	Factory	Control	P*	Factory	Control	P*
1. Worms in stool	19	8	0.07	18	8	0.2	20	9	0.2
2. Joint pains and back ache	33	17	0.03	20	13	0.22	41	36	0.2
3. Infective leasion (Skin)	14	3	0.03	18	2	0.01	12	9	0.2
4. Lymphnode: Cervical, tonsilar and axiliary	18	8	0.1	25	10	0.08	15	0	0.2
5. Glossitis, cheilosic and angular stomatitis	8	2	0.1	8	0	0.05	8	9	0.2
6. Varicose veins	8	0	0.02	6	0	0.1	10	0	0.2
Total	133	64		50	53		83	11	

Note: P* = Probability that the observed difference, or a larger one, could have arisen due to chance.

TABLE 18(j) COMPARISONS BETWEEN FIELD WORKERS AND THE CONTROL GROUP ACCORDING TO SEX AND AGE

Morbidity condition	Prevalance (%) of morbidity condition														
	All subjects			According to sex						According to age					
				Males			Females			18-34 yrs.			35-60 yrs.		
	F*	C*	P*	F*	C*	P*	F*	C*	P*	F*	C*	P*	F*	C*	P*
1. Palpitation, breathlessness and swelling of feet	26	15	0.03	19	9	0.14	29	23	0.42	20	1	0.04	29	39	0.45
2. Intermittent claudication	2	2	0.99	4	2	0.67	0	2	0.31	1	1	0.99	2	4	0.99
3. Head-ache, convulsion and vertigo	41	36	0.41	40	28	0.15	41	45	0.68	38	31	0.29	42	57	0.26
4. Visual disturbances	16	17	0.89	29	20	0.25	10	13	0.62	5	10	0.25	22	48	0.01
5. Pterygium	3	4	0.99	3	5	0.99	3	4	0.99	2	3	0.68	4	9	0.99
6. Neutritis, parasthesias and loss of power	11	5	0.11	2	3	0.99	14	8	0.26	4	4	0.99	14	9	0.75
7. Reflexes: deep, Superficial and visceral	3	1	0.21	2	2	0.99	4	0	0.38	4	0	0.08	3	4	0.99
Total	388	117		123	64		265	53		143	94		245	23	

Note: F*: Field
C*: Control
P*: Probability that the observed difference, or a larger one, could have arisen due to chance.

TABLE 18(k) COMPARISONS BETWEEN FACTORY WORKERS AND THE CONTROL GROUP ACCORDING TO AGE (Males only)

Morbidity condition	Prevalanece (%) of morbidity condition								
	All subjects			According to age					
				18-34 years			35-60 years		
	Factory	Control	P*	Factory	Control	P*	Factory	Control	P*
1. Palpitation, breathlessness and swelling of feet	12	9	0.75	10	6	0.48	13	27	0.99
2. Intermittent claudication	2	2	0.99	2	2	0.99	2	0	0.99
3. Head-ache, convulsion and vertigo	30	28	0.91	38	25	0.21	25	45	0.99
4. Visual disturbances	24	20	0.69	14	13	0.86	30	55	0.17
5. Pterygium	10	5	0.34	6	2	0.35	12	18	0.99
6. Neuritis, paresthesias and loss of power	3	3	0.99	0	4	0.50	5	0	0.59
7. Pallor	6	6	0.99	2	8	0.36	8	0	0.59
8. Reflexes: deep, superficial and visceral	5	2	0.43	2	0	0.49	6	9	0.99
Total	133	64		50	53		83	11	

P* = Probability that the observed difference, or a larger one, could have arisen due to chance.

CHAPTER X(D) LABORATORY INVESTIGATIONS

Results of the laboratory investigations carried out by the field laboratory unit are presented in Tables 19A to 19E.

i) Hemoglobin estimation

Table 19A shows the hemoglobin values classified according to sex in field workers, factory workers and a control group. Mean values and standard deviations are also shown.

On perusal of the table there appears to be a tendency for overall higher readings than expectations based on clinical assessment. In a field situation, this could be due to some dehydration of samples during the time of transportation.

However, since we are mainly interested in group trends, it is interesting to note that the values for females are lesser than male values as expected and also there is a suggestive difference between female field workers (all pluckers) and controls (mostly housewives, students and other unemployed). The proportion with a hemoglobin value of 12 gms or less are 52% and 38% respectively. However, this difference is not significant (P 0.1).

ii) Erythrocyte Sedimentation Rate

Table 19B shows the ESR according to sex in field workers, factory workers and a control group. There are no significant differences between the groups either in males or in females. However, the proportion with an ESR of 21 mm or more is substantially higher in females than in males, both in field workers and the controls (P 0.01) suggesting possibly greater experience of infections.

iii) Total white cell count

Table 19C shows the total white blood counts according to sex in field workers, factory workers and a control group. There are no significant differences between the groups among the males.

Among the females, however, there is evidence that field workers had lower counts than the controls; for instance, the proportion with a count of less than 9000 were 66 percent and 33 percent respectively (P 0.01). The clinical significance if at all of this finding is not very clear.

iv) Urine examination

Table 19D shows the results of the urine examination according to sex in field workers, factory workers and a control group.

Urine albumin

There is a suggestive difference between field workers and controls among females.

Urine sugar

Urine positivity for sugar is significant in field workers both male and female being 3.5 to 3.6 percent. More significantly it is completely absent among factory workers and both control groups. Since urine samples were not collected at the laboratory but brought by the subjects no hasty conclusions can be drawn from these suggestive differences.

TABLE 19A HAEMOGLOBIN ACCORDING TO SEX, IN FIELD WORKERS, FACTORY WORKERS AND A CONTROL GROUP

Haemoglobin (gm/100 ml)	Males						Females			
	Field workers		Factory workers		Control group		Field workers		Control group	
	No.	%	No.	%	No.	%	No.	%	No.	%
7 - 10	4	3.9	5	4.1	1	1.9	37	17.7	4	10.8
11 - 12	15	14.7	12	9.8	6	11.5	72	34.4	10	27.0
13 - 14	28	27.5	41	33.3	19	36.5	82	39.2	19	51.4
15 - 16	46	45.1	53	43.1	20	38.5	16	7.7	3	8.1
17 - 19	9	8.8	12	9.8	6	11.5	2	1.0	1	2.7
Total	102	100.0	123	100.1	52	99.9	209	100.0	37	100.0
Mean		14.3		14.4		14.5		12.2		12.8
Standard deviation		1.96		1.87		1.69		1.91		1.93

The same argument holds good for the percentage positives for acetone in urine and microscope deposits which appear to be much commoner than expected.

V) Stool Examination

Table 19D shows the results of stool examination for ova and cysts according to sex in field workers, factory workers and a control group.

Though there are no significant difference between groups, worm infestations are relatively common in all the groups. Ascariasis ranges from 19.8 to 36 percent, trichuriasis from 2.4 to 7.4 percent and anky ova are upto 4.1 percent.

Though entamoeba histolytica and giardia lamblia cysts were identified in most of the groups, they were not as high as one would expect considering the common histories of diarrhoeas and dysenteries and the potential for transmission of water borne infections.

Control population of females mostly housewives and students have a commoner experience of amoebiasis and trichuriasis.

TABLE 19 B ESR ACCORDING TO SEX, IN FIELD WORKERS, FACTORY WORKERS AND A CONTROL GROUP

ESR/hr (mm)	Males						Females			
	Field workers		Factory workers		Control group		Field workers		Control group	
	No.	%	No.	%	No.	%	No.	%	No.	%
0 - 9	54	59.3	75	68.2	26	63.4	30	16.6	6	18.8
10 - 19	17	18.7	28	25.5	9	22.0	50	27.6	12	37.5
20 - 29	12	13.2	4	3.6	4	9.8	57	31.5	5	15.6
⩾ 30	8	8.8	3	2.7	2	4.9	44	24.3	9	28.1
Total	91	100.0	110	100.0	41	100.1	181	100.0	32	100.0
Mean	11.3		8.7		9.4		21.2		19.3	
Standard deviation	9.78		6.77		7.32		11.93		12.37	

TABLE 19-C TOTAL WHITE BLOOD COUNTS ACCORDING TO SEX, IN FIELD WORKERS, FACTORY WORKERS AND A CONTROL GROUP

Total white blood counts	Males						Females			
	Field workers		Factory workers		Control group		Field workers		Control group	
	No.	%	No.	%	No.	%	No.	%	No.	%
< 7000	23	22.5	26	21.3	8	16.7	52	25.2	6	17.1
7000-	38	37.3	55	45.1	22	45.8	83	40.3	7	20.0
9000-	30	29.4	28	23.0	13	27.1	56	27.2	17	48.6
⩾ 11000	11	10.8	13	10.7	5	10.4	15	7.3	5	14.3
Total	102	100.0	122	100.1	48	100.0	206	100.0	35	100.0
Mean	8635		8448		8628		8369		9139	
Standard deviation	1944		1932		1698		1782		2146	

TABLE 19-D RESULTS OF URINE AND STOOLS EXAMINATIONS ACCORDING TO SEX, IN FIELD WORKERS, FACTORY WORKERS AND A CONTROL GROUP

Examination			Percentage positive in Males			Percentage positive in females	
			Field workers	Factory workers	Control group	Field workers	Control group
Urine	:	Albumin	0.9	1.6	0.0	0.8	4.2
Urine	:	Sugar	3.5	0.0	0.0	3.6	0.0
Urine	:	Acetone	0.9	2.4	1.8	2.4	2.1
Urine	:	Deposits	3.5	3.2	5.3	4.0	4.2
Stools	:	Ascaris	36.1	19.8	30.9	29.0	23.8
Stools	:	Trichuris	7.4	3.6	3.6	2.4	7.1
Stools	:	Anky	2.8	3.7	1.8	4.1	0.0
Stools	:	E. Histolytica	0.9	0.0	1.8	1.6	4.8
Stools	:	Giardia	1.9	3.7	3.6	2.0	0.0
Stools	:	E. Coli	0.0	0.0	0.0	0.0	0.0
Total (range)			107-114	109-126	55-57	245-251	42-48

