Vol : XIV APRIL, 1964 No. 1

A QUARTERLY
DEVOTED TO HYGIENE, PREVENTIVE MEDICINE,
MEDICAL SCIENCE AND ALLIED SUBJECTS.

PUBLISHED BY

THE INSTITUTE OF HYGIENE & PREVENTIVE MEDICINE

6, BIRDWOOD ROAD, LAHORE

Lahore

Printed and Published by the Superintendent, Government Printing, West Pakistan

PAKISTAN JOURNAL OF HEALTH

CONTENTS

INFORMATION

Pakistan Journal of Health is published four times each year.

Articles for publication are understood to be contributed to the *Pakistan Journal of Health* only.

All articles for publication should be typewritten double spaced, wide margins.

Abbreviations as far as possible should be avoided.

All enquiries pertaining to the *Pakistan Journal of Health* should addressed to the Editor, *Pakistan Journal of Health*, 6, Birdwood Road, Lahore.

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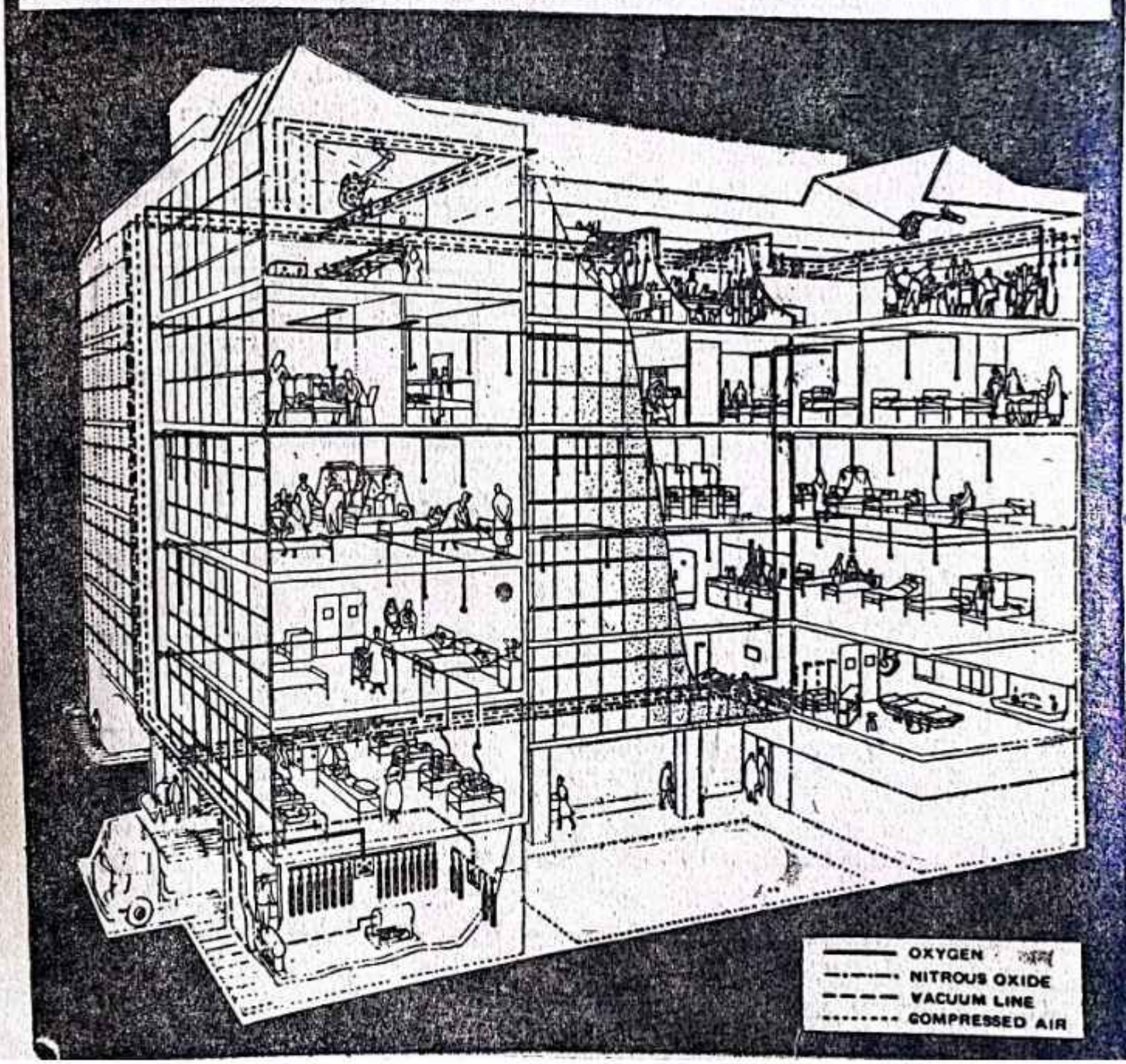

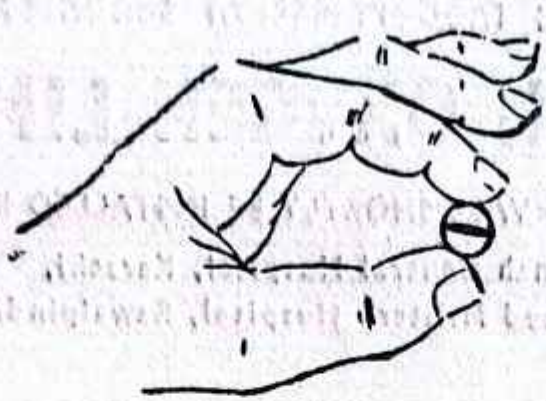

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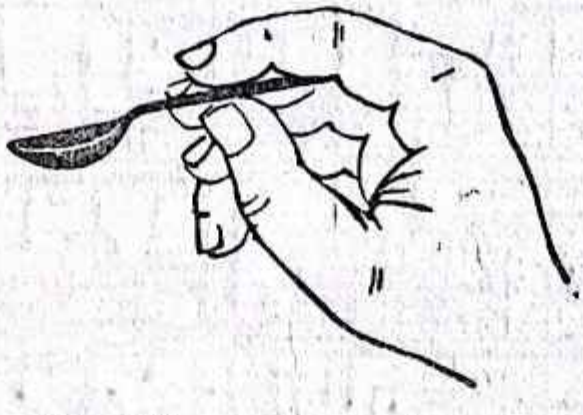

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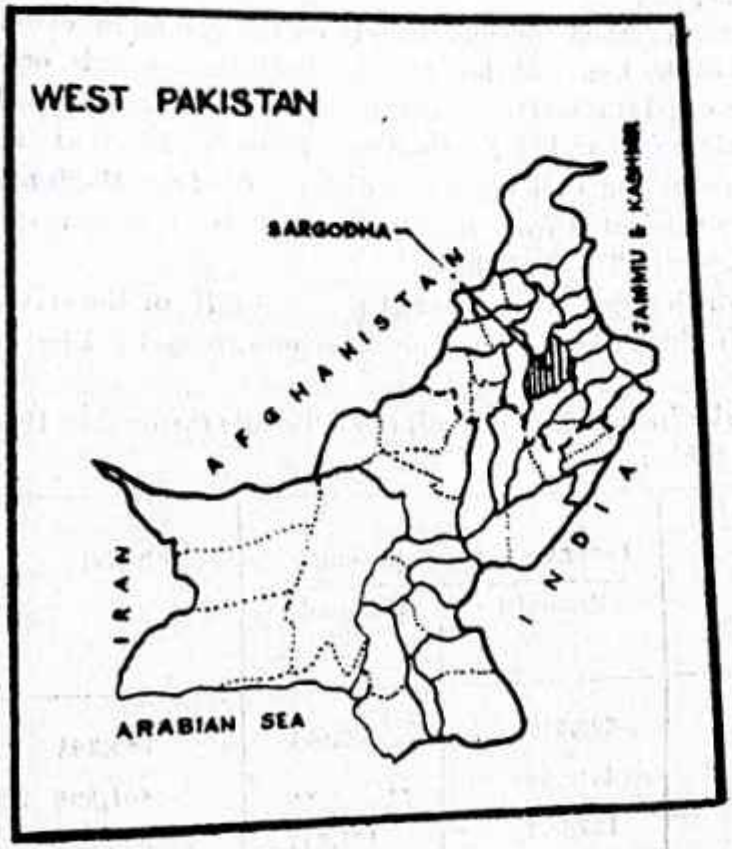
MALARIOMETRIC SURVEYS IN SARGODHA DISTRICT (WEST PAKISTAN)

By

DR. H.A.H. MASHAAL, M.B., CH. B., D.T.M.&H. W.H.O. SENIOR MALARIA ADVISER, WEST PAKISTAN

I. *Introduction*—The writer conducted from 1960 to 1964 malariometric surveys in majority of districts of West Pakistan. Sargodha was surveyed during October, 1963 and April, 1964. The Malaria Control Unit of Sargodha, conducted DDT residual spraying since 1952 as well as anti-malaria drug distribution since 1950. Analysis of malaria control activities since 1950 is discussed and the recent surveys of 1963-64 are analysed. The topography of the district is as follows: It lies roughly between longitude 71° 37 and 73°18′ and latitude 31° 32′ and 32° 46′ with an area of 47,75 sq. miles. It adjoins the districts of Jhelum and Campbellpur on the North, Gujrat on the East, Gujranwala on the South-East where it is separated by river Chenab for a distance of 15 miles, Jhang on the South and Mianwali on the West.



The Jhelum river enters the district at its North-East corner. It flows almost to to West for 60 miles and then turns Southwards running for about 40 miles. Jhelum river divides the district into two parts, more or less equal in surface area. The eastern part comprises of 3 tehsils viz. Bhalwal, Sargodha, and Shahpur (total surface area 2,253 sq. miles) and western part comprises of one tehsil viz. Khushab, having a surface area of 2,522 sq. miles.

Between Jhelum and Chenab rivers, there is a comparatively high long upland tract called the "Bar" while West to Jhelum the mountaineous rango and wide expansion of upland is known as "Thal".

1.1 *Tehsil Bahalwal, Sargodha and Shahpur*—These 3 tehsils are plains and lie between 500—700 ft. above sea level between Chenab and Jhelum rivers with gradual slope towards the South-West. The deposits left by the annual floods of the Chenab are usually sandy while that of Jhelum are rich silt. Areas adjacent to Jhelum river are flooded yearly particularly on the Northern part of Bhalwal Tehsil where villages are not accessible during floods except by boats, while on the South-Eastern side where river Chenab separates the district from Gujranwala, the flood is limited. Since the opening of Lower Jhelum Canal, running through neighbourhood of Gujranwala, the

river discharge is diverted in winter and more or less 20 per cent of the ordinary flood is discharged in summer.

The major part of the 3 Tehsils are irrigated perennially but certain areas situated along the rivers are irrigated seasonally depending upon the rise and fall of the river. Irrigation by canal is by flow, but on high surface land, where the flow system does not work, the lift irrigation is done.

The area irrigated by perennial system depends entirely on the two main canals, Northern and Southern Branches of the Lower Jhelum Canal. Both these canals originated from the Jhelum River as one canal at Rasul Head in Gujrat District (this headworks started 1901). These two canals run parallel South-West through Bhalwal and Sargodha Tehsils and remain separated from each other at a distance of about 15-20 miles. Several small irrigation canals are originated from these two canals to irrigate mainly Tehsils Bhawal and Sargodha and partly Tehsil Shahpur.

The inundation irrigation which depends on seasonal rise and fall of the river, depends mainly on Shahpur Branch which irrigates Shahpur and some areas of Bhalwal Tehsil.

The perennially and seasonally irrigated areas in all the 3 Tehsils (as during 1959-60) are shown in the following table :

Tehsil	Irrigated area in acres		Total
	Perennial	Seasonal	
Bhalwal ..	293,310	50,051	343,361
Sargodha ..	401,808	.. ..	401,808
Shahpur ..	127,888	121,977	249,865

Irrigation by tube-wells and open surface wells is done mainly in Bhalwal Tehsil and in some parts of Shahpur Tehsil. The total well-irrigated area is approximately 50,000 acres.

The Lower Jhelum Canals were started in 1901 and by 1931 large areas in Doab became unfit for cultivation due to water-logging and salinity. Various methods are being applied to improve cultivation by leaching plantation of rice, digging of surface drains, etc.

1.2 *Tehsil Khushab*—This tehsil is on the Western side of Jhelum river and represents more than half surface area of the Sargodha district. Its Northern part contains salt range which enter the district from Mianwali and runs along the entire Northern boundary in curve towards Jhelum district. This part comprises of two slopes, the Northern Slope and the Southern Slope. The Northern Slope show fairly regular disturbance and constant northernly dip. It is 2,500 ft. above sea level with several peaks reaching 3,000 ft. and the highest peak "Sakesar" at 4,000 ft. The Southern Slopes are broken, dislocated and precipitous. The plateaus contained between Northern and Southern Slopes consist of a series of markdely anti-clinal billows enclosing alluvial basins (representing few scattered pockets of cultivation), three of which drain into the salt lakes of Uchhali,

Khabekki and Jahlar. Few miles from the salt range and amidst the slopes before the plains are reached, irrigation is limited by water coming through gorges from hill side and springs. The three most important torrents are the Dadna, the Surakka, and the Vahi.

In the middle of Tehsil, the area is irrigated perennially by canals. The south-western part is a desert with excessive sandy dunes. The only water source in the desert part is deep wells.

2. *Climatology*—The cold season in this district is of 6 months from end of October to March. By end of April, the temperature begins to rise. The average daily maximum temperature during June remains 108° but it rises to 115° when there is scarcity of rainfall. In September and October, the temperature gradually drops.

The main relative humidity during May and June is less than 50 per cent whilst during the remaining months it fluctuates from 67 to 89 per cent.

The amount of rainfall varies considerably in different years. The average annual rainfall is 11·78" (average from 1947 to 1960). During the monsoon period from July to September the average rainfall reaches 7.35". The hilly ranges get more rainfall than the plains. The rainfall in winter is mostly during January and February.

3. *Malaria Control Programme*—Attached to District Health Office of Sargodha there is an Anti-Malaria Unit consisting of one Assistant Entomologist, one Malaria Inspector, 3 Malaria Supervisors, 15 Malaria Patrols (labour), and one Laboratory Assistant. Their activities are confined to Entomological, Blood, and Spleen surveys, DDT residual spraying and anti-malaria drug distribution. As a common practice, they also conduct all kinds of sanitation activities.

The entomological and blood survey data which was obtained by them haphazardly since 1950, is of no epidemiological value. However, in view of the development of high tolerance and resistance in *A. stephensi* and *A. culicifacies* to DDT in some areas of the neighbouring districts, as well as the observation of developing resistance in *P. falciparum* to 4-aminoquinoline, it is important to review the spraying operations and anti-malaria drug distribution data since 1950 till the present investigations.

3·1. *DDT Residual Spraying 1950 to 1963*—Under the Anti-Malaria Organization, DDT residual spraying was started in year 1952 and was carried out till 1963 except 1961 and 1962, hence no data is available for the year 1950, 1951, 1961, and 1962.

The number of villages yearly sprayed are tabulated as follows :—

Tehsils	TOTAL NUMBER OF VILLAGES SPRAYED BY DDT										
	1952	1953	1954	1955	1956	1957	1958	1959	1960	1963	Total
Bhalwal ..	4	143	..	6	30	38	19	17	..	3	276
Sargodha	29	4	..	75	44	6	26	..	14	1	199
Shahpur ..	80	32	20	24	85	47	71	25	3	39	426
Khushab ..	..	..	..	9	9	2	7	..	..	..	27
Total ..	123	179	20	114	174	93	123	42	17	43	928

After a further study of the spraying data it was noticed that the number of villages sprayed once, twice, and thrice were as under :

Tehsil	Number of villages sprayed with DDT			
	Once	Twice	Thrice	Total
Bhalwal	239	17	1	257
Sargodha	148	24	1	173
Shahpur	336	33	8	3 77
Khushab	23	2	..	25
Total	746	76	10	832*

The above data shows that a total of 928 villages were sprayed from 1952 to 1963 but this is a tricky figure as the actual number of villages sprayed was only 832 of which some were sprayed twice or thrice thus raising the number of sprayed villages to 928.

The campaign was conducted once yearly between March and October. It is noticed that most of the sprayed villages received only one cycle during this long period of 12 years and a very limited number was sprayed more than once. It seems that the policy was to shift yearly from one area to another.

It will be seen from the foregoing data that out of 832 villages sprayed, 746 were covered only once. On further study, it was found that out of the 76 villages sprayed twice, only 30 receiveds successive cycles while in the remaining 36 villages, the 2 cycle were separated by two year or more in some cases. Similarly, none of the 10 villages sprayed twice, received spraying cycle in successive years.

It can, therefore, be well observed that the above spraying campaign was carried out in a most unscientific manner with no fruitful results except temporary control.

During the last 12 years more than half of the villages of Shahpur, Sargodha and Bhalwal Tehsil were sprayed once. In Khushab Tehsil about 10 per cent of the villages (only 25 villages) were sprayed during the period 1955 to 1958. These villages are mainly located along the Western bank of Jhelum river.

3·2 *Anti-Malaria Drug Distribution During* 1950—1962—The following drugs were distributed in several villages during the above period. The year in which the drug

*For detailed analysis of D. D. T. spraying data of each Thana yearly since 1252 to 1963 see attached Annex. No. 1.

was distributed is marked :—

Drug	Year in which the drug was distributed in villages												
	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Quinine ..	+	+	+	+	+	+	+	+	+	+	+	+	+
Atabrine ..	—	+	—	—	—	+	+	+	—	—	—	+	—
4-Aminoquinoline													
Resochin ..	—		—	—	—	—	+	+	—	—	—	+	+
Camoquine	—	—	—	—	—	—	+	+	+	+	+	+	+
8-Aminoquinoline:—													
Pamaquine	—	—	—	—	—	+	+	—	+	—	—	—	—
Biguanide :—													
Paludrine ..	+	+	+	+	+	+	+	+	+	+	+	+	+
Pyrimidine:—													
Daraprim	—	—	—	—	—	—	+	—	—	—	+	+	+

Quinine and paludrine were among the drugs distributed frequently and in large amounts. The distribution of Paludrine exceeded 1·3 million tablets of 100-300 mg. during this perio d.

The selection of drugs used for anti-malaria chemotherapeutic purposes was not properly considered. The probability of developing resistance to anti-malaria drugs particularly Biguanide is worth considering. Future investigation should be made in this District as well as its neighbouring districts, viz., Gujrat, Jhelum, Gujranwala, and Jhang before the Malaria Eradication Programme in these Zones reaches in an advanced stage.

4. RECENT MALARIOMETRIC SURVEYS (OCTOBER, 1963)

A comprehensive spleen and parasite surveys were carried out systematically by the author during October 1963. The survey covered 62 village from all Tehsils and thanas of the district. Each village was selected at a distance of 5—10 miles. The results of the survey in villages of each Tehsil are represented in Annexes II to V attached. The location of the surveyed villages are shown in the map at next page.

According to the results of the survey the endemicity of malaria varied considerably in different Tehsils as well as in different areas of the same Tehsil.

4·1 *Tehsil Bhalwal*—It is an area of 817 sq. miles consisting of 283 villages with about 377,000 total inhabitants, in the Eastern part of the district between Jhelum and Chenab rivers. The area is mainly irrigated by canal system. The Northern part of the Tehsil is subjected to yearly flood and waterlogging.

The results of spleen palpation and blood oxamination for parasite in 19 village are given in the following table :—

Age	SPLEEN										PARASITE								
		PALPABLE SPLEEN																GAMETE	
	No. Ex.	1	2	3	4	5	Total	S. R.	AES	A. S.	No. Ex.	V	M	F	MIX	Total	P. R.	+	G. R.
0—1	..	..	..	..	..	..	..	..	..	..	17	1	0	0	0	1	5·8	1	5·8
1+	17	3	3	1	0	0	7	41·1	0·7	0·7	17	7	0	0	0	7	41·1	6	35·2
2—4	58	19	9	2	0	0	30	51·7	1·4	0·7	58	16	0	6	1	21	36·2	15	25·8
5—9	791	331	124	48	9	0	495	62·5	1·5	0·9	791	151	0	54	6	199	25·1	134	16·9
10+	207	87	39	23	6	2	157	75·8	1·7	1·2	207	27	0	18	0	45	21·7	27	13·0
Total ..	1073	440	175	74	15	2	707	65·7	1·5	1·0	1090	202	0	78	7	273	25·0	183	16·7

It will be seen from the above table that a total of 1090 inhabitants were examined for parasite out of which 1073 were examined for spleen in 19 villages. The gross spleen rate reached 65·7 per cent. The average enlarged spleen was noted to be 1·5 and average spleen 1·0. The parasite rate was 25·0 % (202 *P. vivax* 78 *P. faciparum* and 7 mixed). The species distribution was *P. vivax* 72·1% and *P. falciparum* 27·9%.

In thanas Bhera, Miani and Bahalwal, which represent the Northern part of the Tehsil, the spleen rate was high everywhere varying between 52 to 94·3 %.

Also a characteristic feature was the relatively larger size of spleen, AES fluctuated between 1·1 to 2·2 whilst A.S. remained between 0·6 to 2·1. Also in the 3 Northern thanas high parasite rate was found, average reached 30%. *P. vivax* was predominent in all the villages.

In the Southern part of Tehsil, adjacent to Chanab River in Thana Midh Ranjha, a remarkable drop in both spleen and parasite rate was found varying between 21·9 to 37·2 % and 4 to 11·7 %. Also A.S. dropped from over 1% (average of Northern Thana) respectively to 0·4 % (average of Southern Thanas). In Thana Kot Moman, which is located between the two areas, it revealed an intermediate stage. For detail data see Annex. II.

From the study of these data it is observed that malaria endemicity is high (hyperendemic) in the Northern part of the Tehsil along Jhelum river as well as in its central part. The high spleen rates, average enlarged spleen and average spleen, show the influence of the yearly flood by Jhelum river on this area as well as of the expanding canal irrigation system. In the Southern part of the Tehsil where flood is limited due to diversion of a big part of river discharge to the Lower Jhelum Canal, the malaria is moderately mesoendemic.

During May, 1964, the Northern area was re-examined by the author for splenomegaly only. A total of 28 spots representing various localities, farms, scattered houses, etc., were surveyed. The results revealed SR 81·7 % AES 1·7 % and AS 1·4 (total of 417 person were examined out of which 341 revealed positive for palpable spleen 1=152, 2=128, 3=50, 4=11, and 5=0)

During the survey of October 1963 SR, AES, AS were almost high everywhere. The spleen results as compared to the survey of May 1964 in the same area does not show any significant difference.

From the survey conducted in October 1963 it is noticed that spleen rates increase with age groups (minimum 41·1 per cent age-group 1-2 and maximum 75·8 per cent in age group above 10 years while the parasite rates drop as the age increases (Max. 41·1% in children and minimum 21·7% in elders.) It seems that partial immunity is developing in elder age groups due to lower parasite rates inspite of the higher spleen rates.

4.2 *Tehsil Sargodha*—This Tehsil is located between Bhalwal and Shahpur Tehsils. It is adjacent to Jhang district on the Southern border of Sargodha. It has an area of 827 sq. miles consisting 284 of villages with about 513,000 inhabitants. Although the area is not adjacent to any river, it is crossed by irrigation network of canal. The survey covered 10 villages distributed in all the 3 thanas of the Tehsil. The results of spleen and blood examination are as follow :—

Age-group	SPLEEN										PARASITE								
		PALPABLE SPLEEN																GAMETA	
	No. Ex.	1	2	3	4	5	Total	S. R.	AES	A. S.	No. Ex.	V	M	F	MIX	Total	P. R.	+	G. R.
0-1 years	..	..	..	..	..	..	..	..	..	..	2	0	0	0	0	0	0	0	0·0
Over 1 years	2	2	0	0	0	0	2	100	10	1·0	2	0	0	0	0	0	0·0	0	0·0
2-4 years	27	6	4	0	0	0	10	37·0	1·4	0·5	27	8	0	0	0	8	29·6	7	25·9
5-9 years	409	145	45	10	0	0	200	48·8	1·3	0·6	409	54	0	8	1	61	14·9	43	10·5
Over 10 years	108	30	14	3	1	1	49	45·3	1·5	0·7	108	12	0	1	0	13	12·0	11	10 1
Total ..	546	183	63	13	1	1	261	47·8	1·4	0·6	548	74	0	9	1	82	14·9	61	111

The examination of 548 inhabitants for blood, out of which 546 were examined for splenomegaly revealed SR 47·8 % AES 1·4 and AS 0·6. The average parasite rate revealed 14·9 per cent (74 P. vivax 9 P. falciparum and 1 mixed). The species distribution was *P. vivax* 89·2 per cent and *P. falciparum* 10·8 per cent. Gametocyte rate reached 11·1 per cent. For detailed analysis of the above data see Annex. III.

The spleen rate was high amongst different age groups whilst parasite rate was gradually descending from lower age groups to higher age groups. Malaria is more or less mesoendemic. However, the spleen rate in individual villages varied from 23·7 % to 88·0%. The average enlarged spleen fluctuated between 1 to 1·6 whilst As remained between 0·3 to 1·4. There was no remarkable variation in endemicity from one thana to another in this Tehsil though variation between a village and another in the same thana within a range of 3—4 miles was in some areas remarkable, e.g., in Thana Sillanwali, in village Chak No. 116 SB, the spleen rate was 88% and parasite Rate 39·7 % whilst in the neighbouring village Chak 132 SB of the same Thana, the spleen rate was 23·7 % and parasite rate 10·5%. This high variation in endemicity in the neighbouring localities is due to existence of permanent breeding places around Chak 116 SB mainly due to the net work of drainage channels.

4·3 *Tehsil Shahpur*—This is the smallest Tehsil in all the district. It is in an area of 609 sq. miles, consisting of 264 villages with about 218,000 inhabitants. It is a strip of about 50 miles in length and 12 miles in breadth and is located along the Eastern Bank of Jhelum River.

The eastern part of the Tehsil is mainly irrigated by perennial canals whilst the western part adjacent to the river is irrigated seasonally by canals originating from the river. Villages located along the river are subjected to flood that varies every year. (This flood is different from that in the Northern part of Bhalwal Tehsil which is liable to flood yearly.) In some parts of Shahpur tehsil, there is a network of drainage channels. These are located mainly in the Southern part of the Tehsil adjacent to Jhang District.

The results of spleen palpation and blood examination for the parasite are shown in in the following table :—

Age	SPLEEN										PARASITE								
		PALABLE SPLEEN																GAMETO.	
	No. Ex.	1	2	3	4	5	Total	S. R.	AES	A. S.	No. Ex.	V	M	F	MIX	Total	P. R.	+	G. R.
0—1	..	..	..	..	..	..	..	..	..	..	14	1	0	0	0	1	7·1	0	0·0
1+	16	3	7	2	0	0	12	75·0	1·9	1·4	16	6	0	1	1	6	37·5	5	31·2
2—4	46	2	6	6	0	0	14	30·4	2·2	0·6	46	8	0	4	0	12	26·0	6	13·0
5—9	363	87	19	15	1	0	122	33·6	1·4	0·4	363	23	0	9	0	32	8·8	17	4·6
10+	93	29	11	8	3	3	54	58·0	1·8	1·1	93	8	0	3	0	11	11·8	7	7·5
Total ..	518	121	43	31	4	3	202	38·9	1·6	0·6	532	46	0	17	1	62	11·6	35	6·5

It will be observed from the above table that examination of 532 inhabitants for splenomegaly and 518 for blood parasite in 11 villages revealed spleen rate 38·9%. The average P.R. reached 11·6 (46 *P. vivax* 17 *P. falciparum* and 1 mixed) The species distribution showed *P. vivax* 73% and *P. falciparum* 27%. Gametocyte Rate reached 6·5 %. For detail analysis of the about data per village see Annex. IV.

In thana Shahiwal of this Tehsil, in the Southern part the endemicity varied considerably. In village Choweke located along Jhelum river, SR was 13·5 %, PR 2·4% while in Dhirosial 8 miles east to the river Jhelum—SR was 92·8 % and P.R. 41·5 %. This is a striking variation from low to high endemicity. Choweke village along the river is a dry area and not subject to flood yearly except during occasional severe floods. It represents an area of unstable malaria, whilst Dhirosial is surrounded by drainage system and several breeding places which is not related to flood. Malaria endemicity is high regardless of flood. In Dhirosial feature of observation is the high AES 2·1 and high AS 2.

4.4 *Tehsil Khushab*—This tehsil comprises of more than half surface area of the district. It is an area of 2522 sq, miles consisting of 247 villages with about 364,000 inhabitants located in the Western part of the district and adjacent to Jhelum river. The topography of this tehsil varies considerably in flooded areas, irrigated areas mountaineous and desert areas. This was previously discussed in detail. The results of

spleen palpation and biood examinations for the parasite in Khushab Tehsil are given in the following table :

Age group	SPLEEN									PARASITE								
	No. Ex.	PALPABLE SPLEEN 1	2	3	4	5	Total	S. R.	AES	A. S.	No. Ex.	V	M	F	M I X	Total	P. R.	GAMETO. +	G. R.
0—1 year	..	..	..	..	..	..	..	..	..	..	3	0	0	0	0	0	0·0	0	0·0
1+	9	0	0	0	0	0	0	6·6	1·0	0·6	9	1	0	0	0	1	3·3	1	3·3
2—4	30	2	0	0	0	0	2	0·0	0·0	0·0	30	0	0	0	0	0	0·0	0	0·0
5—9	866	112	15	3	0	0	130	15·0	1·1	0·1	866	20	0	11	1	30	3·4	24	2·7
10+	220	32	4	0	0	0	36	16·3	1·1	0·1	220	2	0	5	0	7	3·1	5	2·2
Total ..	1125	146	19	3	0	0	168	14·9	1·1	0·1	1128	23	0	16	1	38	3·3	30	2·6

The examination of 1128 inhabitants for blood, out of which 1125 for enlarged spleen were examined in 22 villages, revealed SR 14·9 % AES 1·1, AS 0·1 and PR 3·3% (23 *P. vivax* 16 *P. falciparum* and 1 mixed) The species distribution was *P. vivax* 59% and *P. falciparum* 41% Gametocyte rate 2.6%. For detailed analysis of the above data please see Annex V attached.

A feature of the observation is the small size of both AES and AS. Also the spleen rate was only 14.9%. The SR fluctuated between 0 to 35.2% (0% in Khattakka village located in dry area in the North and 35.2 % in Chak 54 MB in the irrigated area).

Along Jhelum river, the situation is similar to villages previously discussed in Shahpur Tehsil. In the desert area where water is obtained by deep wells, malaria is non endemic or hypoendemic .In the village Nurpur located in the middle of the desert area, SR was 6.7 % Out of 60 persons examined for spleen, 4 revealed positive. They gave a definite history of settling along the river and left only for few months every year to visit their relatives etc.

In the middle of Khushab Tehsil, where irrigation is expanding by canal system, malaria is mesoend mic. Examples of this are villages Pindi Kauro, Chak 54 MB, Shahwala, Mitta Tiwana, etc. where spleen rates varied between 14 to 35.2%. In the mountaneous Northern areas malaria is of low endemicity along the few springs and their tributaries, as well as foot hill of mountainous range. This is represented in Thana Nowshera where SR fluctuated from 0.0 (in Khattaka village) to 19.2% (in Dhaddar village) amongst mountainous ranges.

Malaria in this Tehsil is not a Public Health Problem except along the Jhelum river where it is subjected to extreme variation of flood.

5. *Recent entomological surveys*

Out of the 62 villages examined for splenomegaly and malaria parasite, 42 were

*Note—Scale of the map is 1″=12 miles.

surveyed for adult Anopheline. In each village one room was selected mostly animal shed, or a bed room adjacent to the animal shed. Flitting method was applied using Pyrethrum 0.2% in Kerosine to achieve total collection. White sheets were spread on the floor and nailed on windows and doors. Surplus furniture was removed. After thorough flitting the room was closed for 15 minutes after which the sheets were removed carefully along with mosquitoes lying dead over them. Experience proved that this was the best and easiest method for assessing densities of Anopheline mosquitoes.

The general results of the entomological survey revealed that out of 42 villages examined, 33 revealed positive for *A. culicifacies*, 34 for *A. stephensi*, 42 for *A. subpictus* 18 for *A. pulcherrimus*, 11 for *A. annularis*, 3 for *A. fluviatilis* and one for *A. hyrcanus*.

The survey was conducted during the month of October 1963 which is more or less the highest peak of transmission season. The results of each village is represented in Annex VI attached.

The survey revealed wide distribution of both *A. culicifacies* and *A. stephensi* in all the district. *A. culicifacies* was predominent and in high densities along Jhelum river and in long standing perennially-irrigated areas as the Northern part of Bhalwal Tehsil or in areas with drainage channels as in Southern part of Shahpur Tehsil. The distribution of *A. culicifacies* and its density in Khushab Tehsil varies considerably due to the extreme topographical character of this Tehsil. The consolidated entomological results of each of the four Tehsils of Sargodha District with average room densities

and density per + room densities from October 1963 survey are summarized in the following table :

Vector	Tehsil	Rooms +	Rooms Neg	Dens. Avrg.	Dens. + room Avrg.	Dens. + room Min.	Dens. + room Max
A. culicifacies	Bhalwal	10	0	102·9	2·9	19	216
	Sargodha	5	0	11·4	11·4	1	28
	Shahpur	5	2	7·1	10·0	2	21
	Khushab	14	7	23·5	35·3	2	137
	Total	34	9				
A. stephensi	Bhalwal	9	1	5·5	6·1	1	14
	Sargodha	4	1	117·4	146·8	6	339
	Shahpur	5	3	27·0	37·8	4	92
	Khushab	17	4	63·7	78·7	1	1090
	Total—	35	8	..	..	..	..
A. subpictus	Bhalwal	10	0	152·1	152·1	26	421
	Sargodha	5	0	197·4	197·4	8	460
	Shahpur	7	0	433·4	433·4	7	2500
	Khushab	21	0	89·2	89·2	1	658
	Total—	43	0	..	..	..	..
A. pulcherrimus	Bhalwal	7	3	8·0	11·4	1	24
	Sargodha	1	4	0·8	1·0	4	4
	Shahpur	5	2	2·7	3·8	1	8
	Khushab	5	16	1·1	·6	1	10
	Total—	18	25				
A. annularis	Bhalwal	4	6	1·8	4·5	1	7
	Sargodha	0	5	0·0	0·0	0	0
	Shahpur	4	3	1·3	2·2	1	5
	Khushab	3	18	0·2	1·3	1	2
	Total..	11	32	..	..	..	..

Victors	Tehsil	Rooms +	Rooms Neg	Dens. Avrg.	Dens. + room Avrg.	Dens. + room Min.	Dens. + room Max
A. fluviatilis	Bhalwal	0	0	0·0	0	0	0
	Sargodha	0	5	0·0	0·0	0	0
	Shahpur	1	6	5·0	5·0	5	5
	Khushab	2	19	4·0	4·0	4	4
	Total—	3	30	..	..	..	..
A. hyrcanus	Bhalwal	0	10	0·0	0·0	0	0
	Sargodha	0	5	0·0	0·0	0	0
	Shahpur	0	7	0·0	0·0	3	0
	Khushab	1	20	3·0	3·0	0	3
	Total .	1	42	..	..	..	..