TABLE 20a DISTRIBUTION OF MEAN ANTHROPOMETRIC MEASUREMENTS BY AGE ON 336 MALES

Age group	Total No.	Weight in Kg.	Height in Cm.	Sitting height in Cm.	Waist height in Cm.	Armspan in Cm.	Full inspiration in Cm.
18	6	48.6 ± 10.0	161.7 ± 10.5	82.3 ± 5.6	98.9 ± 7.4	180.0 ± 10.8	74.3 ± 9.5
19	8	47.5 ± 3.3	164.0 ± 4.0	83.4 ± 4.36	98.4 ± 3.7	181.9 ± 8.0	75.4 ± 2.8
20	6	43.0 ± 5.7	159.0 ± 6.8	79.8 ± 4.6	96.3 ± 6.3	177.7 ± 9.8	75.8 ± 6.6
21	10	44.1 ± 5.9	159.0 ± 6.2	80.2 ± 3.0	96.4 ± 5.5	179.6 ± 9.8	73.6 ± 4.8
22	7	46.4 ± 7.2	158.6 ± 7.4	82.7 ± 4.2	95.3 ± 4.9	176.3 ± 9.4	75.1 ± 4.0
23-27	32	48.8 ± 5.8	162.6 ± 5.9	82.1 ± 3.0	98.5 ± 6.6	183.3 ± 8.0	78.5 ± 4.9
28-32	47	49.8 ± 7.1	162.4 ± 7.0	82.6 ± 3.9	97.3 ± 7.4	184.0 ± 9.6	78.1 ± 5.3
33-37	41	51.9 ± 9.1	162.7 ± 7.0	83.5 ± 4.0	98.1 ± 4.1	182.5 ± 8.0	79.6 ± 5.6
38-42	52	49.6 ± 7.3	163.1 ± 6.9	82.2 ± 5.6	98.5 ± 5.9	184.5 ± 5.99	78.5 ± 4.6
43-47	44	49.5 ± 9.5	161.9 ± 6.9	81.5 ± 3.8	97.8 ± 4.6	183.3 ± 8.98	79.1 ± 6.1
48-52	48	50.2 ± 9.0	159.9 ± 6.0	79.2 ± 6.0	97.0 ± 9.1	183.6 ± 10.00	79.4 ± 5.8
53	35	51.2 ± 7.7	162.2.± 6.4	81.8 ± 3.9	97.0 ± 6.7	184.0 ± 9.99	80.2 ± 5.5

TABLE 20b DISTRIBUTION OF MEAN ANTHROPOMETRIC MEASUREMENTS BY AGE ON 336 FEMALES

Age group	Total No.	Weight in Kg.	Height in Cm.	Sitting height in Cm.	Waist height in Cm.	Armspan in Cm.	Full inspiration in Cm.
18	7	41.5 ± 5.0	151.6 ± 3.7	76.5 ± 3.8	95.0 ± 4.8	172.8 ± 8.0	79.2 ± 6.0
19	15	41.7 ± 4.7	148.7 ± 3.8	76.3 ± 2.6	90.6 ± 3.0	168.9 ± 6.9	77.9 ± 4.9
20	9	44.0 ± 2.0	152.1 ± 5.4	76.7 ± 2.7	93.6 ± 3.9	171.8 ± 6.6	79.4 ± 2.7
21	5	39.8 ± 3.7	146.8 ± 5.5	75.4 ± 4.0	89.6 ± 4.0	166.6 ± 5.0	78.0 ± 7.3
22	7	40.4 ± 6.8	151.4 ± 6.5	75.8 ± 2.4	97.0 ± 6.7	171.1 ±12.8	77.0 ± 4.0
23-27	46	40.7 ± 5.4	148.9 ± 5.9	76.2 ± 2.6	90.7 ± 5.4	168.2 ± 7.7	75.0 ±11.0
28-32	50	41.7 ± 5.8	148.7 ± 4.5	75.8 ± 3.3	89.9 ± 3.9	167.3 ± 5.8	77.2 ± 5.5
33-37	41	40.3 ± 4.8	151.2 ± 5.0	76.1 ± 2.9	90.5 ± 5.0	168.5 ± 7.6	75.0 ± 3.9
38-42	50	39.8 ± 5.9	149.3 ± 5.5	75.5 ± 2.6	89.8 ± 3.9	166.8 ± 3.9	75.3 ± 5.5
43-47	35	40.9 ± 6.4	149.2 ± 4.8	77.5 ± 5.5	91.3 ± 4.0	168.9 ± 6.5	75.7 ± 4.0
48-52	37	40.5 ± 7.1	148.9 ± 6.2	75.0 ± 2.9	90.3 ± 6.5	168.1 ± 9.0	75.8 ± 4.9
53	34	40.2 ± 5.8	146.1 ± 5.9	73.7 ± 3.2	88.6 ± 4.8	164.7 ± 8.1	75.7 ± 4.5

Note: Values are given as Mean ± SD

TABLE 20c DISTRIBUTION OF MEAN ANTHROPOMETRIC MEASUREMENTS BY RELIGION

Religion	HINDU		CHRISTIAN		MUSLIM	
Sex	Male	Female	Male	Female	Male	Female
Total No.	(247)	(269)	(87)	(66)	(2)	(1)
Weight in Kg.	48.8 ± 7.0	40.3 ± 5.0	50.8 ± 6.7	41.3 ± 6.0	60.0 ± 6.0	40.0
Height in Cm.	161.7 ± 6.9	149.0 ± 5.0	162.3 ± 7.0	149.4 ± 5.0	164.0 ± 6.0	152.0
Sitting Height in Cm.	81.6 ± 4.7	75.7 ± 3.0	81.8 ± 4.6	75.6 ± 3.0	85.5 ± 7.0	77.0
Waist Height in Cm.	97.6 ± 5.0	90.0 ± 4.7	97.4 ± 5.0	91.3 ± 2.0	101.5 ± 2.0	91.0
Armspan in Cm.	184.1 ± 9.0	166.0 ± 7.6	183.7 ± 8.6	169.8 ± 7.7	188.5 ± 7.0	171.0
Full inspiration in Cm.	78.0 ± 5.0	76.0 ± 4.7	79.6 ± 6.0	76.8 ± 5.0	88.5 ± 2.0	74.0

Note: 1. Figures in paranthesis indicate total number in each Category.
2. Values are given as Mean ± SD

FIG.-28

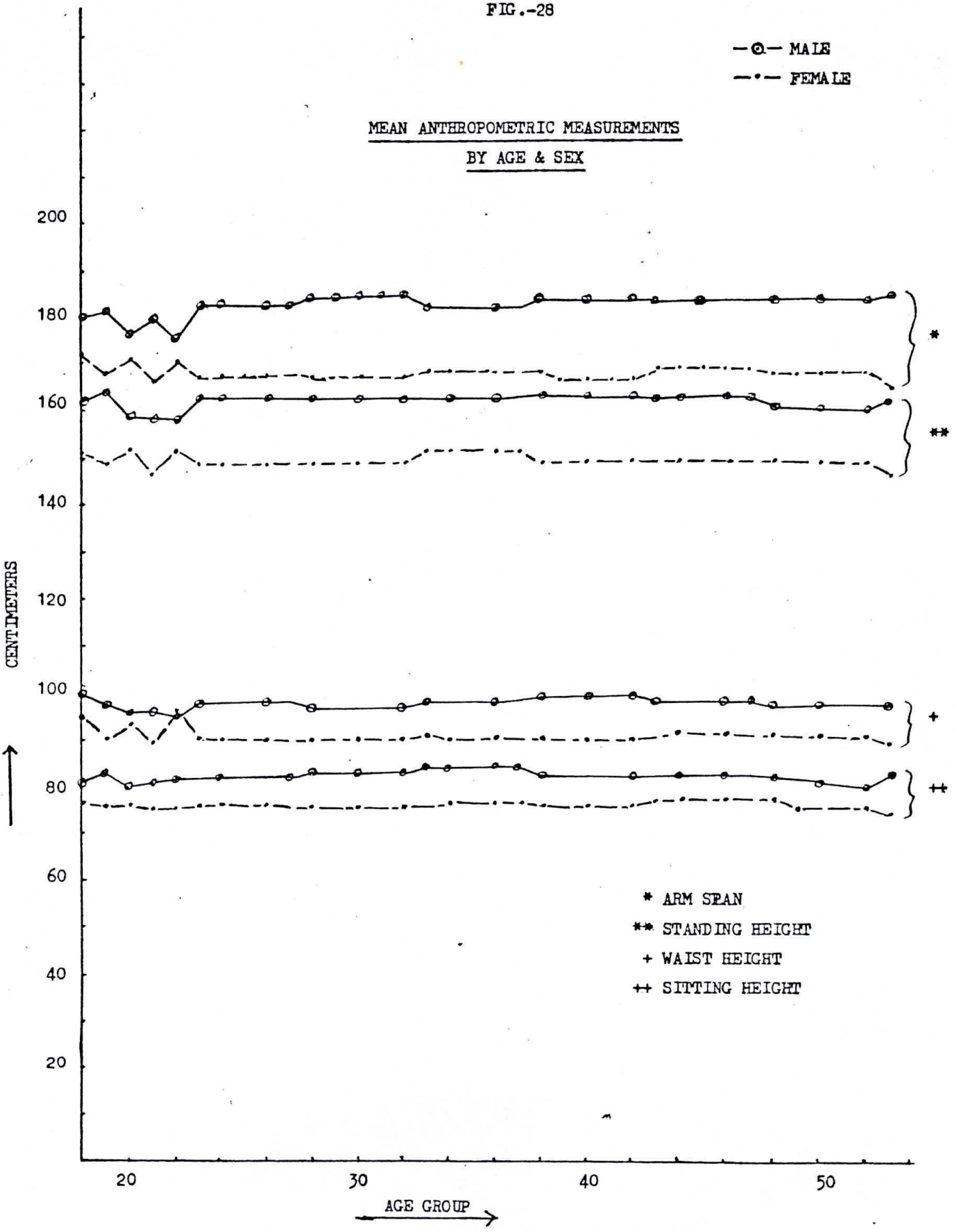

—⊙— MALE
—•— FEMALE
MEAN ANTHROPOMETRIC MEASUREMENTS
BY AGE & SEX
200
180
160
140
120
100
80
60
40
20
CENTIMETERS
*
**
+
++
* ARM SPAN
** STANDING HEIGHT
+ WAIST HEIGHT
++ SITTING HEIGHT
20
30
40
50
AGE GROUP

TABLE 20d DISTRIBUTION OF MEAN ANTHROPOMETRIC MEASUREMENTS BY SOCIO-ECONOMIC CLASSES

Socio Economic Classes	S.E. Class I		S.E. Class II		S.E. Class III		S.E. Class IV	
Sex Total No	Male (5)	Female (6)	Male (62)	Female (24)	Male (204)	Female (203)	Male (65)	Female (103)
Weight in Kg.	50.9 ± 8.0	44.0 ± 6.0	52.2 ± 7.0	40.5 ± 7.0	48.6 ± 7.0	40.7 ± 5.0	48.9 ± 6.0	40.3 ± 6.0
Height in Cm.	160.4 ±10.0	148.0 ± 8.0	163.3 ± 7.0	149.2 ± 6.0	161.1 ± 7.0	148.9 ± 5.0	162.8 ± 6.7	149.6 ± 6.0
Sitting height in Cm.	78.9 ±14.0	75.8 ± 4.0	83.0 ± 4.0	74.8 ± 3.0	81.4 ± 5.0	81.4 ± 5.0	82.1 ± 4.0	75.2 ± 8.0
Waist height in Cm.	93.0 ± 9.0	89.6 ± 4.0	98.8 ± 6.0	90.9 ± 6.0	96.3 ± 7.0	90.3 ± 5.0	99.9 ± 6.0	90.5 ± 5.5
Armspan in Cm.	181.9 ±10.0	171.2 ± 4.0	184.9 ± 9.0	167.0 ±10.0	182.6 ±10.0	168.1 ± 7.0	182.6 ±11.0	167.8 ± 8.0
Full inspiration in Cm.	80.0 ± 5.0	77.5 ± 5.0	80.4 ± 5.0	75.0 ± 6.0	78.3 ± 6.0	78.6 ± 5.0	77.7 ± 6.0	75.9 ± 5.0

NOTE: 1) Figures in brackets indicate total number in each category
2) Socio-economic Classes adapted from B.G. Prasad's (1970) classification.

TABLE 20e DISTRIBUTION OF MEAN ANTHROPOMETRIC MEASUREMENTS BY OCCUPATIONS

Profession	Pluckers		Agriculture		Factory		Miscellaneous	
Sex Total No	Male (6)	Female (230)	Male (142)	Female (40)	Male (105)	Female (16)	Male (83)	Female (50)
Weight in Kg.	57.2 ±13.0	40.0 ± 6.0	48.5 ± 7.0	39.0 ± 7.0	51.0 ± 7.0	40.0 ± 5.0	50.6 ± 9.0	43.6 ± 9.0
Height in Cm.	163.0 ± 2.0	149.0 ± 5.0	161.0 ± 6.0	149.0 ± 6.0	162.3 ± 7.0	148.3 ± 5.0	161.9 ± 7.0	150.6 ± 7.0
Sitting height in Cm.	81.7 ± 3.0	75.6 ± 3.0	81.2 ± 4.0	75.9 ± 3.0	82.3 ± 5.0	74.6 ± 2.0	82.2 ± 5.0	76.0 ± 3.0
Waist height in Cm.	100.8 ± 2.0	90.1 ± 5.0	96.3 ± 8.0	88.0 ± 9.0	98.7 ± 5.0	90.9 ± 6.0	97.3 ± 6.0	93.5 ± 6.0
Armspan in Cm.	188.0 ± 7.0	167.0 ± 6.0	182.0 ± 9.0	166.0 ± 6.0	184.0 ± 9.0	167.7 ±11.0	183.7 ± 9.0	170.0 ± 8.0
Full inspiration in Cm.	78.2 ± 7.0	76.0 ± 5.0	78.0 ± 6.0	74.4 ± 4.0	79.1 ± 5.0	70.4 ± 5.0	78.7 ± 7.0	78.6 ± 6.0

NOTE: 1) Figures in brakets indicate total number in each category
2) Values are expressed as Mean ± SD

CHAPTER X(E) ANTHROPOMETRIC MEASUREMENTS

The measurements of 336 adult males and an equal number of females in the age group 18-53+ were subject to analysis. These belonged to samples from estate A, B and C.

Table 20a and 20b show the dispersion of various measurements grouped according to age and sex. The distribution of these measurements according to religion, occupation and socio-economic condition are shown in Tables 20(c), 20(d) and 20(e).

From the anthropometric data, we can conclude:

(1) The data (Tables 20a and 20e) show that:

i) All skeletal growth in the population reaches optimum by 20, females dimensions being lower at all age group.

ii) Religion and socio economic condition do not modify optimum skeletal growth.

iii) Physical size has little relevance to the selection on a particular job on the plantations.

(2) The mean measurements as well as the variability of these measurements observed in this study are comparable to other studies done on South Indian populations.

(3) The body weights of both male and female subjects in this study are generally lower than the mean weight of each group in the general Indian population but they tend to increase with age as reported in other studies. Their health status was not different enough to explain this finding.

(4) Though the population is of mixed origin, they have been in Nilgiris for many generations and have adopted a common cultural pattern including diet habits which may be reflected in the absence of variation in their anthropometry.

(5) Since there is no selection of manpower in any job, it could be concluded that the present physical requirements for any particular job at the tea estate is not too demanding for rejecting a candidate as unsuitable, purely on his physical dimensions.

(6) As the status of most of the plantation labour in South India are similar, the present data can serve as the norms for physical standards for pre-placement medical examination. It can also serve for the design of machines, cards and even ready made dresses for the use of these plantations.

CHAPTER X(F) CHOLINESTERASE ESTIMATIONS

Table 21(a) shows the mean enzyme activity of each occupational group within the sample of 428 subjects (236 male and 192 females) divided into two broad age groups and by sex.

All the individual values were observed to be well within normal acceptable limits but the mean values in the group showed the following trends:

i) Agricultural workers and sprayers representing the populations exposed to organo phosphorous pesticides have mean enzyme values much lower than factory workers and controls.

ii) Pluckers were also considered exposed population but did not show as marked reduction probably because we found that no pesticide spraying is done on the bushes where plucking is due, possibly to prevent pesticide contamination of tea meant for export. Hence though the potential hazard exists in reality, it is less than the earlier group.

iii) Factory workers had the highest levels.

iv) Miscellaneous groups also tended to show lower values particularly among the young males. Since some of them also do casual jobs they could also be considered exposed group.

v) Enzyme activity levels decrease with age. This is seen in all the age groups except with the miscellaneous group which is probably because of the fact that some of the younger group go for casual work in tea gardens and get exposed to the pesticides whereas the older people have no risk.

vi) It is also observed that the females of the age group of 20-45 among agricultural workers have an average enzyme activity of 82.76 units which is less, when compared to the average enzyme activity of 96.24 units shown by the males in the same group. This is also seen in the total group irrespective of age and occupation. This may be due to the fact that of the total groups of males (181) and females (150) 30% and 84% respectively have definite occupational exposure. This unequal numbers of exposed may be reflected in lower female means and neutralise the advantage of normal physiological phenomena of higher values in females.

vii) The data may also suggest that the rate of reduction of enzyme activity when exposed to organophosphorous pesticides may be related directly to the normal level, ie., the higher the initial level, more will be the drop in level owing to exposure. In other words, the toxicity from the levels of cholinesterase activity suggests that younger people have higher risk of toxicity compared to older people and also young female workers have higher risk than the corresponding females. This is well exemplified by the observation on the agricultural workers where the mean enzyme activity of young females is less than that of young males. This interesting observation needs further substantiation.

CHAPTER X(G) ENVIRONMENTAL HYGIENE PARAMETERS IN FACTORIES

Four medium sized tea factories in the Nilgiris were visited and certain parameters were measured shown in Tables 22A to 22D. The values shown are mean levels of various measurements recorded in the withering, Rolling, Sifting, Firing and Packing sections of these factories.

Measurements included temperature by wet bulb, dry bulb and globe thermometers, noise level and illumination.

Humidity, WBGT index and corrected Effective Temperature (CET) were calculated from above.

Dust concentrations and particulate size were also assessed.

Table 22E shows the range of values by sections of factories amalgamating the recordings in all four factories.

i) Temperature

The over all range of dry and wet bulb temperature recordings are 14.5° -26°C and 18.5°-43°C respectively. Withering lofts are the coolest - being also the highest points in the factory and very well ventilated. The firing/drying sections are the hottest because of the presence of the furnace. The highest temperature recorded was 43 deg. C. Radiant heat was highest in the drying section because of the furnace. The highest temperature recorded was 46 deg. C.

ii) Humidity

Ranged from 23 percent to 96 percent but the overall value was within normal limits. Higher readings were obtained in the withering and rolling sections.

iii) Heat stress indices

WBGT index ranged from 16.3 to 30.9 deg and CET from 15.5 deg to 31 deg C. Except the firing/drying section these were well within normal limits in all the other sections.

iv) Illumination

This parameter showed a very wide range from 5 to 1650 lux. All the sections showed variation in levels of illumination but the overall picture was average.

v) Dust levels

We used a midget impinger to collect dust samples and found the concentration of dust to be between 1.1 to 5.5 million particles per cubic feet in all the sections except the sifting sections where the highest recordings were 59.5 mppcf. Sifting sections have, therefore, a definite dust hazard.

However, since the proportion of particles of less than 5 μ size in all the samples were between 82-100 percent we presumed that the use of midget impinger was excluding collection of larger size dust particles which are expected in situations of dust arising out of vegetable fibres. This phenomena is well known and though we used the midget impinger, since it was the only apparatus available, dust concentrations will have to be redone in the factories in the future using a hexhlet or soxhlet-hexhlet pair described in Pinnagoda (1971), which gives a better quantitative estimation of dust levels.

TABLE 21 MEAN SERUM CHOLINESTERASE ACTIVITY BY AGE, SEX & OCCUPATION

Age Group	SEX	Agricultural workers No.	Agricultural workers mean che. activity	Sprayers No.	Sprayers mean che. activity	Factory Workers No.	Factory Workers mean che. activity	Pluckers No.	Pluckers mean che. activity	Miscellaneous Group No.	Miscellaneous Group mean che. activity	All Workers No.	All Workers mean che. activity
20-45 Years	M	33	101.2 ±21.74	16	95.2 ±20.4	82	117.4 ±16.9	-	-	30	98.7 ±26.19	161	108.39 ±20.06
	F	22	84.4 +15.77	-	-	6	122.8 ±16.85	101	104.5 ±21.03	16	111.3 ±17.22	145	103.18 ±19.6
46 and above	M	19	100.0 ±20.41	1	107.0 ± -	32	111.0 ±17.57	-	-	4	100.8 ±18.89	56	106.47 ±18.16
	F	3	70.0 ±18.35	-	-	2	143.0 ± 1.41	41	99.7 ±23.3	1	120.0	47	100.65 ±22.06
All ages	M	52	100.76 ±21.06	17	95.9 ±19.75	114	115.6 ±17.01	-	-	34	98.95 ±25.2	217	-
	F	25	83.75 ±15.67	-	-	8	127.85 ±14.25	142	103.11 ±21.63	17	111.81 ±16.67	192	-

NOTE: Values are enzyme activity measured at the end of 30 minutes
Group values are expressed as means ± SD

TABLE 22(a) ENVIRONMENTAL PHYSICAL PARAMETERS (Range of values)

Section	No. of Samples	WB °C	DB °C	Humidity %	G.T. °C	WBGT °C	CET °C	Noise db	Illumination (lux)
Withering	36	14.5-20.00	20.00-26.5	44-88	20.00-28.00	16.3-23.5	16.5-24.5	76-92	5-1650
Rolling	49	15.00-20.00	18.5-26.00	33-96	18.5-26.5	17.2-21.8	15.5-22.00	78-86	12-110
Sifting	83	15.00-23.5	19.5-34.00	29-70	19.5-35.00	17.1-26.6	18.00-27.5	78-102	13-190
Firing/ Drying	46	18.5-26.00	21.5-43.00	23-60	28.00-46.00	20.4-30.9	22.00-31.00	70-84	8-700
Packing	11	19.5-23.00	27.00-30.00	42-65	27.00-31.00	22.1-24.5	22.5-25.00	98-102	44-65

TABLE 22b ENVIRONMENTAL PHYSICAL PARAMETERS IN FACTORY - A

Department	Sampling Point	No.of Samples	WB °C	DB °C	Humidity %	GT °C	WBGT °C	CET °C	Noise db	Illumination
Rolling:	1 Rolling Machine	4	17.4 16.5-18.0	20.6 19.5-22.0	73.0 68.0-77.0	20.6 19.0-22.0	18.3 17.6-19.2	19.0 18.0-20.0	80	25
	2 Roll Breaker	4	17.4 16.5-18.0	20.6 19.5-22.0	73.0 68.0-77.0	20.6 19.0-22.0	18.3 17.6-19.2	19.0 18.0-20.0	83	60
Sifting:	1 Sifter	6	17.2 16.0-18.0	21.8 19.5-23.5	63.0 59.0-70.0	22.0 19.5-24.0	18.6 17.1-19.8	19.5 18.0-20.5	86	42
Firing:	1 Drier	6	20.2 18.5-21.0	28.4 26.0-30.0	45.0 42.0-51.0	30.7 29.5-32.0	23.4 21.8-24.0	24.5 23.5-25.0	78	700
	2 Furnace	6	19.8 16.5-22.5	29.3 21.5-34.5	43.0 35.0-60.0	35.3 29.5-40.0	24.5 20.4-27.8	25.5 22.0-28.5	70	60

NOTE: 1) All temperature measurements are means of values recorded by hourly sampling.
2) Second lines indicate range.
3) All measurement were taken for the duration of the shift.