The average density per positive room in Bhalwal Tehsil for *A. culicifacies* was the highest. It reached 102.9 per positive room. All the 10 villages examined revealed positive result with high densities. The minimum density per room for *A. culicifacies* was 19. The villages surveyed were located in the centre and north of Bhalwal Tehsil (Thanas Bhera, Miani, and Bhalwal). This area is flooded yearly with extensive perennial irrigation. This area revealed the highest malaria endemicity in all the districts as previously described.

In Sargodha and Shahpur Tehsils, 10 out of 12 villages revealed *A. culicifacies*. The density varies from 1 (minimum) to 28 (maximum) *A. culicifacies* per positive room. Along canal distributaries and drainage channels the density was high as revealed in Dherosial village.

In Khushab Tehsil, 7 villages out of 14 revealed *A. culicifacies*. The distribution as well as the density in this Tehsil varies greatly. Positive results with heavy densities were almost always detected along the Western bank of Jhelum river and in the newly irrigated central third of the Tehsil between Jhelum and Mianwali districts. In the Northern hilly areas of this Tehsil, *A. culicifacies* was collected in high number from villages adjacent to slow running streams with breeding pits in their beds, as in Banakha village. Other hilly areas depending on deep well or rain water, densities were observed low. In the desert sandy dunes in the Southern third of the Tehsil between Jhelum river and Mianwali number of *A. culicifacies* were collected, or negative results were revealed, for example in Noorpur and Jamali villages.

Susceptibilit of A. culicifacies and A. stephensi to DDT and Dieldrin.

Preliminary susceptibility tests on *A. culicifacies* and *A. stephensi* for DDT and Dieldrin were carried out in September 1960 and April, 1964.

Results of susceptibility to DDT—The test was conducted for *A. culicifacies* in Village Dhero Sial (Shaniwal thana) during April 1964. The consolidated results of 3 replicates are represented in the following table :

RESULTS OF SUSCEPTIBILITY TEST OF *A. CULICIFACIES* TO DDT IN VILLAGE DHEROSIAL, (DISTRICT SARGODHA.) (18-20 April 1964.)

DDT Concentration	Living	Dead	Total	Mortality rate per cent
0·25%	42	17	59	28.8
0.5%	25	34	59	57.6
1.0%	7	55	62	88.7
2.0%	0	60	60	100%
4.0%	0	21	21	100%
Control	40	0	40	0.0%

Susceptibility test for *A. stephensi* in Village Dharah (Shahiwal Thana) was conducted in September, 1963 for 2 replicates and in Chak No. 9 NB in May 1964 for 4 replicates. The consolidated results are as follows :—

RESULTS OF SUSCEPTIBILITY TEST OF *A. STEPHENSE* TO DDT CONDUCTED IN CHAK No. 9 NB (DISTRICT SARGODHA)

	26-27 September 1963				May, 1964			
DDT Concentration	Living	Dead	Total	Percent mortality	Living	Dead	Total	Percent mortality
0.25%	21	0	21	0.0	56	21	77	27.3
0.5%	39	1	40	2.5	46	32	78	41.0
1.0%	35	5	40	12.5	27	53	80	66.3
2.0%	5	35	40	87.5	10	70	80	87.5
4.0%	0	57	57	100%	0	56	56	100%
Control	40	0	40	0.0	58	1	59	1.7

Results of Susceptibility to Dieldrin

Susceptibility tests for both *A. culicifacies* and *A. stephensi* were conducted in Dherosial and Dhel villages to Dieldrin. In Dherosial the test was done in 1 replicate

during April 1964 and in Dhel in two replicates during September 1963. The results are tablated as follows:

DLD Concentration	Dherosial 19 April 1964				Dhel : 26-27 September 1963			
	Living	Dead	Total	Percent mortality	Living	Dead	Total	Percent mortality
0.05%	4	17	21	80.9	39	0	39	0.0
0.1%	2	18	20	90.0	34	6	40	15.0
0.2%	1	19	20	95.0	10	28	38	73.6
0.4%	0	19	19	100	3	17	20	85·0
0.8%	0	20	20	100	2	37	39	94.8
1.6%	0	20	20	100	1	38	39	97.4
4.0%	..	..	..	..	0	39	39	100
Control	20	0	20	0.0	38	0	38	0.0

It will be observed that *A. culicifacies* proved to be susceptible to both insecticides DDT and Dieldrin. However, it is important to analyse the findings of susceptibility test of *A. stephensi* to Dieldrin. Though *A. stephensi* is considered to be susceptible to Dieldrin, it seems to be that heterozygous or homozygous resistant individuals are present in the area under observation, as the high concentration of this insecticide tested in the series (0·4, 0·8 and 1·6 per cent) do not give a 100 percent mortality rate. It is generally agreed that 0.4 percent dieldrin for one hour exposure is normally considered as a discriminative dose for most of anopheles and will kill all the susceptible ones by this concentration. The survived ones from 0·4 per cent or above almost certainly, will be the heterozygous or homozygous resistant individuals.

It appears that DLD resistance of *A. stephensi* will develop fairly rapidly once dieldrin is selected to susbstitute DDT in a residual spraying campaign. Unfortunately the number of mosquitoes used for this series of observations has been low, varying from 20 to 39. It is hardly possible to draw any definite conclusion from such important observation by one or two replicates only. Further investigation to clarify these findings is certainly required during the vector mosquito season.

Discussion 1. Malaria varied greatly in its degree of endemicity in the District. It was found to be non endemic or hypoendemic in desert areas and mountainous ranges and hyperendemic or high mesoendemic in northern areas of Bhalwal Tehsil and several villages distributed all over Bhalwal, Sargodha and Shahpur tehsils where anti-malaria activities were conducted since 1952.

2. The endemicity of malaria was attributed to water-logging, canal irrigation scheme, drainage channels and yearly flooded areas. In desert areas too, malaria endemicity established due to a development scheme. (Thal Development Authority) to provide irrigation in the desert by canal distributaries. Areas in desert which were far from this scheme and where water-supply entirely depended on deep wells, were found to be non-endemic or low degree of endemicity as in Nurpur and Gamalia.

The low parasite rate in hyperendemic areas amongst the adult age group (above 10 years) with gradual increase in younger age groups may be attributed to semi-immunity developing in older age groups.

3. The main vector found in the district was *A. culicifacies* in high densities, particularly in hyper-endemic areas. On the other hand, there appeared to be no relation between high density of *A. stephensi* and endemicity. In several villages where *A. stephensi* was collected in high number, endemicity was found to be low. However, in certain localities, high endemicity of malaria was noticed in presence of *A. stephensi* associated with *A. culicifacies*.

4. An important feature of the recent survey in Sargodha district was that inspite of malaria control activities since 1950 and DDT residual spraying since 1952, the malaria endemicity was very high in controlled areas. During spraying in control operations, 90 per cent of the sprayed villages were covered with DDT residual spraying only once in 12 years and the spraying operations were shifted to a new area yearly.

5. No co-relation could be found between the extensive distribution of several anti-malaria drugs yearly since 1950 and malaria endemicity. The prevalence of malaria were mainly in areas under control. It is difficult to assess the role of anti-malaria drugs under the circumstances where DDT and drug distribution were irregular, covering the endemic areas. The extensive distribution of Biguanides with an irregular interval since 1952 to 1963 may play a role in development of drug resistance. Also the detection of high tolerance of *A. stephensi* to dieldrin is an unfavourable sign for the use of this insecticide in the area in future.

6. There is a considerable movement of population from desert areas to irrigated areas. All positive spleen and blood cases in desert areas gave a definite history of visiting irrigated areas frequently and staying there for months together.

7. A well planned and organized Malaria Eradication Programme was implemented late in 1963 and the total coverage by DDT residual spraying (1. gm sq.m. in 2 cycles yearly) is expected to be achieved for the first time in 1964.

In area where malaria is non endemic or low hypoendemic as in certain parts of the desert in Sargodha district; DDT spraying is recommended to be carried out once yearly with 2 gm/sq.m. for 3 years provided active case detection is established from the 1st year of attack phase. Similar process may be adopted in mountainous areas (Northern part of Khushab Tehsil). In the other 3 tehsils of this district *viz.*, Bhalwal, Sargodha and Shahpur, as well as in the central part of Khushab tehsil and along the western bank of Jhelum river, malaria is mesoendemic or hyperendemic. Here residual spraying should be carried out in 2 cycles with 1 gm per sq. m. DDT for 4 successive years.

SUMMARY 1. A malariometric and entomological survey of all tehsils and thanas of Sargodha district represented through various areas was conducted for the 1st time in Sargodha district. 62 villages were surveyed and 3298 inhabitants were examined.

2. Results revealed that malaria is hyperendemic in areas subjected to yearly floods, water-logging, drainage channels and canal irrigation distributaries, e.g; in Bhalwal, Sargodha, Shahpur tehsils. Along Jhelum river at its entrance of the district in Bhalwal tehsil, malaria is hyperendemic in areas which are regularly flooded every year, while on the southern side of Jhelum river (between Khushab and Shahpur tehsils) where the area is not subjected to yearly floods regularly, malaria is unstable and mesoendemic.

3. Two species of malaria parasite were found. *P. vivax* and *P. falciparum*. Species distribution is 74·2 % P. *vivax* and 25·8 % P. falciparum.

Presence of *A. culicifacies* is almost always found in malarious areas with high density and high endemicity where *A. stephensi* is not so frequent. The role of A. stephensi requires thorough study in its vectorial capacity.

4. Though malaria control activities were being conducted for the last 12 years, the procedure of control measures resulted in limited fruitful results,if any. Detailed analysis of DDT and drug distribution has already been discussed.

5. *A. culicifacies* proved to be susceptible to both DDT and DLD. Though *A. stephensi* is considered to be susceptible to dieldrin, it seems to be that heterozygous or homozygous resistant individuals are present. It appears that DLD resistance of *A. stephensi* will develop fairly rapidly once DLD is selected to substitute DDT in residual spraying.

ACKNOWLEDGEMENT

The author is grateful to Lt.- Col. M.K.Q. Hashmi, Director, Malaria Eradication Programme [Pakistan, and Lt. Col. M.K. Akhtar, Provincial Chief, Malaria Eradication Programme, West Pakistan, for all the facilities ex tended in carrying out these investigations.

The author is also thankful to Malaria Eradication Programme personnel who have helped him in field surveys particularly Mr. Muhammad Hanif Lang, Chief Lab. Technician, and Mr. Muhammad Fazil, the experienced Insect Collector.

The author has to express his gratitude to Mr. Muhammad Saeed Chaudhry and Mr. Nasir Uddin Mirza, Assistant Entomologists of the Malaria Eradication Programme, for carrying out the susceptibility tests.

The author is grateful to the staff of Anti- Malaria activi ties attached to the District Health Office, Sargodha particularly Mr. Ahmad Baig Mirza, Assistant Entomologist sfor his assistance in collecting the previous data as required.

The author has also to thank his Secretary Mr. S.A. Mazhar, for his valuable assistance in finalization of the report and typing draft correctly.

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ANNEX I

NUMBER OF VILLAGES SPRAYED IN SARGODHA DISTRICT FROM 1952 TO 1963

Thana	Tehsil	1952	1953	1954	1955	1956	1957	1958	1959	1960	1963	Total	Sprayed once	Sprayed twice	Sprayed thrice
Sargodha Saddar ..	Sargodha ..	29	4	..	47	17	..	25	..	14	..	136	106	15	..
Karana ..	Ditto ..	..	..	..	23	23	4	1	..	..	..	51	34	7	1
Bhagtanwala ..	Ditto ..	..	..	..	3	1	..	..		..	..	6	4	1	..
Silanwali ..	Ditto ..	..	..	..	..	3	2	..	..	..	1	6	4	1	..
	Total Tehsil Sargodha ..	29	4	..	75	44	6	26	..	14	1	199	148	24	1
Shahpur Saddar ..	Shahpur ..	50	2	..	16	21	14	19	4	..	2	128	85	14	5
Saniwall ..	Do. ..	..	..	13	4	46	3	42	15	..	2	125	119	3	1
Jhawerian ..	Do ..	30	30	7	4	18	30	10	6	3	35	173	132	16	3
	Total Tehsil Shahpur ..	80	32	20	24	85	47	71	25	3	39	426	336	33	8
Midhranjha ..	Bhalwal ..	..	..	..	..	..	38	..	..	..	..	38	38	..	..
Bhera ..	Do. ..	2	63	..	2	24	..	12	11	..	..	114	85	13	1
Miani ..	Do. ..	..	56	..	..	10	..	7	6	..	..	79	79	..	..
Bhalwal ..	Do. ..	12	24	..	4	2	..	..	..	..	3	45	37	4	..
	Total Tehsil Bhalwal ..	14	143	..	6	36	38	19	17	..	3	276	239	17	1
Katha Sagral ..	Khushab ..	..	..	..	..	2	..	..	..	..	..	2	3	..	..
Khushab ..	Do. ..	..	..	..	7	2	..	7	..	..	..	16	16	..	..
Mitha Tiwana ..	Do. ..	..	..	..	2	1	..	..	..	..	1	3	1	1	..
Naushera ..	Do. ..	..	..	..	..	4	2	..	..	..	..	6	4	1	..
	Total Tehsil Khushalb ..	..	..	..	9	9	2	7	..	..	..	27	24	2	..
	Grand Total ..	123	179	20	114	174	93	123	42	17	43	928	747	76	10

Note—No spraying was done in 1961 and 1962 in any [illegible] Tehsil.

ANNEX I

RESULTS OF MALARIOMETRIC SURVEY CONDUCTED IN OCTOBER 1963

BY DR H. MASHAAL WHO SR. ADVISER, MEP

DISTRICT—SARGODHA TEHSIL—BHALWAL

	SPLEENS			PARASITES		

Kwashera ..	..	Do. ..	..	..	..	..	4	2	..	..	..	..	..	6	4	1	..						
		Total Tehsil Khushalb ..	..	..	..	9	9	2	7	..	..	..	..	27	24	2	..						
		Grand Total ..	123	179	20	114	174	93	123	42	17	43	928	717	76	10							

Note—No spraying was done in 1961 and 1962 in any of the Tehsils.

ANNEX I

RESULTS OF MALARIOMETRIC SURVEY CONDUCTED IN OCTOBER 1963

DISTRICT—SARGODHA BY DR H. MASHAAL WHO SR. ADVISER, MEP TEHSIL—BHALWAL

Map Sr. No.	Locality	Thana	Population	Spleens										Parasites											
					Palpable spleens					T. enlarged spleens	S.R.	A.E.S.	A.S.	Infants			All age groups including infants								
				No. Ex.	1	2	3	4	5					No. Fx.	+	IPR	No. Ex.	V	M	F	Mix	T. parasite.	P.R.	Gameto +	Gameto G.R
1	Wazidi Jhumat	Bhera ..	514	61	28	16	5	1	0	50	81.9	1.5	1.3	6	1	16.7	67	25	0	4	1	28	41.8	25	37.3
2	Chawa ..	Do. ..	5,650	50	22	8	2	0	0	32	64.0	1.4	0.9	..	..	..	50	3	0	1	0	4	8.0	3	6.0
3	Dhal ..	Do. ..	1,771	42	19	11	4	0	0	34	80.9	1.5	1.3	..	..	..	42	8	0	5	0	13	30.9	11	26.2
4	Romjhanwala ..	Do. ..	1,310	49	25	11	2	0	0	38	77.5	1.4	1.1	..	..	..	49	17	0	5	0	22	44.8	16	32.6
5	Wadhen ..	Miani ..	1,771	42	16	10	8	1	0	35	83.3	1.8	1.5	..	..	..	42	9	0	6	1	14	33.3	13	30.9
6	Hazurpur ..	Do. ..	1,738	53	18	20	8	3	0	49	92.4	1.9	1.8	..	..	..	53	13	0	6	1	18	34.0	11	20.7
7	Kalianpur ..	Do. ..	1,563	45	20	3	1	0	0	24	53.3	1.2	0.6	..	..	..	45	9	0	0	0	9	20.0	8	17.8
8	Ratto Kala ..	Bhalwal ..	4,533	68	37	12	3	2	0	54	79.4	1.4	1.1	..	..	..	68	15	0	7	0	22	32.3	21	30.8
9	Chak 3 Shumali	Do. ..	1,155	70	21	19	20	4	2	66	94.3	2.2	2.1	4	0	0.0	74	29	0	12	1	40	54.0	14	18.9
10	Salam ..	Do.	6,315	72	34	22	4	3	0	63	87.5	1.6	1.4	..	..	..	72	24	0	2	1	25	34.7	5	6.9
11	Bhalwal ..	Do. ..	5,563	100	47	4	1	0	0	52	52.0	1.1	0.6	..	..	..	100	16	0	3	0	19	19.0	17	17.0
12	Lakiani ..	Kot Moman	2,756	50	29	6	3	0	0	38	76.0	1.3	1.0	..	..	..	50	4	0	6	0	10	20.0	5	10.0
13	Chak 20 SB ..	Do. ..	892	93	23	11	0	0	0	34	36.6	1.3	0.5	7	0	0.0	100	8	0	5	0	13	13.0	11	11.0
14	Bhabhara ..	Do. ..	3,954	70	31	14	12	1	0	58	82.8	1.7	1.4	..	..	..	70	11	0	14	2	28	32.3	16	22.8
15	Halpur ..	Midh Ranjha	1,545	50	25	3	0	0	0	28	56.0	1.1	0.6	..	..	..	50	2	0	0	0	2	4.0	0	0.0
16	Midhranjha ..	Do. ..	2,708	41	7	2	0	0	0	9	21.9	1.2	0.3	..	..	..	41	2	0	0	0	2	4.8	2	4.8
17	Kot Naja ..	Do. ..	1,195	25	6	0	0	0	0	6	24.01	1.0	.2	..	..	..	25	1	0	0	0	1	4.0	1	4.0
18	Laksin ..	Do. ..	1,737	41	16	0	1	0	0	17	41.4	1.1	0.5	..	..	..	41	1	0	1	0	2	4.8	1	2.4
19	Doda ..	Do.	5,409	51	16	3	0	0	0	19	37.2	1.1	0.4	..	..	..	51	5	0	1	0	6	11.7	3	5.8
	Total Tehsil Bhalwal ..		52 080	1073	440	175	74	15	2	706	65.7	1.5	1.0	17	1	5.9	1090	202	0	78	7	273	25.0	183	16.7

ANNEX III

RESULTS OF MALARIOMETRIC SURVEYS CONDUCTED IN OCTOBER 1963.

DISTRICT—SARGODHA

BY DR. H. MASHAAL, WHO SENIOR ADVISOR

TEHSIL—SARGODHA

Map. Serial No.	Locality	Thana	Population	Spleens									Parasites										
				Palpable spleen						Total enlarged Spleens	S.R	AES	A.S.	*Infant*			*All age groups including infants.*							
				No. Ex.	1	2	3	4	5					No. Ex.	+	IPR	No. Ex	V	M	F	M I X	Total para site	P.R	Gametocytes +	Gametocytes G.R
1	Qadirpur ..	Sargodha ..	*600	69	28	10	2	0	0	40	57.9	1·3	0.8	..	..	..	69	8	0	0	0	8	11.6	8	11.6
2	Mari ..	Do. ..	4,517	50	11	1	0	0	0	12	24.0	1·1	0.3	..	..	..	50	3	0	0	0	3	6.0	3	6.0
3	Bhachranwala	Do. ..	673	45	10	0	1	0	0	11	24.4	1·2	0.3	..	..	..	45	0	0	0	0	0	0·01	0	0.0
4	Chak 103 N.B.	Do. ..	1,429	50	12	0	1	0	0	13	26.0	1·1	0·3	..	..	..	50	10	0	0	0	10	20.0	10	20.0
5	Chak 81 S. B.	Bhagtanwala	1,326	58	17	7	2	0	0	26	44.8	1·4	0.6	1	0	0.0	59	11	0	5	0	16	27.1	13	22.0
6	Dinpur Chak 80	Do. ..	1,450	50	32	0	0	0	0	32	64.0	1·0	0·6	..	..	..	50	2	0	0	0	2	4·0	2	4.0
7	Chak 98 S.B. ..	Do. ..	1,645	50	27	7	1	0	0	35	70·0	1·2	0.9	..	..	..	50	7	0	1	0	8	16.0	8	16.0
8	Chak 116 S.B.	Sillanwali ..	1,911	67	27	28	3	1	0	59	88.0	1·6	1.4	1	0	0.0	68	27	0	1	1	27	39.7	9	13.2
9	Chak 132 S.B.	Do. ..	1,693	38	6	3	0	0	0	9	23.7	1·3	0.3	..	..	..	38	4	0	0	0	4	10.5	4	10.5
10	Chak 154 N.B.	Do. ..	928	69	13	7	3	0	1	24	34.8	4·6	0.6	..	..	.	69	2	0	2	0	4	5.8	4	5.8
	Total Tehsil	Sargodha ..	16,172	546	183	63	13	1	1	261	47.8	1·4	0.7	2	0.0	0·0	548	74	0	9	1	82	14.9	61	11.1

Approximate

ANNEX IV

RESULTS OF MALARIOMETRIC SURVEYS CONDUCTED IN OCTOBER 1963.

TEHSIL—SHAHPUR

RESULTS OF MALARIOMETRIC SURVEYS CONDUCTED IN OCTOBER 1963.

DISTRICT—SARGODHA

BY DR. H. MASHAAL, WHO SENIOR ADVISER

TEHSIL—SHAHPUR

Map Serial No.	Locality	Thana	Population	Spleens: Palpable spleen No. Ex.	1	2	3	4	5	Total enlarged spleens.	S.R.	AES	A.S.	Parasites: Infants No. Ex.	+	I.P.R.	All age groups including infants No. Ex.	B	M	F	Mix	Total parasite	P.R	Gameto +	G.R
1	Jhawarian ..	Jhawarian ..	4,255	42	14	0	0	0	0	14	33.3	1.0	0.3	..	..	..	42	2	0	0	0	2	·7	2	4.7
2	Kalrah ..	Do. ..	3,021	50	6	0	0	0	0	6	12.0	1.0	0.1	..	..	..	50	0	0	0	0	0	0	0	0.0
3	Shahpur Saddar	Shahpur ..	2,803	100	19	4	2	0	0	25	25.0	1.3	0.3	..	..	..	100	0	0	1	0	1	1.0	1	1.0
4	Jahanabad ..	Do. ..	2,913	48	5	1	0	0	0	6	12.5	1.2	.1	..	..	..	48	0	0	0	0	0	0.0	0	0.0
5	Kangra ..	Shahiwal ..	43	13	1	1	0	0	0	2	15.4	1.5	0.2	4	0	0.0	17	0	0	1	0	1	5.9	0	0.0
6	Dharah ..	Do. ..	728	17	2	3	1	1	0	7	41.2	2.1	0.9	1	0	0.0	18	4	0	0	0	4	22.2	4	22.2
7	Dhirosail ..	Do. ..	407	83	24	26	21	3	3	77	92.8	2.1	2.0	6	1	16.7	89	29	0	9	1	37	41.5	14	15.7
8	Kot Gul Kaliar	Do. ..	1,542	45	10	4	3	0	0	17	37.8	1.6	0.6	..	..	..	45	3	0	3	0	6	13.3	5	11.1
9	Thatti Jallal ..	Do. ..	1,623	51	23	3	2	0	0	28	54.9	1.2	0.7	..	..	..	51	4	0	0	0	4	7.8	3	5.8
10	Chaweke ..	Do. ..	653	37	4	0	1	0	0	5	13.5	1.4	0.2	3	0	0.0	10	1	0	0	0	1	2.5	1	2.5
11	Thatti Lang ..	Do. ..	1,072	32	13	1	1	0	0	15	46.9	1.2	0.6	..	..	..	32	3	0	3	0	6	18.7	5	15.6
	Total Tehsil Shahpur		19,060	518	121	43	31	4	3	202	38.9	1.6	0.6	14	1	7.1	532	46	0	17	1	62	11.6	35	6.5

RESULTS OF MALARIOMETRIC SURVEYS CONDUCTED IN OCTOBER 1963

By Dr. H. Mashaal, WHO Sr. Adviser, MEP

DISTRICT—Sargodha

Map Sr. No.	Locality	Thana	Population	Spleens: No. Ex.	Palpable spleen 1	2	3	4	5	Total enlarged Spleens	S.R	AES	A.S	Parasites — Infants: No. Ex.	+	IPR	All age groups including infants: No. Ex.	V	M	F	Mix	Tot. parasite	P.R.	Gameto +	G.R.
1	Uchhali ..	Nowshera ..	3,387	67	2	0	0	0	0	2	3·0	1.0	0.0	2	0	0·0	69	0	0	0	0	0	0·0	0	0·0
2	Sadhi Jaiwal ..	Do. ..	1,356	50	3	0	0	0	0	3	6·0	1·0	0·1	..	..	..	50	1	0	0	0	1	2·0	0	0.0
3	Dhaddar ..	Do. ..	1,833	83	13	3	0	0	0	16	19·2	1·2	0·2	..	..	..	83	1	0	4	0	5	6·0	4	4·8
4	Khattakka ..	Do. ..	667	37	0	0	0	0	0	0.0	0·0	0.0	0·0	..	..	..	37	0	0	0	0	0.0	0·0	0	0.0
5	Benakhha ..	Do. ..	2,301	22	7	1	0	0	0	8	6·0	.0	0·1	..	..	..	22	0	0	3	0	3	13 6	3	13·6
6	Hardo Sodhi	Do. ..	1,025	64	5	0	0	0		5·0	7·8	1·0	0.1	..	..	..	64	0	0	0	0	0	0.0	0	0.0
7	Pail ..	Kotha Sagr	4,075	82	4	0	0	0	0	4·	4.8	1.0	0.1	..	..	..	82	0	0	0	0	0·	0	0	0·0
8	Kotha Masral	Ditto	1,600	41	6	0	0	0	0	6·	14.6	1·0	0.2	..	..	..	41	0	0	0	0	00	0	0	0·0
9	Nari ..	Do. ..	4106	50	5	0	0	0	0	5·	10·0	1·0	0·1	..	..	..	50	3	0	0	0	3·0	6·0	3	6·0
10	Pindi Kaura ..	Khushab ..	662	33	6	0	0	0	0	6	18.2	1.0	0·2	1	0	0.0	34	1	0	1	0	2.0	5·9	2	5·9
11	Chak 54 M.B.	Do.	633	51	16	2	0	0	0	18	35.2	1·1	0·4	..	..	..	51	3	0	4	0	7	13.7	5	9·8
12	Thatti Kalran	Do.	330	27	6	0	0	0	0	6	22.2	1·0	0·2	..	..	..	27	0	0	0	0	0	0·0	0	0·0
13	Name Wali ..	Do.	735	50	9	6	2	0	0	17	34.0	1.6	0·5	..	..	..	50	0	0	2	0	2	4·0	2	4·0
14	Hamoka ..	Do.	1,965	50	9	2	0	0	0	11	22.0	1.2	0·3	..	..	..	50	0	0	0	0	0	0·0	0	0·0
15	Shah Wala ..	Gunjal ..	1,245	50	10	0	0	0	0	10	20·0	1·0	0·2	..	..	..	50	0	0	0	0	0	0·0	0	0·0
16	Adhisargal ..	Do.	1,851	41	3	0	0	0	0	3	7.3	1·0	0.1	..	..	..	41	1	0	0	0	1	2·4	1	2·4
17	Mitta Tiwana	Mitha Tiwana	8,434	50	7	0	0	0	0	7	14·0	1.0	0.1	..	..	..	50	3	0	1	0	4	8.0	1	2·0
18	Roda ..	Ditto	4,490	61	1	0	0	0	0	1	1.6	1·0	0.0	..	..	..	61	3	0	0	0	3	4·9	3	4·9
19	Girot ..	Ditto	3,084	56	14	3	0	0	0	17	30.3	1.0	0.3	..	..	..	56	0	0	0	0	0	0·0	0	0·0
20	Jaurra Kalan	Noorpur ..	2,343	50	12	2	1	0	0	15	30·0	1.1	0·3	..	..	..	50	5	0	1	1	5	10·0	5	10.0
21	Jarrali ..	Ditto	3,133	50	4	0	0	0	0	4	8·0	1·0	0.1	..	..	..	50	1	0	0	0	1	2.0	1	2·0
22	Noorpur ..	Ditto ..	3,770	60	4	0	0	0	0	4	6.7	1.0	0.1	..	..	..	60	1	0	0	0	1	1.7	0	0.0
	Total Tehsil	Khushab ..	53,025	1125	146	19	3	0	0	168	14·9	1·1	0.2	3	0	0.0	1128	23	0	16	1	38	3.3	30	2·6

ANNEX VI

RESULTS OF ENTOMOLOGICAL SURVEY (ADULT CAPTURE) CONDUCTED IN SARGODHA DISTRICT FROM 1 to 31 OCTOBER 1963

Culicis	Pulch.	Annua.	Fluviat.	Hyrcan.

ANNEX VI

RESULTS OF ENTOMOLOGICAL SURVEY (ADULT CAPTURE) CONDUCTED IN SARGODHA DISTRICT FROM 1 to 31 OCTOBER 1963

Tehsil	Thana	Map No.	Village	Date Oct.	Culicif.		Step.		Subpic.		Pulch.		Annua.		Fluviat.		Hyrcan.	
					F	M	F	M	F	M	F	M	F	M	F	M	F	M
BHALWAL	Bhera ..	1	Wazidi ..	31	81	11	6	2	334	87	9	0	0	0	0	0	0	0
		2	Chawa ..	31	26	10	11	3	60	35	19	1	6	1	0	0	0	0
		3	Dhal ..	31	92	30	7	4	155	129	21	3	0	0	0	0	0	0
		4	Bomjhanwala ..	30	158	37	7	0	83	64	4	0	1	0	0	0	0	0
	Miani ..	5	Wadhen ..	30	43	23	4	0	53	35	7	3	0	0	0	0	0	0
		6	Hazurpur ..	30	114	21	3	0	65	20	11	0	5	0	0	0	0	0
		7	Kalianpur ..	30	27	4	1	0	17	9	0	0	5	0	0	0	0	0
	Bhalwal ..	8	Ratto Kala ..	31	18	1	0	0	78	16	0	0	0	0	0	0	0	0
		10	Salam ..	31	153	57	3	1	73	29	1	1	0	0	0	0	0	0
		11	Bhalwal ..	31	91	22	3	0	84	18	0	0	0	0	0	0	0	
SARGODHA	Sargodha	1	Qadirpur ..	29	1	0	5	1	7	1	0	0	0	0	0	0	0	0
		2	Mari ..	29	0	1	91	86	41	17	0	0	0	0	0	0	0	0
		3	Bhachranwala ..	29	17	11	292	47	88	76	0	0	0	0	0	0	0	0
		4	Chak 103 N.B..	1	6	1	0	0	185	112	0	0	0	0	0	0	0	0
	Sillanwali	10	Chak 154 N.B.	1	13	6	47	18	250	210	4	0	0	0	0	0	0	0

RESULTS OF ENTOMOLOGICAL SURVEY (ADULT CAPTURE) CONDUCTED IN SARGODHA DISTRICT FROM 1 TO 31 OCTOBER —1963.

Tehsil	Thana	Map S. No.	Village	Date	Culcif.		Steph.		Subpic.		Pulch.		Annual.		Fluviat.		Hyrnc.	
				Oct.	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Shahpur		1	Jhawrian ..	29	12	9	55	37	96	87	3	0	2	0	0	0	0	0
		2	Kalrah ..	30	0	0	0	0	5	2	0	0	1	0	0	0	0	0
		3	Shahpur ..	28	8	2	4	0	30	14	0	1	0	0	0	0	0	0
		4	Jahanabad ..	29	7	3	17	1	57	44	5	1	5	0	0	0	0	0
		8	Kot Gul Kalian ..	1	0	0	0	0	26	14	0	0	0	0	0	0	0	0
		9	Thatti Jallal ..	1	4	3	85	35	95	64	0	1	0	0	0	0	0	0
		10	Chaweke ..	1	2	0	5	0	930	1,570	5	3	1	0	5	0	0	0
Khushab	Nowshera	1	Uchhali ..	2	0	0	4	5	5	11	0	0	0	0	3	1	0	0
		2	Sadhi Jaiwal ..	27	5	0	13	0	5	1	0	0	0	0	0	0	0	0
		3	Dhaddar ..	2	2	0	446	644	10	0	1	0	0	0	3	1	0	0
		4	Khattakka ..	2	14	3	4	6	41	6	0	0	2	0	0	0	0	0
		5	Benakha ..	27	70	5	13	1	40	3	0	0	0	0	0	0	3	0
		6	Hardo Sodhi; ..	27	7	0	3	0	1	0	0	0	0	0	0	0	0	0
	Kotha	7	Pail ..	2	0	0	0	1	2	4	0	0	0	0	0	0	0	0
	Sagral	9	Nari ..	2	2	1	8	5	53	53	1	0	0	0	0	0	0	0

RESULTS OF ENTOMOLOGICAL SURVEY (ADULT CAPTURE) CONDUCTED IN SARGODHA DISTRICT FROM 1 TO 31 OCTOBER 1963.

Tehsil	Thana	Map Serial No.	Village	Date	Culicif.		Steph.		Subpic.		Pulch.		Annual.		Fluviat.		Hyrean.	
				Oct.	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Khushab—*contd.*	Khushab	10	Pindi Kaura ..	28	38	14	5	4	72	32	0	0	0	0	0	0	0	0
		11	Chak 54 M.B. ..	28	71	66	6	6	36	47	10	0	0	0	0	0	0	0
		12	Thatti Kalran ..	28	19	36	18	29	94	159	1	3	1	0	0	0	0	0
		13	Name Wali ..	28	27	15	4	2	6	0	0	0	0	0	0	0	0	0
		14	Hamoke ..	27	6	0	1	0	6	0	0	0	0	0	0	0	0	0
	Gunjal	15	Shah Wala	25	0	0	0	0	5	6	0	0	0	0	0	0	0	0
		16	Adhisargai ..	25	0	0	0	0	55	9	0	0	0	0	0	0	0	0
	Mitha Tiwana	17	Mitha Tiwana ..	28	13	0	29	0	86	37	6	1	1	0	0	0	0	0
		18	Roda ..	26	0	0	0	0	9	14	0	0	0	0	0	0	0	0
		19	Girot	26	46	17	58	7	226	66	0	0	0	0	0	0	0	0
	Noorpur ..	20	Jaurra Kalan	26	1	16	3	13	201	457	0	0	0	0	0	0	0	0
		21	Jamali ..	26	0	0	0	0	11	1	0	0	0	0	0	0	0	0
		22	Noorpur ..	26	0	0	1	0	3	1	0	0	0	0	0	0	0	0

SANDFLIES AS VECTORS OF HUMAN DISEASES IN WEST PAKISTAN

By

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The occurance of sandfly fever in the Chitral Valley, North-west Frontier and Quetta was first reported by McCarrison (1908) and Graham (1915). Later, in another study, Young *et al.* (1925) pointed out the prevalence of sandfly fever in the Peshawar area. In a recent survey of sandfly fevers, Barnett (1961) found that the disease and its vector are endemic and abundant in regions of West Pakistan. Not long ago, epidemics of Oriental Sore (cutaneous leishamaniasis) occurred in various areas all over the country. Sporadic cases of Oriental Sore can still be seen throughout the province. Shortt *et al.* (1925) demonstrated the role of *Phlebotomus sergenti*, a common sandfly found all over West Pakistan, in the dissemination of *Leishmania tropica* in the Punjab. In pre-partition India, according to Sinton (1925), the regions in which Oriental Sore was known to be endemic were the valleys theof Indus from Peshawar to Sind, the North-west Frontier, the plains of the Punjab and the regions about Cambay. This area is said to be bounded in the east by a line joining Bombay with Delhi. This boundary line also marks the eastern limit of *P. sergenti* distribution in the Indo-Pakistan sub-continent.