TABLE 22c

ENVIRONMENTAL PHYSICAL PARAMETERS IN FACTORY - B

Department	Sampling point	No.of Samples	WB °C	DB °C	Humidity %	GT °C	WBGT °C	GET °C	Noise db	Illumination
Withering	1 Fan end	4	19.3 19.0-20.0	22.0 22.0-22.0	78.0 76.0-84.0	22.6 22.5-23.0	20.3 20.1-20.9	20.6 20.5-21.0	88	23
	2 Mid point	4	19.3 19.0-20.0	22.0 22.0-22.0	78.0 76.0-84.0	22.6 22.5-23.0	20.3 20.1-20.9	20.6 20.5-21.0	81	35
	3 Opp. to fan end	4	19.5 19.0-20.0	22.5 22.0-23.0	77.0 76.0-80.0	23.3 23.0-23.5	20.7 20.2-21.1	21.5 21.0-22.0	76	85
Rolling	1 Rolling machine	4	20.5 20.0-21.0	22.1 21.0-23.5	87.0 80.0-96.0	22.4 21.5-23.5	21.0 20.5-21.6	21.0 20.0-22.0	80	75
	2 Roll breaker	4	20.5 20.0-21.0	22.1 21.0-23.5	87.0 80.0-96.0	22.5 21.5-23.5	21.0 20.5-21.6	21.0 20.0-22.0	84	75
	3 Fermen -tation	4	20.1 19.0-21.0	22.0 20.5-24.0	85.0 80.0-95.0	22.5 21.0-23.5	20.8 19.6-21.8	20.0 17.5-21.5	82	55
Sifting	1 Fibrex machine	7	21.8 20.5-23.0	31.2 29.0-34.0	44.0 39.0-47.0	32.1 29.0-34.5	24.9 22.9-26.6	26.0 24.5-27.5	82	115
	2 Sifter	6	22.3 21.5-23.5	31.8 30.0-33.5	45.0 38.0-47.0	32.3 30.5-34.0	25.3 24.2-26.4	26.4 25.0-27.5	84	47
	3 Milling Machine	7	20.2 19.5-21.5	29.1 27.0-32.0	43.0 35.0-52.0	30.6 28.0-33.5	23.3 22.4-25.6	25.1 24.0-27.5	83	65
	4 Winnower	7	21.9 21.0-23.0	31.3 28.5-34.0	44.0 39.0-51.0	31.8 29.0-35.0	24.9 23.4-26.6	26.1 25.0-27.5	81	110
Firing	1 Drier	4	26.0 26.0-26.0	38.3 36.0-40.0	38.0 33.0-45.0	40.4 38.5-42.0	30.3 29.8-30.8	30.6 30.0-31.0	80	8
	2 Furnace	4	20.5 19.0-22.0	27.0 26.0-29.0	55.0 52.0-58.0	29.5 28.0-31.0	23.2 21.7-24.7	24.8 23.5-26.0	75	75
Packing	1 Packing	6	20.1 19.5-21.0	28.1 27.0-30.0	48.0 42.0-54.0	28.3 27.0-31.0	22.6 22.1-23.7	23.7 22.5-25.0	102	44

NOTE:

(1) All temperature measurements are means of values recorded by hourly sampling

(2) Second lines indicate range

(3) All measurements taken for the duration of the shift.

TABLE 22d

ENVIRONMENTAL PHYSICAL PARAMETERS IN FACTORY - C

Department	Sampling point		No.of Samples	WB °C	DB °C	Humidity %	GT °C	WBGT °C	CET °C	Noise db	Illumination
Withering	1	Loft Fan end	6	20.0 18.5-21.0	23.5 20.0-26.5	74.0 52.0-88.0	23.7 20.0-26.5	21.1 19.0-22.5	21.0 17.0-24.0	92	140
	2	Opp. to fan end	6	19.8 18.0-21.0	23.6 20.0-26.0	71.0 56.0-83.0	24.1 20.0-28.0	21.1 18.6-23.5	21.4 16.5-24.5	80	1650
Rolling	3 1	Rolling machine	5	17.0 16.0-18.0	20.0 19.0-21.0	74.0 63.0-82.0	20.0 19.0-21.0	17.9 17.3-18.6	17.8 15.5-19.5	78	50
	2	Roll Breaker	5	17.0 16.0-18.0	20.0 19.0-21.0	74.0 63.0-82.0	20.0 19.0-21.0	17.9 17.3-18.6	17.8 15.5-19.5	86	90
	3	Fermentation	5	17.0 16.0-18.5	20.1 18.5-21.5	74.0 59.0-87.0	20.1 18.5-21.5	17.9 17.2-19.1	17.2 15.5-20.0	80	50
Sifting	1	Fibre Machine	6	22.1 20.5-23.5	29.3 28.0-30.5	54.0 48.0-60.0	29.8 28.0-31.0	24.4 23.1-25.5	25.4 24.5-26.0	86	190
	2	Sifter	6	21.9 20.0-23.5	29.7 28.0-31.0	51.0 45.0-55.0	29.9 29.0-31.0	24.3 22.6-25.8	25.6 24.5-26.0	92	50
	3	Milling	6	21.8 19.5-23.0	29.5 26.0-31.5	51.0 46.0-60.0	30.0 27.0-31.5	24.3 21.8-25.2	25.6 23.5-26.5	102	175
	4	Winnower	6	21.9 20.0-23.5	29.5 28.0-31.0	51.0 45.0-55.0	29.9 29.0-31.0	24.3 22.6-25.8	25.6 24.5-26.0	86	70
Firing	1	Drier	5	21.7 21.0-22.5	28.4 27.0-30.0	55.0 53.0-57.0	31.6 29.0-34.0	24.7 23.7-26.0	26.1 25.0-27.5	76	35
	2	Furnace	5	22.3 22.0-23.0	30.2 29.0-31.0	51.0 46.0-56.0	33.2 32.0-34.0	25.6 25.2-26.3	27.0 26.5-27.5	72	55
Packing	1	Packing	5	21.6 21.0-23.0	27.1 26.0-29.0	60.0 55.0-65.0	27.0 26.0-29.0	23.3 22.5-24.5	24.2 23.5-24.5	98	65

NOTE:

(1) All temperature measurements are means of values recorded by hourly sampling.

(2) Second lines indicate range

(3) All measurements were taken for the duration of the shift.

TABLE 22e ENVIRONMENTAL PHYSICAL PARAMETERS IN FACTORY - D

Depart ment	Sampling point	No.of Samples	WB °C	DB °C	Humidity %	GT °C	WBGT °C	CET °C	Noise db	Illu-mina-tion
Withering	1 Loft Fan end	4	17.0 16.0-18.0	24.3 23.0-25.0	48.0 44.0-50.0	24.9 23.5-26.0	19.4 18.3-20.4	--	86	5
	2 Loft Mid Point	4	16.1 15.0-16.5	22.9 21.5-24.0	50.0 47.0-52.0	23.4 22.0-24.5	18.3 17.1-18.9	-	74	12
	3 Loft Opp. to fan end	4	15.9 14.5-17.0	21.5 20.0-22.5	56.0 51.0-59.0	22.5 20.5-24.0	17.9 16.3-19.1	-	69	260
Rolling	1 Rolling machine	8	16.0 15.5-16.0	24.8 23.0-25.5	39.0 35.0-50.0	25.4 23.5-26.5	18.8 17.9-19.5	-	80	30
	2. Roll breaker	8	16.0 15.5-17.0	24.8 23.0-26.0	41.0 35.0-48.0	25.4 23.5-26.5	18.8 17.9-19.8	-	86	12
	3 Fermenta-tion	8	15.5 15.0-16.5	24.6 23.0-26.0	38.0 33.0-48.0	25.3 23.5-26.5	18.4 17.6-19.5	-	78	110
Sifting	1 Fibrex machine	8	18.2 16.0-20.0	26.7 25.5-29.0	44.0 32.0-49.0	27.4 26.5-29.5	21.0 19.3-22.9	-	78	16
	2 Sifter	8	18.1 15.0-19.0	26.6 26.0-28.0	42.0 29.0-48.0	27.2 25.5-30.0	20.8 18.5-23.0	-	82	24
	3 Milling machine	8	18.1 15.0-19.5	26.8 26.0-28.5	42.0 29.0-51.0	27.7 26.5-29.0	21.0 18.5-22.4	-	86	13
Firing	1 Drier	8	22.1 20.5-25.0	35.0 29.5-43.0	34.0 23.0-45.0	39.8 33.0-44.5	27.4 24.3-30.9	-	82	30
	2 Furnace room	8	19.6 18.5-21.0	27.9 25.9-30.0	46.0 39.0-57.0	37.9 32.0-46.0	25.1 23.0-27.9	-	84	80

N O T E:

(1) All temperature measurements are means of values recorded by hourly sampling

(2) Second lines indicate range

(3) All measurements were taken for the duration of the shift.

vi) Noise levels

Decibel levels were measured in 36 points in various sections of all four factories. All the levels were higher than 70 dB. Thirty one points had a level between 70-90 dB and 5 points had levels above 90 dB. These were the fan end of the withering section in Factory 'C', the Sifting and Milling machines in Factory 'C' and the Packing sections of Factories 'B' and 'C'. No audiometric assessment of the workers was possible because of the non-availability of a mobile audiometric unit.

CHAPTER X(H) MISCELLANEOUS DATA

During the field study we reviewed the records maintained by the estate offices and medical centres on tea production, types of job, productivity, absenteeism (due to sickness and other reasons) and outpatient/in-patient records. Without requiring to collect any data separately and specifically for our study we looked at monthly trends over the reference year, May 1978 to April 1979 to determine any information of epidemiological significance. The main aim was to try and look at available data on the estates, so that simple methodiogies can be worked out to derive information and trends on health.

(a) Seasonal variations of work and sickness absenteeism

The following are some of the important trends seen during the 12 month review.

Figure 29 is a graphic recording of monthly tea production, mandays worked by male and female workers, mendays lost due to sickness and other leave, for a 15 months period.

Figure 30 is a graphic recording of monthly variations of jobs on an estate and the relation with sickness absenteeism. Though there are many jobs on the estate, for the purpose of comparison five major jobs ie., agricultural work, plucking, spraying, chemical weeding and factory work are shown. Agricultural work included clearing, manuring, pruning, lopping and other miscellaneous but related activities.

The important conclusions derived from a perusal of both graphs are:

i) Seasonal variations of jobs

Tea production peaks in March, May-June and November and is low in July, August, October and January.

The five jobs shown in the graph have their own peaks and lows depending on season, weather conditions and needs of the tea bush.

Agricultural work

Peaks in July, September, December and March and is low in May, June, November and February. Range is 80-1400 mandays per month.

Plucking

Peaks in May, June, December and March and is low in September, October and February. Range is 3000-8500 mandays per month.

Spraying

Peaks in August, December, February and March and is lowest in May to July. Range is 10-500 mandays per month.

Weeding

Peaks in September, December and March and is lowest in May and February. Range is 100-950 mandays per month.

Factory work

Peaks in July, September, December and March and is low in May, June, November and February. Range is 130-770 mandays per month.

Incidentally February is the month of annual leave and this explains the reason why all work is at its lowest ebb during this month.

Epidemiologically these variations are of significance since cases of illnesses due to the hazards of specific work processes may report to hospital during the peak seasons of that work process. Because of the

FIG.-29

PRODUCTION Vs MANDAYS WORKED AND LOST DUE TO SICKNESS/OTHER LEAVE

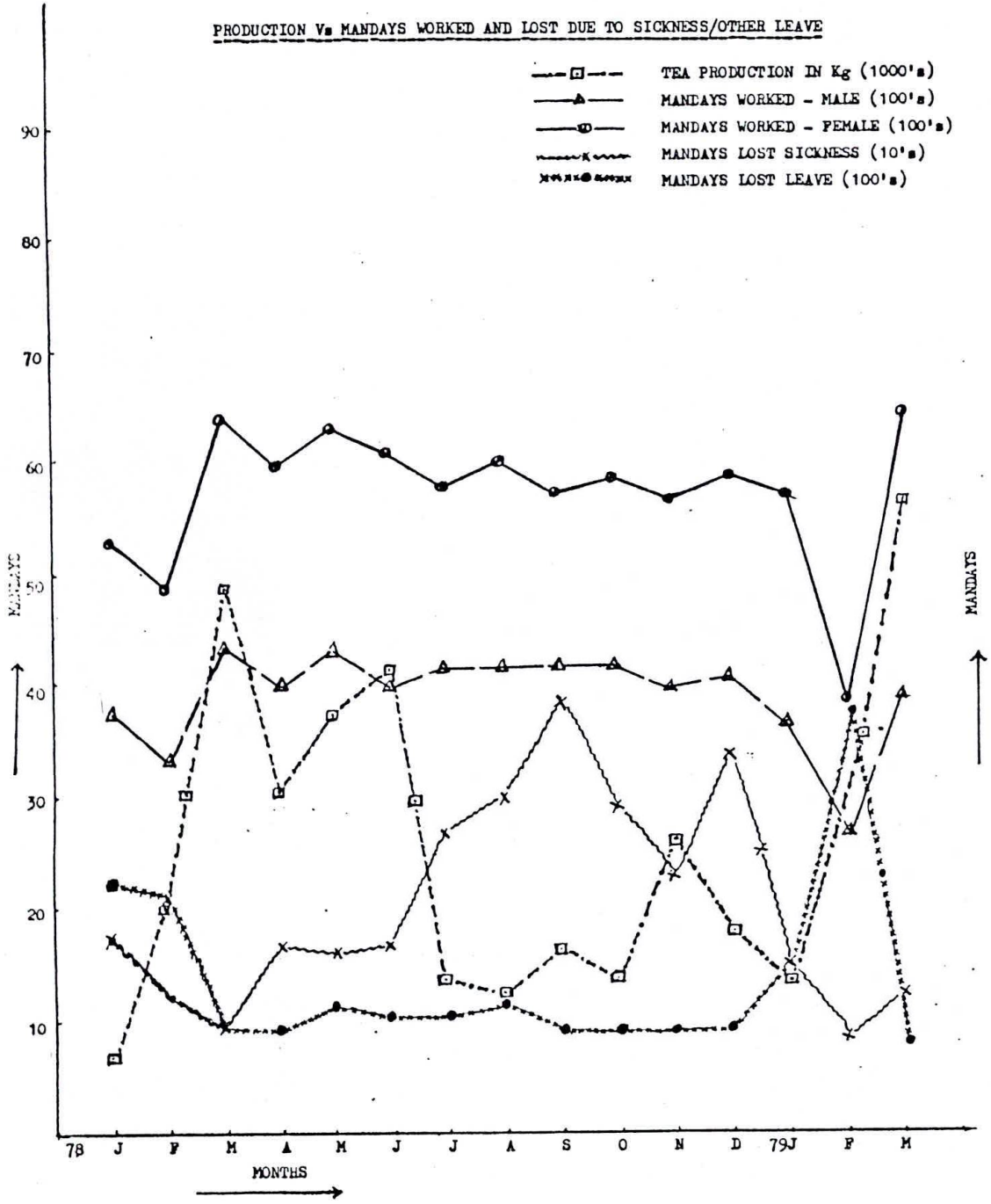
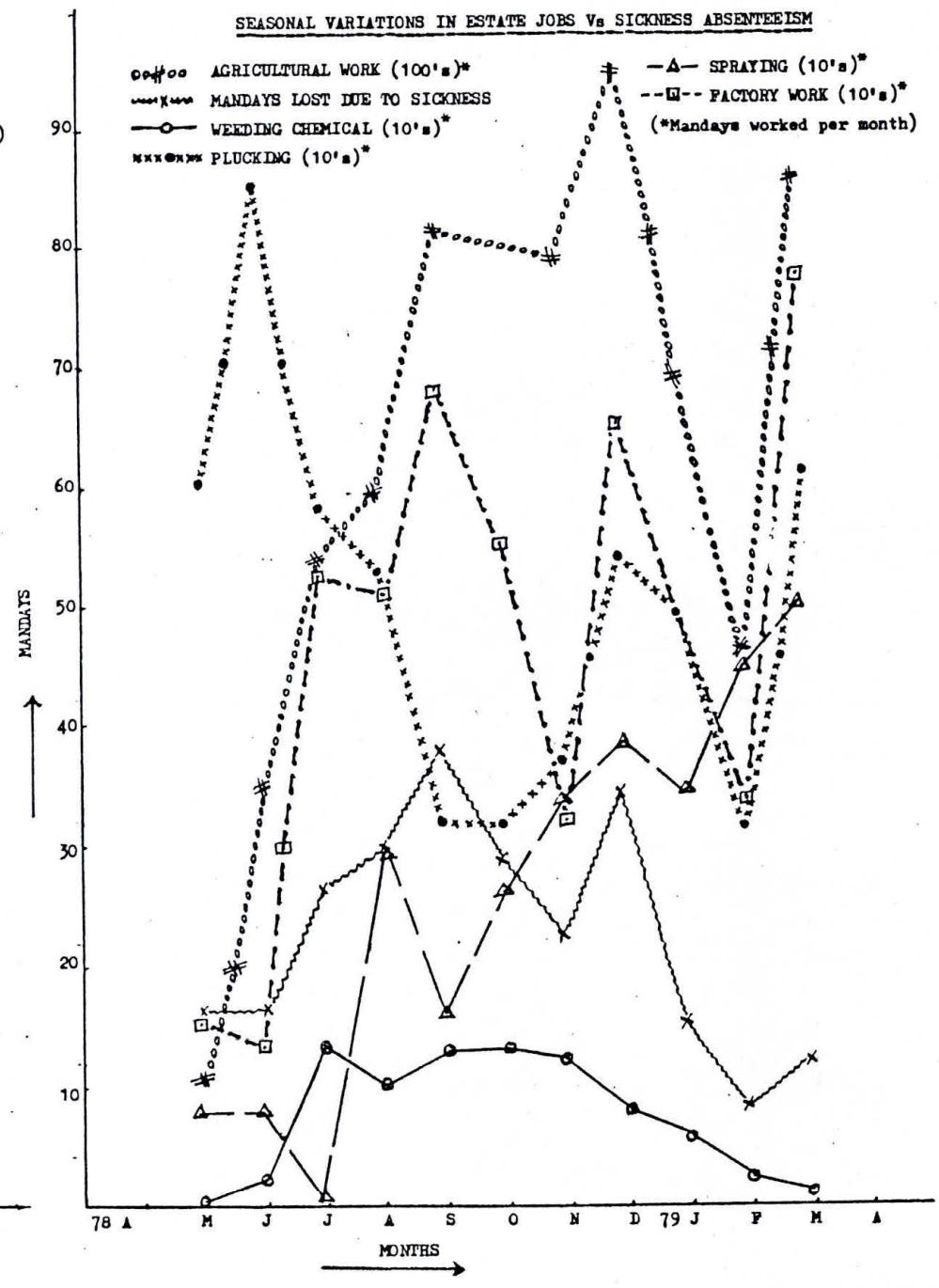


FIG.-30

SEASONAL VARIATIONS IN ESTATE JOBS Vs SICKNESS ABSENTEEISM



increased volume of specific work there is a tendency to put more hands on the job and many of these may be more inexperienced hands, hence adding to the health risk.

ii) Productivity pattern

Mandays worked by male and female workers show similar trends - these being more or less parallel throughout the year. They peak in March and May and are lowest in February which is the annual leave period. They coincide with the peaks of tea production in March and May but interestingly not in November. The range is 2600-4300 mandays per month in males and 3700-6400 womandays in females.

iii) Sickness absenteeism

Mandays lost due to sickness peak in September and December and are lowest in February and March. The sickness is marked between July to December - the monsoon and winter months. The range is between 80-400 mandays per month.

iv) Absenteeism other than sickness

Mandays lost due to other leave remains constant between March to December and increases in January and peaks in February which as has been mentioned before coincides with the annual leave period. The range is between 900-1200 mandays per month and 2100-2200 in January and February.

v) Suggested co-relationships in these trends

Sickness absenteeism peaks in September which coincides with peaks in factory work and weeding.

The second peak of sickness absenteeism in December coincides with peaks in factory work - weeding, plucking and spraying. This consistency in the peaks of absenteeism with factory work and weeding cooperations is an interesting correlation worth investigating further. Sickness absenteeism itself can be further classified by types of illness or these graphs linked to hospital morbidity statistics and probable causal relationships discovered.

It is also possible that there are other factors responsible for this trend which need to be further investigated.

The same trends should be studied for 5-10 year periods before definite inter-relationships or conclusions can be drawn and this could prove to be a very important study of great epidemiological significance.

Another important use of studying seasonal variations of jobs will be for the purpose of timing future field studies to coincide with peaks in productivity and work performance, eg., December may be a better month than May-June which was selected for this study.

Some more data in this area have been collected and is being analysed. The results will be reported subsequently.