Recently Nur Ahmad *et al.* (1960) discovered an endemic focus of Kala-azar in Baltistan at an elevation of 7,700 to 8,400 feet. The existence of Kala-azar in the adjoining vallley of Ladakh (Indian occupied Kashmir) was reported earlier by Jacob and Kalra (1951). These authors located sandflies up to a height of 12,000 feet and recovered three species of sandflies from the Kala-azar endemic area, namely *P chinensis*, *P.* major and *P. sergenti*. The collection of sandflies made in the Baltistan area by the Armed Forces Institute of Pathology comprised mainly two species— *P. chinensis and P. kandelakii.*

Until the discovery of Kalar-azar in Baltistan in 1960, West Pakistan was considered free from this disease and hence this discovery is of importance from the Public Health stand point.

Malaria and Sandfly fever—In West Pakistan, Malaria has caused more morbidity and mortality than all other diseases combined (Yaqub and Swaroop 1945). The seasonal increase of malaria has been so regular since antiquity that it has masked other febrile diseases as a cause of sickness and death during the season of its prevalence. Observations have shown that both sandflies and mosquitoes require more or less identical climatology for their population build-up. In West Pakistan, generally, there is a sharp rise in the incidence of fever cases during the months of March and April, and again from September to November after the monsoon. This rise in fever cases has been shown to corres-pond with the overall mosquito population build-up. Observations also show that, as a rule along with the rise in mosquito population indoors, the population of sandflies also increases. This especially applies to the vector species involved in Papatasi Fever and Oriental Sore, namely, *P. papatasi* and *P. sergenti*. Keeping in view the findngs of Barnett *et al.* (*loc. cit.*), it will not be erroneous to suspect that the enormous number of fever case during spring and autumn, labelled as malaria, may include many cases of sandfly fever. The circumstances which preclude the recognition of a different etiology of fever

cases other than malaria, and which obscure the identity of sandfly fever— have been the following —

(1) Predominance of mosquitoes, conspicuous due to their size compared to sandflies which are hardly visible.

(2) Clinical resemblance of symptoms in malaria and sandfly fever.

(3) Lack of diagnostic tfacilties and difficulties in carrying out laboratory tests for sandfly fever rapidly and on a large scale. Barnett (1961), on the basis of laboratory findings strongly suspects presence of new members of the sandfly fever group in West Pakistan, in addition to the well known Sicilian and Naples strains. The presence of multiple immunologically distinct viruses further complicates the situation in organising comprehensive laboratory procedures for the specific identification of the febrile virus diseases.

(4) Absence of a specific chemotherapy for sandfly fever.

(5) Short duration of the disease which may terminate on the administration of anti-marlaia drugs, simulating malaria infections.

Oriental Sore—In the last decade or so the incidence of cutaneous leishmaniasis, (Oriental Sore) seems to have markedly diminished in the Punjab. Cases are seen, but rarely. The simple explanation for the low incidence of this disease is found in the intensive and extensive use of residual insecticide (DDT.) in connection with malaria control operations all over the province. In the transmission of *L. tropica* at least two feeds by the same insect, with an interval in between, are absolutely necessary, for which duration the sandfly may not survive long enough in the presence of insecticide deposits to pass on the disease. Contrary to this is sandfly fever, which may be transmitted through a single bite of the insect. Well-founded evidence now exists that the vector sandfly maintains the infections by trans-ovarian transmission of the virus from generation to generation. In such a case, regardless of the life span of the vector fly, which may be so short as to permit the fly only the initial blood meal, the disease will continue in the population exposed to the bites of these insects.

RESISTANCE TO INSECTICIDES AND THE EFFECTS OF THE MALARIA ERADICATION CAMPAIGN ON THE INCIDENCE OF DISEASES TRANSMITTED BY SANDFLIES IN WEST PAKISTAN—A DISCUSSION

Recently, a Malaria Eradication Programme has been launched in West Pakistan and wide-spread use of DDT., aimed at total coverage of the rural population, is being applied. Once this programme reaches the end point successfully, human *Plasmodia* will be rooted out from the indigenous infective cases. In achieving the elimination of the *Plasmodia* (*P. vivax and P. falciparum*) transmission is interrupted by reducing the life span of the endophilic vector mosquito and bringing down its number to a level where malaria transmission does not occur. The malaria eradication activities are to be continued for a limited and specified duration, till such time that the infection present in the human hosts has died out or climinated. It is to be hoped that at the end of this programme some other arthropod borne diseases affecting man shall have as well receded to insignificance. Should these diseases continue, it will be a reflection on certain special characteristics of the causative agents, or that of the vector, or of both, such as the capacity of the microorganism to survive in another host besides man and the inordinate feeding habit of the vector transmitting the disease. All such diseases will be zoonoses, i.e., diseases transmissible from animal to man. Pavlovsky (1955) has drawn attention to diseases

that are maintained in wild animals in *nidi* (nests), where suitable vectors are present and ecological conditions are favourable for their continued transmission to man or domestic animals when these intrude upon these *nidi*?

As yet there is no evidence of sandflies having developed resistence to D.D.T., the insecticide in use in this country. Experience has shown that a single application of D.D.T. may result in the absence of sandflies from the infested rooms for about one year. However, we have recovered sandflies, in sproyed villages though not in large numbers, from houses and rooms which were not sprayed or were replastered with mud shortly after the spraying of D.D.T. Newly built houses in the villages, though surrounded by sprayed houses, always yielded a few sandflies on a thorough search. From these observations it may be inferred that freedom from sandfly-borne diseases will be conferred but only temporarily as an incidental by-product of the National Malaria Eradication Programme.

As soon as the maintenance phase of the Malaria Eradication Programme is reached and the insecticidal application is interrupted, it has been observed elsewhere that the overall mosquito population grows over and above their usual population in normal years. This increase in number of mosquitoes occurs because of the fact that after malaria eradication has been achieved the normal mosquito and, malaria control activities cease. The same is expected in our region and therefore, it may be anticipated that the sandfly population will build up rapidly shortly after the insecticidal application has been discontinued. The longevity of the vector sandflies will also be prolonged with the depletion by aging, of insecticide present in the interior of the dwellings. Malaria of course, will have been eradicated should due results follow and the state in the area would then be one of anophelism without malaria. The diseases vectored by sandflies may show wide-spread flare-ups by veasor of the varied characteristics of their causative agents, as against the frail, host specific human plasmodia.

It is known that the sandfly virus usually persists only for a very short duration in the human host. This suggests that either the reservoir of infection exists elsewhere, outside man, or that the virus persists in the fly through trans-ovarian transmission. Widespread epidemics of sandfly fever may, therefore, be anticipated on account of the fact that a continued absence of the disease for some years may have resulted in the gradual loss of conferred immunity to this disease in the local population. According to Barnett (*loc. cit*), immunity, against sandfly viruses is constantly reinforced in nature by superimposed and frequent inapparent infections. It is perhaps for this reason that the immunological patterns in the local population do not commensurate with the actual state of sickness, which should have been witnessed when a completely non-immune population is exposed to such a risk.

Oriental Sore occurs as a natural disease in dogs and cats (Manson Bahr, 1957). Sinton (1925) has shown that the Leishmania Sore occurring on the nose of dogs in India carries the same organism as the sores on humans, and is transmissible between each host. Shortt *wet al.* (1935) showed that flagellate forms of *L.tropica*, which developed in *P.sergenti* fed on cases of Oriental Sore, are infective when inoculated into monkeys (*Macacus rhesus*). Other domestic and wild animals have been found infected with *L.tropica* in Cutaneous Sores (Manson-Bahr, *loc cit*). The extent of infection with *L.tropica* in the local animals has not been studied. However, if the infection exists in these animals, and also sporadically in humans, as soon as the vector regains its natural population-potential the disease will most likely re-establish itself with renewed vigour and virulence.

As already stated kala-azar has not been known from the plains of West Pakistan The absence of its vector, i.e., *P. argentipes*, was considred to be the reason for the non-existance of this disease from that area. According to Sinton (1925), the recorded distribution of *P. argentipes* is bounded in the West by a line joining Bombay and Delhi which also marks the western limits of the distribution of Kalazar in India.

In a recent survey of sandflies in Lahore district we captured several specimens of *P. argentipes*. The identification has since been confirmed by Dr. D. J. Lewis of The British Museum (Natural History). This is the first record of the presence of *P. argentipes* in West Pakistan without the presence of Kala-azar in the area. In Lahore *P. argentipes* seems to be confined in small areas close to the forests. In the history of Kala-azar, Napier (1926) has quoted instances of the areas where the disease appeared spontaneously and established itself. In other instances, Kala-azar has been shown to have disappeared spontaneously in areas where it was endemic for years. Although the presence of *P. argentipes* was considered to be the most important factor in establishing Kala-azar, there must have been other epidemiological factors which caused the disease to vanish inspite of the fact that *P.argentipes* remained abundant. In Lahore the population of this fly is quite small. With the existance of the focus of infection of Kala-azar up north in the hills, *i.e*, Baltistan, it is most unlikely that this diseases may further spread in the plains because of the apparent absence of the vector in the intervening plains. and their small number, where present. However, in this context, the follcwing quotation from Sinton (1927) may be found intresting.

"It is interesting to note that since Savage (1927) reported a cass of apparently indigenous kala-azar at Sanawar in the Simla Hills at a height of about 5,000 feet, a few specimens of *P. argentipes* have been collected from a neighbouring village. This is a unique record, for neither this species nor kala-azar had previously been recorded at heights above 2,000 feet nor so far west in India."

In an extensive collection of sandflies made in Lahore, Gujrat and Peshawar Region during the last two years, we have been able to collect the following species which are mentioned below in order of prevalence. Further to a previous record of sandflies of West Pakistan (Nasir, 1959), we record the presence of *P. argentipes* from these areas for the first time:—

1. *S. babu.*
2. *P. papatasi.*
3. *P. sergenti.*
4. *S. baghdadis.*
5. *S. punjabensis.*
6. *S. christophersi.*
6. *S. squamipleuris.*
8. *S. clydei*
9. *S. bailyi.*
10. *P. argentipes.*
11. *S. theodori.*
12. *S. hadgsoni*

In addition recently we received two specimens of male sandflies collected in the Gilgit area. Both specimen havo been identified and found to be *P. papatasi* and *P. chinensis.*

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THE FATTY ACID COMPOSITION OF GHEES, VENASPATIES AND SOME EDIBLE OILS OF WEST PAKISTAN*

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Renewed interest in studies of lipids, lipid metabolism, and disorders related to lipid transport have been facilitated by the development of gas liquid chromatgraphy (G. L. C.). These studies in turn have revealed the importance of polyunsaturated fatty acids in human diets. It is well documented that a dramatic decrease in serum cholesterol levels occurs when the percentage of dietary polyunsaturated fatty acid is increased (1, 2), and that polyunsaturated fatty acids are essntial in the diets of infants (3). Polyunsaturated fatty acids also have been related to the etiology of atherosclerosis (4).

Thus to facilitate development of investigations in Pakistan on the metabolism of lipids and on the role of polyunsaturated fatty acids in the Pakistani diet, it is important to know the composition of fats available to local people for their daily purchase and use. This report describes fatty acid patterns, particularly polyunsaturates, in some commonly used local fats and oils available to the people in local markets.

Methods—

Samples were collected during November and December of 1963 from the following markets : — .

Akbari Mandi in Lahore City, the village bazaar in Lulliani, and the bazaar in the Gujranwala district. Some of the ghee samples were obtained from private homes in these areas

The samples were stored in small glass stoppered bottles under nitrogen at a temperature of 5°C until analysed.

Saponification numbers in duplicate and iodine numbers in triplicate were done on samples of each kind of fat and oil. The estimation of saponification number and the per cent unsaponifiable matter was done using the method of Bolton and Williams (5). The iodine number was determined by the iodine monochloride method of Wijis (6).

Preparation of fatty acid esters prior to G. L. C.—Two to three hundred milligrams of each sample were placed in a 15 ml. glass stoppered centrifuge tube. Ten ml. of 0·5N sodium methoxide in methanol were added. The tube was stoppered and the stopper tightly taped to the tube. The tube was then incubated at 55°C in a water bath for thirty minutes, and shaken intermittently during the incubation. The methylation mixture was cooled and transferred to a separatory funnel with 10 ml. of 5 per cent hydrochloric acid. The tube was washed three time with water and washings were added to the contents in the funnel. (Special care was taken to assure complete washing of methylated fat from the tubes, particularly for ghees, because methylated fat remaining in the tube might not be of the same composition as that of the original mixture.) Ten ml. of diethyl ether were added and the mixture was shaken thoroughly. The methyl ethers which collected in the upper ether layer were withdrawn into another centrifuge tube and the solvent was evaporated under nitrogen at a temperature less than 50°C.

The accuracy of the methylation procedure using sodium methoxide was checked by the alternate method of saponification and direct methylation of the extracted fatty acids with borontrifloride in methanol. Four samples of mustard seed oils were saponified by boiling with 0·5 N ethanolic potassium hydroxide for 30 minutes. The

*This study was supported by a grant from the National Institute of Health, U. S. A. to the University of Maryland under the International Health Act 1960.

nonsaponifiable matter was removed by the method of Bolton and Williams (5). The fatty acids were liberated from their soaps by acidifying with hydrochloric acid and the free fatty acids were extraced into petroleum ether (B. P. 40—45°C). The solvent was evaporated under nitrogen at a temperature less than 50°C. The fatty acids were methylated by the direct addition of 5 ml. borontrifloride in methanol (7). The methylated acids were extracted into petroleum ether, the solvent evaporated, and the esters chromatographed.

The comparative data between the two methods of methylation did not show any noticeable difference in fatty acid patterns. Therefore, the latter procedure was not used for the remaining samples for fear of loss or change in the structure of fatty acids at the boiling temperature of alcohol. The sodium methoxide method is quite convenient and is as accurate, if not more accurate, than the longer more tedious saponification procedure.

G. L. C.—The methyl esters were chromatographed on an E. I. R. Gas Chromatograph which contained a Lovelock ionization detector (8) with radium as the source of beta ionization. A U-shaped column 2½ meters long and 5 mm internal diameter was used. The liquid phase was 13 per cent diethylene glycol succinate (DEGS) coated on a siliconized inert support of 80—100 mesh Gas Chrom P (9). Argon was the carrier gas. The linearity of chromatographic response was checked with fatty acid standards* prior to the analyses of unknowns. Peaks were identified on the basis of retention factors calculated relative to methyl stearate. Quantitation of the chromatogram was achieved by triangulation of the individual peak areas, calculating the total area and expressing the areas of each peak as a per cent of the total (10).

Different fat and oil samples were chromatographed at different temperatures to attain the highest linearity according to the nature of the fatty acids present. The different conditions of temperature used are given in Table I.

TABLE I

TEMPERATURE CONDITIONS FOR G. L. C. ANALYSIS

Description	Inlet Temp. °C	Column Temp. °C	Detector Cell Temp. °C
Ghees and Coconut Oil	200	150	183
Vanaspaties, Cottonseed oils, and Sesame oils	235	175	210
Mustard, seed oils Rape seed oils	243	185	217

However, for all of the G. L. C. determinations the gas flow was 50 ml. argon per minute, the chart speed 20 inches per hour, the detector sensitivity 1 ×10—7 milliamperes, and the voltage applied across the detector cell 600 volts.

Results and Discussion—

The iodine numbers, saponification numbers, and nonsaponifiable matter are presented in Table II. The values found are within the range of standard values reported

*Obtained from the Programe Officer, Lipid (Standards) Programe, National Heart Institute, National Institute of Health, Bethesda, Maryland, U.S.A.

for these fats and oils. The results of the G. L. C. analyses of the fatty acids are given in Table III-A & B.

The data shown in Table III reveal quite a difference in the fatty acid patterns in some of the oils from patterns reported in the literature for similar oils. This difference was inherent in samples of oils and not in the methods used. To speculate on possible reasons for this difference is beyond the purpose of this study. Rather we have sought to analyse samples representative of fats and oils available in the bazaars for local consumption.

The term "polyunsaturated" fatty acids as used in this study means fatty acids containing more than one double bond per fatty acid molecule. Linolenic acids are examples of poly-unsaturated acids. In the six ghees analysed no polyunsaturated fatty acids were detected. Linoleic acids at a level of only 1 per cent of the total fatty acids was present in the home made butter sample.

Vanaspaties are commercially hydrogenated vegetable oil mixtures. Cottonseed oil is reported to be the major constituent in almost all brands of vanaspaties analysed. Table III reveals that during hydrogenation the amounts of stearic & oilic acids which were 1·5 per cent and 15·0 per cent in cottonseed oil increased to 7·0 per cent and 74·0 per cent, respectively, in vanaspaties. The linoleic acid which was 60 to 65 per cent in cottonseed oil was reduced to only trace amounts.

Soyabean oil contains almost 65 per cent polyunsaturated acids, 61 per cent of the total being linoleic acid. The mustardseed oils and the rapeseed oils resembled each other closely in the extent of total polyunsaturation. However, in mustardseed oil the polyunsaturated fatty acids were contributed by linoleic and linolenic acids in almost equal proportions while in the three samples of rapeseed oils somewhat different proportions of linoleic and linolenic acids were found.

Sesame oil, though not normally used in the Pakistani diet has been included in the study because it is one of the constituent vegetable oils used for preparation of vanaspaties. Sesame oil contains an average of 47 per cent of total fatty acids as linoleic acid. In contrast, however, coconut oil though it contained a high percentage of low molecular weight fatty acids (less than fourteen carbons) contained practically no unsaturated acids.

Conclusions—

Ghees which form the major dietary fat of the people of West Pakistan contain practically no polyunsaturated fatty acids. Similarly, vanaspaties which are being used increasingly as substitutes for ghee contain only trace amounts of polyunsaturated fatty acids. Mustardseed, rapeseed, sesame, soyabean, and cottonseed oils contain relatively high amounts of polyunsaturated fatty acids. The contribution of polyunsaturated acids is lowest in mustardseed and rapeseed oils and highest in soyabean and cottonseed oils.

It is hoped that the data from this study will be useful to others investigating the implication of dietary fats to the health of people of West Pakistan.

Acknowledgements—

The authors acknowledge with thanks the help rendered by Mr. Sarfaraz Ali, B. Sc., A. H. in determining iodine numbers of the analysed fats and oils.

TABLE II

SOME CHEMICAL PROPERTIES OF FATS AND OILS

Name and Place of Collection	No.		Saponification No.	Non-Saponifiable Matter per cent	Iodine No.
Ghees from Bazaars of Lahore and Lulliani.	3	Average	229	0·7	30
		Range	227—234	0·6—0·8	26—33
Ghees (Home made) from Lulliani and Gujranwala		Average	226	2·0	35
		Range	225—229	1·6—22	30—40
*Home made Butter	1		190	1·4	32
Vanaspaties (Different brands) ..	9	Average	192	1·1	67
		Range	191—194	0·6—1·2	58—70
Cottonseed oil (Lahore)	2	Average	193	1·0	109
		Range	193—193	0·5—105	98—119
Cottonseed oil (Lulliani)	1	..	195	0·9	132
Soyabean oil (white (Lahore)	1	..	193	1·3	123
Mustardseed oil from Lahore and Gujranwala	2	Average	174	1·2	100
		Range	173—175	0·9—1·4	99—101
Mustardseed oil (Lulliani)	3	Average	174	0·9	102
		Range	172—176	0·8—1·1	99—103
Rapeseed oil (Lahore)	3	Average	176	0.9	101
		Range		0·8—1·1	91—116
Sesame oil (Lahore)	1	..	187	0·6	105
Sesame oil	2	Average	193	0·2	108
Lulliani and Gujranwala		Rang	192—195	1·0—1·4	104—107
Coconut oil (Lahore)	1	..	257	1·5	10

*Lot of water was seen in the butter sample.

TABLE III

(A)

G. L. C. Analyses Results

Fatty acid composition in per cent of the total fatty acids in Ghee, Vanaspaties and Coconut Oil.

Description	Saturated Acids									Mono unsaturated Acids				Poly unsaturated Acid	
	4:0*	6:0	8:0	10 0	12:0	14:0	16:0	18:0	20:0	12:1	14:1	16:1	18:1	18:2	18:3
Ghee—Lahore food stall ..	tr.	0·8	0·9	1·6	1·9	12·1	49·7	6·2	tr	tr	1·3	2·3	23·2	..	..
Ghee—Lahore Bazar	tr.	1·3	1·1	2·0	2·2	12·2	44·2	12·2	tr.	tr	tr	tr.	25·0	..	..
Ghee—Lulliani Bazar	tr.	0·6	0·5	0·9	1·4	10·6	48·8	12·0	tr	tr	1·9	1·8	21·6	..	..
Ghee—Lulliani (Home made) ..	tr.	0·4	1·6	3·5	4·1	10·9	45·0	8·6	tr.	tr.	tr.	tr.	17·9	..	..
Ghee—Gujranwala (Home made) ..	tr.	1·0	0·9	2·4	2·1	13·7	54·4	5·9	tr	tr.	tr.	tr.	19·6	..	..
Ghee—Gujranwala (Home made) ..	tr.	0·8	0·6	0·6	0·9	10·2	61·3	10·7	tr.	tr.	tr	1·7	13·8	..	..
Butter—Lulliani (Homemade) ..	tr.	0·3	0·4	0·6	0·9	9·2	66·4	4·0	tr.	tr	tr..	tr.	17·2	1·0	..
Vanaspaties—Average of 9 Brands ..	..	..	..	..	..	tr	tr	13·5	9·2	..	..	..	..	77·0	tr.	..
Coconut Oil—Lahore Bazar ..	..	..	..	5·1	6·3	73·5	15·1	tr.	tr.	..	..	..	..	tr.	..	..

*See foot note Table IIIb (B).

TABLE III

(B)

G. L.C. Analyses Results

Average Fatty acid composition in per cent of total fatty acids

OIL

Description No.	Saturated Acids							Mono unsaturated Acids			Poly unsaturated Acids	
		12:0*	14:0	16:0	18:0	20:0	22:0	16:1	18:1	22:1	18:2	18:3
Cottonseed oil—Lahore ..	2	tr.	0·5	26·8	1·2	..	..	tr.	12.7	..	61·3	..
Cottonseed oil—Lulliani ..	1	..	..	7·8	2·2	..	..	..	19.6	..	65·0	5·4
Soyabean oil (white)—Lahore ..	1	..	..	10·8	2·4	..	..	..	22.0	..	60·8	4·2
Mustardseed oil—Lahore ..	2	..	..	2·1	tr.	..	..	..	12.2	53·1	15·9	16·6
Mustardseed oil—Lulliani and Gujranwala	3	..	..	2·0	tr	..	..	..	11·5	55·4	15·8	15·8
Rapeseed oil—Lahore ..	3	..	..	3·1	0·5	..	..	..	14.4	43·0	23·8	15·2
Sesame oil—Lahore ..	1	..	..	7·0	2·8	tr	..	..	44.9	..	45·4	..
Sesame oil—Lulliani ..	2	..	..	7·0	2·2	0.4	..	..	41.1	..	49·3	..

*The figure on the left indicates the number of carbon atoms in the acid chain while the figure on the right indicates the number of double bonds in the molecule, *i.e.* 12:1 means 12 carbons and one double bond in the fatty acid molecule

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INSTITUTE OF HYGIENE AND PREVENTIVE MEDICINE LAHORE
ANNUAL REPORT FOR THE ACADEMIC YEAR, 1962-1963*

Mian Abdur Rashid, Ladies and Gentlemen.

It is a matter of great pleasure to me and my faculty colleagues to have you all here this morning. We have the privilege to extend you a hearty welcome.

We are thankful to Mian Abdur Rashid and owe him a sense of gratitude that he found time to grace this occasion in spite of great inconvenience to him. We have really an intrinsic feeling of happiness this morning. Your kind presence, Sir, is not only inspiring but most encouraging to us.

For the spread and maintenance of common communicable diseases, tropical and sub-tropical countries are said to offer optimum conditions. To cure clinical cases is a never ending programme. It involves colossal expenses to the National exchequre. Most of the communicable diseases are preventible. This method of combating diseases is not only effective but also much cheaper. In under developed countries, it is a boon and an ultimate hope.

Prevention of diseases is a highly technical job and requires properly trained and well experienced personnel in the technique. At the time of partition the country was almost denuded of medical officer qualified in preventive medicine. It is very expensive to send our people abroad for higher training in Public Health as it involves a heavy load on the National Resources. Thanks to the foresight of Lt.-Col. S. M. K. Mallick, the then Director of Health Services, that course for Diploma in Public Health was started here in 1949.

The Institute is completing its 15th year of life. During this short span of life, it has made good progress both in the field of training and research. It has rendered a valuable service to the nation by training 205 medical graduates in Public Health and has saved more or less Rs. 2·5 million worth of foreign currency, which is a colossal saving indeed.

For the first ten years, the Institute managed its survival without a budget of its own.A budget provision was however, made in 1959 for the first time. It is still passing through phases of development.

There are six full-fledged departments with well qualified and highly experienced whole time professors and other teaching staff. In two departments, *viz.*, Sanitary Engineering and Nutrition and Dietetics, however, no whole time professors have so far been appointed. At present there are 20 whole time teachers, 30 visiting teachers and 8 honorary teachers. The honorary teachers include the staff of University of Maryland, Research Centre, WHO, Malaria Eradication Team and U.S.A. A.I.D. Besides we do not fail to avail the opportunity of arranging lectures by distinguished visiting foreign teachers.

During the academic year under report 13 graduate doctors qualified for D.P.H. These graduates were drawn from both wings of the country and the majority belonged to government departments. In October, 1963, 32 medical graduates were admitted to D.P.H. Course. This is the maximum number of admissions so far made to the D. P. H. Class.

*Read on the occasion of world Convocation on 7th April, 1964 by Dr. Nazir Ahmed, Dean, Institute of Hygiene & Preventive Medicine, Lahore.

This year, a post-graduate Diploma in Maternal and Child Health (D.M.C.H.) has also been started. Seven candidates (6 women and 1 man) have been admitted. The male candidate hails from East Pakistan and together with a woman candidate from West Pakistan is a stipendiary of the West Pakistan Maternity and Child Welfare Association. The Department of Maternal and Child Health planned the courses of instructions.

An Orientation Course for training in Public Health of non-D.P.H. Medical Officers of Rural Health Centres and Assistant District Health Officers, has also been started recently. There are 12 doctors in this course, two from each region. The practical part of this training has been arranged at Rural Health Centre, Lulliani.

ANCILLARY HEALTH PERSONNEL

(1) The Institute continued the training of Sanitary Inspectors. For the Sanitary Inspector's Certificate Examination the Institute is affiliated with the West Pakistan State Medical Faculty.

During the academic year 1962-63, candidates were admitted to this class. Of these 21 qualified in the Annual Examination held in July 1963 and 36 in the Supplementary Examination held in September 1963.

This year there are 61 students in this class. To equip the future Sanitary Inspectors to meet the newer demands placed upon them in regard to their field duties and to give them proper orientation in the field of Public Health, essential changes have been made in their curriculum. This change will have highly salutary effect.

(2) Laboratory Assistants deputed by various District Health Officers were given training in Parasitology and Bacteriology laboratories.

ACTIVITIES OF VARIOUS DEPARTMENTS

1. The department of Epidemiology and Biostatistics completed "Flea-index and rat population studies" in collaboration with the department of Medical Entomology and Parasitology and found that average number of fleas on rats in Lahore did not exceed 3. The corresponding rat flea index was 0-47.

Demographic Survey is being carried out in three villages of Lahore district to find out the correct birth rate, death rate and causes of mortality.

To prevent epidemics of diarrhoeal diseases and enteric infections in the community, examination of drinking water from public supplies and aerated and ice factories was carried out as a routine measure in the Epidemiological Laboratory.

2. The department of Medical Entomology and Parasitology studied the density and seasonal variation of Anopheline and Culicine mosquitoes and their biting and resting habits in various areas of Lahore and Sheikhupura. The data is being analysed.

A study of dynamics of mosquitoes with particular reference to culicines has been carried out in Lahore and the paper is under preparation.

Parasitological survey of school-going children and of the Sanitary staff of Lahore Corporation was carried out during the year. *E. histolytica* was not found to be of importance in these two groups. The Giant Round worm (*Ascaris lumbricoides*) was incriminated to be moss common parasite and the hook-worm infection was encountered in nearly 45 per cent cases examined.

Parasitological survey of Sahowali village in Lahore Corporation area is in progress. The parasitic picture in this semi-urban population did not differ much from what was observed in the communities examined before. Therapeutic Intestopan trials on ca es positive for amoebic protozoa in this population are also under way.

The department extended full co-operation to the International Medical Research Centre of the Maryland University in its research pilot project at village Khurshidwala. Seventy per cent persons examined were found carrying one or the other intestinal parasite.

Parasitological investigations of morbid material from animal sources was also extensively carried out with a view to find out numerical density and corresponding importance of the parasites which may infect man.

3. The department of Bacteriology is carrying out an investigation on the sensitivity pattern of Mycobacterium tuberculosis against streptomycin, P.S. and INH. The scheme partly financed by Pakistan Medical Research Council and also Lahore District Tuberculosis Association. Preiminary observation on sensitivity pattern o *M. tuberculosis* isolated from 84 patients treated in hospitals or clinics show that 6 per cent strain are resistant to streptomycin, 17 per cent to INH and 8·5 per cent strain to PAS and a very low percentage to the combined drug therapy.

A survey of Corynebacterium diphtheriae in the throat of the population of village Khurshidwala in conjunction with Maryland University American Team of the Pakistan Medical Research Centre has also been carried out. Immunological behaviour against past diphtheria infection is being carried out by Schick test in different age groups. Preliminary observations show that fairly large percentage of adult population is immune to diphtheria. Schick antigen was received through courtesy of University of Maryland, Pakistan Medical Research Centre.

(4) The department of Public Health Practice carried out the following studies:—

(1) The economic significance of tuberculosis in Pakistan.

(2) Age and sex characteristics of tuberculosis among 1,304 children is a selected area in Lahore.

(3) Incidence of tuberculosis in a village (Lahore) population and its aelationship with the economic factors.

(4) Study of the attitude of some para-medical personnel in Lahore.

The department has prepared a comprehensive questionaire and has sent it to all the public health administrators in West Pakistan, with a view to collect to unthenticated data regarding the existing system of Public Health Administration in Pakistan. A study of the effect of mass inoculation with triple antigen on lowering death rates of infants and pre-school children in Lahore Cantonment is in progress.

An unstinted consultative service as provided to voluntary health agencies in the field of Tuberculosis and Maternity and Child Welfare.

The health education section of the department remained actively involved in organising a community health education programme in Lahore Cantonment for producing acceptibility and response to the mass inoculation project started in the area by the M.C.W. Association of Pakistan.

5. The department of Maternal and Child Health is carrying out a research on pregnancy wastage in mothers, registered for care with Maternity and Child Health Centres; Saddar Area, Lahore. Some 1,000 families will be covered in this project. The department also provide guidance to the voluntary agencies engaged in maternal and child health work.

6. The department of Occupational Health is carrying out an investigation into Industrial Health Problems to define the nature and extent of illnesses, accidents and hazards. In all 200 factories are included in this programme. So far 80 industrial con cerns have been surveyed. Sanitary conditions and health provision in majority of the concerns are non-existant. The risk of accidents due to unfenced machinery is also great.

BUILDING AND CONSTRUCTION WORK

The various sections of University of Maryland, P.M.R.C. have mostly been equipped and started functioning.

The newly constructed block on the West of the main building is occupied by the Malaria Eradication Training Centre. The activities of the training centre are far too many so that it is not practicable to utilise its lecture theatre or any other component without seriously distributing the working of the training centre. The expanding needs of the Institute on the other hand have affected us badly and it will take another 3-4 years before the training of malaria eradication personnel to an end and the accomodation becomes available to us.

Building of the Animal House has also been completed but the essential fixtures and other structural requirements are still awaiting completion. As soon as that is done animal experimentation would be initiated to fill the essential gap in some of our research programmes.

The construction of administrative block including a Library and Museum is urgently needed.

The accommodation position is pretty tight for the proper functioning of the Institute.

PAKISTAN JOURANAL OF HEALTH AND LIBRARY

The Institute is successfully publishing Pakistan Journal of Health since 1951. In exchange of this journal 78 journals of repute from U.S.A., U.K., and other countries are received by us.

FACULTY MEMBERS

I. *Department of Occupational Health—*

1. Dr. Niaz-ud-Din, M.B., B.S. (pb.), D. P. H. (Lond.), .D.T.M. (L 'Pool), D.I.H. (Lond), L.M. (Dublin) .. .. Professor and Dean (on leave).

2. Dr. Manzoor Ahmad Malik, M.B., B.S. (Pb.). M.D.P.H. (Lond.),D, I.H. England .. .. Demonstrator.

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2.	Mr. M.A. Bhatti, M.A. (Pb.)	Demonstrator in Biostatistics.

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1.	Dr. M. Atiqur Rahman Ansari, Ph.D. (Pb.), D.Sc. (Pb.), Sc.D. (Paris), F.P.A.S., F.E.S.I.	Professor.
2.	Dr. Z.A. Sapru, M.B., B.S. (Pb.), D.P.H. (Pb.), D.T.M.&H. (England)	Assistant Professor
3.	Mr. A.S. Nasir, B. S c. (Alig.), M.P.H.	Entomologist
4.	Dr. Nazir Alam Naru, M.B., B.S., D.P.H. (Pb.), D.T.M.&H. (England).	Demonstrator.

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2.	Dr. Mrs. S.R. Bokhari, M.B., B.S. (Pb.), D.Bact. (Lond.). ..	Assistant Professo
3.	Dr. Hashim Ali Kazmi, M.B., B.S. (Pb.). D.P.H. (Beirut). ..	Demonstrator.