(b) Hospital Birth and Death Register

The entries were analysed for the reference year May 1978 to April 1979.

There were 18 births and 8 deaths and 2 deaths under one year of age.

On the assumption that these would represent the actual numbers of births and deaths on the estate since registration ensures maternity benefit, funeral benefit and other help from the management vital indices for the estate were calculated.

i) Crude birth rate = 17.9/1000
ii) Crude death rate = 7.9/1000
iii) Infant mortality rate = 111

iv) Age of mothers

Further analysis of the 18 births recorded showed that 55% of the mothers were in the 20-24 age group mostly first and second para.

v) Site of delivery

There were 10 home deliveries (55 percent) and 8 hospital deliveries (45 percent) and there were equal number of workers and non-workers among the mothers (9 each).

vi) Age and causes of death

The deaths were mostly at home (seven) and only one in the hospital. Four deaths were certified with causes such as cirrhosis liver, pulmonary odema, status epilepticus and hypertension with hemiplegia. The

deaths were distributed over all the age groups. Two were 0-1 year, none in the 1-4 age group, one in 5-14, one in 15-44, 2 in 45-59 age group and 2 above sixty.

The numbers were too small to calculate morbidity/mortality rates. Analysis of these registers for longer periods of time could show useful epidemiological trends.

CHAPTER XI DISCUSSION

(A) Summary of Findings

The pilot study undertaken by us had a very wide scope of investigation. On review of the literature, it was obvious that all the studies done on plantations had been on selected sections of the population, ie., children, workers and so on and not on the total population. In some, the family had been the Unit of investigation like Ramalingaswami 1949 but in none had all the families been studied. We proposed such a community based study in order to get a baseline health profile of all components of the population - different age groups, different occupational groups and so on so that meaningful comparisons can be made and occupational and home environment influences can be differentiated. This is particularly important in studies on agricultural communities where the distinct differences between home and work environment as in the industrial situation, do not exist. Questions such as whether hazards of snake bites or ankylostomissis are an occupational risk or a home risk, and if both then how much is the additional occupational risk etc., can be answered or atleast attempted to be answered in the presence of total population data. The problem of total population survey however adds an important quantitative load on the field team making logistics rather challenging. A certain loss of depth perception of problems is bound to take place when one is investigating hundreds rather than tens of people since there are limits to the questions, examinations and laboratory investigations that can be carried out in the field.

Keeping these in mind we will recapitulate the main findings of the study as follows:

i) The pilot study was carried out on approximately 1400 subjects on three estates in the Nilgiris (1189 in Estate 'A').

ii) The total population of one estate and the factory workers and families of the second estate and the factory workers were covered in the study.

iii) The family was the unit of investigation in Estates A & B.

iv) Data on demographic characteristics, medical history, anthropometry, physical examinations and laboratory investigations of urine, stool and blood was done on all the subjects, cholinesterase levels especially of the working population was estimated and special investigations such as radiological examination of the chest were carried out whenever indicated.

v) The data presented on the analysis of the total population of Estate A (1189 individuals in 261 families) shows a predominantly younger population showing evidence of stability, higher literacy rate, better acceptance of family planning and lower unemployment rates than the general population. The population both Hindu and Christian had a very large percentage of scheduled castes and tribes. Average family size was 4.5, dependency ratio 58.32 and predominantly lower and lower middle income groups.

vi) The status of home environment was average in terms of lighting, ventilation, electrification, kitchens and bathrooms and very good in terms of water supply (91.5 percent got a protected tap water supply). Sanitation arrangements were provided but poorly maintained.

vii) Health Status: The data on 655 subjects in the working age group 18-60 was analysed to build up a health status profile.

The top ten causes for morbidity on the plantations are leech bites, backaches and joint pains, respiratory infections, anemia, insect stings, accidents in men, menstrual problems and leucorrhoea in women, worm infestations, headaches and symptom of reduced appetite.

Field workers experience of worm infestations, leech bites, insect stings, anemia, joint pains and back aches is significantly more than the control group who share the same home environment. Histories of parasthesia and neuritis are also more common. Varicose veins, snake and scorpion bite, disturbed sleep and reduced appetite are also common.

Factory workers experience worm infestations, joint pains and back ache, signs of vitamin B deficiency, varicose veins, infective lesions of skin more than the control group.

Respiratory signs and symptoms are highly prevalent in all groups probably reflective of the weather conditions in the hills. Though males in field and factory had a much higher prevalence this was not statistically significant.

viii) Laboratory investigations showed evidence of anemia in all groups of females and worm infestations - ascariasis, ankylostomiasis, trichuriasis in all the groups. Amoebiasis and giardiasis were also common.

ix) Anthropometry showed mean measurements comparable to other South Indian populations. Body weights in both males and females were lower than general Indian population. Inspite of mixed origins the anthropometry was homogenous and there was no self selection by occupation. Religion and socio-economic class had no-modifying effect.

x) Cholinesterase levels were within normal limits for all occupational groups but agricultural workers and sprayers (exposed population) had values lower than factory workers and controls. There was some evidence that younger age groups and especially females had greater risk of developing toxicity to organophosphorous pesticides.

xi) Occupational hygiene parameters measured in the factory environment showed a potential noise hazards in all sections especially the Packing and Sifting sections, evidence of heat stress in the drying/firing section and a dust hazard in the sifting section.

xii) Preliminary analysis of work, productivity and sickness absenteeism data collected on a monthly basis showed that sickness absenteeism was relating to peaks in factory operations and weeding operations with some consistency.

xiii) To conclude the health profile of the tea plantation workers show evidence that the important occupational hazards are stings and bites and problems of the musculo-skeletal systems. High prevalence of worm infestations and respiratory problems may be reflective of sanitation and weather conditions and anemias may be reflective of the nutritional status and ankylostomiasis. The risk of toxicity to agricultural chemicals particularly organophosphorous pesticides though not conclusively proved is strongly suggested by the presence of symptoms reported in literature to be associated with chronic toxicity and changes in cholinesterase levels. Accidents rates are high in men in both the field and factory and skin infections and varicose veins in males in factory. These need further substantiation. Six symptoms of disturbed sleep, reduced appetite, weakness, nausea and fullness, abdominal pain and painful/burning micturition though highly subjective are rather common and need to be thoroughly investigated.

(B) Comparisons

Review of literature shows that very few studies were done on total population of the estate and hence comparisons of the findings of this pilot study with other reported studies is not possible.

i) Ramalingaswami and Patwardhan (1949) studied 1592 individuals - samples of families from many estates. Our findings, 30 years later show similar findings on weight, vitamin B deficiency, anemia, skin infections and upper respiratory infections. Since we took only the occupational age group in the first stage of our analysis a direct comparison of data cannot be made though this will be attempted in Stage II when the total population data will be present, ie., under 18 and over 60's.

Interestingly, they too reported histories of vague symptoms such as lack of appetite, abdominal distension, early fatigability and symptoms of gastro-duodenal ulcers as signs needing further investigations.

Vitamin A deficiency and malaria are not as important problems now as before.

ii) Our findings on gastro-intestinal infections and worm infestations are slightly higher than those reported by UPASI (1979) and the interns in Narayan (1978) but probably a truer representation since they are backed by laboratory investigation of stool and not review of hospital data as the earlier study.

iii) Our findings re-emphasise and corroborate the conclusions drawn by interns of St. John's Medical College in their short term projects reported by Narayan 1982 in areas such as accidents, respiratory diseases, water borne diseases, anemia and gynaecological complaints. However, since most of these projects were not total population data but 'opportunistic' samples direct comparisons are irrelevant.

iv) The study on coir workers reported by the Regional Occupational Health Centre (ICMR) in the Annual report 1978 (R.O.H.C. 1979) is probably the only other total population study which is really comparable with our study. There asthma, elephantiasis, skin diseases, fever with cough, gastro-intestinal illnesses and bleedings were found to be the commonest cause of morbidity. Coir workers had the same experience as non-coir workers and controls though there was an attributable extra risk for skin diseases, respiratory

diseases and elephantiasis because of the occupation. Elephantiasis common in the coir population were absent in our sample since ours was a non-filarious region.

(C) Limitations of Data

i) A study with such a wide scope as this, because of its pilot nature, cannot indicate more than trends in morbidity patterns and suggestive differences between occupational groups and controls. Further detailed investigations need to be done in the morbidity patterns of anemia, musculoskeletal disorders, respiratory diseases, gastro-intestinal problems, and pesticide toxicity with better links between symptomatology, history and examination and laboratory findings.

ii) Some of the difference between occupational groups and controls especially in the older age groups can be biased by the fact of smaller numbers in the control groups. This would mean that age related symptoms and signs cannot be as easily separated between worker and non-worker groups.

iii) Due to problems of logistics and some variations and field modifications in laboratory technique we would caution any conclusions on our hemoglobin estimations and cholinesterase levels beyond the observation of suggested group trends. These need to be repeated after further standardization of technique to be able to draw definite conclusion.

iv) In the factory environment measurements the use of midget impinger to collect dust sample created biased readings since all the samples appeared to have mostly dust of less than 5 micrograms in size. When dealing with vegetable dusts hexlets are better as reported in literature. We used the former in the absence of the latter equipment mainly to establish some quantitative/qualitative difference between dust levels in various sections.

(D) Methodological Problems

i) Controls

A study such as this has an important problem of comparisons with controls. We got over this by selecting estates closer to a small town so that we could get a control population of adult males and females who lived on the estate but worked in non-tea jobs both inside as well as outside the estate.

Though we succedded to some extent it is obvious from Table 13 that the controls are comparable in numbers only in the 18_34 age groups, there being very small numbers in the 35-44 and 45-60 age groups.

ii) Job divisions

Though we attempted this in our study, jobs both in the field and factory are interchangeable and definite job allotments are not given. For instance in the factory it is not easy to divide all workers into one of the sections since many work between two or three sections. Field workers are put on factory jobs temporarily during times of peak production. Old field workers are often put on lighter factory jobs. Agricultural workers and sprayers are not distinctly classifiable. Such situation prevents further clear cut analysis of data as in factory by section or specific hazardous jobs. Experience of working in both or many types of jobs on the estate are not uncommon and hence epidemiological analysis in neat categories are impossible. This is a serious but real limitation to be accepted in planning of research on agricultural populations.

iii) Home and work environment

Categorisation is also neither easy nor realistic since in an agricultural community, these are closely inter-related and hazard at work only increases an additional risk factor to the same hazard operational already in the home environment, eg., bites and stings, hookworm, gastrointestinal disease and so on.

iv) Statistical problem

In interpreting the differences seen between groups we kept in mind the fact that when a large number of tests of significance are undertaken on some data, a few differences might turn up as statistically significant at the 5 percent level even though in reality there are no genuine differences (ie., if we did 100 tests of significance it may be expected that 5 of them will turn out to be statistically significant at the 5 percent level. Hence some of the differences we found may be whims of chance and further data has to be collected on those aspects in greater detail to actually confirm or corroborate the suggestive differences).

(E) Further Analysis

Further analysis of the data is still going on. Among other things we plan to:

i) Present the morbidity patterns in 0-5, 6-12, 13-17 and 60+ age groups to get additional evidence to separate out general environmental risk from occupational factors.

The total population data rather than only the 18-60 age groups will make comparisons with reported studies much easier.

ii) Separate the sprayers from the rest of male agricultural workers and see the comparative trends keeping in mind the problem mentioned in d(ii). Similarly findings on female factory workers will also be analysed. Though the numbers are less than 20 in both cases some differences may be discovered keeping the problem of limitations in numbers in mind.

iii) Respiratory problems and skin diseases have been studied in greater detail and if case histories are studied rather than presence/absence of individual signs and symptoms more data of clinical significance can be presented in these two problems.

iv) Analysis of the causes of sickness absenteeism is also being done from data collected during the study.

v) In a study such as this comparison between occupational groups and controls on point by point be it sign or symptom may not show differences that are statistically significant. But consistency in trends in differences between groups of signs and symptoms may help to identify areas of potential or chronic risk, especially when there is growing interest and concern, on the use of such a large range of agricultural chemicals. Effects of tea alkaloids and other constituents in certain jobs in the estate could also be conjectured based on observation of group trends. This is being further planned and any suggestions and experiences of such analysis by readers and reviewers of this paper will be very much appreciated.

Recommendation for Follow-Up

This was meant to be only a pilot study useful in determining trends and identifying areas of further investigation.

Many findings of this study because of its wide ambit throws up possibilities for future study.

(A) Study of Pesticide toxicity

Three areas need to be studied in much detail with reference to pesticide hazard on the estates.

i) Repeating of cholinesterase levels on a large sample of the estate population to corroborate trends suggested by this study.

ii) A detailed historical and medical assessment of sprayers and their morbidity/symptom experience.

iii) A wider KAP study of pesticide use among all the estates to assess methods of use, application, formulation and identify potential hazards. The latter is particularly important from the point of view of field action to be undertaken if the hazard is established and action by managements are necessary. KAP of managers, supervisors, medical staff and sprayers themselves will be thought provoking.

(B) Studies on anemia and its relation to nutritional factors, hookworm infestation, pregnancy wastage, work efficiency and productivity.

(C) Studies on Energy Expenditure of field workers particularly agricultural labour and pluckers--to be related to diet and work out puts.

(D) Study of vital losses among female workers and also gynaecological problems and their relation to work.

(E) A study of mortality rates and causes of death (refer Mackay, 1967 and 1979).

(F) Further investigation into the patterns of work and sickness absenteeism along lines suggested in Chapter X(H).

(G) Study on patterns of Respiratory Diseases and skin diseases on tea estate.

(H) Repeat of study of Dust hazards in the factories and relation to respiratory and other morbidity along the pattern used by Pinnagoda, 1971.

(I) Ergonomic and physiological assessment of pluckers (also suggested by Rahmathullah, 1981).

While further studies on tea plantations may be planned, it is very necessary that a similar pilot study be undertaken on a coffee estate and a rubber estate. These studies could well use the experience of the tea study and make suitable modifications or additions in the protocols, field methodology and laboratory techniques, to be used.

Many more studies can be suggested, but from our field experience and contact with the plantations one observation in the planning of these future studies may be very important.

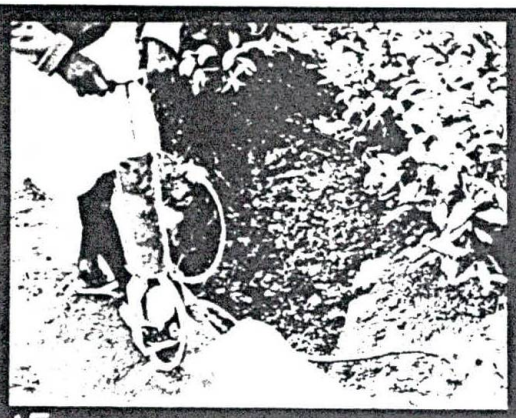
There exists in the plantations a medical set up at the estate level and the central level in which enthusiastic medical officers are available, many of whom have attended continuing education programmes organised by us. With a little bit of initial help in appraisal of information and planning of the studies (especially standardising proformas and methods of analysis), the medical officers are quite capable of undertaking most of the above suggested follow up studies under the encouragement, technical supervision and support of the Medical Advisor.

This will not only reduce logistic problems involved with movement of field teams, but more important it will stimulate a spirit of enquiry among the medical profession already linked to the plantations by virtue of their occupation. Such a process of involving medical officers can be initiated by making "Research in Plantation Medicine" - the theme of the next annual conference and after some exposure to discussions on field oriented research methodologies small working groups can be organised to plan and undertake some of the above projects.

Those studies requiring laboratory investigation and or physiological and ergonomic assessment can be supported by field units established temporarily by the Regional Occupational Health Centre, Ross Institute Unit of Occupational Health, Tocklai Experimental Station (Assam), National Institute of Occupational Health and other interested institutions in the country.

Though the above suggestions are outside the ambit of this report as such they are made with the hope that existing medical personnel on the plantations will be stimulated to see the wealth of epidemiological research possibilities that exist in closed communities such as plantations. By planning of simple field oriented and worker relevant research project, this mine of information can be tapped imaginatively without requiring too much financial inputs from outside.

This approach will contribute primarily to greater improvements in the health of the worker but secondarily and equally significantly to the professionalisation and research orientation of the medical workers in the estates and the growth and future of the tea industry, since man maintenance (ie., workers health) is fast becoming the key word of future industrial and agricultural development.



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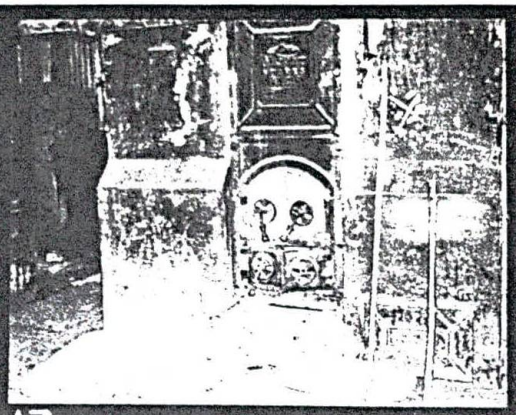

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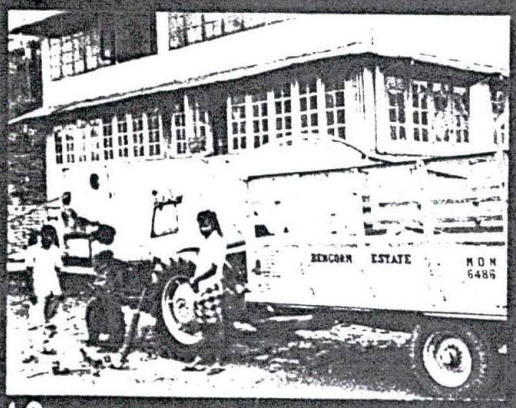

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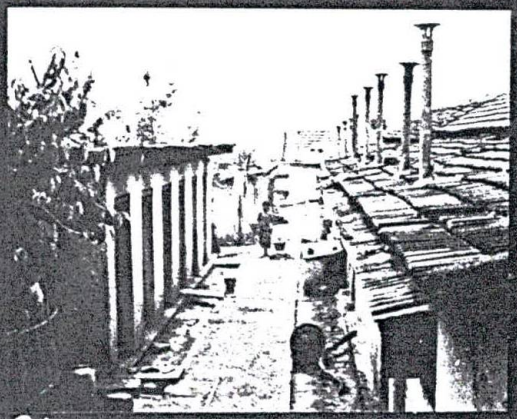

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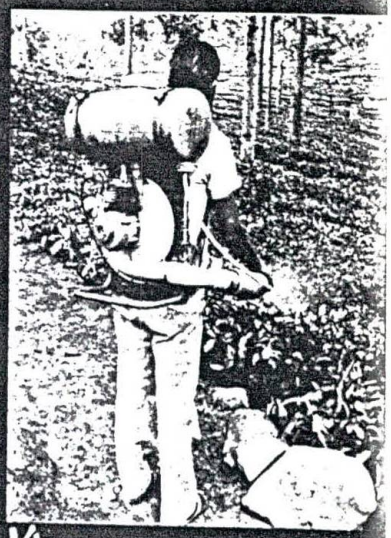

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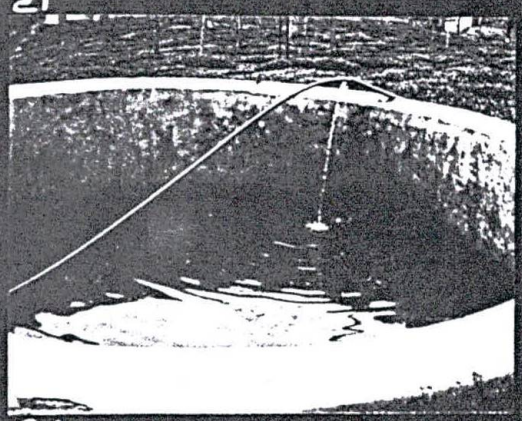

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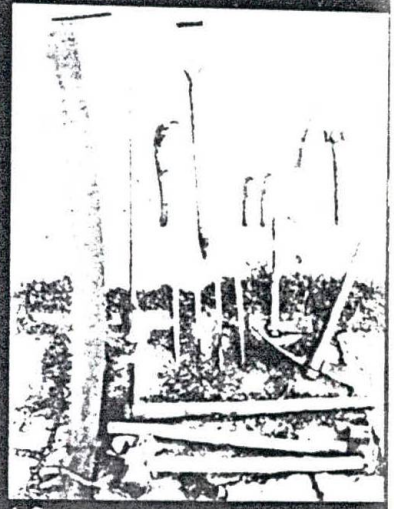

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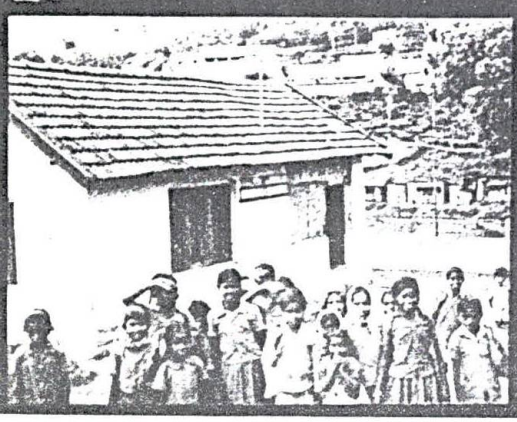

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Abbreviations used are as follows:

E.O.H.S. Encyclopedia of Occupational Health and Safety

I.L.O. International Labour Organization

G.O.I. Government of India

H.M.S.O Her Majesty's Stationery Office (U.K.)