V. *Departmeent of Public Health Parctice—*

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2.	Dr. Z.A. Khan M.B. B.S., D.P.H. (Pb.), M.P.H. (Mich.)	Assistant Professor
3.	Mrs. Rashida Ijaz, M.A. (Pb.), M.P.H. (Cauf.) ..	Health Education Officer.
4.	Dr. Shaukat Ali Shah, M.B., B.S. (Pb.), D.P.H. (Pb.)	Demonstrator.

VI. *Department of Maternal and Child Health—*

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2.	Dr. (Miss) H.M. Saeeda, M.B., B.S., D.P.H. (Pltt) ..	Demonstrator.
3.	Mrs. Asghari Allah Bux, M.A. (Pb.)	Social Worker.
4.	Mrs. Farhat S. Bokhari.	Public Health Nurse.

VII. *Department of Nutrition and Dietetics—*

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2.	Dr. Abdul Ghani, M.B., B.S. (Pb.), D.P.H. (Pb.) ..	Demonstrator.

VIII. *Department of Sanitary Engineering—*

1.	Professor	(Vacant).
2.	Dr. Sanaullah Qureshi, M.B., B.S., D.P.H. (Pb.) ..	Demonstrator.
3.	Mirza Ather Baig	Chief Sanitary Inspector.

LIST OF PUBLICATIONS OF THE INSTITUTE FOR THE YEAR 1962-63

1. Ansari, M.A.R. and Ahmad N. (1963) : Flea Index in Lahore. *Pak. Jour. Hlth.* 13 (2) : 188-151.
2. Ansari, M.A.R. and Nasir, A.S. (1963) : A survey of Guinea- Worm Disease in the Sind Desert. *Pak. Jour. Hlth.* 13(2) : 152-167.
3. Ansari, M.A.R., and Sapru, Z.A. (1963) : A Survey of human intestinal parasites in conservancy staff of the City Corporation of Lahore. *Pak. Jour. Hlth.* 13 (3) : 196-232, 13 (4) : in press.
4. Ahmad, N., Mahmud, M. and Qureshi, M.S. (1961) Epidemiological Observations based on Cholera Outbreak in Recent Years in West Pakistan *Pak. Jour. Hlth.* 12(2) July Issue.
5. Awan, A.H. (1962) : Administrative Management of T.B. Clinic and Their Home Care Programme. *Bullentin of Pak. Med. Association.* 1 (3) : 148-159.
6. Awan, A.H. (1962) : Rehabilitation of Tuberculosis *Pak. Jour. Hlth.* 12(3) : 148-159.
7. Awan, A.H. (1962) : Health and Social Pathology. *Pak Jour. Hlth.* May Issue.
8. Awan, A.H. (1962) : Rural Health Problems in Pakistan, *Medicus.* November and December Issue.
9. Awan, A.H. (1962) : Civili zation, Medicine and Tuberculosis. *Pak. Journ. Hlth.* January Issue.
10. Awan, A.H. (1962) : Food and its Relationship with the Problems of T.B. in Pakistan, *Pak. Jour. Hlth.* July Issue.
11. Awan, A.H. (1962) : Students and Social Work in the Field of Public Health. *Social Work Review.* (V).
12. Awan, A.H. (1963) : Medical Social Work. *Mother and Child.* February Issue.
13. Awan, A.H. (1963) : Economic Significance of Tuberculosis *Challenge.* May and June Issue.
14. Awan, A.H. Awan, A.K. and Hashmi, S. (1963) : Age and Sex as Related to the Incidence of Tuberclosis amongst the Child Population of Qila Gujjar Singh of Lahore. *Medicus.* December Issue.
15. Awan, A.H. and Hashmi, S. (1963) : Tuberculosis Survey of 670 students of St. Anthony High School, Lahore. *Medicus.* October Issue.
16. Awan, A.K. (1962) : Environmental Sanitation, Water supply and Infant Mortality in Qila Gujjar Singh Area as observed in a Maternal and Child Health Programme. *Medicus.* August and Spetember Issue.
17. Awan, A.K. (1962) : Causes of Infant and Maternal Mortality. *Mother and Child Magazine.* November Issue.
18. Khan, A. Majid and Ahmad, N. (1962) : Outbreak of Cutaneous Anthrax in Jhang District *Pak. Jour. Hlth.* 12(2) : July Issue.
19. Khan, A. Majid and Gilani, S. (1963) : Scrub Typhus in Sialkot District. *Pak. Jour. Hlth.* 13(2)—(88-95.

BOOK REVIEW

Progress in Nutrition and Allied Sciences Edited by D.&P. Cuthbertson, C.B.E., M.D., D.Sc., LL. D., F.R.S.E. (Pp. 452 viii, 50 s.) 1963. Edinburgh and London : Oliver and Boyd.

This volume is comprised of thirtynine essays contributed by members and ex-members of the Rowett Research Institute. It deals with the various aspects of nutrition of agriculturally important animals and the man. It would be a useful reference book for those engaged in Food and Agriculture Organisations.

ZAFFAR-UL-AZIZ
M.B.B.S. (Pb.) D. Bact. (Londion),
M.C. Path. (London), F.I.C.S.

LIV—1123—HD—28-10-64 SGPWP Lahore.

PAKISTAN JOURNAL OF HEALTH

S/2

Vol : XIII - 13 JANUARY 1964 No. 4

A QUARTERLY
DEVOTED TO HYGIENE, PREVENTIVE MEDICINE,
MEDICAL SCIENCE AND ALLIED SUBJECTS.

PUBLISHED BY

THE INSTITUTE OF HYGIENE & PREVENTIVE MEDICINE

6, BIRDWOOD ROAD, LAHORE

Lahore
Printed and Published by the Superintendent, Government Printing, West Pakistan
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COTENTS

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Pakistan Journal of Health is published four times each year.

Articles for publication are understood to be contributed to the *Pakistan Journal of health* only.

All articles for publication should be typewritten double spaced, with wide margins.

Abbreviations as far as possible should be avoided.

All enquiries pertaining to the *Pakistan Journal of Health* should be addressed to the Editor, *Pakistan Journal of Health*, 6, Birdwood Road, Lahore.

Demands for reprints must be forwarded at the time of submission of the article for publication. Contributors receive 20 reprints of their papers free and additional copies at cost price.

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Single copy	.. Rs. 1·75	Excluding postage.
Annual subscription	.. Rs. 6·00	Excluding postage.
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Title page	.. Rs. 150·00	per insertion.
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A SURVEY OF HUMAN INTESTINAL PARASITES IN THE CONSERVANCY STAFF OF THE CITY CORPORATION OF LAHORE

BY

PROFESSOR DR. M. ATIQUR RAHMAN ANSARI, PH. D. (PB.)., SC. D. (PARIS), D. SC. (PB.), F. P. A. S., F.E.S.I., F.R.E.S., *Professor of Medical Entomology and Parasitology* ; *and*

DR. ZAFAR ALI SAPRU, M.B. B.S., D.P.H. (Pb.), D.T.M.H. (LONDON), *Assistant Professor of Medical Entomology and Parasitology*, Institute of Hygiene and Preventive Medicine, LAHORE.

*Continued from the *Pakistan Journal of Health, Lahore;* 13(3) : 196—232 (1963)

SINGS AND SYMPTOMS

Our wills and fates do so contrary run
That our devices still are overthrown,
Our thoughts are ours, their ends none of our own.
(*Shakespeare: Hamlet*)

Human parasites represent a very small portion of much wider world of closely related parasites occurring in other animals. Formerly, the parasitologists claimed to determine the culprits involved with precision and accuracy. The discovery of closely allied forms and strains and races of same parasites has made the job rather complicated. Thus at times it becomes a problem to determine what clinical laboratory procedure will be of value in a particular survey to differentiate the race involved.

The parasites, residing in the human intestine, are now known to involve so many organs and tissues of the body, that the modern parasitologist cannot help thinking of the symptoms and syndromes involved.

Entamoeba histolytica, for instance, is both a parasite and a commensal. This parasite is notorious for a multi-symptom disease *viz.*, amoebic colities and dysentery, septic peritonitis, hepatitis, lung infection and skin ulcers. This state of affairs warrants the laboratory worker to be familiar with various classical syndromes evoked by the presence of different parasites.

From a perusal of the symptoms manifested by different parasites, we are forced to conclude that parasitologists should not only be familiar with parasites alone but should also be well versed in other different fields viz., dentistry, dermatology, gastro-enterology, haematology, neurology, ophthalmology, urology, etc., etc. The other alternative, rather sober and serene solution, is that there should be a team work between clinicians, pathologists and parasitologists.

Practically all the text books, both on clinical parasitology and medicine, give a long list of symptoms under each parasite and, we the teachers, probably without an exception, pass this information from year to year, to our pupils without comments. Although we adopt lying down position yet we always feel that there is a necessity to

assess the symptomatology and dispel the confusion from the mind of the practitioners, laboratory workers and parasitologists.

We agree that each animal, which gets an opportunity to enter our body, tries to live in a state of equilibrium. Accidentally some, in a zeal to exist, invade and live within tissues and begin to play a role of a parasite. Those which choose to live in the intestinal lumen, for instance, continue undergoing tremendous evolutionary processes. Side by side with a pathogenic race, an innocent race continues evolving. Experimental evidence exists, practically for all the animal parasites of man, to show that the host parasite relationship oscillates fairly regularly between virulence and avirulence. In some the phenomenon is well marked, while in others it does not modify to a perceptible level. A simple diagramatic representation of the affairs may be of the pattern given in the figure.

The avirulent form is not associated with any symptoms. For a practicising physician, a parasite may provoke symptoms at one time but it has also a latent phase of chronic infection and the carriers are all symptomless.

Signs and symptoms, as given in books, do not seem to have any definite diagnostic value. Real symptoms, if well defined for any one parasite, may probably be suggestive of a tentative possibility. Experience in clinical method of approach is by no means an accurate presumptive diagnosis but always precedes a laboratory work. Is this procedure fine enough or mutable, is the question and since long awaiting an answer. At present there appears to be an elaborate exaggeration and erroneous correlation of unrelated symptoms to simple parasitism. Standardlisation of symptoms and signs attributable to each parasite is now over due.

The list of symptoms and signs attributed to different parasites, commonly encountered in this country, are given below. A perusal of this list will show that almost all the symptoms are attributable to all the intestinal parasites. At the very sight, it appears to be an extensive stretch of imagination. If one worker speaks of headache and visional disturbances and acute conjunctivitis due to common round-worm infection, the other does not hesitate to add sexual disturbances, rhematoid arthritis, meningititis and hematuria due to it. We are afraid, that if this competition continues, some original thinker may claim one day that this parasite is very helpful in spacing pregnancies and inducing safe abortions. Gods of Family Planning will certinly owe a sense of gratitude to such a contributor. This fine addition to our knowledge will not only help them in Family Planning approach but will also provide an answer to taboos viz., social, ethical and religious. Parasitologist are thankful to their colleagues in the clinical field for the valuable guidance they rendered in an indirect identification of suspects, but not for silly brain waves. All efforts, therefore, should be made to refute what the poet C. Churchill once said : "*Most of those evils we poor mortals know, from doctors and imagination flow.*"

Professor M. Afzal Husain, H.Q.A., M.A. (Cantab), Hon. D.Sc. (Pb.), Hon. LL.D. (Toronto), F.N.I., F.P.A.S., F.E.S.I. (formerly Chairman, Pakistan Public Service Commission, Karachi and Vice-Chancellor Panjab University, Lahore) once said to his post-gra-

duate classes that it took a decade or two to pull a discovery into a text-book but alm st a century to push a blunder out of it. *We know that good discoveries are monuments without a tomb.* One who dedicates his life to extend the boundaries of science must combine the qualities of a saint/scholar/soldier. It is always profitable to have advice and councel. As one of his desciples, we advocate that lies are preventable in science and must be prevented. Research is to remove confusion. We should do the right, when we would, for the would change, who knows what.

Most of these observations are probably based on the response of the host to the specific treatments. Does the elimination of a symptom indicate that it was positively due to a particular parasites? Serious attempts should always be made to correlate this basic sciences with clinical interpretations. Clinical symptomatology, pathology and parasitology must go together. Work in a directly opposite direction has not served as useful purpose in the past and is not going to serve any useful purpose in future either.

False association of symptoms to a parasite has done greater harm than good. *Parasite-phobea* is a worst disease caused by a knowledge of these symptoms. We know of cases, who just after knowing of the presence of an endo-parasite showed serious clinical manifestations and sensitization phenomenon but before such a knowledge the parasite was tolerated without even mild symptoms. We, therefore, must resolve to sift chaff from the grain and establish true relationship between parasites and their manifestations. The world-wide tendency to widen symptomatology to include syndrome remote from the seat of predilection of the parasite are due to various reasons. One is zeal on the part of the worker to give something new. This latter trend must be stopped. It reminds us of Shakespeare who said:

"I come to bury Caesar, not to praise him,
The evil that man do lives after them,
The good is oft interned with their bones".
(Julius Caesar : 3 (2)

Signs and symptoms associated with infection with intestinal parasites may be conveniently mentioned under various systems as follows:—

A : SYMPTOMS AND SIGNS REFERRABLE TO DISGESTIVE SYSTEM (INCLUDING GASTRO-INTESTINAL TRACT, LEVER, PANEREAS, GALL BLADDER)

1. *Anorexia* (*Loss of appetite*)—

(*i*) There may be marked loss of appetite in *balantidiasis.*

(*ii*) Appetite may also be killed in early stages of *amoebiasis.*

(*iii*) There may be poor appetite in *giardiasis* if accompanied with chronic diarrhoea.

(*iv*) Poor appetite is also one of the manifestation in *trichuriasis* of children.

(*v*) Children, who remain disturbed during night due to nefarious activities of seat-worm (*enterobiasis*) also have poor appetite.

(*vi*) Anorexia is one of the symptoms in early stages of hook-worm (*ancylostomiasis*) infection.

(*vii*) Loss of appetite may be the only symptom in children suffering from dog-tapes worm (*Dipylidium caninum*).

(*viii*) Round-worm infection, though notorious for gluttony, yet in sensitive cases it may also kill the appetite.

2. *Capricious appetite* (Hunger).—

(*i*) *Taenia saginata*—Infection make one glutton.

(*ii*) Some children, carrying a heavy load of *Ascaris* worms, remain hungry and have an unsatisfiable desire to eat. In endemic areas, the children are usually greedy.

3. *Vague Abdominal Discomfort*—(*i*) Large proportion of infected persons in *amoebiasis*, complain of abdominal discomfort.

(*ii*) About 30—40 per cent whip-worm infections have periodic abdominal distress. A vague burning sensation is reported by 15—20 per cent patients.

(*iii*) Vague abdominal discomfort and acute coliky pain in epigestric region is common symptom of *ascariasis*.

(*iv*) Heaviness and sensation of weight is usually felt in epigastric region in *Taenia saginata* infection.

(*v*) Slight intestinal disturbances may be complained of by children carrying dog-tape-worm. These symptoms are due to the metabolic wastes of the worm absorbed into the system.

4. *Nausea*—(*i*) Nausea may suggest *balantidiasis*, *amoebiasis* of caecum, *ancylostomiasis/necatoriasis* and beef-tape-worm infections.

(*ii*) Nausea is often a symptom in *D. feragilis* infection.

(*iii*) Nausea may also be one of the symptoms in *ascriasis*.

5. *Vomiting*—(*i*) Frequent vomiting may occure in *balantidiasis* and *amobiasis* of caceal area alone.

(*ii*) A patient harbouring *D. faragilis* occasionally suffers from this symptom.

(*iii*) Vomiting may occasionally occur in *ancylostomiasis/necatoriasis*.

(*iv*) *Post-prandial* vomiting has been recorded in beef-tape-worm infection.

(*v*) Vomiting may also precede, coincide or follow the reverse passage of rounds worms through the mouth opening. In more sensitive persons, this may, however, also occur independently of the passage of the worm.

6. *Abnormal Eructations* (belching)—(*i*) Eructations may occur in 25—30 per cent whip-worm infections.

(*ii*) The act of bringing up gas is also frequent in *ascariasis*.

7. *Flatulence*—(*i*) Distended abdomen and severe flatulence may occure in heavy hook-worm infection.

(*ii*) Abdominal distention with flatulence also occur in some cases of whip-worm infection.

(*iii*) Flatulence is also an evidence of duodenal disturbance in *giardiasis*.

8. *Indigestion*—(*i*) About 30—40 per cent cases of *trichiuriasis* suffer from indigestion.

(*ii*) Severe hook-worm infection also interferes with proper digestion of the ingested food.

(*iii*) Severe *ascariasis* may also upset digestion. Poor digestion in this case is mainly due to the inflammed bowels.

(*iv*) Indigestion may also be caused by dog-tape-worm infection in children.

9. *Geophagea*—Craving of ingesting clay is a characteristic feature in hook-worm infections. Further it has been observed to be of more severe nature than noticed in women during pregnancies.

10. *Heart burning*—Heart-burning is a queer sensation and has been encountered in some cases suffering from *ancylostomiasis/necatoriasis*.

11. *Pot-belly*—(*i*) The bulbous belly is a typical physical sign in children carrying *ancylostomiasis/necatoriasis*.

(*ii*) Heavy round-worm infection in children is well known to cause protuberant abdomen.

12. *Abdominal tenderness*—(*i*) There may be exquisite tenderness of the entire abdominal region if the peritonitis is involved in *amoebiasis*.

(*ii*) Tenderness of abdominal wall may be complained of in *D. fragilis* infection.

(*iii*) Tenderness of duodenum, jejunum and/ilium may occur in severe hook-worm infection. In some cases there may be pain in this region.

13. *Pain*—(*a*) *Epigastric region*—(*i*) Dull epigastric pain is common in severe *giardiasis*.

(*ii*) Marked epigastric pain is also experienced in children suffering from *trichiuriasis*.

(*iii*) Epigastric pain is accompanied with fullness of abdomen in hook-worm infections and is usually received when the patient eats bulky food or ingests clay.

(*iv*) Acute epigastric pain may occur in *ascariasis*. In some cases, however, the pain experienced is vague and dull.

(*v*) Hunger-pain frequently develops towards the end of incubation period in beef-tape-worm infection.

(*b*) *Lower abdominal pain*—(*i*) When caecal area is exclusively involved in *amoebiasis*, the patient usually complains of pain over Mac Burney's point.

(*ii*) Vague to moderate pain may be one of the complaints in *D. fragilis* infection due to superficial irritation. This amoeba has been found in the lumen and crypts of intestinal glands with ingested R. B. Cs.

(*iii*) More or less 35—40 per cent cases of *trichiuriasis* may complain of pain over MacBurney's point.

(*iv*) Abdominal pain is common feature of whip-worm infection and is more felt in the lower quadrant.

(*v*) Children suffering from *hymenolepiasis* also commonly complain of abdominal pain, which is said to be of nervous origin especially in case of multiple infection.

(*v*) Hook-worm infection is sometimes the root cause of the painful abdomen. It occurs when the duodenum, jejunum and ilium are involved in the infection. Due to disorder of the motor function in the mesenteric and submucosal nerve plexus the patient becomes irritant and short tempered.

(*vi*) Acute intermittent intestinal colic, sometimes mimicking appendicities, is initiated by the presence of *Ascaris* worms.

14. *Tenesmus*—(*i*) Tenesmus is frequently reported in *balantidiasis*.

(*ii*) It is usually absent in *amoebiasis* but in some cases, however, moderate tenesmus occurs.

(*iii*) Tenesmus may also occur in heavy *trichiuriasis*.

15. *Colic*—(*i*) The presence of many seat-worms in the rectum may cause violent rectal colic in some cases.

(*ii*) Abdominal colic, accompanied by severe diarrhoea and dysentery, are usually characteristic of chronic *balantidiasis*.

(*iii*) Beef-tape-worm infection may give rise to severe or dull intestinal colic.

16. *Intestinal obstruction*—(*i*) Tangled mass of writhing *Ascaris* worms are notorious for mechanical obstruction in the intestines and provoking *ileus* or causing acute intestinal obstruction.

The vagrant *Ascaris* worms also sometimes are responsible for blockage of ampula of Vater (hepato-pancreaticampula) and the common bile duct.

(*ii*) Beef-tape-worm infection has also at times been responsible for acute intestinal obstruction.

(*iii*) Chronic intestinal *amoebiasis* may cause stricture of the lumen of large intestine and lead to chronic intestinal obstruction.

(*iv*) Amoebic granuloma may sooner or later cause intestinal obstruction.

17. *Intestinal interssusception*—(*i*) Intestinal interssusception may sometimes be the result of intestinal *amoebiasis* in adults usually with the ileo-caecal part of the intestine, forming the apex of the tumour mass.

(*ii*) Heavy round-worm infection may, when the parasites form a mass in the intestine, induce a state of volvulus.

18. *Constipation*—(*i*) About 30—40 per cent of the chronic cases, suffering from whip-worm infection, usually complain of periodical constipation.

(*ii*) Severe c onstipation may also alternate with acute dysentery and diarrhoea in hook-worm infection.

19. *Diarrhoea*—(*i*) Almost every patient suffering from *balantidiasis* passes diarrhoeal stools.

(*ii*) Chronic diarrhoea, with gruelly and steatorrhoic stools containing large amount of mucous and undigested free fat, but without blood may occur in acute *giardiasis*, generally in children but rarely in adults.

(*iii*) Usually moderate and sometimes profuse diarrhoea is a prodromal episode in *amoebiasis*. There is generally an urgent desire to deaecate. The stool may occasionally be formed or semiformed but always suspended in copious amount of mucous. Sometimes the stool may contain mucous alone.

(*iv*) Frequency of stools with mucous may be experienced in *D. fragilis* infection.

(*v*) Diarrhoea, containing blood-streaked stools, may occur in a heavy infection of whip-worm. Such case may pass sufficient amount of mucous, if the infection is confined in the recto-sigmoidal region.

(*v*) Diarrhoea may also occur in severe *ascariasis*.

(*vi*) Diarrhoea usually occurs towards the end of incubation period in beef-ta peworm infection. In some cases, prolonged watery diarrhoea may even prove fatal.

(*vii*) Diarrhoea, of imperfectly digested food, occurs in *ancylostomiasis* where the victim eats ravenously due to insatiable appetite.

20. *Melaena*—Black, tarry stools may be only prominent symptoms in some cases of intestinal *amoebiasis*.

21. *Steatorrhoea*—According to Veghelyi (1941), *giardiasis* establishes a (partial or complete) barrier to fat absorption in the upper small bowels. When the infection is very heavy, the stool may have overtly characteristic appearance—bulky, acidic, pale, frothy and fatty. In case of the barrier being partial, the steatorrhic condition may be overlooked.

22. *Dysentery*—(*i*) Severe type of dysentery may occur in some cases of *balantidiasis*—Such cases are usually with ulceration of the intestines.

(*ii*) In amoebic dysentery, considerable amount of blood and mucous is evacuated with formed or semi-formed stools. There is urgent desire, after every short interval, to defaecate and after evacuation there is slight relief.

(*iii*) The presence of *G. intestinalis* in dysenteric stools is more than mere coincidence. The presence of these flagellates in the intestines produces lot of mucous at the site of infection. The incidence of flagellate dysentery is however, high in children and of low frequency in adults.

(*iv*) In some cases of *ancylostomiasis*, usually in terminal stages, the patient may pass frequent dysenteric motions, which may be difficult to distinguish from other dysenteries.

23. *Prolapsus recti*—(*i*) *Prolapsus recti* is characteristic of heavy chronic whipworm infection of the rectum in children.

(*ii*) The condition is also common in long standing cases of *enterobiasis*.

24. *Mega colon*—Colon may get enormously distended in chronic cases of *amoebiasis*.

25. *Duodenitis*—Chronic and haemorrhagic duodenitis is most common manifestation in severe *giardiasis*.

26. *Diverticulitis*—(*i*) Inflammation of diverticulum usually occurs in severe *ascariasis*.

(*ii*) Diverticulitis may also occur in intestinal *amoebiasis*.

27. *Gastric and duodenal trauma*—Wandering *Ascaris* worms are sometimes responsible for gastro-duodenal trauma in endemic areas. This injury in some cases leads to serious consequences.

28. *Appendicitis*—(*i*) Acute and sub-acute appendicitis may arise as a complication of *amoebiasis* of caecal area.

(*ii*) *D. fragilis* may also induce appendicitis.

(*iii*) Heavy infection of appendicular mucosa with *Trichocephalus trichiurus* may allow pathogenic organisms to enter the tissue and set in an acute or sub-acute inflammatory process.

(*iv*) Brisk movements of female seat-worms may cause appendicitis.

(*v*) At times, the individual segment (proglottids) of beef-tape-worm become lodged in appendicular lumen and cause acute inflammation in the appendix.

(*vi*) Vagarant round-worms may pass into an intestinal diverticulum and initiate *diverticulitis*.

(*vii*) Appendicitis may, in rare occasions, be caused by a female round-worm getting into the lumen of appendix and laying eggs therein. In such cases, the appendicular lumen has generally been found to be packed with *Ascaris* ova.

(*viii*) Vagarant seat-worms may get into the lumen of appendix and cause appendicitis.

29. *Amoebic typhlitis*—In intestinal amoebiasis, caecum may be the only portion involved, giving rise to symptoms which may be confused with appendicitis.

30. *Tumours, ulcers and abscesses*—(*i*) Chronic *amoebiasis* may cause the formation of a granulomatous mass (amoeboma) along the length of the large intestine. This tumour is most frequently found in caecum, transverse colon and sigmoid colon and may be mistaken for a carcinomatous growth.

Ulceration of the skin, generally in the peri-anal region, may result due to invasion with *E. histolytica* which, in extreme cases, may lead to extensive necrosis and gangrena. Colonic appendicular and hepatic drainage in surgical conditions of *amoebiasis* may also be a cause of dermal *amoebiasis* leading to ulceration, necrosis and gangrene.

(*ii*) Ulceration of stomach, small intestine and colon may also be caused by *I. butschlii*.

(*iii*) Rarely a nasal polypus may be caused by metastatic invasion by *E. histolytica*.

(*iv*) *Tangled masses of Ascaris* worms are sometimes suggestive of abdominal tumours, gastric and duodenal ulcers.

Volvulus of the intestines may be caused by heavy *Ascaris* infection. In such cases, round-worm infection has to be seriously considered in differential diagnosis.

(*v*) Syndrome of peptic ulcer may also be met with in some case of beef-tape-worm infection.

31. *Perforation*—(*i*) Perforation of the descending and ascending colon may result when the patient's resistence is very low and the motile *E. histolylica* (trophozoite) is highly virulent. When such perforation is slow and insidious, it may lead to pericolic or paracolic abscess (intra-peritoneal or retro-peritoneal). In fulminating cases the intra-peritoneal perforation may occur with dramatic suddenness and cause generalised peritonitis. The retro-peritoneal abscess may ultimately make its way down through the psoas muscle and appear in the inner aspect of the upper part of the corresponding thigh. In some rare cases however, the supprative invasion of the ischiorectal mass of tissues may occur and form *Ischiorectal abscess.*

(*ii*) *Ascaris* worms may perforate the bowels, most commonly in the region of ileo-caecal valve and burrow into the abdominal wall, giving rise to the formation of an abscess—an unusual attempt on the part of human organism to get rid of the parasite.

Sometimes the tiny, pearly, nodules in the mesentery, formed by the encysted ova of round worm, may perplex the surgeon as to their exact nature.

Wandering worms may also perforate oesophagus and vomited out or perforate the diaphragm and enter the pleural cavity causing plourisy and empyema.

32. *Peritonitis and Peritoneal abscess*—(*i*) *Amoebiasis* may be accompanied by the perforation of bowels and peritonitis. This condition may occur when the colonies of the parasite become established in submucosa and continuously erode mesenteric venules.

(*ii*) Whip-worm may reflexly cause appendicitis and peritonitis (Savil).

(*iii*) The thread-worms may directly be responsible for catarrhal *appendicitis.*

(*iv*) Penetration of the round-worms into peritonial cavity leads to *peritonitis* either of generalised order or a localised one resulting in the formation of an abscess, which may find its way to the exterior helping the worms to escape.

33. *Enlargement and tenderness of Liver with or without suppuration*—(*i*) Amoebic-colitis may sometimes be associated with the enlargement and tenderness of liver (hepatic amoebiasis) without fever, and without subphernic bulging or diaphragmatic impairment.

Single or sometimes multiple abscesses in the liver are commonly known to occur with or without manifest involvement of intestines with amoebic infection.

Enlarged, tender liver may occur in accute amoebic hepatitis, if one or more foci, are established. Fever with chill (mimicking malaria) together with moderate neutrophilic leukocytosis, are also some of the signs and symptoms of acute amoebic hepatitis.

(*ii*) Entery of vagarant *Ascaris* worms into the parenchyma of the liver may cause necrosis of liver cells and liver abscess.

(*iii*) Segments of *T. saginata* have been recovered from liver abscess.

34. *Jaundice*—(*i*) Obstructive jaundice may result from pressure exerted on biliary

passages by wide and extensive amoebic abscesses of the liver.

(*ii*) Round-worm may enter bile duct and lead to obstructive jaundice.

35. *Cholecystitis*—(*i*) Either the extension of necrotic process from liver abscess or the infection ascending from the gut through the biliary tract may involve gall bladder and cause *amoebic cholecystitis*. It is a rare manifestation and has been recorded chiefly by French workers.

(*ii*) Inflammation of gall bladder has been usually traced to *giardiasis*. Whenever the system is involved in the infection, this acute and failrly long ailment may occur in 20 per cent cases.

(*iii*) *Ascaris* worms may also be cause of this condition by obstructing common bile duct.

(*iv*) Syndrome of gall-bladder disease may be met with in beef-tape-worm infection.

36. *Haemorrhagic pancreatitis*—The wandering *Ascaris* worms may initiate hemorrhagic pancreatitis by blocking the pancreatic duct due to occlusion of ampula of Vater by inflammatory reaction induced by the infection.

37. *Hernia*—Cases of inquinal or umbilical hernia due to heavy infection with *Ascaris* worms have also been reported.

B. SIGNS AND SYMTOMS SUGGESTIVE OF CARDIO-VASCULAR DISORDERS.

1. *Vasomotor disturbances*—It is of occasional occurrence in hook-worm infection. It may be accompanied with lassitude.

2. *Blood Pressure*—Almost in all hook-worm infections, the blood pressure is of the following pattern:—

(*i*) Diastolic blood pressure may remain normal.

(*ii*) Systolic blood pressure may be considerably diminished.

3. *Weak pulse*—Large percentages of persons carrying severe hook-worm infection usually have weak pulse.

4. *Palpitation of Heart*—Palpitation of heart and haemic murmurs in chronic hook worm infection is one of the common findings.

5. *Cardiac Hypertrophy*—Tremendous cardiac hypertrophy has been found a constant sequal in prolonged hook-worm anaemia.

6. *Cardiac Dilatation*—Cardiac dilatation is one of the complications encountered in severe cases of whip-worm infection.

7. *Amoebic pericarditis*—Chronic amoebic abscess of liver, especially of the left lobe, may involve the pericardium through the diaphragm and cause purulent pericarditis, which, if the patient survives at all, may result in constrictive pericarditis. The infection may also be carried through blood.

8. *Syncope*—Attacks of syncope are liable to occur in severe hook-worm infections of fairly long duration.

9. *Cardiac murmur*—Haemic murmur is a common auscultatory finding in advanced cases of hook-worm infections.

10. *Cardiac Penetration*—The wandering *Ascaris* worms may some times penetrate the heart often with fatal consequnces.

11. *Haemorrhage*—(*i*) Bleeding is one of the complications encountred in some cases of amoebic colitis.

(*ii*) The ulceration caused by ciliates, sometimes becomes haemorrhagic.

(*iii*) Removal of whip-worm with anthelminthics usually results in petechial haemorrhages at the site of attachement. It mimicks hook-worm infection and one of the common causes of confusion in clinical practice.

(*iv*) Petechial hamorrhages is also produced by the filiform larvae of *S. sterocoralis* during skin invasion.

(*v*) The migrating larvae of the giant-round-worm, when escape from the blood vessels into the lung alveoli do not only cause trauma but also petechial haemorrhages.

12. *Blood Picture*— (*a*) (*i*) *RBCs* may decrease in hepatic and intestinal *amoebiasis, balantidiasis, strongyloidiasis, trichiuriasis, ascariasis and* (definitely) *encylostomiasis.* The protozoal parasites may cause fall in R.B.C. count because of the haemorrhage caused by their activity. The helminthic parasites, however, may lower the count either by sucking blood of their host or through the action of their toxins or both.

(*ii*) *Hoemoglobin percentages* may fall in hepatic and intestinal *amoebiasis, balantidiasis, strongyloidiasis, trichiuriasis, ascariasis* and (definitely) *ancylostomiasis.*

(*b*) *Leukocytosis*—(*i*) It is one of the syndromes of hepatic amoebiasis.

(*ii*) During early stages of active infection, polymorphonuclear-leukocytosis (upto 25000) with eosinophilia (as high as 40 p. c.[m. m.) is characteristic in *strongyloidiasis.* In chronic infections, leuckocytosis changes to neutropenia with relative monocytosis and moderate eosinophilia. It persists for years.

(*iii*) Typical leukocytosis (upto 17,000 per cu mm. of blood) with predominant eosinophilia occurs in hook-worm infection. Later leukocytosis count drops to normal or below but eosinophilia may remain moderately high.

(*iv*) Leukocytosis (with 6-34 per cent eosinophilia) is characteristic in *Taenia saginata* infection. Later in the course of the disease there may be leucopenia.

(*v*) *Large mononuclears* increase in *trichiuriasis, strongyloidiasis* and *ancylostomiasis.*

(*c*) *Leukopenia*—Slight and perceptable leukopenia may occur in some cases having severe infection of beef-tape-worm.

13. *Anaemias*—(*i*) Prolonged watery diarrhoea in *balantidiasis* may cause anaemic skin ,

(*ii*) Yellow, palor skin usually occurs in *ancylostomiasis/necatoriasis.*

(*iii*) In *trichiuriasis*, there may be systemic intoxication and frequently secondary anaemia.

(*iv*) There is mechanical loss of blood at the site of attachement of hook-worms, together with copious amount of seapage from abandoned holds. Anaemia usually begins to appear 10—20 weeks after exposure to infection. In mild infection, however the anaemia is negligible and therefore, not appreciated.

14. *Oedema*—(*i*) Oedema of the face and hands commonly occurs in whip-worm infections.

(*ii*) Congestion and oedema is a usual feature at each site of infection by the filiform larvae of *S. stercoralis.* Inflammation however, does not occur if the infection is not accompanied by pyogenic organisms.

(*iii*) Severe hook-worm infection also causes oedema of the face or legs and in some cases of the whole body. It is one of the characteristics of this disease. When oedema is confined to face or legs alone, the other parts of the body however, show signs of emaciation.

(*iv*) *Palpebral oedema* generally occurs when the vagrant larvae of *Ascaris* pass through the tissues of eyelids.

C. Symptoms and Signs relating to Respiratory system

1. *Halitosis*—Considerable number of childern carrying *Ascaris* worms have bad and offensive breadth.

2. *Cough and Coryza*—(*i*) Some cases with hook-worm infection, one or two weeks after the skin infection, complain of cough with coryza and sore-throat. These symptom may last for 2-3 weeks.

(*ii*) *Ascaris* infection may also cause symptoms of bronchitis, when the larvae are passing through bronchial tubes.

(*iii*) Cough is a common symptom in children infected with intestinal worms.

3. *Bronchial asthma*—The metabolites of the mature *Ascaris* worms are notorious for initiating one or the other serious sensitization phenomenon in their victims. Bronchial asthma has been reported to have occurred only in sensitive patients.

4. *Empyaema*—(*i*) Injury to pleural cavity in *ascariasis* is frequently associated with empyema.

(*ii*) *Empyaema* may also be due to extension of amoebic liver abscess into pleural cavity.

The pus formed and collected in the cavity is not only irritating but a serious sign.

5. *Pneumonitis*—The migrating filiform larvae of *Strongyloides*, *Ascaris* and hook-worm produce petichial haemorrhages at site, where pulmonary blood vessles are broken into capillaries in the inter-alveolar septa. In severe infections respiration is usually embarrassed considerably because small pools of blood accumulate in the alveoli and smaller branchioles. There is general oedema of the lungs also.

This condition is comparatively well marked in *strongyloidiosis* and *ascariasis* than in hook-worm infections. In children, *Ascaris* pneumonitis may occur usually 1—5 days after exposure. Pneumonitis of *Strongyloides* origin is said to be the basis for activating quiescent pulmonary tuberculosis.

6. *Dyspnoea*—(*i*) According to Getz (1945), dyspnoea is one of the symptoms in *trichiuriasis.*

(*ii*) *Dyspnoea* may also occur in severe hook-worm infection as also when the larvae of *Ascaris* worms are present in the alveolar spaces.

Dyspnoea may also be accompanied by peritonitis due to *ascariasis, amoebiasis, trichiuriasis,* etc.

Some degree of oedema of glottis and larynx may occur when round-worms are vomitted out and this leads to dyspnoea. Larvae of round-worms during their passage may also initiate dyspnoea.

(*iii*) *Empyaema* caused by perforating *Ascaris* worms, as well as amoebic abscess may cause severe dyspnoea.

(*iv*) Marked dyspnoea may result from invasion of right lung by amoebic abscess.

7. *Haemoptesis*—(*i*) During migration, the *Ascaris* larvae may initiate mild haemoptesis, generally with several larval worms in the sputum.

(*ii*) Blood-tinged, rusty expectoration may also be encountered in cases infected with *Strongyloides.*

(*iii*) Feeble haemoptesis has been observed in *ancylostomiasis.*

8. *Suffocation*—(*i*) There are cases on record, where the vomited *Ascaris* worms are passed into larynx and produced suffocation. Obstruction of larynx may initiate serious crisis or even cause death in children.

(*ii*) The migrating larvae of hook-worm or *Ascaris* may cause odaema of glottis and induce symptoms of suffocation.

9. *Pulmonary abscess and gangrene*—(*i*) *Amoebiais* may also cause directly or indirectly abscess of lung and in rare cases gangrene.

(*ii*) A solitary case of lung abscess is also on record due to *I. butschlii.*

(*iii*) The wandering *Ascaris* worms, some times penetrate the lung of the patient, and produce pulmonary abscess or gangrene.

(*iv*) Segments of beef-tape-worms have been, in rare instances, encountered in lung abscess.

10. *Broncho pneumonia*—(*i*) *E. histolytica* may be carried through the circulation to the lungs and may give rise to a condition resembling broncho-pneumonic consolidation especially on the right side.

(*ii*) Young *Strongyloides,* when passing through the lung, produce symptoms simulating broncho-pneumonia.

(*iii*) Chronic bronchitis may also be due to heavy whip-worm infection.

(*iv*) In the course of their journey through the lung alveoli, the larvae of *Ascaris* worms may, especially when pathogenic organisms are also present, cause broncho pneumonic patches of consolidation and in extreme cases of complete lobes thus givingrise to serious symptoms characteristic of the lesion.

11. *Pain in chest*—(*i*) Intense pain in lower right region of chest occurs due to inflammation of diaphragmatic pleura in *amoebiasis*. There is also persistent unproductive cough associated with this condition.

(*ii*) Pain of chest may also be referred to peritonitis due to *ascariasis, trichiuriasis.*

12. *Intra-thoracic burning*—In *strongyloidiasis*, generalised intra-thoracic burning is experienced between 3rd-4th day of infection.

D.—Dermatological Reactions

1. *Macular erythematous spots*—(*i*) Minute macular erythematous spots are characteristic of *strongyloidiasis*. These are found ar each point, a filiform larva of the worm penetrates the skin of the victim.

(*ii*) Similar spots may appear at the point of penetration of hook-worm larvae on the skin.

2. *Pruritis*—(*i*) Violent pruritis occurs in 15—20 per cent whip-worm infections.

(*ii*) Intense pruritis, usually accompanied by petecheal haemorrhages, i s produced by the invading filiform larvae of *S. stercoralis*.

(*iii*) Almost intolerable *pruritis ani* is set up in *enterobiasis*. It is usually more severe after sunset and during night in most children.

(*iv*) Intense itching is usually experienced when hook-worm larvae penetrate the skin.

(*v*) Troublesome itching at the anus may be experienced when the round-worms are making their way out.

3. *Dry-ness of skin*—(*i*) It occurs in whip-worm infection.

(*ii*) Skin may become dry and harsh in hook-worm infection. In advanced cases of the trouble the hair also be come dry and life-less.

4. *Pallor of the skin*—There is always increased demand for a greater circulating blood volume in the vital areas in hook-worm infection. This urgent demand is met at the cost of the peripheral blood-flow which is considerably reduced rendering the skin markedly pale.

5. *Perspiration*—Severe hook-worm infection usually reduces rate of perspiration.

6. *Creeping eruption*—Fillform larvae of various hook-worms cause cutaneous lesions on unprotected parts of the body.

7. *Ground itch*—Ground itch, incessant itching followed by burning, oedema and erythema of the site usually occurs when III stage filiform larvae of hook-worm bore the skin. These sites of entry, may ultimately develop into papular eruptions and ending in painful vesicles. The usual sites are between toes, lateral and dorsal surfaces of feet, but may also develop at other places.

8. *Allergy*—The *Ascaris* and other worms are known to secrete/excrete several toxins in their body.

The round worms are known to produce *anaphylaxins, neurotoxins hemolysins* and *endocrinotoxins*, etc. It has been observed that laboratory workers, who handle material contaminated with the tissue of these animals, often develop serious allergic manifestations. These effects may also be due to emanations. The following allergic manifestations have been observed :—

(*a*) *Status asthmaticus*—This catastrophe may manifest itself as a complecation in cases who develop asthma due to *ascariasis.*

(*b*) *Urticaria*—(*i*) Intense periodic or regular urticaria has been found occurring in some cases having whip-worm infection.

(*ii*) Individuals, carrying *S. steroralis* infection previously, if subjected to another exposure to this worm, frequently develop incessant urticaria together with other sensitization reactions.

Men and women, who have genito-urinary *strongtyloidisis*, usually have severe urticaria of the skin around the external orifice.

(*iii*) *Ascaris* worms, after attaining maturity in the bowels, are reported to add metabolites and cause severe and pronounced urticarial rash and other sensitisation phenomenon in their host.

(*c*) *Dermatitis*—(*i*) Migrating females of seat-worm are notorious for causing *pruritus ani.* Severe scraching of the irritated region may some times result in dermatitis of the perianal and perineal regions. In some books this condition has been described as one of eczema which appears to be an exaggeration of the exact nature of the lesion.

(*ii*) Localised dermatitis is generally the rule with the penetrating larvae of hook-worm.

E. Symptoms and Signs Involving Genito-Urinary System.

1. *Haematuria*—In the presence of *Ascaris* adults in the bowl and also during the bilogical incubation period, signs and symptoms of haemuturia may often occur.

2. *Albuminuria*—In advanced and chronic stages of hook-worm infection, the patient may show symptoms of albuminuria.

3. *Renal Colic*—(*i*) If the *Ascaris* larvae reach the general circulation and filter out into the kidneys, they may cause most dramatic attack of renal colic.

(*ii*) Hook-worm larvae may also initiate an attack of renal colic.

4. *Nephrosis*—Serious nephrosis may occur in advanced stages of *ancylostomiasis/necatoriasis.*

5. *Nocturia*—(*i*) Genito-urinary *strongyloidiosis* does not only cause diurnal urgency to urinate but also urinary incontinence.

(*ii*) Severe *enterobiasis* in children, may be a common cause of "wet-beds". Involuntary discharge of urine (enuresis) has some times very bad effect on the per-

sonality of children. The badly infected children have a feeling of inferiority complex, become timid and are guilty conscious.

(iii) Whip-worm infection in children and some times in adolescents may also, cause "wet-beds".

6. *Mucoid vaginal discharge*—*(i)* Young girls, having heavy infection of *Enterobius vermicularis*, may often pass mucoid vaginal discharge.

(ii) Vagrant *Ascaris* worms may some time get into the female urinary—genitalia and cause serious disturbances.

(iii) Infection with *Trichomonas vaginalis* is frequently the cause of leucorrhoea with creamy white, viscid frothy discharge.

7. *Salpingitis*—*(i)* Invasion of the fallopian tubes with *E. histolytica* may be one of the causes of salpingitis, which in severe cases may proceed to ulceration, necrosis and gangrene of the tissues invaded.

(ii) Round-wrom may insinuate its way into the fallopian tubules and initiate salpingitis. The worm has been found sometimes encysted in the fallopian tubes.

(iii) The vagrant gravid females of seat-worms sometimes migrate up the vagina, uterus and fallopian tubules, where they either become encysted or penetrate into the peritoneal cavity and encyst on the peritoneum. While in tubules, the worms may some times produce symptoms of salpingitis.

8. *Vaginal and cervical amoebiasis*—Cases are on record where ulceration of vagina and uterine cervix was found to be the result of invasion with *E. histolytica*. It may be a pre-disposing factor in abortions and miscarriages.

9. *Penile amoebiasis*—Amoebic lesions of the penis have been observed in those husbands whose wives had amoebic infection of vagina and cervix.

Penile *amoebiasis* has almost exclusively been noticed amongst people who had not been cercumcised. Such patients exhibit lesions, characteristic of phagedena.

10. *Puberty*—Hook-worm infection retards, retracts or retrenches endocrine secretions. The diminished and damaged secretions delay puberty level in the community.

11. *Nosurnal emissions and Spermatorrhoea*—Long continued irritation due to *Enterobius vermicularis* and *trichiuriasis* may be a predisposing factor in the causation of abnormal night discharges in adults. Severe enterobiasis, of long duration may also similary induce spermatorrhoea.

12. *Sexual perversions*—Tickling sensation caused in some individuals by the activity of seat-worms and whip-worms may arouse sexual feeling and ultimately lead to indulgence in *masturbation* in both sexes. History of *sodomy cases*, in case of passive agents, has in some cases, been traced to infection with seat-worms and whip-worms.

Uncontrolable sex urge may arise in some case of acute *enterobiasis* and *trichiuriasis* and be responsible for serious sex crimes.

13. *Impotency*—*(i)* Damage to sexual urge and power has been attribtuted to severe hook-worm infection in some communities.

(*ii*) The vagrant *Ascaris* worms sometimes penetrate the male genito-urinary tract and cause severe damage.

14. *Abortions and Miscarriages*—(*i*) *Amoebiasis* of vagina and uterine cervix may play an important role in abortions and miscarriages.

(*ii*) Hook-worm infections may in severe cases cause abortions and miscarriages.

F. Signs and Symptoms relating to Special Sense Organs.

1. *Retinitis*—(*i*) *Ascaris* larvae, if per chance get into general circulation and pass through eyes, may cause retinitis.

(*ii*) Haemorrhagic retinitis may also be caused by hook-worm infection.

2. *Dark shades below eyes*—Tired eyes in children usually indicate several sleepless nights due to noxious *enterobiasis*. Highly disturbed children ultimately develop dark shades under their eyes.

3. *Acute conjunctivicis*—Presence of giant round-worms in the bowel may cause acute *conjunctivitis*.

4. *Photophobia* (morbid dread or fear of light)—

Presence of the giant round-worms in the bowels, intereferes with the adjustment mechanism of the eyes to light.

5. *Dimness of vision*—Well marked infection of hook-worms may give rise to dimness of eyes.

(*i*) *Strabismus*—State of having cross-eyes is common in beef-tape-worm infection

(*ii*) *Optical illusions* is of common occurrence in beef tape-worm infection.

(*iii*) *Diplopia*—Beef tape-worm infection may be responsible for double immage of the same object.

(*iv*) *Pupillary* inequality may also occur in beef-tape-worm infection.

6. *Otitis media*—If, by accident, the *Ascaris* worms pass into the eustachian tubes, they provoke *otitis media*.

G. Signs and Symptoms Suggestive of lesions of Central Nervous System and Psychotic conditions.

1. *Headache*—(*i*) Patients suffering from *balantidiasis* may have severe headache.

(*ii*) Severe *hymenolepiasis* is also cause of severe headache in young girl patients.

(*iii*) Chroni *trichiuriasis*, *strongyloidiasis* and hook-worm infections also cause dull headache.

2. *Lassitude and general malaise*—(*i*) For several weeks, in early stages of *amoebiasis*, the patient has a vague feeling of uneasiness.

(*ii*) Round-worm infections, hook-worm infections and *trichiuriasis* are also cause of uneasiness.

(*iii*) In hook-worm infection, lassitude is almost always complained of during advanced stages of the disease.

3. *Depression*—There is usually profound depression in chronic *strongyloidiasis*, round worm infections and severe hook-worm disease.

4. *Neurasthemia*—Chronic intractable intestinal *amoebiasis* may establish a state of neurasthenia in some patients.

5. *Restlessness*—(*i*) Twitching and restlessness occurs in *ascariasis*. It is said to be due to the absorption of metabolites and foreign proteins from the worm by sensitive persons.

(*ii*) In chronic *strongyloidiasis*, a patient may become restless if auto-infection occurs uninterruptedly.

(*iii*) Restlessness is a common feature in *enterobiasis*. 99·9 per cent experience it and 0·1 per cent who do not, are liars because of a feeling of shame and inferiority complex.

6. *Insomnia*—(*i*) Severe *balantidiasis* may predispose victim to insomnia.

(*ii*) Severe and constant pruritis due to *enterobiasis* may also cause insomnia in children.

(*iii*) Abnormal wakefulness also occurs in *trichiuriasis*.

(*iv*) A patient suffering from chronic *strongyloidiasis* may also complain of sleeplessness.

(*v*) Foreign proteins derived from *Ascaris* worms, when absorbed in the system, also cause insomnia in senstive persons.

(*vi*) Severe *hymenolepiasis* also is one of the causes of sleeplessness in children.

7. *Convulsions*—(*i*) Very sensitive children having severe *enterobiasis* may have attacks of convulsions.

(*ii*) Heavy *hymenolepiasis* may also be responsible of convulsions in children.

(*iii*) Heavy *ascariasis* in children is some—times cause of severe attacks of convulsions and death.

8. *Neurotoxic symptoms*—(*a*) *Melancholia* may be induced in repeated and heavy hook-worm infections.

(*b*) *Apathy* is somtetimes attributed to severe hook-worm infection.

(*ii*) Mental apathy may also occur in *amoebiasis*.

(*c*) *Sympathetic neurosis*—(*i*) Getz (1945) has attributed sympathetic neurosis to whip-worm infection.

(*ii*) In occasional infantile *trichiuriasis* there is marked nervousness.

(*iii*) Reflexes are usually exaggerated in whip-worm infections.

(*d*) *Mental dullness*—(*i*) Children having severe hook-worm infection are comparatively dull than those who are not carrying the worms. Intelligence quotient was found to vary remarkably with the intensity of infection.

(*ii*) Nervous manifestations in children due to heavy *hymenolepiasis* are also well marked.

(*e*) *Meninges and choroid plexus*—Filiform larvae of thread-worms (*Strongyloides stercoralis*), when fail to penetrate through the pulmonary capillaries to reach alveoli, may migrate into pulmonary venules and gain access to the general circulation and may reach anywhere in the body. Their presence in cerebral blood vessels, and, perivascularly, in pools of blood, in the cerebellar mininges, and choroid plexus has been demonstrated by Yamaguchi (1925) and Faust (1935).

(*f*) *Angio-neurotic oedema* has been frequently reported in late stages of *Ascaris* infection. It is attributed to strong sensitization to the worm.

(*g*) *Meningismus* may be caused by the absorption of toxic secretions/excretions (*ascarions*) in case of round-worm infections. Symptoms simulating encephalitis may or may not coexist in such cases.

(*h*) The seat-worms erode caecal mucosa, expose sympathetic nerve endings, and ultimately cause nervous reactions in children.

9. *Neuropathy*—A variable types of neuropathies may occur in beef-tape-worm infection.

(*i*) *Chorea*—Characteristic twitching tremors and odd purposeless movements, simulating chorea, may occur in certain cases of beef-tape-worm infections.

10. *Epilepsy*—(*i*) Occasional epilaptic fits may occur in children carrying a heavy load of whip-worm infection.

(*ii*) Epileptic fits may also be due to *Ascaris* larvae, when accidently got into general circulation and migrate through the capillaries of the brain.

(*iii*) Heavy laod of *Hymenolepis nana* is also frequent cause of epileptiform—fits in delicate children.

(*iv*) Epileptic fits may also occur in beef-tape-worm infections.

11. *Brain abscess*—Single or multiple brain abcesses may occur in *amoebiasis* and very rarely in case of infection with *Iodamoeba butschilii*.

It is commonly haematogenous in origin but may be concomitant with amoebic abscess of liver or lungs.

12. *Idiocy*—(*i*) Children suffering from chronic *ascariasis* have been shown to be mentally less alert. After removal of worms, the scholastic ability usually improves considerably.

(*ii*) The proportion of idiots is more in hook-worm stricken communities than in those where the disease is not endemic.

13. *Night mares*—(*i*) Heavy infection with seat-worms may initiate nervous disorder resulting in the manifestation of night-mares in children.

(*ii*) Children having round-worms have also severe night-mares.

14. *Tinnitis*—Tinnitis is complained of in severe *ancylostomiasis*.

15. *Vertigo* (*Dizziness*)—(*i*) 20—30 per cent of the children carrying a heavy load of whip-worm infection suffer form vertigo.

(*ii*) Heavy infection of *Hymenolepis nana* in children induces a sensation of whirling or unsteadiness. The dizziness is frequently attended by nausea, vomiting and weakness.

(*iii*) Vertigo is frequently complained of in advanced cases of hook-worm infection.

16. *Meningitis*—Meningitis is one of the common manifestations in *ascariasis*.

17. *Invasion of brain*—Some workers have encountered round-worm astrayed into brain substance.

18. *Neurotoxic Symptoms*—(*i*) At least 25—30 per cent patients suffering from whip-worm infection show one or the other symptoms which may be referrable to neurotoxic manifestations.

(*ii*) Absorption of metabolic waste in dog-tape-worm infection generally causes toxic nervous manifestations in children.

19. *Systemic intoxication*—(*i*) The absorbed products of *Taenia saginata* create systemic intoxication in the patients.

(*ii*) Waste metabolites in dog-tape-worm infection may also evoke systemic intoxication.

(*iii*) Systemic intoxication has also been encountered in patients carrying dwarf-tape-worms (*Hymenolepis nana*).

H. Biochemical Changes in Body Fluids.

1. *Hypercholesterolaemia*—Some workers have noticed hypercholesterolaemia in advanced hook-worm infections.

2. *Hypoproteinaemia*—Hypoproteinaemia is also one of the serious signs in advanced cases of *ancylostomiasis/necatoriasis*.

3. *Pre-eclamptic/toxaemia and eclampsia*—Advanced cases of hook-worm infection exert deleterious effect on the kidneys, which may ultimately lead to toxaemias of pregnancy such as pre-eclamptic toxaemia and eclampsia.

I. Behaviouristic Symptoms

(*a*) *Nail-biting* occurs commonly in *enterobiasis* and latter may develops into a habit.

(*b*) *Nose-picking* habit commonly occurs in *enterobiasis*.

(*c*) *Grinding of teeth* at night occurs in *enterobiasis*, *ascariasis* and hook-worm infections.

(*d*) *Inattention*; loss of concentration is a common feature of severe infection of *enterobiasis* in children.

(*e*) *Masturbation* : considerable proportion of children get into this habit as a result of noticeable scratching of the anal region in *enterobiasis*.

J. Granulomatous Reactions

(*i*) *Ascaris* larvae, which are normally not used to invade human body and are ingested accidently, in their zeal to adapt to new environments, may wander about

into unnatural foci and usually get trapped there and elicit chronic inflammatory reactions, frequently providing granulomatous masses and simulating neopsaltic growths. Some times a clinician is tempted to diagnose a mass of round-worms as a new growth.

(*ii*) Similarly in chronic *amoebiasis*, a granulomatous tumour appears in the rectum which unless subjected to biopsy is confused with cancer of the rectum.

(*iii*) *Nasal polypi*—Invasion of nasal mucosa with *E. histolytica* may provoke chronic inflammatory granulomatous hyperplastic reaction, leading to formation of nasal polypi.

K. Febrile Reactions

(*i*) *Amoebiasis* does not only give local pain, if viscera are involved, but also accompanied with fever. Low grade fever however, usually occurs with hepatic *amoebiasis*.

(*ii*) Low grade fever may be found in *D. fragillis* infection.

(*iii*) Moderate febrile reaction (99—101°F) may be found in whip-worm infection.

(*iv*) Low grade, intermittent or subcontinued type of fever usually occurs in hook-worm infections.

(*v*) There is always elevation of temperature to 102·9—104°F (39·4—40°C) with rapid, shallow, irregular respiration of asthmatic type, accompanied with frequent spasms of coughing, bronchiolar rales and physical signs of lobular involvement, usually lasting for 1-2 weeks in *ascariasis*.

The presence and activity of *ascariasis* in young children may be characteristically associated with low grade fever.

L. Sub-normal Temperature

The patient suffering from hook-worm infections, may have sub-normal temperature and their body may feel cold even in hot weather.

M—Spontaneous Expulsion

(*i*) The *Ascaris* adults may some times pass out spontaneously per anus in some patients. It may occur either due to slight dietary indiscretions or due to disturbed digestion. The wandering worms may also be vomited. At times they also manage to pass through the nares and cause alarming sequelae in children.

(*ii*) Patients carrying *T. saginata*, from time to time, sometimes frequently and even daily, pass gravid segments in their stools but may also pass out spontaneously while the patient is sitting or standing. If such thing happens, while one is sitting with friends, one becomes nervous and feels small.

N—Miscellaneous

1. *Splenomegaly*—Spleen may be enlarged due to amoebic abscess of the organ or due to thrombosis of portal vein in cases of chronic hepatic *amoebiasis*.

2. *Spleen abscess*—In rare cases, spleen may be the site of infection with *E. histolytica*, resulting in the formation of an abscess the parasites being carried through blood circulation from primary amoebic foci in the intestinal tract.

3. *Adrenal, nephritic, ureteric, vesicular and urethral abscesses* may also be formed due to invasion with *E. histolytica*, haemmatogenously.

4. *Ascites*—Chronic amoebic liver abscess, in the neighbourhood of portal fissure, may induce thrombosis in the portal vein and lead to ascites.

5. *Sigmoido-vesical fistula*—This has been observed in very rare cases of chronic intestinal *amoebiasis*. This condition is invariably accompanied by the formation of adhesions with neighbouring structures.

6. *Paraplegia* may be due to invasion of motor area of brain with the round-worm larvae.

O—Signs and Symptoms due to Nutritional Deficiencies and Disorders

1. *Avitaminosis*—Marked Signs of avitaminosis may occur in prolonged *hymenolepiasis*. It is the result of continued poor intake of food.

2. *Muscular Weakness*—(*i*) *Balantidiasis* of long duration, lowers physical conditions of the patient and muscular weakness is one of the common complaints.

(*ii*) Children suffering from *ascariasis* are usually physically less developed. With the removal of the parasite, the general condition speedily improves, the metabolism is corrected, the nutrition level rises and the children becomes physically fit and mentally alert.

3. *Emaciation*—(*i*) There is usually considerable loss of weight in *balantidiasis*.

(*ii*) in *giardiasis*, if accompanied with chronic diarrhoea, there is always constant loss of weight in children. It is attributed to dehydration.

(*iii*) Rapid loss of weight may occur as prodromal episode of diarrhoea in *amoebiasis*, hepatic involvement and perforation of the liver abscess usually aggravates the condition. Emaciations may be well marked in these patients who worry and resort to unbalanced diet.

(*iv*) Twenty-five per cent cases of *trichiuriasis* are under weight. In some cases, there is marked emaciation and dry-ness of skin.

(*v*) General emaciation of the body, combined with oedema of the face, is one of the characteristic features of *ancylostomiasis/necatoriasis* and there is notable loss of weight in children.

(*vi*) Constant annoyance caused by the wandering females of *E. vermicularis* is also responsible for the constant loss of body weight in children.

(*vii*) Loss of body weight has also been observed in heavy infection of *Taenia saginata*.

4. *Prostration*—Great depression (and exhaustion) of the vital functions is one of the symptoms in acute *amoebiasis.*

5. *Lumbago*—Presence of whip-worms may some times cause continuous pain in the *lumbar region* of the child patients.

From the foregoing narration of signs and symptoms, that may be associated with or consequent upon parasitic infection of gastro-intestinal tract, it seems apparent that practically few lesions and abnormalities of any system of human body have been spared to which one or more combination of the signs and symptoms of intestinal parasitic infection do not coincide. The signs and symptoms of an infection of the digestive tract may sometimes be so misleading that an average clinician is apt to concentrate his attention to the investigation of the system to which they usually pertain. It is quite possible that the parasitic infection may co-exist with any disease complicating the clinical picture and thus confusing the mind of the clinician or, that signs and symptoms of intestinal parasitic invasion may aggravate those of another disease to which they simulate and in this way the clinician may be misled to misjudge the prognosis. But the greatest misfortune comes when, due to utter disregard of the possibility of a particular medical or surgical emergency being the result of intestinal parasitic invasion, the clinician is tempted to go ahead with his usual line of treatment often with disasterous results. Perforation of intestines, causing peritonitis or peritoneal abscess by round worms, appendicities by *E. histolytica*, *Enterobius vermicularis*, lung abscess and empyema by *E. histolytica* or round worms or oedema glottis by *Ascaris* worms in the course of their migration towards the mouth are some of the classical examples which may be cited in this connection. It would, thus be clear, that if the clinician wants to avoid the chances of a dangerous situation, a careful stool examination by a highly experienced clinical pathologist of all patients is an absolute necessity. A single stool examination, if found negative, must be repeated if the circumstances of the case so require.

It warms the very sickness in my heart.
that I shall live and tell him to his teeth,
"Thus diddest thou". (Shakespear).

Method and Material

An ideal method of stool collection is that the individuals, who are to be examined should come to the laboratory to daefecate. A dose of saline purgative (we generally recommend Mag. Sulph.) if administered a couple of hours before, will help in the recovery of the stool sample from the right person. We have recorded more frauds in stool supplies than we have heard of for other commodities. In another survey, not so far published, we experienced that "substitution of other human or animal stools" is not an uncommon practice. Most of the mothers, in this country, due to certain fags and superstitions, usually refuse point blank to give the stool samples of their children. Not infrequently, we were supplied the stools of a servant or an old great grand granny, divided in several faecal containers and labelled as (1) *Ghazala* (12 yrs); (2) *Ghayur* (10 yrs); (3) *Ghias* (7 yrs); (4) *Ghosia* (3 yrs) and etc., etc. This experience unfortunately came from one of the very highly cultured family, living in elite quarters of Lahore. We are now amply used to the rhythms of sarcastic remarks and dare not grumble at these here. We know

"a double-blessing is a double-grace". It will not be out of place to mention that on the other hand we had a tame success with a warry mother in obtaining a stool sample of the child complaining of tooth-ache. For this success we owe a sense of gratitude to one of our colleagues in *"practicing field."* This instance gives us a glimpse of attitudes. Our intelligentia even, does not understand that a stitch in time saves nine. They do not mind a pound for cure but grudge a penny for prevention. Probably they do not want to be conscious of the coming events, as it makes cowards of us all. But we will also remind them the poet of young who said "Pygmies are pygmies still, though perched on alps."

Alas, regardless of their doom,
The little victims play!
No sense have they of ills to come,
Nor care beyond today. (Gray).

The conservancy staff of the City Corporation of Lahore collects daily at a centre. From this place, their chief deploys them for duty. We made use of this situation for these studies with his active co-operation.

The conservancy staff was fully briefed of the devastating activities of the intestinal parasites and damage feared to the community. The aims and objects of the fact-finding programme were fully made known to them. Special instructions were also given regarding the collection of the stools samples. This briefing in our experience worked well in creating an "acceptance attitude." All out co-operation was not only promised but also came forth as a spontaneous action and our procedure was simplified. A group of persons (as many as could be conveniently examined every day) was given labelled collection jars a day before examination, with the instructions that the jar (with the stools in it) will be brought next day to the depot and delivered to the laboratory man on duty. At the time of collection, a brief history and necessary details of each donor was also entered on the correspondingly numbered *pro forma* on the spot. The distribution of bottles to the fresh batch were also made at this time. The whole work was carried out under the strict supervision of the Chief Sanitary Inspector-in-Charge of the conservancy staff.

Gross inspection of each stool sample was made to know the consistency and component elements before subjecting it to miscroscopic examination.

For direct examination, small lump of stool was mixed in concentrated solution of NaCl (Sp. gr. 1,200) in a 15 ml capacity specimen tube. A clean 22 × 22 mm. square cover slip was super imposed on the top of the film. The cover slip, after 20—30 minutes was removed and placed on a clean microscope slide for examination. Each examination was made for 10—15 minutes under high power before it was stained with a drop of lugol's iodine to study the diagnostic features of parasites present. This method usually gives information about these parasites which are far the largest in number in the case under study. Slight and neglegible infections are, however, invariably missed. In surveys, we are interested in knowing what ordinarily we do not bother to find, i.e. over-all quality of parasite load in the community.

In some cases, a small lump of the stool was emulsified in a drop of physiologic saline (normal salt solution) on a slide. A portion was stained with Lugol's iodine and a portion

was left unstained. Each portion was then covered with a separate cover slip. Precautions were taken that a film of *reading opacity* was obtained in each case.

A garden-pea size of the stool sample was well macerated with a glass rod - in tap water or physiological solution (with 10 parts of water or physiological salt to each part of sample in a centrifuge tube and spinned at a moderate speed (1500—2000 r. p. m.) for 1-2 mts. The supernatant liquid was poured off. Two to three spinings were done before final examination.

Zinc Sulphate centrifugal-floatation technique although considered by some to give better results did not give any substantial advantage over the direct method was not therefore, used extensively.

Polyvinyle Alcohol fixative (PVA) and MIF (Merthiolate-iodine-Formaldehyde) fixative-stain were also not used.

We must admit, that the methods we made use of do not pretend to give the exact number of parasites harboured by the case but these techniques do furnish an approximation, which makes it possible to classify the cases. The relative severity of the parasites was conveniently ascertained from the number of cysts/ova per field. The presence of each parasite was categorically graded into light, mild, moderate, heavy and severe infection in the light of their presence *viz.*, one in several fields, 1-2 in each field, 2-3 in each field, 3-4 in each field, or 4 and above in each field on an average.

All these examinations were made for 41 days, commencing from February 16 through March 29, 1963. A perusal of table V will show that Lahore has minimum number of clinical cases of diarrhoea and dysentery during this part of the year. During this period the climatic conditions and other factors conducive to higher incidence of gastro-intestinal disorders are least favourable. It is to be pr sumed that the incidence of clinical manifestations of the pre-existing parasitic infections as well as factors favourable for transmission of parasites are comparitively few during this period.

Original Observations

"I cannot confirm the public charge against him, to help. Avenge the dark murder."
(Sophocles: Oedipus Rex).

A. Incidence of all species of intestinal parasites—

The incidence of various intestinal parasites in the conservancy staff of the City Corporation, Lahore (based on one, normally passed stool examination, both by direct and concentration methods) is presented in table VII.

It may be considered as a most conservative estimation, because consensus of opinion warrants that at least six repeated examinations should be made before to be certain that a possible infection has not been missed. To obtain a satisfactory diagnosis, a microscopist needs to be slow and steady because in survey work, the examination is something more than mere routine. In our experience, repeated examinations do not ordinarily add significantly to what may be discovered in two-direct and one concentration methods. For all practical purposes, therefore, we may take these figures as true approximations.

During this survey, we found that 89·75 per cent of the total number of conservancy staff examined, were infected with either protozoan or helminthic parasites. The majority

were, however, found carrying helminthic parasites.

The table illustrates most graphically that we could recover only five species of protozoas and six species of helminths.

1. *Protozoan parasites*—55·13 per cent of the persons examined were found carrying protozoal parasites—

(*i*) The outstanding feature of this survey for intestinal parasites is that although *Entamoeba histolytica* is one of the much more talked about protozoan parasites in this country, yet the figures obtained in this survey do not seem to present any serious situation. Out of 86 persons with protozoan infection, only 8 or 5·13 per cent had *E. histolytica*. In all of these positive cases, the infection level was of very low degree and the form of the parasite involved was small. We did not prepare any permanent stained preparation and therefore, could not ascertain the race involved. None of the positive cases complained of any abdominal distress, diarrhoea or dysentery at the time of examination nor gave a history of dysentery, having occurred on any previous, or very recent past occasion. These were not dysenteric convalescents. Shall we look upon these cases as potential sources of danger to the community or consider them carriers of a closely allied commensal amoeba (*E. hartmanni* or non-pathogenic small strain of *E. histolytica*. We wonder, if small strain of pathogenic *E. histolytica* is of common occurrence and is decidedly a separate and stable entity. Morphological differences—position of karyosome, character of encrusted chromatin on the periphery of the nuclear membrane, character of chromatoidal bodies, presence of glycogen mass and structure of vacuolation in cysts are better appreciated in haematoxylin stained slides. To differentiate variants in routine surveys is something which appears more of cheating than real.

(*ii*) *Entamoeba coli* was found only in 20·52 per cent cases. The infection rate in all cases remained light. In few odd cases the infection level was found of mild grade.

(*iii*) *Iodamoeba butschlii* occurred in 15·29 per cent cases. The quality of infection was again, generally of light or mild nature. In two persons, however, the infection was found to be of moderate or heavy degree. This amoeba is of doubtful importance. It was once suggested, that the motile forms may sometimes invade intestinal wall and taken to extra-intestinal viscera and initiate lesions. We failed to encounter any case with symptoms.