R.O.H.C. Regional Occupational Health Centre, Bangalore

R.I.U.O.H Ross Institute Unit of Occupational Health, Bangalore

U.P.A.S.I United Planters' Association of Southern India

C.L.W.S. Comprehensive Labour Welfare Scheme

APPENDIX-A

BASELINE INFORMATION FROM ESTATES TO BE INCLUDED IN ICMR PILOT STUDY: NILGIRIS:

PRELIMINARY SURVEY

1. Name of the estate : _____
2. Postal address : _____

_____

3. Name of the Manager : _____
4. Telegraphic address (if any) :

5. Telephone Number : _____
6. Distance from Coonoor-Glenview : _____
7. Planted area in hectares : _____

Tea : _____

Others (Specify) : _____

8. Total No. of workers employed in 1978

a) Residential :

b) Non-residential :

_____

Total

_____

c) Permanent :

d) Temporary :

_____

Total

_____

e) Male : _____

f) Female : _____

g) Adolescent : _____

Total

_____

Divisions if any	Total Population Resident	No. of Workers	
		Factory	Field

9. Demographic data:-

Total population resident on estate. =

Number of resident families =

Number of resident single workers =

10. Facilities:-

a) Total no. of housing units =

b) Number of creches =

c) Number of schools (type specify) =

d) Number of labour clubs =

e) Number of latrines =

f) Number of flushout units =

g) Water supply sources:-

Wells =

Streams =

Reservoirs =

h) Protection:-

Chlorinated/other protection/ not protected =

Number of water points-

a) Lines =

b) Field =

11. Classification of estate work population: (Numbers):-

		Total:
Administrative:-		
Management	:	
Office Staff	:	
Field Staff	:	
Factory Staff	:	
Medical	:	
Any other (Specify)	:	
Skilled workers:-		Total: _____
Watchmen	:	
Driver	:	
Carpenter	:	
Mason	:	
Tabal man	:	
Engine driver	:	
Pump operators	:	
Machanic	:	
Cook	:	
Hospital Orderlies	:	
Chest Maker	:	
Midwives	:	
Any other (Specify)	:	
Factory workers:		
Collectors/spreaders	:	
Rollers	:	
Packers	:	
Sifters	:	

Drivers	:		
Any others (Specify)	:		
Field Workers:-			Total: _____
Planters	:		
Pruners	:		
Loppers	:		
Chemical weeding	:		
Manual weeding	:		
Manuring	:		
Road Builders	:		
Firewood cutting	:		
Pluckers	:		
Sweepers	:		
Sprayers	:	a) Power:	_____
		b) Hand :	_____
Creche attendants	:		
Any others(specify)	:		

12. Fertilisers used :

13. Pesticides used :

14. Weedicides used :

15. Health services:

Medical staff :

Date of completion of Form: _____ .

(Signature)

APPENDIX-B

ICMR PILOT PROJECT

Regional Occupational Health Centre & Ross Institute
Unit of Occupational Health (SJMC)

No Family Card No.....

Name Check Roll No.

(a) Occupational History

1. Present Occupation (with duration)

(a) Field : Plucker Agricultural Worker
Sprayer Supervisor

(b) Factory : Withering Rolling
Sifting Firing
Packing etc. Supervisor

(c) Any other (specify)

2. Additional Occupation (specify)

3. Previous Occupations with duration of each

Sl. No.	Occupation	Years & durations
(a)		
(b)		
(c)		

(b) Personal History

1. Appetite Normal Reduced Increased
2. Sleep Normal Disturbed
if disturbed, specify in what way:
3. Micturition
(i) Frequency Normal Decreased Increased
If increased: Day Night Both
(ii) Volume Normal Decreased Increased

4. Bowels
Normal Abnormal
If abnormal, specify:
5. Smoking Habits (describe amount if elicited)
Never smoked Recently stopped
Occasional smoker Regular smoker
6. Other Tobacco Habits
Chewing Snuff
7. Alcohol (Describe Type & amount, if elicited)
Not habituated Occasionally -- Regular
8. Other Chewing Habits
Present Absent
Betel Nut Betel Leaf Others
9. Other Drug YES NO
If yes, specify
Prescribed/self medicated

(c) For women workers only

1. Menstrual History
Cycle Regular Irregular
Duration Regular Irregular
Quantity of flow: Normal Less Excessive
Pain Yes No
LMP
2. Obstetrical History
Abortion Premature
Still births Liveborn
Total No. of living children
3. Gyn History
Leucorrhoea Yes/No Pruritis .. Yes/No
Prolapse Yes/No

(d) Family History

Asthma	Yes/No	Diabetes	Yes/No
Tuberculosis	Yes/No	Hypertension	Yes/No
Chr. Dermatitis	Yes/No	Allergies	Yes/No
Peripheral Neuritis	Yes/No	Mental Illness	Yes/No

Any other specify:

(e) Past History

Asthma	Yes/No	Diabetes	Yes/No
Tuberculosis	Yes/No	Hypertension	Yes/No
Chr. Dermatitis	Yes/No	Allergies	Yes/No
Peripheral Neuritis	Yes/No	Mental Illness	Yes/No

Any other, specify:

(f) Assessment of work (as stated by worker)

Hot	Cold	Sitting	Standing
Damp	Dusty	Monotonous	Boring
Smelly	Smoky	Noisy	Fatiguing

Do you relate any of above factors with any health condition

If yes, specify

(g) Presenting symptoms

Weakness Yes/No

Loss of weight Yes/No

1. Cardio-respiratory

Palpitation	Yes/No
Breathlessness	Yes/No
Chest Pain	Yes/No
Dry cough	Yes/No

Cough with expectoration

Hemoptysis Swelling of feet

Intermittent claudication

Raynaud's phenomenon

2. Gastro-intestinal

Nausea .....Vomiting .....

Feeling of illness .....Abdominal pain.....

Constipating.....Diarrhoea.....

Worms in stool.....Bleeding per rectum.....

Tarry stools.....Piles.....

3. Neurological

Visual disturbances	Incoordination
Hearing disturbances	Headaches
Neuritis	Vertigo
Parasthesias	Tinnitus
Loss of power	Convulsions

4. Skeletal

Joint Pains Back aches

5. Miscellaneous

Swellings/Lumps Impotence

6. Skin changes

Colour	Yes/No
Sensation	Yes/No
Infection/lesion	Yes/No

If positive then:

(i) Duration of dermatitis/skin change .....

(ii) Present before joining occupation Yes/No

(iii) Aggravated by occupation Yes/No

(iv) Itching Yes/No

(v) Burning Yes/No

(vi) Are other workers similarly affected Yes/No

Site

Characteristics

(h) General Examination

Weight Height

Chest measurement Inspiration

Expiration

Pulse Rate..... Rhythm

B.P. Systolic/Diastolic Regular/Irregular

Lymphadenopathy Present Absent

If present, specify chain/s

Cyanosis Nil Peripheral

Pallor Bone deformities

Jaundice Elephantiasis

Glossitis Varicose veins

Cheilssic Hernia

Ang. stomatitis Hydrocele

Odema over feet

(i) Systemic Examination

1. Respiratory

Rate

Movements Equal Unequal

Percussion Normal Dull Resonant

Breath sounds Normal Increased Decreased

Adventitious sounds Present Absent

If present, specify rhonchi/rales/crepitations/rub

2. Cardio-Vascular

JVP	Normal	Raised
Cardiac dullness	Normal	Increased Decreased
Heart sounds	Normal	Abnormal
Murmurs	Present	Absent

3. Abdomen

Tenderness	Yes/No	Liber palpable	Yes/No
Spleen Palapable	Yes/No	Other lumps	Yes/No
Fluid	Yes/No		

4. Nervous system

Intelligence Memory

Cranial Nerves Normal Abnormal

If abnormal, specify

Gait Normal Abnormal

Muscle tone Muscle nutrition

Muscle power

Sensations Normal Altered

Reflexes Superficial _____

Deep

Visceral

Babinskis Sign..... Rombergs Sign.....

Coordination Normal Altered

Date..... Investigator .....

(J) Investigations

1. Haemoglobin gms/100 ml
2. Leucocyte N-count E- L- M- T B-
3. PBS .....
4. ESR
5. Urine Albumin
6. Urine sugar
7. Urine Deposits
8. Stools
9. Chest X-Ray

Date..... Investigator .....

APPENDIX-C

I C M R PILOT PROJECT

(Additional Information for under 12)

1. PAST HISTORY:

Measles	:	Poliomyelitis	:	Diarrhoea	:
Chickenpox	:	Rheumeatic Fever	:	Dysentery	:
Smallpox	:	Tuberculosis	:	Ear infections	:
Diptheria	:	Malaria	:	Eye infections	:
Whooping Cough	:	Asthma	:	Scabies/skin infections	:
				Worms	

2. IMMUNIZATION SCHEDULE:

BCC				
Smallpox				
DPT	1st	2nd	3rd	Boosters
Polio	1st	2nd	3rd	Boosters

3. NUTRITIONAL ASSESSMENT:

Head circumference : _____cms

Mid Arm circumference : _____cms

Nutritional deficiency signs-(+ve only) :

(Additional Information for under 2)

1. FEEDING HABITS:

Breast fed alone

Supplements alone

Breast fed + Supplement

Mention type of supplements:

APPENDIX-D

REGIONAL OCCUPATIONAL HEALTH CENTRE
BANGALORE

ENVIRONMENTAL SURVEY

Sample No ---------- Date ----------

Name of the Industry/Institution .....

Sampling Point .....

Nature of Sampling operation .....

Sample type: Dust/Gas/Fumes .....

Rate of collection .....

Sampling commenced at .....Terminated at .....

Duration of Sampling ..... minutes

Quantity of sample collected ..... Litres/cft

Trapping medium .....

Temperature measurements:

WB..... °C...DB.....°C

GT..... °C...KT.....Seconds

BOTSFORD .....

Sampling done by .....

Name in Block Letters

SAMPLE ANALYSIS

Sample No---------- Date ----------

Estimation/Analysis done on .....At.....

Results:

1.
2.
3.

Internal Standard ..... Dilution factor .....

Analysis done by .....

ame loc ter

REGIONAL OCCUPATIONAL HEALTH CENTRE, BANGALORE AND
ROSS INSTITUTE UNIT OF OCCUPATIONAL HEALTH (SJMC)

(ICMR PILOT PROJECT)

Family Card FC No

Estate ..... Division ..... Line ..... House No .....
Religion and Caste..... Postal Address .....

Sl No	Name	Relation	Age	Sex	Marital state	Place of birth	Education	Occu-pation	Stay in Estate

Census

Date	Name	Age	Event	Date	Name	Age	Event

Date .....

Name of the Investigator .....

FAMILY DETAILS

1. Number of members in the house .....
2. Number of earning members .....
3. Total floor area .....
4. Number of rooms .....
5. Natural lighting .....
6. Ventilation .....
7. Water supply .....
8. Electric power supply .....
9. Flooring .....
10. Separate Kitchen .....
11. Smoke outlet:-
    Chimmney .....
    Special tiles .....
    Window .....
12. Bath room .....
13. Lavatory attached/public .....
14. Type of Drainage .....
15. Type of waste disposal:
    Refuse .....
    Garbage .....
    Animal waste .....
16. Possessions:
    Utensils .....
    Tables .....
    Chairs .....
    Bed .....
    Almirah .....
    Fans .....
    Radio .....
    Animals .....