(*iv*) *Endolimax nana* was found to be most uncommon. This amoeba is most delicate and does not survive long under unfavourable extrinsic conditions. These studies were made during early spring. If the dry and moderately cold climat accounts for the low incidence; it will be answered in surveys to be conducted during an other season. Light infection was discovered in one

solitary case.

(v) *Giardia intestinalis* was the only one species of flagellates, which was found during these studies. Out of 86 persons carrying protozoan parasites, 45 were passing cysts of the duodenal flagellate. 29 per cent of the infections, appears to be an unusually high incidence in an adult group. These observations lead us to suspect this infection to be strongly endemic in Lahore. As far as we remember the infection rate in adults elsewhere usually varies from 1—10 per cent. In very few surveys however, the incidence was found to be 20—30 per cent. We should expect much higher incidence in children.

These flagellates are reported to feed on the mucous secretions. Their presence and constant irritation to the glandular crypts is not considered to give an evidence of duodenal disturbances. In our experience it does manifest dull abdominal distress and periodic loose bowels. The trouble has been periodically well marked in children than in adults. This survey, however, did not lend us any support to understand the symptoms initiated by this parasite alone.

2. *Helminthic parasites*—The conservancy staff of the city Corporation of Lahore was found infected with six different types of helminths. Out of 156 persons examined, 112 (71·8 per cent) were found carrying one or the other of these parasitic worms.

(i) Highest number of cases suffering from helminthiosis were infected with hook worms. Since this report is exclusively based upon the recovery of eggs in the stools, an attempt to identify the species involved was not made. However, on our previous experience we may mention here that in Lahore both *Ancylostoma duodenale* and *Necator americanus* are present. The old world form predominates, fairly widely, over the American murderer which may occur in negligible few numbers.

Ahmadet el (1959) found 454 males and 924 females out of 1378 adults isolated, two of which, however (one male and a female) were *N. americanus*. In another communi- cation, it is reported that for every 500 *Ancyclostomas* there occur 1000 *Necators* in Indo-Pakistan sub-continent. From a study of the socio-economic level of this community, its cultural pattern, appropriate conditions of the surrounding fields and suitability of meteorological conditions, we may probably get an answer to the high incidence.

We did not try to find out the intentity of hook worm infection in any of the 69 positive cases found. We always wished to know the worm burden in these cases by one of the egg count techniques but could not manage easily in the midst of great, mural and extral mural stress. Light, mild, moderate, heavy and severe cases of infection shown in the table I are based on the number of eggs found per field and the clinical symptoms presented by the positive cases. We hope to fulfil this desideratum in some of our next attempts.

(*ii*) *Ascaris lumbricoides* is one of the most familiar parasite of the Lahorites. We have yet to come across a man who would say that he did never pass "earth worm" like nematod in his life time. According to Stoll 488 million cases, constituting approximately 75·78 per cent of the total world cases, occur in Asia alone.

More or less one third of the total persons examined had round worms. The infection, however, was found to be of mild or moderate grade.

(*iii*) *Enterobius vermicularis* is also one of the most common parasites. About seat worm we always feel that on inter ogation 99·9 per cent will claim of having *enterobiasis* and 0·1 per cent who will deny will be either liars or shy. The eggs of these worms are seldom present in more than 5·10 per cent stools of infected individuals. For significant results, perianal scrapings or Grahams swab may be examined soon after the subject awakens in the morning. It is amazing to us that in this survey, the coprological examination gave us 14·74 per cent infection. According to Stoll the incidence of *enterobiasis* in Asia is 32·5 millions, and constitutes 15·5 per cent of the world figure.

(*iv*) *Trichocephalus trichiurus* is usually common parasite in Lahore but it was most unexpected experience for us to find it only in one person in this group.

Stoll has stated that 355·1 million persons in the world suffer from whip-worm annually, out of which 63·93 per cent inhabit Asia alone. Ordinarily the incidence and intensity of trichuriasis is on an average high in areas of high rainfall, high humidity and dense shade. The eggs do not survive long in temporary drought and heat. Direct sunlight and severe cold kills them. Cannot do well in decomposing organic matter or on heavy soil, cinder, ashes and dust either.

(*v*) *Hymenolepis nana* occurs more commonly in you ng age groups than in advanced age groups.

According to Stoll, 20·2 millions people of the world suffer from *hymenolepiasis* annually. It is said to be particularly common in Indo-Pakistan sub-continent. The incidence in the community under discussion, was found to be 4·49 per cent, which was considerably lower than what we have observed in routine examinations. However, we should not forget that both, the incidence and the intensity of the infection, are considerably high in children. In endemic areas the adults gradually develop resistance to its infection. There is definite resistance to super-imposed infections also. The continued high infections are attributed to *inter-auto-infections*.

(*vi*) *Taenia saginata* is responsible for beef taeniasis particularly in Muslim countries. According to Stolls' most conservative estimate, 38·9 millions persons of the world, annually fall a prey to the depredations of beef-tape-worm. Although an average Pakistani claims to consume thoroughly cooked beef, yet there is no dearth of such people (usually in urban population alone) who relish only smoked *tikka-kababs, seish-kababs*, pickled and salted hunter beef. The number of beef-tape-worm infections today are steadily increasing in those Lahorites, who have a fancy for these meat preparations. Most of the conservancy staff of the city Corporation of Lahore cannot either afford to eat *Kababs* or due to some religious restrictions and taboos (specially *Balmikis*) do not take meat at all. Negligible infection rate found in this community is a mere reference to the situation.

TABLE VII

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES IN THE STOOLS OF CONSERVANCY STAFF EXAMINED—CONTD.

Entamoeba histolytica	*Entamoeba coli*	*Iodamoeba butschlii*	*Endolimax nana*	*Giardia intestinalis*	*Hook worms*	*Hymenolepis nana.*	*Ascaris lumbricoides*	*Enterobius vermicularis*	*Trichocephalus trichiura*	*Taenia saginata*	Age (in years)
..	..	..	..	..	..	..	2	..	..	..	16
R	..	R	..	R	..	..	..	..	..	..	16
R	..	R	..	R	..	..	3	..	..	..	16
..	R	..	..	..	..	..	..	..	..	..	17
..	..	..	..	..	1	..	2	..	..	..	17
..	R	R	..	R	1	..	1	..	..	..	17
..	..	..	..	R	..	..	2	..	..	..	17
R	..	R	..	..	..	..	..	R	..	..	18
..	R	R	..	..	2	..	3	..	..	..	18
R	..	..	..	..	..	..	..	..	..	..	18
..	..	..	..	..	..	..	2	..	..	..	18
..	R	..	..	..	..	..	1	..	..	..	18
..	R	..	..	..	1	..	..	..	..	..	18
..	..	..	..	..	1	..	2	..	..	..	18
..	..	..	..	R	..	..	1	..	..	..	18
..	..	..	..	R	..	..	1	..	..	..	18
..	..	..	..	..	..	..	1	..	..	..	18
..	..	..	..	..	..	..	1	..	..	..	18
..	..	..	..	..	1	1	2	..	..	..	18
..	..	..	..	R	..	..	2	1	..	..	18
..	..	..	..	..	R	..	..	..	..	..	18
..	R	..	..	..	..	..	..	..	..	..	18
..	..	..	..	R	1	..	..	..	..	..	18
..	..	..	..	..	R	..	..	..	..	..	18
..	R	..	..	..	..	..	2	..	..	..	18
..	..	R	..	..	R	..	..	..	..	..	18
..	R	..	..	R	..	..	1	..	..	..	18
..	..	..	..	..	1	..	1	..	..	..	18

TABLE VII—contd.

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES IN THE STOOLS OF CONSERVANCY STAFF EXAMINED.—CONTD.

Entamoeba histolytica	*Entamoeba coli*	*Iodamoeba butschlii*	*Endolimax nana.*	*Giardia intestinalis*	*Hook worms*	*Hymenolepis nana*	*Ascaris lumbricoides*	*Enterobius vermicularis*	*Trichocephalus trichiura*	*Taenia saginata*	Age (in years)
..	..	R	R	..	..	..	..	..	..	..	18
..	R	..	..	..	..	..	..	..	..	..	18
..	..	..	..	..	..	..	..	..	..	..	18*
..	..	..	..	..	1	..	2	..	..	..	18
..	..	..	..	..	1	..	..	..	..	..	18
..	..	..	..	..	1	..	..	..	..	..	18
..	..	..	..	..	..	..	2	..	..	..	18
..	..	..	..	R	1	..	2	..	..	..	18
..	..	..	..	..	..	1	..	1	..	..	18
..	..	..	..	..	..	..	1	..	..	..	18
..	..	..	..	3	..	..	..	1	..	..	18
..	..	..	..	..	..	..	..	..	..	..	19*
..	1	..	..	..	2	..	..	..	..	..	19
..	R	R	..	..	1	..	..	..	..	..	19
..	R	..	..	R	..	..	1	..	..	..	19
..	..	..	..	..	..	..	1	..	..	..	19
..	..	..	..	..	1	..	1	..	..	..	19
..	..	..	..	..	..	..	..	..	..	..	19*
..	R	..	..	R	..	..	..	..	..	..	19
R	R	..	..	..	1	..	..	..	..	..	19
..	..	..	..	..	1	..	..	..	..	..	20
..	..	..	..	..	..	..	2	2	..	..	20
..	..	..	..	R	R	..	..	..	..	..	20
..	..	..	..	..	..	..	1	..	..	..	20
..	..	..	..	..	..	..	1	..	..	..	20
..	..	..	..	..	..	..	1	..	..	..	20
..	..	..	..	..	1	..	..	..	..	..	20

TABLE VII—contd.

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES IN THE STOOLS OF CONSERVANCY STAFF EXAMINED—CONTD.

Age (in years)	*Entamoeba histolytica*	*Entamoeba coli*	*Iodamoeba butschlii*	*Endolimax nana*	*Giardia intestinalis*	*Hook worms*	*Hymenolepis nana*	*Ascaris lumbricoides*	*Enterobius vermicularis*	*Trichocephalus trichiura*	*Taenia saginata*	Age (in years)
18	..	..	..	..	R	2	..	..	..	..	..	20
18	..	R	R	..	..	..	..	1	..	..	..	20
18	..	R	..	..	R	..	..	1	..	..	..	20
18	..	..	..	..	R	..	..	..	1	..	..	20
18	..	..	..	..	R	..	..	..	..	..	..	20
18	..	..	..	..	..	1	..	..	1	..	..	20
18												
18	5	16	9	1	18	23	2	31	7	..	..	59
18												
18	..	..	..	..	R	1				..	..	21
18	..	..	3	..	..	..	1	..	..	..	..	22
19*	..	..	..	..	..	1	..	..	..	..	..	22
19	..	..	..	..	..	..	..	1	..	..	..	22
19	..	R	..	..	..	..	..	..	..	..	..	22
19	..	..	R	..	..	1	..	..	..	..	..	22
19	..	..	..	..	..	..	1		..	..	..	22
19	..	..	..	..	..	1	..	1	..	..	..	22
19*	R	R	R	..	R	..	..	..	1	..	..	23
19	..	..	..	..	R	..	..	..	..	..	..	23
19	..	..	..	..	..	1	..	..	..	..	..	23
20	..	..	R	..	..	..	..	..	..	..	..	23
20	R	R	4	..	R	..	..	..	2	..	..	23
20	..	R	..	..	..	1	..	2	..	..	..	24
20	..	R	R	..	..	..	..	..	..	..	..	24
20	..	..	R	..	..	1	..	..	..	..	..	24
20	..	R	..	..	..	4	..	..	..	..	..	24
20	..	..	..	..	..	..	..	..	..	..	..	24*
20	..	R	..	..	..	..	..	..	..	..	..	24

TABLE VII—contd

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES IN THE STOOLS OF CONSERVANCY STAFF EXAMINED—CONTD.

Entamoeba histolytica	*Entamoeba coli*	*Iodamoeba butschlii*	*Endolimax nana*	*Giardia intestinalis*	*Hook worms*	*Hymenolepis nana*	*Ascaris lumbricoides*	*Enterobius vermicularis*	*Trichocephalus trichiura*	*Taenia saginata*	Age (in years)
..	..	R	..	R	..	..	1	..	..	..	24
..	..	..	..	..	2	..	..	..	..	..	24
..	..	R	..	R	1	..	..	..	..	..	24
..	..	..	..	..	..	..	1	..	..	..	24
..	..	..	..	..	..	..	1	..	..	..	24
..	..	..	..	R	1	..	1	..	..	..	24
..	..	..	..	..	..	..	1	..	..	..	24
..	..	..	..	..	1	..	R	..	..	..	24
..	..	..	..	R	1	..	..	..	..	..	24
..	..	R	..	..	..	..	..	..	..	..	25
..	..	..	..	..	..	..	..	..	..	..	25*
	R	..	..	..	1	..	..	..	..	..	25
..	..	..	..	R	1	..	..	1	..	..	25
..	..	..	..	..	..	..	..	..	..	..	25*
..	R	..	..	..	1	..	1	..	..	..	25
..	..	..	..	R	3	..	2	..	..	..	25
..	R	..	..	R	1	..	1	..	..	..	25
..	..	..	..	..	..	..	..	..	..	..	25*
..	..	..	..	..	..	..	..	1	..	..	25
..	R	..	..	..	..	..	..	1	..	..	25
2	11	10	..	11	18	2	12	5	..	..	39 cases
..	1	..	..	..	2	..	..	..	..	..	26
..	..	..	..	..	..	..	1	..	..	..	26
..	1	..	..	..	1	..	..	..	..	..	26
..	..	..	..	..	1	..	1	..	..	..	27
..	..	..	..	..	..	..	..	1	..	..	27
..	..	..	..	R	..	1	1	..	..	..	27
..	..	..	..	..	1	..	..	..	..	..	27

TABLE VII—contd.

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES IN THE STOOLS OF CONSERVANCY STAFF EXAMINED—CONTD.

Entamoeba histolytica	*Entamoeba coli*	*Iodamoeba butschlii*	*Endolimax nana*	*Giardia intestinalis*	*Hookworms*	*Hymenolepis nana*	*Ascaris lumbricoides*	*Enterobius vermicularis*	*Trichocephalus trichiura*	*Taenia saginata*	Age (in years)
..	..	..	..	..	I	..	..	..	..	..	27
..	..	..	..	1	1	..	..	..	..	..	27
..	..	..	..	..	I	..	..	..	..	..	27
..	..	..	..	..	I	..	..	..	..	..	28
..	..	..	..	..	1	..	1	..	..	..	28
..	..	..	..	..	..	..	..	..	..	..	28*
..	..	..	..	..	..	..	..	..	..	..	28*
..	..	..	..	..	..	..	..	..	..	..	28*
..	..	..	..	..	I	..	..	..	..	..	30
..	..	R	..	..	..	..	..	..	..	..	30
..	..	..	..	..	..	..	..	.	..	..	30
R	..	R	..	..	..	..	..	..	..	..	30*
..	..	..	..	R	..	..	..	..	..	..	30
..	..	..	..	..	..	..	2	1	..	..	30
..	..	..	..	R	1	..	1	..	..	..	30
..	..	..	..	..	..	..	..	..	..	..	30*
..	..	..	..	R	1	..	..	..	..	..	30
1	2	2	..	5	12	1	6	2	..	..	24 cases
..	..	1	..	..	1	..	1	R	..	1	31
..	R	..	..	..	1	..	..	..	..	..	35
..	..	..	..	..	..	..	..	1	..	..	35
..	..	..	..	..	3	..	..	..	..	..	35
..	..	..	..	R	..	..	..	..	..	..	35
..	..	..	..	..	1	..	..	1	..	..	35
..	..	..	..	..	..	..	..	1	..	..	35
..	1	1	..	1	4	..	1	4	..	1	7

TABLE VII—contd.

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES IN THE STOOLS OF CONSERVANCY STAFF EXAMINED CONTD.

Entamoeba histolytica	*Entamoeba coli*	*Iodamoeba butschlii*	*Endolimax nana*	*Giardia intestinalis*	*Hook worms*	*Hymenolepis nana*	*Ascaris lumbricoides*	*Enterobius vermicularis*	*Trichocephalus trichiura*	*Taenia saginata*	Age (in years)
..	1	..	..	R	..	1	1	1	..	..	38
..	..	..	..	..	..	..	1	..	..	..	38
..	..	..	..	R	1	..	..	..	..	..	38
..	1	..	..	..	1	..	..	R	..	..	40
..	..	..	..	..	..	..	..	..	..	..	40*
..	..	..	..	R	1	..	..	..	..	..	40
..	2	..	..	3	3	1	2	2	..	..	6 cases
..	R	..	..	..	..	..	..	..	..	..	42
..	..	..	..	..	1	..	..	..	..	..	45
..	..	..	..	..	..	..	..	..	..	..	45*
..	1	..	..	..	1	..	..	..	..	..	45
..	..	..	..	..	1	..	..	..	..	..	45
..	..	..	..	..	..	..	..	..	..	..	45*
..	2	..		..	3	..	..	..	..	..	6 cases
..	..	R	..	..	..	..	..	..	..	..	50
..	..	..	..	R	..	..	..	..	..	..	50
..	..	R	..	..	..	..	..	..	..	..	50
..	..	..	..	R	..	..	1	1	..	..	50
..	..	..	..	..	..	..	..	..	..	..	50*
..	R	..	..	..	..	..	..	1	..	..	50

TABLE VII—concld.

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES IN THE STOOLS OF CONSERVANCY STAFF EXAMINED—CONCLD.

Entamoeba histolytica	*Entamoeba coli*	*butschli*	*Endolimax nana*	*Giardia intestinalis*	*Hook-worm*	*Hymenolepis nana*	*Ascaris lumbricoides*	*Enterobius vermicularis*	*Trichocephalus trichiura*	*Taenia saginata*	Age (in years)
..	..	..	..	R	..	..	..	..	..	..	50
..	..	..	..	R	..	..	3	..	..	..	50
..	..	..	..	..	1	..	..	1	..	..	50
..	1	..	..	..	..	..	..	..	..	..	55
..	..	..	..	R	1	..	..	..	..	..	55
..	..	..	..	..	1	..	..	..	..	..	56
..	..	..	..	R	1	..	..	..	R	..	58
..	..	..	..	R	2	1	..	..	..	..	60
..	..	..	..	..	1	..	..	..	..	..	65
..	2	2	..	7	6	1	2	3	1	..	15 cases
8	36	24	1	45	69	7	54	23	1	1	140 Total Positive 89·75
5·13	20·52	15·39	0·64	28·85	44·23	4·44	34·62	14·74	0·64	0·64	Percentages of total examined
5·72	23·71	17·4	0·71	32·14	49·29	5·0	38·57	16·43	0·71	0·71	Percentages of total found infected.

Abbreviations :—

*Cases free of all infections, absent unknown.

R—one in several fields, *Light infection.*

1—one or two in each field, *Mild infection.*

2—two or three in each field, *Moderate infection.*

3—three or four in each field, *Heavy infection.*

4—four or more in each field, *Severe infection.*

Eh.—*Entamoeba histolytica,* (Dysentery amoeba).

Ec.—*Entamoeba coli,* (Colon amoeba).

En.—*Endolimax nana*, (Lesser amoeba).
Ib.—*Iodamoeba butschlii*, (Iodine-cysts).
Gi.—*Giardia intestinalis*, (Duodenal flagellate).
Hw.—*Ancylostoma duodenale*—(Old world Hook-worm).
Necator americanus —(New world Hook-worm).
Hn.—*Hymenolepis nana*, (Murine tape-worm).
Al.—*Ascaris lumbricoides*, (Giant Intestinal round-worm).
Ev.—*Enterobius vermicularis*, (Seat-worm).
Tt.—*Trichocephalus trichiurus*, (Whip-worm).
Ts.—*Taenia saginata*, (Beef-tape-worm).

B—Incidence of Protozoan and Helminthic parasites alone (Table VIII)

(*i*) *Incidence of intestinal protozoa*—This survey demonstrates that only 21 persons out of 140 found infected, were harbouring protozoan parasites. 14 of these cases were in 16—30 years age groups while only 7 fall in 31—65 years age group.

(*ii*) *Incidence of intestinal helminths*—This survey records that the number of persons harbouring helminthic parasites alone was almost twice the number carrying protozoan parasites alone. 34 of these persons were in 16—30 years age group, while 10 fall in 31—65 years age group.

(*iii*) *Incidence of mixed infections both protozoan and helminthic parasites*—The number of persons carrying mixed infection was more or less equal to the persons infected with protozoan and helminthic parasites separately. 62 persons harbouring both helminthic and protozoan parasites were in 16—30 years age group while 21 persons fall within 31—65 years age group.

TABLE VIII

SHOWING INCIDENCE OF PROTOZOAN OR HELMINTHIC PARASITES ALONE AND CASES CARRYING BOTH PROTOZOAN AND HELMINTHIC PARASITES.

Age groups (in years)	No. of cases examined	No. of cases positive ((per centages)	No. of cases carrying protozoan parasites alone (percentages)	No. of cases carrying helminthic parasites alone (percentages)	No. of cases carrying both helminthic and protozoan parasites (percentages)
16—20	59	56(94·94)	6(10·71)	23(41·07)	27(48·22)
21—25	39	35(89·74)	6(17·14)	1(31·43)	28(51·43)
16—30	24	19(62·51)	2(10·53)	10(53·68)	7(35·79)
16—30	122	110(90·16)	14(12·73)	34(30·91)	62(56·36)
31—35	7	7(100·00)	1(14·29)	4(57·14)	2(28·57)
36—40	6	5(83·33)	0(0·00)	1(20·00)	4(80·00)
41—45	6	4(66·66)	1(25·00)	2(50·00)	1(25·00)

TABLE VIII—contd.

SHOWING INCIDENCE OF PROTOZOAN OR HELMINTHIC PARASITES ALONE AND CASES CARRYING BOTH PROTOZOAN AND HELMINTHIC PARASITES—CONTD.

Age groups (in years)	No. of cases examined	No. of cases positive (percentages)	No. of cases carrying protozoan parasites alone (percentages)	No. of cases carrying helminthic parasites alone (percentages)	No. of cases carrying both helminthic and protozoan parasites (percentages)
45—65	15	14(93·33)	5(35·71)	3(21·43)	6(42·86)
31—65	34	30(82·35)	7(23·33)	10(33·33)	13(43·33)
Total	156	140(89·75)	21(15·00)	44(31·43)	75(53·57)
Age-groups			16-65 yrs.	16-30 yrs.	30-65 yrs.
Cases carrying protozoan parasites (percentages) ..			36(69·09)	20(66·66)	96(69·43)
Cases carrying helminthic parasites (percentages) ..			96(87·27)	23(76·66)	119(85·0)

C—INTENSITY OF INTESTINAL PROTOZOAN AND HELMINTHS (TABLE IX)

In all the cases carrying *E. histolytica*, the burden of protozoan appeared to be relatively low. In this connection we would call attention to periodicity in cyst formation and irregularity in laying of eggs. This interruption is an excitement to those who study the effect of drugs. The factors responsible for the cyclic behaviour of the parasites may be many, both of extrinsic and intrinsic origin. It is a regular phenomenon and has been studied in almost all parasites. In *E. coli* the periodicity is of 10—14 days, *E. histolytica* observes a period of 6—20 days and more and cyst production in *G. intestinalis* is also distinctly cylic in character (Ansari, 1953).

Out of 36 cases of *E. coli*, 29 had very light infection, while only 7 had mild infection. The picture is more or less similar for *I butschlii*. In this case 21 were light infections, 1 each was of mild, heavy and severe grade. There was only one case of *E. nana* and that too was of light infection. *G. intestinalis* was found to be of light grade in 43, mild and heavy in 1 each.

Hook-worm was found to be very predominating. The burden of the worm was light in most cases. It was of mild or heavy grade in one case each. *A lumbricoides* was also very common, mostly varying between mild and moderate infections. 3 persons, however were carrying very heavy infection. Infections was, however, light in one person. *E. vermicularis* was found in 23 cases. Mild grade infection was noticed in 18 persons. Light grade and moderate infection were found in 3 and 2 cases respectively. It was most unusual to find only one case of *T. trichiurus* in this series. The infection was of low grade. Mild infection of *H. nana* was found only in 7 cases. It also appeared to be unusual. A solitary case of mild grade infection of *T. saginata* was also detected.

TABLE

SHOWING NUMBER OF LIGHT, MILD, MODERATE, HEAVY AND SEVERE OF THE CONSERVANCY

Age (in years)	Entamoeba histolytica					Entamoeba coli					Iodamoeba butschli				
Age groups	Li	Mi	Mo	He	Se	Li	Mi	Mo	He	Se	Li	Mi	Mo	He	Se
16 to 20 ..	5	..	..	..	..	15	1	..	..	..	9	..	..	..	..
21 to 25 ..	2	..	..	..	..	11	.	.	..	..	8	..	..	1	1
26 to 30 ..	1	..	..	..	..	..	2	..	..	..	2	..	..	..	..
31 to 35 ..	..	.	.	..	..	1	..	..	..	..	..	1	..	..	..
36 to 40 ..	..	..	..	..	..	..	2	..	..		..	..	..	..	..
41 to 45 ..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
46 to 65 ..	..	..	..	..	.	1	1	..	..	..	2	..	..	..	..
Total ..	8		..	..	..	29	7	..	..	..	21	1	..	1	1

IX

CASES OF INFECTION OF INTESTINAL PARASITES IN SEVEN DIFFERENT AGE GROUPS STAFF, LAHORE

Endolimax nana					Giardia intestinalis					Hook worms				
Li	Mi	Mo	He	Se	Li	Mi	Mo	He	Se	Li	Mi	Mo	He	Se
1	..	..	..	..	17	..	..	1	..	4	16	3	..	..
..	..	..	..	..	11	..	..	..	..	..	15	1	1	1
..	..	..	..	..	4	1	..	..	..	..	11	1	..	..
..	..	..	..	..	1	..	..	..	..	..	3	..	1	..
..	..	..	..	..	3	..	..	..	..	..	3	..	..	..
..	..	..	..	..	..	..	..	..	..	..	3	..	..	..
..	..	..	..	..	7	..	..	..	..	..	5	1	..	..
1	..	..	..	..	43	1	..	1	..	4	56	6	2	1

TABLE
SHOWING NUMBER OF LIGHT, MILD, MODERATE, HEAVY AND SEVERE
OF THE CONSERVANCY

Age (in years)	Hymenolepis nana					Ascaris lumbricoides				
Age groups	Li	Mi	Mo	He	Se	Li	Mi	Mo	He	Se
16 to 20	..	2	..	..	..	..	17	12	2	..
21 to 25	..	2	..	..	..	1	9	2	..	..
26 to 30	..	1	..	..	..	..	5	1		..
31 to 35	..	..	..	..	..	..	1	..	..	..
36 to 40	..	1	..	..	..	..	2	..	..	..
41 to 45	..	..	..	..	..	..	..	..	..	..
46 to 65	..	1	..	..	..	..	1	..	1	..
Total	..	7	..	..	..	1	35	15	3	..

CASES OF INFECTION OF INTESTINAL PARASITES IN SEVEN DIFFERENT AGE GROUPS STAFF, LAHORE

Enterobius vermicularis					Trich ocephalustrichiurus					Taenia saginata				
Li	Mi	Mo	He	Se	Li	Mi	Mo	Ho	Se	Li	Mi	Mo	He	Se
1	5	1		..	..	..	..	..	..	..	..	..	..	..
..	4	1	..	..	..	..	..	..	..	..	..	..	..	..
..	2	..	..	..	..	..	..	..	..	..	..	..	..	
1	3	..	..	..	..	..	..	..	..	..	1	..	..	..
1	1	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	3	..	..	..	1	..	..	..	..	..	..	..	..	..
3	18	2	..	..	1	..	..	..	..	..	1	..	..	..

D. INCIDENCE OF VARIOUS INTESTINAL PARASITES WITH REFERENCE

Usually age influences the incidence of various intestinal parasites in a community. age groups are equally susceptible to the infection of various intestinal parasites. Some chance of exposure. Decline in incidence; due to real immunity to intestinal parasites Majority of the intestinal parasites are typically much more prevelant in children than in by the children, especially in the courtyard and around the house does not only pollute the en-and wallow in the same fields, pick up viable eggs and unknowingly ingest them. Ascaris manure obtained from human night-soil are another source of contamination. Eating of Hook worm infection occurs in fields. Children walking barefooted in the fields and more chances of contact with the infective stage. Here, it is primarily the occupation up to 30 years of age and marked decline after 40 years of age, *H. nana* is again a door

TABLE

SHOWING INCIDENCE OF VARIOUS PARASITES IN

Age groups (in years)	Total Examined	Total Infected with percentages	Eh.	Ec.	Ib.	En.
16 to 20 ..	59	56	5	16	9	1
		94·94	8·93	28·57	16·07	1·78
21 to 25	39	35	2	11	10	0
		89·74	5·71	31·43	28·57	0
26 to 30 ..	24	19	1	2	2	0
		62·51	5·26	10·53	10·53	0
31 to 35 ..	7	7	0	1	1	0
		100·00	0	14.29	14·29	0
36 to 40 ..	6	5	0	2	0	0
		83·33	0	40	0	0
41 to 45	6	4	0	2	0	0
		66·66	0	50	0	0
46 to 65 ..	15	14	0	2	2	0
		93·33	0	14·29	14·29	0
Total	156	140	8	36	24	1
Percentages of the total examined		89·75	5·13	20·52	15·39	0·64
Percentages of the total infected			5·72	23·71	17·14	0·71

TO AGE OF PERSONS (TABLE X.)

The epidemiological situation suggests, that not as a rule but as a matter of fact, all adults do not show high incidence of a parasite perhaps because they had lesser probably occurs in few. This immunuty is usually partial in nature and is an exception. adults not as a rule again but because they court infections. Promiscuous defaccation vironment but also cause of contamination of the same children in return. Children play Ascries is door yard and house-hold infection and this is how it spreads. Vegetables raised on Eating of imprefectly washed raw vegetables is one of causes of high incidence of intestinal parasites. play grounds contact the infective stage. The man behind the plough has comparatively of the victim which is responsible for the incidence. Its greatest incident may be expected yard infection and may be expected high in children than adults.

DIFFERENT AGE GROUPS (IN YEARS).

Gi.	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
18	23	2	31	7	0	0
32·14	41·07	3·57	55·35	12·50	0	0
11	18	2	12	5	0	0
31·43	51·43	5·71	34·29	14·28	0	0
5	12	1	6	2	0	0
26·84	63·16	5·26	31·58	10·53	0	0
1	4	0	1	4	0	1
14·29	57·14	0	14·29	57·14	0	14·29
3	3	1	2	2	0	0
60	60	20	40	40	0	0
0	3	0	0	0	0	0
0	75	0	0	0	0	0
7	6	1	2	3	1	0
50·00	42·85	7·14	14·29	21·43	7·14	0
45	69	7	54	23	1	1
28·85	44·23	4·49	34·62	14·74	0·64	0·64
32·14	40·29	5·00	38·57	16·43	0·71	0·71

The community under observation consisted of adults alone. We are, therefore, not competent to express our opinion or comment on the rate of incidence in age groups between one month to 15 years. For convenience of discussion we have split the community into seven series of five years each. The incidence of infection of both pathogenic and non-pathogenic protozoa and helminths for each 5 years group is presented in Tables XI—XVIII.

(i) *Incidence of infection in* 16—20 *years of age group* (*Table XI*)—Out of 59 persons examined, 56 persons were found infected either with protozoan, helminthic or both parasities.

Amongst the protozoan parasites, *G. instestinalis* (18), *E. coli* (16), *I. butschlii* (9), *E. histolytica* (5), and *E. nana* (1) occurred in the descending order of incidence mentioned each parasit e.The load of infection was light, except one case of *G. intestinalis* in which the infection was rather heavy.

A. lumbricoides—was found to be comparatively common helminthic infection. The load of infection was mild in 17, moderate in 12 and heavy in 2 cases.

Hook worm infection was found in 41 per cent cases. It was light in 4, mild in 16 and moderate in 3 .

Seat worm infection was found in 12·50 per cent cases. The infection load was more or less of mild nature.

Mild dwarf type-worm infection occurred in two cases.

TABLE XI

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES (PURE AND MIXED INFECTION) IN 16—20 YEARS OF AGE GROUP

	Eh.	Ec.	Ib.	En.	Gi.	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
Eh	**1**	1	3	0	2	1	0	1	1	0	0
Ec.	1	**2**	4	0	5	7	0	8	0	0	0
Ib.	3	4	**0**	1	3	4	0	4	1	0	0
En.	0	0	1	**0**	0	0	0	0	0	0	0
Gi.	2	5	3	0	**1**	5	0	10	3	0	0
Hw.	1	7	4	0	5	**4**	1	9	1	0	0
Hn.	0	0	0	0	0	1	**0**	1	1	0	0
Al.	1	8	4	0	10	9	1	**10**	2	0	0
Ev.	1	0	1	0	3	1	1	2	**0**	0	0
Tt.	0	0	0	0	0	0	0	0	0	**0**	0
Ts.	0	0	0	0	0	0	0	0	0	0	**0**
Total	5	16	0	1	18	23	2	31	7	0	0

(ii) Incidence of infection in 21—25 years of age group (Table XII)—There were 39 persons in this series, out of which 35 were found carrying one or the other protozoal/ helminthic or both parasites.

Light infection of *E. histolytica* was found only in two persons. Light *grade infection of E coli* and *G. intestinalis* occurred in 11 cases. 8 with light, one each of heavy and serious grades of infection were found of *I. butschlii.*

Hook worm infection again predominated in this group.15 mild and one each of moderate, heavy and serious grade infection were found.*A lumbricoides* was next in importance of light (1), mild (9), and moderate (2) grades.

TABLE XII

SHOWING INCIDENCE OF VARIOUS PARASITES (PURE AND MIXED) IN 21—25 YEARS OF AGE GROUP

	Eh.	Ec.	Ib.	En.	Gi.	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
Eh.	**0**	2	2	0	2	0	0	0	2	0	0
Ec.	2	**2**	3	0	3	5	0	3	3	0	0
Ib.	2	3	**2**	0	4	3	1	1	2	0	0
En.	0	0	0	**0**	0	0	0	0	0	0	0
Gi.	2	3	4	0	**1**	7	0	4	3	0	0
Hw.	0	5	3	0	7	**3**	0	7	1	0	0
Hn.	0	0	1	0	0	0	**1**	0	0	0	0
Al.	0	3	1	0	4	7	0	**4**	0	0	0
Ev.	2	3	2	0	3	1	0	0	**1**	0	0
Tt.	0	0	0	0	0	0	0	0	0	**0**	0
Ts.	0	0	0	0	0	0	0	0	0	0	**0**
Total	2	11	10	0	11	18	2	12	5	0	0

(iii) Incidence of infection in 26—30 years age group (Table XIII)—In this series 19 out of 24 were found infected either with protozoa/helminths or both.

Protozoan parasites were encountered in 9 persons. Light infection of *E. histolytica* occurred only in one case. Mild infection of *E. coli* occurred in two cases, *I. butschlii* was found in 2 persons. 4 light and a mild infection of *giardiasis* was also encountered.

16 persons in this series were found carrying helminthic parasites, Hook-worm infection of mild grade was recorded in 11 cases and in one person however, the incidence was of moderate nature. Mild grade infection of *ascariasis* was found in 5 persons, in one the infection was of moderate type. Mild infection of seat worm occurred in two persons . Mild infection of *H. nana* was detected only in one person.

TABLE XIII

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES (PURE AND MIXED INFECTIONS) IN 26—30 YEARS OF AGE GROUP

	Eh.	Ec.	Ib.	En.	Gi.	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
Eh.	0	0	1	0	0	0	0	0	0	0	0
Ec.	0		0	0	0	2	0	0	0	0	0
Ib.	1	0	1	0	0	0	0	0	0	0	0
En.	0	0	0	0	0	0	0	0	0	0	0
Gi.	0	0	0	0		3	1	2	0	0	0
Hw.	0	2	0	0	3	5	0	3	0	0	0
Hn.	0	0	0	0	1	0	0	1	0	0	0
Al.	0	0	0	0	2	3	1	1	1	0	0
Ev.	0	0	0	0	0	0	0	1	1	0	0
Tt.	0	0	0	0	0	0	0	0	0		0
Ts.	0	0	0	0	0	0	0	0	0	0	
Total	1	2	2	0	5	12	1	6	2	0	0

(iv) Incidence of infection in 31—35 *years age group (Table XIV)*—It was a small series of 7 person, all infected with protozoal/helminthic or both parasites.

Three persons had protozoan parasites. *E. histolytica* was conspicuous by its absence in this series. One mild case, each of *E. coli, I. butschlii* and *G. intestinalis*, was, however, encountered.

Helminthic parasites occurred in 6 persons. Four had hook worm, out of which 3 had mild grade and one was heavily infected. Mild infection of *A. lumbricoides* was encountered in only one person. 4 seat worm infections, one with mild and 3 with moderate infections, were also encountered.

A mild infection of *T. saginata* was discovered only in this series. It seems very possible that this parasite has a greater affinity for middle age group.

TABLE XIV

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES (PURE AND MIXED INFECTIONS) IN 31—35 YEARS OF AGE GROUP

	Eh.	Ec.	Ib.	En.	Gi	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
Eh.	**0**	0	0	0	0	0	0	0	0	0	0
Ec.	0	**0**	0	0	0	1	0	0	0	0	0
Ib.	0	0	**0**	0	0	1	0	1	1	0	1
En.	0	0	0	**0**	0	0	0	0	0	0	0
Gi	0	0	0	0	**1**	0	0	0	0	0	0
Hw.	0	1	1	0	0	**1**	0	1	2	0	1
Hn.	0	0	0	0	0	0	**0**	0	0	0	1
Al.	0	0	1	0	0	1	0	**0**	1	0	1
Ev.	0	0	1	0	0	2	0	1	**2**	0	1
Tt.	0	0	0	0	0	0	0	0	0	**0**	0
Ts.	0	0	1	0	0	1	0	1	1	0	**0**
	0	1	1	0	1	4	0	1	4	0	0

(v) *Incidence of infection in 36—40 years age group (Table XV)*—Out of 6 persons in this group 5 persons were found having protozoan/helminthic or both parasites.

Out of 4 persons carrying protozoan parasites, 2 had mild grade infection of *E. coli.* Very light infection of *G. intestinalis* was recorded from 3 persons.

There was a preponderance of mild hook-worm infection in 3 persons out of 5 in this series. Mild infection of *A. lumbricoides* was encountered in 2 persons. One light and a mild grade infection of *E. vermicularis* was also detected. Light infection of *H. nana* occurred in one person.

TABLE XV

TABLE XV SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITES (PURE AND MIXED INFECTIONS) IN 36—40 YEARS AGE GROUP

	Eh.	Ec.	Ib.	En.	Gi	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
Eh.	0	0	0	0	0	0	0	0	0	0	0
Ec.	0	0	0	0	1	1	1	1	2	0	0
Ib.	0	0	0	0	0	0	0	0	0	0	0
En.	0	0	0	0	0	0	0	0	0	0	0
Gi.	0	1	0	0	0	2	1	1	1	0	0
Hw.	0	1	0	0	2	0	0	0	1	0	0
Hn.	0	1	0	0	1	0	0	1	1	0	0
Al.	0	1	0	0	1	0	1	1	1	0	0
Ev.	0	2	0	0	1	1	1	1	0	0	0
Tt.	0	0	0	0	0	0	0	0	0	0	0
Ts.	0	0	0	0	0	0	0	0	0	0	0
	0	2	0	0	3	3	1	2	2	0	0

(vi) *Incidence of infection 41—45 years of age group (Table XVI)*—Out of 6 persons in this series, only 4 had infection of either protozoa/helminthic or both. Protozoan parasites occurred in two cases. Both had the common colon amoeba. Out of helminthic parasities, only hookworm infection was detected in 3 cases.

TABLE XVI

SHOWING INCIDENCE OF VARIOUS INTESTINAL PARASITIES (PURE AND MIXED INFECTIONS IN 41—45 YEARS AGE GROUP

	Eh.	Ec.	Ib.	En.	Gi.	Hw.	Hn.	As.	Ev.	Tt.	Ts.
Eh.	**0**	0	0	0	0	0	0	0	0	0	0
Ec.	0	1	0	0	0	1	0	0	0	0	0
Ib.	0	0	**0**	0	0	0	0	0	0	0	0
En.	0	0	0	**0**	0	0	0	0	0	0	0
Gi.	0	0	0	0	**0**	0	0	0	0	0	0
Hw.	0	1	0	0	0	2	0	0	0	0	0
Hn.	9	0	0	0	0	0	**0**	0	0	0	0
As.	0	0	0	0	0	0	0	**0**	0	0	0
Ev.	0	0	0	0	0	0	0	0	**0**	0	0
Tt.	0	0	0	0	0	0	0	0	0		0
Ts.	0	0	0	0	0	0	0	0	0		0
Total	0		0	0	0	3	0	0	0	0	0

(vii) *Incidence of infection in 46—65 years as age group*—(*Table XVII*) Out of 15 persons in this series, 14 had either protozoan/helminthic or both infections.

Protozoan infection occurred in 11 cases. No infection of *E. histolytica* could be detected. Light to mild grade infection of *E. coli* and *I. butschlii* was found in two cases each. The preponderance of *G. intestinalis* infection in this series was rather unusual. The infection was of light grade in all the cases.

Helminthic infections were detected in 9 cases. When compared with other age group series and in the light of protozoan infection, this number is far too less. May we suspect that helminthic parasites have lesser affinity for advanced age groups. Or these persons had little chances of contact with the source of infection. However, there was still preponderance of hook worm infection in this series also. 5 mild and a moderate infections were detected. Mild infection of *E. vermicularis* was found in 3 persons. *A. lumbricoides* occurred in two cases, in one it was of mild grade, while in the other it was a heavy infection. A light infection of *trichuiriasis* occurred in this series alone. Mild infection of *H. nana* was also detected in one person.

TABLE XVII

SHOWING INCILENCE CF VARIOUS INTESTINAL PARASITES (PURE AND MIXED INFECTIONS IN 4P—CF YEARS OF AGE GROUP.

	Eh.	Ec.	Ib.	En.	Gi.	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
Eh.	**0**	0	0	0	0	0	0	0	0	0	0
Ec.	0	**1**	0	0	0	0	0	0	1	0	0
Ib.	0	0	**2**	0	0	0	0	0	0	0	0
En.	0	0	0	**0**	0	0	0	0	0	0	0
Gi.	0	0	0	0	**2**	3	1	2	1	1	0
Hw.	0	0	0	0	3	**2**	1	0	1	1	0
Hn.	0	0	0	0	1	1	**0**	0	0	0	0
Al.	0	0	0	0	2	0	0	**0**	1	0	0
Ev.	0	1	**0**	0	1	1	0	1	**0**	0	0
Tt.	0	0	0	0	1	1	0	0	0	**0**	0
Ts.	0	0	0	0	0	0	0	0	0	0	**0**
	0	2	2	0	7	6	1	2	3	1	0

E. Single Parasite Infections (TABLE XVIII).

It was not uncommon to find a person with a solitary intestinal parasite. It will be interesting thing to be noted here, that the stools of all pure infection cases were examined several times before recording the results. Pure infection were more of helminthic parasites than of protozoan parasites. There were 18 pure infection cases of protozoan as against 38 of helminths in this series.

Pure infection case of *E. histolytica* was encountered once. There were more or less equal number of pure infection cases of *E. coli* (6), *I. butschlii* (5) and *G. inetestinalis* (6).

Out of 69 hook worm cases, 17 persons had only this parasite and out of 54 round worm cases 16 were pure (single) infection cases. Four cases of *E. vermicularis* and one case of *H. nana* were also pure infection cases.

TABLE XVIII

SHOWING SINGLE PARASITE INFECTIONS IN VARIOUS AGE GROUPS (IN YEARS).

Age group	Eh.	Ec.	Ib.	Gi.	Hw.	Hn.	Al.	Ev.	Total : % ages	Total examined infected
16—20 ..	1	2	..	1	4	..	10	..	18: 32·14	59/56
21—25 ..	..	2	2	1	3	1	4	1	14: 40·00	39/35
26—30 ..	..	..	1	1	5	..	1	1	9: 47·37	24/19
31—35 ..	..	..	..	1	1	..	..	2	4: 57·14	7/7
36—40 ..	..	..	..	..	..	..	1	..	1: 20·00	6/5
41—45 ..	..	1	..	..	2	..	..	..	3: 75·00	6/4
46—65 ..	..	1	2	2	2	..	..	..	7: 50·00	15/14
Total ..	1	6	5	6	17	1	16	4	56: 35·90	156: 140
Percentage ..	0·71	4·28	3·57	4·28	12·14	0·71	11·43	2·85	56: 35·90	156/140

F. Multiple Infections of Intestinal Parasites (TABLE XIX—X)

Out of 140 positive cases, there were 56 pure infections, 52 double infections.

24 triple infections, 3 quadruple and 5 quintuple infections. The relevant information is presented in Table XIX. The protozoan and helminthic parasites involved in various combinations are given in Table XX.

(*i*) Amongst the double-infection cases, in 5 cases the association was involved within protozoan parasites, in 32 cases protozoan were associated with helminths, while in 15 cases only helminthic parasites were associated.

(*ii*) There were 24 triple infection cases in this group. The association more or less predominated between two helminthic parasites and a protozoan parasite (usually between *G. intestinalis*) throughout the series. There were 6 cases in which the association was established between two protozoans and a helminth (usually hook-worm).

There was only one solitary case, however, where the association was found established between three protozoan parasites (*E. histolytica, I. butschlii* and *G. intestinalis*).

(*iii*) In the three quadruple infections, association in two cases was established between two protozoan and two helminths. In one case, however, round worm was associated with three protozoa. It was interesting to find *A. lumbricoides, G. intestinalis* and *E. coli* in all the three cases. Hook worm occurred in two and in one it was replaced by *E. histolytica*.

(*iv*) In 5 quintuple infections, hook worms are involved in two cases, round worms are involved in three cases, *E. vermicularis* appears in four cases while *T. saginata* and *H. nana* are involved once each. *G. intestinalis, I. butschlii* and *E. coli* were conspicuous in four of these cases. *E'. histolytica* occurred in two cases only. In two cases the association existed between one helminth (*E. rmicularis*) and four protozoas (*E. histolytica, E. coli, I. butschlii* and *G. intestinalis*), in one the association existed between two helminths (hook-worms and Round-worm) and three protozoas (*E. coli, I. butschlii* and *G. intestinalis*), in one case two protozoas (*E. coli* and *G. intestinalis*) and three helminths viz., Hook-worms, Round-worms, and Seat-worms had joind hands in a war against the victim, in another case the

association existed between four helminths viz., Hook-worms, Round-worms, Seat-worms and Beef tape-worms and one protozoa—*I. butschlii*.

TABLE XIX

SHOWING NUMBER OF PURE, DOUBLE, TRIPLE, QUARDRUPLE, AND QUINTUPLE INFECTIONS IN DIFFERENT AGE GROUPS (IN YEARS).

Age groups (in years)	Total examined	Total positive	Single infection	Double infection	Triple infection	Quadruple infection	Quintuple infection
16—20 ..	59	56 (94·94)	18 (32·14)	24 42·86)	11 (19·64)	2 (3·57)	1 (1·79)
21—25 ..	39	35 (89·74)	14 (40·00	11 (31·43)	7 (20·00)	1 (2·86)	2 (5·71)
26—30 ..	24	19 (62·51)	9 (47·37)	8 (42·11)	2 (10·52)	.. ..	.. ..
31—35 ..	7	7 (100·00)	4 (47·14)	2 (28·57)	.. ..	.. ..	1 (14·29)
36—40 ..	6	5 (83·33)	1 (20·00)	2 (40·00)	1 (20·00)	.. ..	(20·00)
41—45 ..	6	4 (66·66)	3 (75·00)	1 25(·00)	.. ..	.. ..	.. ..
46—above ..	15	14 (93·33)	7 (50·00)	4 (28·57)	3 (21·43)	.. ..	.. ..
Total ..	156	140	56	52	24	3	5
Percentage infected (of the total examined).	..	89·75	35·90	32·70	15·40	1·90	3·85
Percentage infected (of the total positive).	..	100	40·00	36·48	17·14	2·15	4·28

TABLE

SHOWING THE PARASITES INVOLVED IN SINGLE, DOUBLE, TRIPLE AND

Type of infection	Age groups		
	16—20	21—25	26—30
Single	Eh. (1) Ec. (2), Gi. (1), Hw. (4), Al. (10),. (18:32·14)	Ec. (2), Ib. (2), Gi. (1), Hw. (3), Hn. (1), Al. (4), Ev. (1), (14:40·00)	Ib. (1), Gi(1), Hw. (5), Al. (1), Ev. (1), (9: 47·37)
Double	Ib. En. (1), Gi. Ec. (1), Gi. Ev. (2), Hw.Ib.(1),Hw. Al.(5), Hw. Ev. (1), Hw. Gi. (3), Hw. Ec. (3), Al.Ev. (1), Al. Ec. (2), Al. Gi. (3), Hn. Ev. (1). (24: 42·86)	Ec. Ib. (1), Ib. Gi. (1), Hw. Al. (2), Hw. Ec. (2), Hw. Gi. (2), Hw. Ib. (1), Hn. Ib. (1), Al. Ec. (1), (11:31·43)	Eh. Ib. (1), Hw. Al. (2), Hw. Gi. (2), Hw. Ec. (2), Al. Ev. (1), (8:42·11)
Triple	Eh. Ib. Gi. (1), Eh. Ib. Ev. (1), Eh. Ec. Hn. (1), Hw. Hn. Gi. (1), Hw. Gi. Al. (1), Hw. Ib. Ec. (1), Al. Ev. Gi. (4), Al. Ib. Ec. (1), (11:19·64)	Hw. Al. Gi. (2), Hw. Al. Ec. (2), Hw. Gi. Ev. (1), Hw. Gi. Ib. (1), Al. Gi. Ib. (1), (7:20·00)	Hw. Al. Gi. (1), Al. Hn. Gi. (1). (2:10·52)
Quadruple	Hw. Al. Gi. Ec. (1), Al. Gi. Ec. Eh. (1). (2:3·57)	Hw. Al. Gi. Ec. (1). (1:2·86)	.. ..
Quintuple	Hw. Al. Gi. Ec. Ib. (1). (1:1·74)	Eh. Ec. Ib. Gi. Ev. (2). (2:5·71)	.. ..
Total infected (with percentages)	56 (94·94)	35 (89·74)	19 (62·51)
Total examined ..	59	39	24

XX

QUADRPULE AND UINTUPLE INFECTIONS (NUMBER OF CASES) IN DIFFERENT AGE GROUPS IN, (YEARS)

Age Groups			
31—35	36—40	41—45	46 and above
Gi. (1), Hw. (1), Ev. (2). (4:57·14)	Al. (1). (1:20·00)	Ec. (1), Hw. (2). (3:75·00)	Ec. (1), Ib. (2), Gi. (2), Hw. (2). (7:50·00).
Hw. Ec. (1), Hw. Ev. (1). (2:28·57)	Hw. Gi. (2). (2:40·00)	Hw. Ec. (1). (1:25·00)	Hw. Ev. (1), Hw. Gi. (1), Al. Gi. (1), Ev. Ec. (1). (4:28·50)
.. ..	Hw. Ev. Ec. (1). (1:20·00)	.. ..	Hw. Gi. Hn. (1), Hw. Gi. Tt. (1), Al. Gi. Ev. (1). (3:21·43)
.. ..	.. ..	.. ..	.. ..
Hw. Al. Ev. Ts. Ib. (1). (1:14·29)	Al. Ev. Hn. Gi. & Ec. (1). (1:20·00)	.. .. ..	.. .. ..
7 (100·00) 7	5 (83·33) 6	4 (66·66) 6	14 (93·33) 15

G. Incidence of Intestinal Parasites according to the Locality (Table XXI)

The incidence of intestinal parasites varies with the cultural and aesthetic standards of the people. Our people are not conservative. They are readily co-operative and very enthusiastically take up any thing useful. As the saying goes, "Money makes the mare go,"* is terribly involved. The common man hasn't has enough resources and he hasn't has proper guidance either. Governmental agency formerly did not approach the common man as a guide but as a boss. The common man was not involved into any programme as a partner. The project was usually thrust upon him without giving him a chance to understand the planned undertaking. The programmes flopped because common man; for whose interest it was, avoided to be involved because of ignorance. Why do we have slums? Why do the ill-planned colonies still sprout in this country? Why do our people think that improvement of environmental sanitation is somebody's else job? We know the answer, but what we are going to do about it. We can only remind of *all help is for those who can help themselves.* The hatcheries of the intestinal parasites can stop functioning if there are missionaries to look after environmental sanitation.

Else where in this paper, we have endeavoured to give brief discriptions of the areas from where the conservancy staff of the City Corporation hails. Table XXI gives the distribution of the intestinal parasites in this staff with respect to their residence.

TABLE XXI

TABLE XXI SHOWING DISTRIBUTION OF INTESTINAL PARASITES ACCORDING TO THE RESIDENTIAL QUARTERS OF THE CONSERVANCY STAFF

Sectors	Eh.	Ec.	Ib.	En.	Gi.	Hw.	Hn.	Al.	Ev.	Tt.	Ta.
1. Ravi Road ..	2	8	3	..	7	10	1	9	4	1	..
2. Badami Bagh ..	1	8	3	..	7	12	2	9	6	..	..
3. Misri Shah ..	2	1	3	..	4	2	..	4	1	..	..
4. Balal Ganj ..	..	3	3	..	8	8	2	15	1	..	..
5. Krishan Nagar ..	3	8	5	..	13	21	2	9	6	..	..
6. Pakki Thatti ..	..	3	4	1	1	11	..	4	2	..	1
7. Mozang, etc. ..	..	5	3	..	5	5	..	4	3	..	..
Total ..	8	36	24	1	45	69	7	54	23	1	1
Percentages of the total examined.	5·13	20·52	15·39	0·64	28·85	44·23	4·49	34·62	14·74	0·64	0·64
Percentages of the total infected.	5·72	23·71	17·14	0·71	32·14	49·29	5·00	38·57	16·43	0·71	0·71

Jedhi kothi dune, usde kamle wi siyane.

Highest number of cases of *E. histolytica* were recorded from Krishan Nagar, Ravi Road area and Misri Shah. No case of this parasite was encountered in those coming from Balal Ganj, Pakki Thatti and Mozang sector.

Highest number of the cases of *E. coli* were from Ravi Road area, Badami Bagh and Krishan Nagar sectors. Five cases were found from Mozang. Three cases of each were found from Balal Ganj, Pakki Thatti. Misri Shah gave us only one case.

The number of *I. butschlii* cases were the same from almost all the sectors except from Krishan Nagar and Pakki Thatti, which had 4 and 5 cases, respectively.

Thirteen cases of *giardiasis* were recorded from Krishan Nagar, Ravi Road and Badami Bagh gave 7 cases each, Bilal Ganj sector gave 8 cases, Mozang and Misri Shah gave us 5 and 4 cases, respectively, while Pakki Thatti gave only one case.

Hook-worm infection was highest in Krishan Nagar, it gave us 21 cases as against 12 from Badami Bagh, 11 from Pakki Thatti, 10 from Ravi Road and 8 from Balal Ganj. From Misri Shah and Mozang sectors there were 2 and 5 cases only.

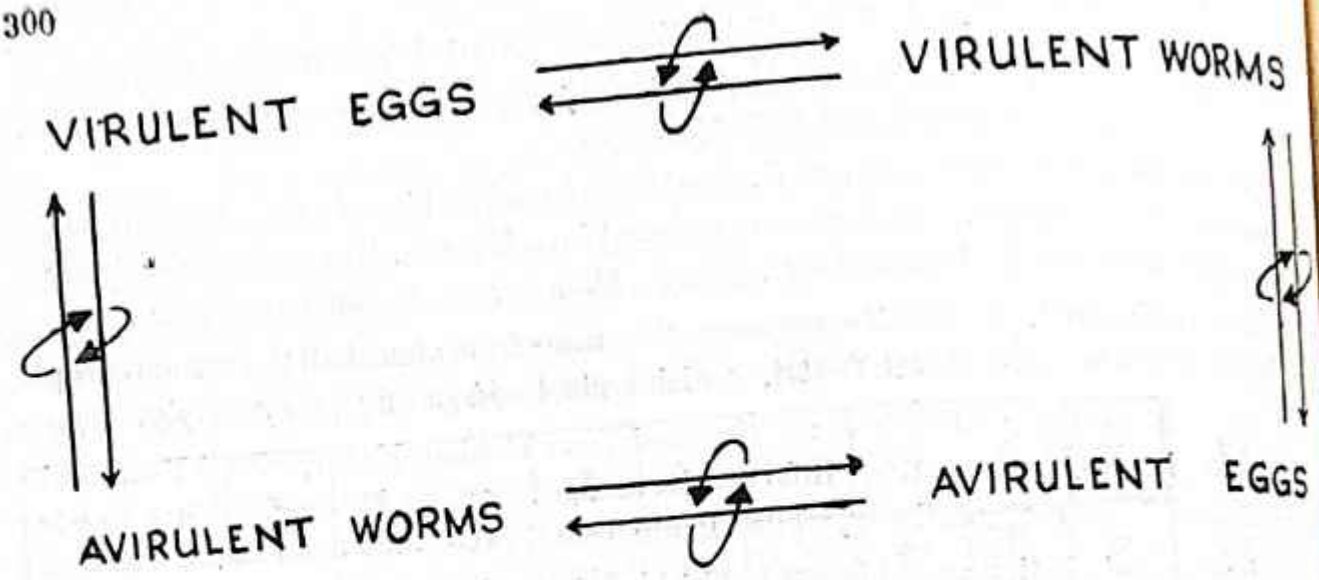
Fifteen cases of *A. lumbricoides* were found from Balal Ganj, 9 each from Ravi Road, Badami Bagh and Krishan Nagar and 4 cases each from Misri Shah, Pakki Thatti and Mozang sectors.

As we have said before, finding of seat worms eggs in the stools is not a rule but a chance. The figures obtained from each sector may not therefore, indicate endemicity and intensity in the area therefore, left without comments.

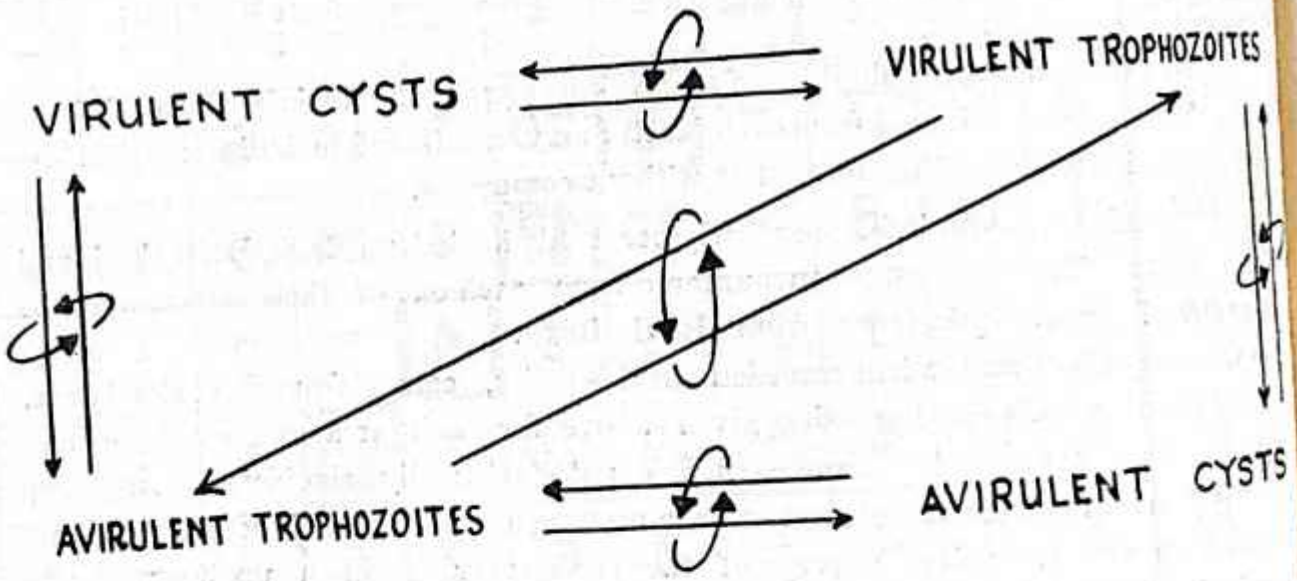
The dwarf-tape-worm infection mostly occurred in Badami Bagh, Balal Ganj and Krishan Nagar. Two cases were encountered from each one of these sectors and one solitary case of *hymenolepiasis* was from Ravi Road.

One case of beef-tape-worm recorded in this series, comes from Ravi Road area.

The figures of individual parasites given above, for each area and sector are not comparable since the sample from each was not statistically significant. Anyhow, the information is of particular interest to us in making a record of their occurrence from these areas, so that extensive surveys of these areas may be taken up at some later date and reliable approximations of the true incidence of the intestinal parasites are known.

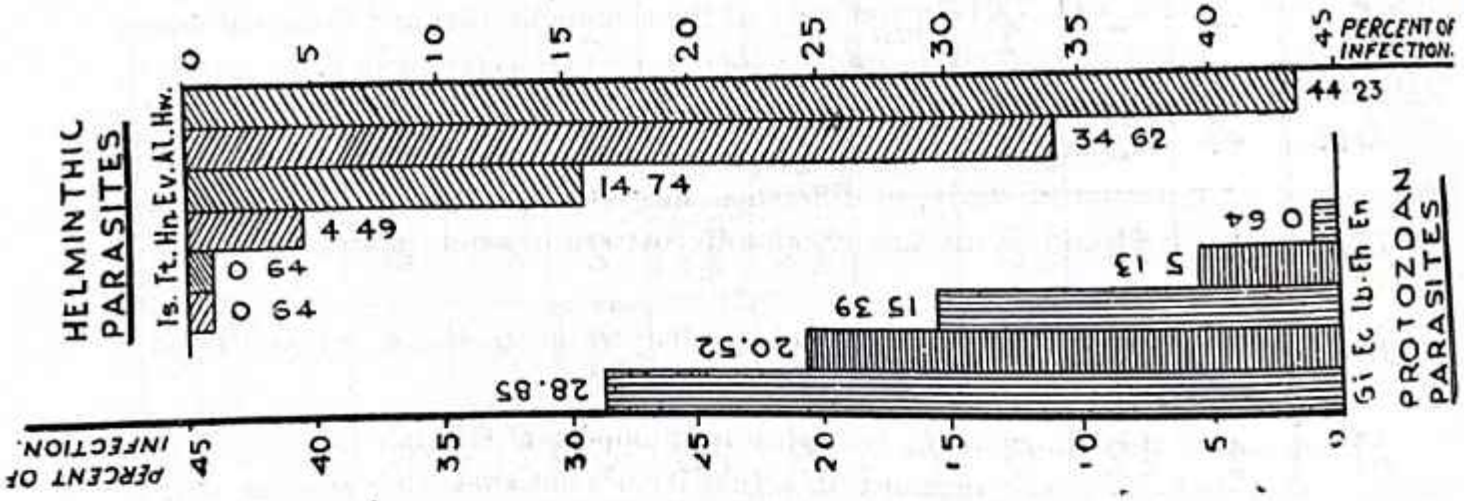


A. HELMINTHIC PARASITES



B. PROTOZOAL PARASITES

	Eh	Ec.	Ib.	En.	Gi.	Hw.	Hn.	Al.	Ev.	Tt.	Ts.
Eh	1	3	6	-	4	1	-	1	3	-	-
Ec	3	6	7	-	9	17	1	12	6	-	-
Ib.	6	7	5	1	7	8	1	6	4	-	1
En.	-	-	1	—	-	-	-	-	-	-	-
Gi.	4	9	7	-	6	20	3	19	8	1	-
Hw.	1	17	8	-	20	17	2	20	6	1	1
Hn.	-	1	1	-	3	2	1	3	2	-	-
Al	1	12	6	-	19	20	3	16	6	-	1
Ev.	3	6	4	-	8	6	2	6	4	-	1
Tt.	-	-	-	-	1	1	-	-	-	—	-
Ts.	-	-	1	-	-	1	-	1	1	-	—


HELMINTHIC PARASITES
Is. Ft. Hn. Ev. Al. Hw.
0 64
0 64
4 49
14 74
34 62
44 23
0 64
5 13
15 39
20.52
28.85
PROTOZOAN PARASITES
PERCENT OF INFECTION.
0 5 10 15 20 25 30 35 40 45

SUMMARY

TIS HARD TO SAY IF GREATER WANT TO SKILL APPEAR IN WRITING OR IN JUDGING ILL:
(POPE)

1. Data are presented on the intestinal protozoan and helminthic parasites of a sample of conservancy staff of the City Corporation of Lahore. 156 persons were examined during the period commencing from February 16 and ending on March 28, 1963. The conservancy staff consists of economically poor section of our population. Opportunities of exposure and re-exposure in this section are relatively abundant. They live under slum, crowded environments, eat un-wholesome food and soiled vegetables, drink opaque or bad water which has direct or open communication with effluent, usually use unclean utensils and have filthy hands. Human faeces is always on their clothes. They are discharging the duties of a scavanger since 2000 years or more before Christ.

2. This data is based on the examination of one single, usually formed stool, from each case. The examinations were made both by direct and concentration methods.

3. The data was analysed by age groups. The whole picture is presented in tabulated form (Table VII-XXI) in the body of the communication and discussed briefly *ad seriatum*. It is not attempted to compare these rates of infection with figures given by other workers from else where. These figures are derived from a different type of population and are not comparable with figures collected from any other kind of population because of short duration of study, of difference in examination technique, of variance in age groups involved and of diagonally opposite pattern of sanitary standards of the homogenous community.

4. From the data before us, it is concluded that *G. intestinalis*, *E. coli* and *I. butschlii* are common protozoan infections.

According to the clinicians, *E. histolytica* is an important endemic infection of our country. This study however, demonstrates, that it does not constitute even an important fraction of the total parasitic infections as far as the conservancy staff of city corporation is concerned. We did not do mensuration, therefore, the race of *E. histolytica* involved could not be ascertained. We also did not make any permanent slides and ascertain the presence of *E. hartmanni*. This appears to be a serious lecunae in these studies. We would very much like to find answers to these question in our future surveys.

The rate of infection with *E. coli* was high. It was more or less four times the infection of *E. histolytica*, amounting to 20·5 per cent in persons examined.

The infection rate with *E. nana* was unexpectedly very low in this community.

I. butschlii was found less common than *E. coli* and *G. intestinalis* and none of the positive cases complained of any abdominal distress.

G. intestinalis is primarily an infection of children. In the adults examined, its incidence was unexpectedly and greatly in excess, giving cause to suspect it an endemic infection in Lahore. It was found in about 29 per cent persons examined.

5. The eggs of the helminthic parasites, viz., *A. duodenalis*/*N. americanus*, *A. lumbricoides* and *E. vermicualris* were encountered very frequently and it was concluded that

worm burden forms serious public health problem of this community. The hook-worm infection was found in more or less 45 per cent persons examined. From a study of socio-economic level of this community, their cultural pattern and the physical environments in which they live, one may say that high rate of hook-worm infection is not a surprise. It will be fine if these findings persuade some one to carry out studies on the nutritional deficiencies of this group of people.

Both epidemiologically and clinically, *A. lumbricoides* is probably one of the most important parasites of Lahorites. There are known permanent foci in congested localities. Greater incidence may be expected in areas having suburban conditions with unsati factory sanitary provision for the disposal of human excreta and improper water supply. Faci. lities for propogation are sure and sound. Effective and uninterrupted transmission takes place from door yards, courtyards, contaminated water supply, dust storms, flies and raw vegetables. Promiscuous defaecating habits have made extensive "seed-beds" of *ascaris* worms around the town. The incidence was found to be 34·62 per cent. It appears a very conservative figure. A detailed consideration of those harbouring males, young females, quiescent and spent females of the worm would probably give us signifi. cantly increased figures.

E. vermicularis is notorious for group infections. Huddling together and congestion helps in its propogation not within a family but also within a community. It is an infec. tion which cannot be fully estimated from coprological examination. An incidence of 14·74 per cent, based on stool examination alone indicates that it is very widely spread parasite.

6. Choice of laboratory method, out of many methods available, is an individual decision. Perfection comes with practice and experience. No comments are, therefore, added on laboratory proceedings.

7. Essential clinical features, associated with different parasitic infections, have always remained shortcuts to the identification. Although signs and symptoms have no diagnostic value, yet in the absence of bedside identification of parasites, remained an advantage. A summary, of signs and symptoms in volved with different parasites, therefo re, has been given in the body of the communication for ready recknoning.

ACKNOWLEDGEMENT

Our thanks are due to Dr. Mazhar Hussain, M. B., B. S., D. P.H., W. P.H. S.(I), Chief Medical Officer of Health, City Corporation of Lahore, for unstinted help and co-operation rendered during the collection of the stool samples from the conservancy staff, Lahore.

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ETHIONAMIDE IN THE TREATMENT OF CHRONIC PULMONARY TUBERCULOSIS

By

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With the appearance of resistant strains of tubercle bacilli against the standard chemotherapeutic drugs, *i.e.*, streptomycin, P.A.S. and isoniazid, a need has always been felt for some new anti-tuberculous drugs which could be effective and do not show cross resistance with other agents.

Encouraging results were reported with the use of ethionamide in vitro against isoniazid resistant strains of tubercle bacilli by Rist and others (1958) and later by Brouet and others (1959). Since then, many more reports have appeared regarding the efficacy of this new oral anti-tuberculous drug.

This paper reports the results of seven patients treated with ethionamide in combination with a standard drug. All these patients had gross lesions with multiple cavitation, and their tubercle bacilli had become resistant to two out of the three standard drugs. These patients had been treated for long time previously with standard drugs but their sputum still showed tubercle bacilli. Therefore, each of these patients was given ethionamide plus one of the three standard drugs to which the tubercle bacilli were still sensitive. The supply of the drug being limited, only seven cases could be included in this series.

Clinical material—Each of these cases was subjected to sensitivity tests against streptomyein, P. A. S., isoniazid and ethionamide. They all were sensitive to ethionamide but each one of them was sensitive to only one of the three standard drugs as mentioned above and therefore their combinations were as follows :—

1. M.A. Females, age 27 years—Ethionamide 1 Gm+Isoniazid.300. mgms. daily.
2. A.W.-Male, age 50 years—Ethionamide I Gm. +Isoniazid 300 mgms. daily.
3. G. B.-Male, age 45 years—Ethionamide I Gm.+Isoniazid 300 mgms. daily.
4. S. A.-Female, age 28 years—Ethionamide I Gm +P.A.S. 12 Gms. daily.
5. Z.A.-Male, age 45 years—Ethionamide I Gm+P.A.S. 12 Gms daily.

6. A.M.-Male, age 35 years—Ethionamide IGm+Isoniazid 300 mgm. daily.

7. F.K.—Male, age 38—Ethionamide I Gm+Streptomycin I Gm. Daily.

Sensitivity testing—Sensitivity tests were done in all the seven cases before the treatment was started. The technique used was as follows.

Growths from primary cultures were emulsified in 0.5 ml sterile distilled water. Using a standard loop of 3 mm. diameter, one loopful of emulsion was spread over the Lowenstein—Jensen medium slopes containing respectively 5, 10, 20, 40, 80, 160 micrograms/ml. ethionamide. The results were reported as a resistant ratio. H37 RV and other sensitive strains are commonly inhibited by 10 mgm per ml. This observation is supported by the results of sensitivity of more than 75 strains of tubercle bacilli done in this laboratory on ethionamide. In none of the cases included in this trial and even in others not included in the trial, the resistence ratio was more than one.

Duration of treatment—All these cases were in-patients at the time of commencement of trial. One of these left the hospital against medical advice but had developed toxic symptoms before leaving the Hospital. She was reported to have died a few days later.The remaining six cases were hospitalized for periods ranging from four to eight month and were followed up later in the clinic during the course of the treatment and for some time afterwards.

Dosage—Treatment was started with 250 mgm of Ethionamide morning and evening; and the dose was increased to 500 mgm. twice daily within a week according to the tolerance of the drug by the individual patient. The companion drug was either stremptomycin I gram daily or P. A. S. 4 grams thrice a day or isoniazid 150 mgm twice daily, depending upon the sensitivity result as already discussed.

Radiographic extent of disease—Before the start of treatment radiographic assessment was made by a postero-anterior film of the chest. All cases showed moderately advanced disease with multiple cavitation. One case had unilateral disease while all others had bilateral disease.

Laboratory Tests—Besides culture and sensitivity tests for tubercle bacilli done on monthly basis, as described earlier, weekly examinations of urine and direct smear sputum microscopy were carried out regularly. Blood urea estimation, B.S.R., total and differential white cell count and X-Ray examination of chest were done every month.

Toxic reactions—The main complications encountered were malaise, nausea,vomiting,anorexia, upper abdominal pain and skin reactions. One patient also developed pain in the small joints of hands and feet. The complications are listed in table I.

TABLE I

(SHOWING COMPLICATIONS ENCOUNTERED WITH ETHIONAMIDE)

Complications	Case No.						
	1	2	3	4	5	6	7
1. Malaise ..	+	+	..	+	..	..	+
2. Nausea ..	+	..	..	+	..	..	+
3. Vomiting ..	..	..	..	+	..	..	..
4. Anorexia ..	+	..	..	+	..	..	..
5. Upper abdominal pain	+	+	..	..	..	..	+
6. Peripheral sensory changes.	..	..	..	..	..	..	+
7. Skin reactions ..	+	+	..	..	..	+	+
8. Joint pains ..	..	..	..	..	..	..	+

Case Summaries—

Case 1—M.A. female 27 years. Extensive fibro-caseous cavitary disease of three years duration. General condition poor. Sputum culture showed tubercle bacilli resistant to streptomycin and P. A. S. Treated with ethionamide 500 mgm. twice daily and isoniazid 150 mgm. twice daily. Gastro-intestinal symptoms appeared as metallic taste in the mouth, nausea and abdominal discomfort. There was generalised itching, and burning sensation in the body. These toxic manifestations disappeared with stoppage of drug. Drug restarted and above symptoms reappeared. Drug continued for 5 months. No change in general condition or X-ray chest. However sputum converted into negative after 2 months treatment.

Case No. 2—A. W., male, 50 years, bilateral fibro-caseous cavitary disease of 2½ years duration. Treated with ethionamide and isoniazid. He developed mild symptoms e.g., metallic taste, abdominal discomfort, itching and burning sensation but later tolerated the drug well. Very slight improvement in general condition and radiologically. Sputum converted negative in 2 months and remained so thereafter.

Case 3—G. B., male 45 years. Unilateral cavitary disease of 3 years duration. Treatment with ethionamide and isoniazid. No toxic symptoms noted. Slight improvement in general condition. No significant change in X-ray,. Sputum convertion did not take place uptil 6 months of treatment.

Case 4—S. A., female, 28 years. Extensive cavitating bilateral disease of 3½ years duration. General condition was poor. Sputum culture showed tubercle bacilli resistant to streptomycin and isoniazid. Treatment started with ethionamide and P. A. S. She developed severe nausea and vomiting and drug had to be stopped

after a week. She refused to restart the drug and left the hospital.

Case 5—Z. A. male, 45 years, Fibro-caseous disease of 2 years duration. Tubercle bacilli resistant to streptomycin and isoniazid. Treated with ethionamide and P. A. S. He developed mild gastro-intestinal symptoms in the beginning, otherwise tolerated the drug well. No change radiologically but slight improvement in general condition. Sputum convertion after two months treatment.

Case 6—A. M., male, 35 years. Bilateral cavitating disease of chronic nature and 3 years duration. Had extensive treatment at home. Treated with ethionamide and isoniazid in dosage described earlier. He had mild gastro-intestinal symptoms and skin reactions such as tingling and sensation of pins and pricks but drugs continued. No radiological change noticed but there was slight improvement in his general condition. Sputum was converted negative after two months treatment.

Case 7—F. K., male 38 years. Fibrocaseous disease right lung with advanced multiple cavitated lesion in the left lung of long duration. Resistant to P. A. S. and isoniazid. Treated with ethionamide 500 mgm. twice daily and streptomycin 1 gram daily. Had mild gastro-intestinal symptoms such as metallic taste, nausea, loose motions, itching and burning sensation in whole body. After 5 months treatment he developed pains in smaller joints of hands and feet which subsided on stoppage of drug. Slight improvement clinically and radiologically. Sputum converted into negative after 4 months.

Discussion

Whatever favourable results were obtained, can be attributed to ethionamide in combination with one of the standard drugs. Since almost all the standard drugs had been given to these cases for a long period prior to this trial, therefore it is not difficult to conclude that ethionamide must have played a major role in the changes noticed in this trial. The result in one case is inconclusive, because she left the ward and died soon after. Out of the remaining six cases sputum became negative in five of them and remained so for periods varying from five months to ten months depending upon their follow up.

The clinical, radiologizal and bactenological changes are given in Table II.

TABLE II

Showing Changes in General Condition, Chest-X-Ray and Sputum Conversion

Case No.	General condition	Radiological changes	Sputum conversion
1. M. A. ..	No improvement ..	No change ..	Yes.
2. A. W. ..	Slight improvement ..	Slight improvement ..	Yes.
3. G. B. ..	Slight improvement ..	No change ..	No.
5. Z. A. ..	Slight improvement ..	No change ..	Yes.
6. A. M. ..	Slight improvement ..	No change ..	Yes.
7. F. K. ..	Slight improvement ..	Slight improvement ..	Yes.

These changes are not much encouraging. Bearing in mind, the chronic nature of disease and extensive radiological evidence not much changes could be expected in these cases. However, the results indicate that the drug has a definite value in bacteriological convertion of sputum which should be considered as a great helping factor in chronic cases.

SUMMARY

Seven patients with chronic active cavitating pulmonary tuberculosis were treated with ethionamide in combination with one of the standard drug. In one case result could not be ascertained. Sputum conversion was obtained in five, out of six cases. General improvement of slight degree was noticed in five cases. The drug was reasonably tolerated with minor toxic symptoms except in one case. Though a small series, but conclusion can be reached that ethionamide may be valuable in sputum conversion.

Our thanks are due to Messrs. MAY AND BAKER (Pakistan) Limited for the supply of Ethionamide (Trescatyl).

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IMMUNIZATION IN CHILDREN

by

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tomology
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gy.

In developing countries like our own, many a million still fall a prey to the devastations of diseases which could well be prevented by active measures of immunization. These measures have already led to virtual disappearance of terrible afflictions like smallpox, cholera, diphtheria and tetanus in advanced countries and have caused a remarkable fall in the incidenceof many other diseases like Poliomyelitis, Whooping cough and Tuberculosis, etc.

The only way towards progress lies in early control of these diseases by prompt measures. This becomes a very vitally important issue when it is realised that how quickly various diseases like Smallpox etc., can be transmitted across the Globe due to facilities of modern travelling. Most effective measures to achieve such an ideal would be to prevent the diseases by active immunization at an early age or halter it by passive immunization soon after its onset.

Immunization in children can be described under two headings (1) Active Immunization, (2) Passive Immunization.

1. Active Immunization

(*a*) *Diphtheria*—At least 70 per cent of the population must be protected to ensure control of diseases by herd immunity. All currently available antigens are satisfactory, but alum containing toxoids such as A.P.T. and P.T.A.P. are no longer used in view of the reports that they are more likely than non-absorbed preparations to provoke paralysis in the injected limbs of the patients who contract Poliomyelitis in the ensuing month. (Medical Research Council, 1956)

When Diphtheria immunization is being given separately it is now recommended that two injections of 1 ml. formol toxoid be given not less tha n one month apart at 8-9 months of age with reinforcing doses of 0.5 ml. at 10 years and 0.25 ml. at 15 years. (Lancet 1957). Many health authorities have found that these separate antigens are impracticable under present day conditions.

If Diphtheria is present in the community and rapid primary immunization is required, three injections of 1 ml. fluid Diphtheria toxoid should be given at 10 days interval. For children previously immunized a single reinforcing dose as small as 0 2 ml. fluid formol toxoid will raise the anti body titre to a safe level in a few days. Large doses may give rise to re-actions in adolescents and adults, though young children tolerate formal toxoid well; it it is far less irritant than A. P. T. and P. T. A. P.

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tive Medi-
cine, Lahore

The importance of susceptibility test *i. e. Schik Test* should not be forgotten. Schick test is a biological test to find out if a person has already developed his or her own Diphtheria anti-toxin and so is no longer susceptible to the disease. It consists of an intradermal injection of Schick toxin. The dose is 0.2 ml. (1 Schick dose) inoculated intradermally into left arm. 0.2 cc heated toxin (control) is inoculated similarly into right arm. Read at 48 hours, and 5 days.

Positive—Redness and swelling in test arm only.

Negative—No reaction.

Schick positive and swab negative cases should be considered susceptible to the disease and for such cases immunization is essentially required.

(*b*) *Triple Antigen Immunization Against Diphtheria Pertussis and Tetanus*—1 cc. triple antigen by deep I/C injection at intervals of at least one month beginning at the age of two months or soon after is well recommended schedule. In exceptional circumstances, the first interval may be extended to three and the second to six months without restarting the course. A booster injection of triple antigen is advised at 15-18 months of age.

Risk from *whooping cough* is greatest in the 1st six months of life. At this time the reisk from Diphtheria is negligible. For the first few months babies of immune mothers may continue to carry inherited Diphtheria anti-toxin, which interferes with response to immunization. The anti-toxin is excreted at the rate of about 15% per week, so that Diphtheria inoculations should theoratically be delayed until it has fallen below 0·04 units per ml. at 4·5 months.

Inoculations rather earlier can, however, be considered with virtual disappearance of the disease abroad, few mothers have high anti toxin levels to pass on to their offsprings many investigators have found that it is possible to immunize the great majority of infants between 2 and 5 months and an early booster injection will protect them all.

(*c*) *Tetanus*—Primary vaccination against tetanus is generally combined with vaccination against enteric fever(for adults) and with vaccination against Diphtheria (for childeren). In exceptional circumstances however, it may be carried out separately by injecting tetanus toxoid (T. T.) simultaneously. In such cases T. T containing 20 Lf. doses per ml. is usually used in the following dosage irrespective of age and sex.

1st Injection 0·5 ml. ..	2nd Injection 0.5 ml. ..	3rd Injection 0·5 ml
	6—12 weeks after 1st injection ..	6—12 month after 2nd injection.

Maintenance of Immunity—Except for the first two maintenance doses for children for which D.T. will normally be given, uncombined tetanus toxoid will be used for maintaining immunity to tetanus. Under normal conditions a maintenance dose of 0.5 ml. is given by subcutaneous injection every five years.

(*d*) *Enteric Group of Fevers*—Infants under one year old will not be inoculated against Enteric. Children of from one to 12 years inclusive will be inoculated subcutaneously with diluted typhoid paraty phoid vaccine (diluted T. A. B.). Diluted vaccine contains 1000 millions killed organisms (400 million Salmonella-typhi, 300 millions Salmonella para typhi and 300 millions Salmonella para typhi B per, ml.). Intradermal injection of children is not easy and the advisibility of using that route for them depends on a future assessment of the degree of liability to skin sensatization by it. The first and third doses for primary vaccination and all subsequent doses are 0·2 ml. The second dose for primary vaccination will generally be 0.4 ml. though for undersized children, or following any thing more than a mild reaction through the first dose, the second dose also should not be greater than 0.2 ml.

(Alcoholised vaccine is no longer used). Intramuscular route should be avoided.

Degree, duration and maintenance of immunity—Inoculation does not give full protection agianst enteric and though case incidence should be lessened, overt infections may still occur in those who are inoculated. When this happens the severity of the disease is not likely to be mitigated by the inoculation. It is hard to assess the duration of immunity following injections of T. A. B. vaccine. Protection is assumed to be maintained for one year and basal immunity to exist for three years after primary immunization or a maintenance dose. Those at risk are given annual doses to preserve protection and those not at risk are given doses every three years to maintain basal immunity.

(*e*) *Cholera*—Babies under one year are not normally immunized against cholera as the risks of contracting this infection are slight at this age. For primary vaccination two doses of vaccine are injected simultaneously at an interval of 7—28 days (preferably the interval should be 14—28 days though as one of only 7 days is undesirably short and should be avoided except in emergency). Adults and children over five years should be given 0·5 ml, as first dose and 1·0 ml. as second dose Children of 1—5 years should be given 0·25 ml. as first dose and 0·5 ml. as second dose. Immunity duration is short lived and maintenance doses are needed every six months for those at risk.

(*f*) *B.C.G. Vaccination (Immunization against T.B.)*—B.C.G. vaccination of children can be considered under three categories :—

I. New born infants of Tuberculous mothers

(*i*) *No contact with mother after birth*—A new born infant of a tuberculous mother should be removed from its mother at birth. No Heaf or other Tuberculin test is then needed , and the infant should be vaccinated with B.C.G. on the fourth or fifth day after birth. The baby should be kept segregated from the mother for a further six weeks after which a Heaf test will be carried out. If this is positive the child may be returned to the mother who should in the mean time has been told how to protect the baby from infection. Annual follow up Heaf tests are necessary. If the post-vaccination test is negative separation from the mother is continued for a further three weeks before a second Heaf test is made. If this is positive the child is returned to mother. If negative the baby is revaccinated, further action being as after the first vaccination.

(*ii*) *Contact between baby and mother after birth*—If there has been any contact between mother and infant after birth the child is segregated from mother for six weeks. A Heaf test is then carried out and the child vaccinated if this is negative. Action after vaccination is as in (*i*) above.

II. Older children who are contact cases

Action required is as for infants who have been in contact with tuberculous mothers except that :

(*i*) a Heaf test is done before the prevaccination segregation.

(*ii*) segregation must be supervised but need not be in hospital .

III. CHILDREN NOT KNOWN TO BE CONTACT CASES

The Heaf test may be carried out at any age but which is most suitable and the age at which vaccination of negative reactors is required depend upon prevailing circumstances. When it is known that the tuberculin positive rate in children in a locality is high (30 per cent or more) children of such a locality should be Heaf tested at an age (*e.g.* 3—5 years) when they may be exposed outside the home and be vaccinated forthwith if tuberculin negative. On the other hand when the tuberculin positive rate among children under five is very low, B.C.G., vaccination is not at once necessary even if the Heaf test has been carried out at this earlier age and is negative. Vaccination interferes with the future diagnostic value of tuberculin tests and may well be deferred until the child is ten years old; when, of course, B.C.G. must still not be given without a repetition of Heaf test, with a negative result.

(*g*) *Poliomyelitis*—This is not legally required but is strongly recommended when it is available. It should precede smallpox vaccination by at least 2 weeks (and yellow-fever preferrably by 3—4 weeks).

It is paradoxical that the public health measures which have done so much to reduce or eliminate other infective diseases should have increased the risk of parlytic poliomyelitis. In communities living under primitive conditions infant inherit protection from their mothers under its cover they begin to acquire a natural immunity so that during the first few years of life most of them develope antibodies to all the three virus types. Paralysis is very rare at any age. Gelf and et al. (1957) studying a mixed community in a highly endemic area in Louisiana, found that Polio-viruses of all the three types were circulating continually, the transmission being regulated by seasonal limitation of contact and by personal hygiene. In this area nearly three-quarters of the children were immune by school age, the greatest spread of infection being among children aged 2-5, from whom it extended to other members of the family. In the most advanced society virus dissemination is reduced and exposure is delayed. For reasons not fully understood., this creates an explosive epidemiological situation and greatly increases the chances of any infection that does occur being paralytic or even fatal.

There is a convincing evidence from large scale trials in America, Canada and Britain that immunization with Salk type vaccine is 70 per cent effective (Med. Research Council 1957 B) but like other vaccines it does not provide complete protection. Cases of poliomyelitis have been reported in triple vaccinated subjects.

Primary Vaccination—Primary vaccination consists of 4 doses each of 1.0 ml. injected intramuscularly into the deltoid (usually of the left arm). The interval between the first and the second dose should be at least 3 weeks and the third for at least 6 months These intervals may, if necessary, be extended to 3 and 18 months respectively. A fourth dose is given 6 to 12 months after the third.

Maintenance Doses—Following the fourth dose further maintenance doses are probably required every five years.

Oral Route Administration of Vaccine—Living attenuated Poliomyelitis vaccine has been prepared recently and successfully tried in Russia. It is given by mouth and the Oral Route Administration provides certain additional advantages. It enables the vaccine to act on the intestinal mucosa so possibly to render the mucosal cells resistent to infection as well as nearly preventing the development of paralysis in those infected, and the pro-

vocation of paralysis which may possibly result from the injection of inactivated vaccine in the presence of an epidemic, is not to be feared. Oral immunization also reduces the total number of injections and individuals needs and the vaccine is cheaper to make.

(*h*) *Smallpox*—A strong argument usually forwarded in respect of vaccination against smallpox in infancy is based on the fact that the complications of this malady have been proved to be severer and more frequent when vaccination is carried out at a later age period than when it is done in infancy. Further more risks of infecting rest of the population in the world due to increased international travel can be decreased only by immunization against smallpox in infancy. Certificate becomes valid after 8 days of successful primary take and on the day of revaccination and remains so for 3 years.

Now smallpox vaccine is also prepared in dry form in freezed dried vacuum sealed preparation of living vaccinia virus which is reconstituted just before use with the diluent provided with it. It is supplied in 25 dose and 100 dose packs. Dried vaccine lasts indefinitely at refrigerator temperature (2°*C* to 10° *C*), for a year when kept in a cool dark place (not over 15° *C*); or for one month at tropical temperatures. The reconstituted vaccine should be used at once but will retain potency for one week if kept in the refrigerator.

Doses—The number of pressures to be made depends on whether the vaccination is primary or a revacination (and if the latter after how long an interval), on the age of the subject, whether it is a repeat following an immediate previous failure and on the imminence of risk, as shown in the table below:—

	Degree of risk	Nature of vaccination	Number of drops of vaccine	Number of pressure per drop	Remarks
Infant ..	Normal ..	Primary ..	1	30	
	Epidemic, or undue prevalence of smallpox	Primary ..	2 or 3	30	Drops on 2 or 3 separate areas an inch apart.
	Normal ..	Revaccination (after first infant vaccination).	1	10	Primary response likely.

Response to vaccination can be given in stages as mentioned below:—

	Papule	Vesicle	Pustule	Scab	Scab off
Primary ..	4 days	5 days	8 days	11 days	21 days.
Vaccinoid or Accelerated ..	2 days	3 days	4 days	5 days	8 days.

Immediate or Immune Papule under 1 day (usually no vesicle. Fades within 3 days)

The time given may vary considerably.

Immunization of Contacts—All persons who are known to have been in contact with a case of smallpox should be vaccinated or revaccinated at once. Those who have never been vaccinated before or whose vaccination history is considered unsatisfactory should also be given post-vaccinal gamma globulin by intramuscular injection. This material is obtained from the plasma of recently vaccinated individuals and contains antibodies to vaccinia virus. The best dose has not yet been determined. In general 1·0 to 1·5 gms. may be given to adults and to children alike, but doses of 2·0 gms. or more may be desirable for unvaccinated close contacts. Vaccination should when practicable precede injection of the gamma globulin by 12 to 48 hours then interference with active immunization by the injected antibodies is unlikely and the vaccination should be successful, if it is not, however, it should be repeated.

For chalking out immunization programme designed to protect children; any of the following two types of schedules can be adopted against five diseases. The Schedule A is usually preferred;—

SCHEDULE A

Age	Visit	Vaccine	Injection	Interval
5 weeks 6 months	1	Pertussis ..	1	4 weeks or more between each.
	2	Pertussis ..	2	
	3	Pertussis ..	3	
7-10 months	4	Poliomeolitis ..	4	4 weeks or more
	5	Poliomylitis ..	5	
	6	Diphtheria and Tetanus ..	6	4 weeks
	7	(Diphtheria, Tetanus and Pertussis) ..	7 8	
15-18 months	8	Diphtheria and Teanus	9	
		Poliomyelitis* ..	10	
		Small pox sometimes during the first 5 years		
School entry	9	Diphtheria and Tetanus ..	11	
8-9 years	10	Diphtheria and Tetanus	12	
		Smallpox (re-vaccination)		
10-15 years	11	B.C. .G ..	13	

*There is no doubt that a fourth dose of poliomyelitis vaccine will be necessary but the exact timing of this has not yet been decided.

SCHEDULE B

Age	Visit	Vaccine	Injection	Interval
2-6 months	1	Triple (Diphtheria, Tetanus and Pertussis). ..	1	4 weeks or more between each.
	2	Triple (Diphtheria, Tetanus and pertussis)	2	
	3	Triple (Diptheria, Tetanus and Pertussis). ..	3	
7-10 months	4	Poliomyelitis ..	4	4 weeks or more.
	5	Poliomyeltis ..	5	
15-18 months	6	Triple (Diphtheria, Tetanus and pertussis) Piliomyelitis* ..	6	
			7	
		Smallpox sometimes during the first 5 years		
School entry	7	Diphtheria and Tetanus ..	8	
8-9- years	8	Diphtheria and Tetanus Small-pox (re-vaccination)		
10-15 years	9	B.C.G. ..	10	

There is no doubt that a fourth dose of poliomyelitis vaccine will be necessary, but the exact timing of this has not yet been decided.

2. Passive Immunization

(*a*) *Tetanus*—Tetanus anti toxin (A.T.S.) is prepared by immunizing horses with tetanus toxoid followed by tetanus toxin. The plasma or serum collected from these animals is refined and concentrated.

Tetanus anti-toxin should be given to prevent tetanus developing following wounds or injuries when the patient is non-immune and the injuries are such as to give rise to risk of tetanus.

Doses—Non immune persons should be given a dose of 1500 international units of tetanus anti-toxin by intramuscular injection after a sensitivity test. Except in the case of an individual who has had previous injections of serum (including serum vaccine preparations, *e.g.*, Diphtheria T.A.F.), when the dose may be raised to 10,000 units, this should generally suffice. However, similar doses may be given at weekly intervals, if considered necessary, in the light of clinical progress.

Duration of effect of tetanus anti-toxin, after treatment—The protective effect of injection is generally at its heigh in two or three days. It may be adequate for about 2 weeks, which has become slight before three weeks have passed. Since one treatment with anti-toxin is liable to render the future use of anti-toxin of less value the last dose of it given on such a first occasion should be followed after 6 to 8 weeks, by the first

dose of vaccine for primary vaccination against tetanus. (If vaccine is given earlier, remaining anti-toxin may interfere with the active response).

(*b*) *Diphtheria*—Passive immunization against diphtheria may be required in the following circumstances.

(*i*) For contacts of cases of diphtheria unless such contacts are known to be immune.

(*ii*) For persons who are not known to be immune and who are at risk during the explosive outbreaks of diphtheria.

Prophylactic dosage of diphtheria anti-toxin—500—2000 units of diphtheria anti-toxin may be given intramuscularly after sensitivity test.

Duration of Passive Immunity after treatment—The protection afforded by the above-mentioned dose usually lasts for about 2 weeks. In a person sensitized by previous injection of serum the duration of protection may be much shorter perhaps only 2 or 3 days.

(*c*) *Role of Gamma Globulin in Passive Immunization*—The gamma globulin fraction of the serum proteins contains almost all the antibodies against bacteria and viruses. In clinicial use it has the advantage that the equivalent doses only about 1/20th that of whole serum, as well as greater stability and virtual freedom from risk of transmitting serum hepatitis. The principal uses of it can be mentioned in the following diseases:—

(*i*) *Measles*—To abort or modify the disease in young or debilitated children and to control institutional outbreaks. As a rule modification is preferable since this is followed by permanent active immunity. Given within 6 days of exposure, 250 mg. will usually prevent the disease in infants and modify it in children over one year (McDonald and Cockburn, 1954). The protection lasts about 3 weeks.It is ineffective once the rash has appeared.

(*ii*) *German Measles*—To protect women exposed in the first four months of pregnancy and prevent damage to the foetus 1.5 g. should be given without delay, desirably within a week of exposure.

(*iii*) *Poliomyelitis*—To provide protection for about 5 weeks for young children, pregnant women and tonsillectomised subjects. It is effective when given before exposure, but its value in home contacts is negligible because they have probably already been infected when the first case is diagnosed.

(*iv*) *Infective hepatitis*—To control institutional outbreaks and to protect, for example pregnant women, nurses or certain children with in 7 days of exposure for subjects below and above the age of 10 years dosage is respectively 250 and 300 mg.

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DEMOGRAPHY AS A SCIENCE AND IT'S EXISTENCE IN PAKISTAN

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Demography as a science has to play a very important and significant role in the development of Pakistan or we can say that without a sound knowledge of this science we cannot keep pace with the rapidly advancing world. Demography provides us a real picture of the nation's health and its socio-economic status. In other words demography is concerned with the growth, development and movements of population as a whole. Demography constitutes most important part of statistics and a good statistical system is the back-bone of human activities. In order to have an idea of national economy and its impact upon the social status of the people, it is very necessary to have an accurate statistical data. In this atomic age of ours proper planning in unthinkable without a sound knowledge of statistical methods and in Pakistan like all other countries the success of national projects hinges on the quality of statisticians to a large measure.

For all types of demographic studies we are mainly concerned with the details of human population of a particular area. Information about age, sex births, deaths, migration, marriages, divorce, infant mortality, occupation of different earning members, type of household, education, locality and many other socio-economic problems is elicited and interpretted through the science of demography. Without knowing the demographic characteristics of the population of a country we can-not proceed further with proper and methodical planning. In Pakistan the importance of statistics especially of demography has been realised by the Government and the Health Department is trying its best to equip the medical men with this science.

Demographic activities may be called (Human Book-Keeping) for the work is concerned with the maintenance of the charateristics of the population from birth till death. In Pakistan Public Health authorities, relying on system functioning irregularly or inefficiently, remain ignorant of the physical conditions of the people, of the revailing diseases and their age, sex, local and seasaonl distribution. Generally speaking it may be said that no infectious disease except cholera, small-pox, fevers and plague are reported from rural areas. For other diseases in the rural areas, few reports are made. In the light of the information available, the authorities will lack accurate knowledge indispensible to the framing of future legislation in the interest of public health. No one with a little common sense would venture to invest money where accounts are not properly maintained and regularly audited. It is only by such means as the statistical data, that the directors of successful commercial enterprises are kept informed of the exact state of affairs at all times of all branches of their business. Similarly details characterising health, disease and medical policies if not submitted to regular and objective audits throughout the year, effective plans cannot be made and functions successfully.

The present day procedure in official demgoraphy undoubtedly owes much to William Farrthan to any other person. So far he can safely be regarded as the greatest medical statistician ever born and lived. The application of statistical methods to the study of biological problems began with Galton. He may be said to have been the founder of

science of biometry. (Biometry is the branch of science which studies the quantitative aspects of vital phenomena.)

Pakistan is an over populated country with population, excluding Jammu and Kashmir, Gilgit and Baltistan, Junagarh, Manavader and Pakistan enclaves in India on 1st February, 1961 was 9,38,31,982 persons including 1,11,369 Non-Pakistanis. There are 4,93,08,645 males and 4,44,11,968 females in Pakistan. In 1951 the population of the corresponding territory was 7,58,79,165 including 2,066,69 non-Pakistanis and also the estimated population of Gawadar (13,000) which become a part of Pakistan in 1958. The population in 1961 has thus registered an increase of 23·70 per cent of the total population, (23·00 per cent of males and 24·4 per cent of females). The total area of Pakistan is 8,65,529 square miles. West Pakistan with 84·9 per cent of the total area has 45·8 per cent of the population. On the other hand, East Pakistan with only 15·1 per cent of the total area has 54·2 per cent of the population. The brief comparison of the rate of growth within the two wings of Pakistan indicates large scale population movements and greater development opportunities in West Pakistan and a rather immovable population with little room to shift the pressure in East Pakistan. The average density of 253 persons per square mile for the whole country makes an extraordinary wide range of variation between the two wings, more especially between large administrative areas within the provinces. For every person on a square mile of land in West Pakistan, East Pakistan has about seven.

In sharp contrast, 10 out of 17 districts of East Pakistan have density of more than 1,000 persons per square mile. Briefly the distribution and concentration of population in Pakistan makes a fascinating study bringing out in bold relief the problems of land utilisation, prospects of diversification of occupation and the trends of pop ulation movement in different parts of the country.

The ration of men to 100 women for Pakistan as a whole was 113 in 1951 and 111 in 1961. This sex ratio for rural area in Pakistan is 109 and for urban area 129 as shown by the Census of 1961. The higher number of males in the urban population is mostly due to the fact that there have always been more males than females among the migrants. Among different types of communities, the sex composition is not uniform. The ratio is considerably higher is urban area than rural area. In 1961 census it was Reported that in urban population there are 29 per cent more males than females.

In 1951 Census as a result of high mortality and high fertility, Pakistan had extremely young population. Their age pyramid revealed a very broad base with quickly attenuated top. It stood in marked constrast to the kind of pyramid found in countries with low fertility and mortality. Slightly more than the half of the population is represented by the age group 10—39. In Pakistan as in the rest of the world, the number of boys at birth was greater than that of girls but, owing to their higher mortality rate this numerical advantage was lost before they were one year old. The shortage of girls began at the age of ten and became greater during the age period 40—50 and after the age of 55 women regained their superiority in number.

The above given figures provides us a sound ground that the population of Pakistan is increasing very rapidly. If this rate of expansion is allowed to continue unchecked we

will have to suffer from many socio-economic problems which are already creating innumerable trouble in the proper development and advancement of the country. The main cause of these difficulties is the lack of statistical data regarding Pakistan especially the East Pakistan and the former Punjab, which had been divided at the time of partition. The division of the sub-continent and its attendant aftermath made it impossible to get sound reliable statistical information. As it has already been pointed out, in Pakistan between the census of 1951 and 1961 our population has increased, at the rate of 2·37 per cent per year as compared to the rate of increase of 1·7 per cent per year for the rest of the world. This rapid multiplication is leading us to serious socio-economical and political problems which in turn have a very grave effect on the public health. Due to this abnormal increase in population we have not been fully able to fulfil the objectives of the First and Second Five Year Plans. In order to maintain any population grounup adjusted to the surroundings we require a simultaneous increase in our food-grain, housing, water supply, public utilities, services and other human necessities. Our resources are limited and are not increasing as rapidly as our population is. The Pakistan Planning Board in its preliminary recommendations has stated that even if all the resources were exploited to raise the food production, the rate of increase of food production-he will lag behind the rate of increase of population. To the limitation of family size there is much of opposition. Some religious groups may oppose family limitation, on moral principles. Other groups believe that children add much to the joy of living and bringing comfort, social security and joy in the old age. Other people feel and advocate that children should be given a full education and various opportunities and advantages of modern society and so favour the family limitation. From the health point of view it is important to improve our social and economic standards which are related to the population. If health has to be improved, growth of population must be controlled and for that family limitation needs be advocated.

It is encouraging to note that quite a number of statisticians and technicians and others are conducing study surveys to find out the sources of unreliability and defficiency existing is the statistical data. There are two types of population statistics :(*i*) census (*ii*) registration of events as and when they occur. In addition it is also possible to obtain both types of information by means of special sampling survey. This was the technique used by Social Sciences Research Centre of the Panjab University, Lahore, while collecting the requisite information about socio-economic studies and fertility experiences for the citizens of Lahore in collaboration with the population Council, New York. The contribution of Mr. Khalid Hayat Khan to the developing of Demographic Science in Pakistan is tremendous. Khan's distribution is the result of his efforts and dedication to the cause of this science. The efforts, of Dr. A. H. Awan in this field are also appreciable. A study of some of the population characteristics in the area of Nicholson Road, Lahore, was conducted by Mr. S. M. Anwar and Dr. Siddiqui. Dr. Zia-ud-Din read a paper "Demographic study in West Pakistan" in the International Conference at Vienna. A study was also conducted in Qilla Gujjar Singh area of Lahore to find out relationship between economic-status, environmental sanitation and infant health.It was found that infant mortality decreased as the *per capita* income increased and it was less in those families where the standards of

environmental sanitation were good. A study was conducted for the village Budhopur (District Gujranwala) by six men from the University of Cambridge. In this study the influence of social organisation on the individual groups, on village politics, social grouping, mutual alliance, marriages etc., has been examined with great thoroughness. The standard of cultivation implements used, crops growing, yield obtained and income earned have also been observed. This information, it is, visualised will be of far reaching importance when projected to those high up in the hierarchy. There is still further need for thorough and unbiased studies.

Vital events, that is age sex, births, deaths, migration, marriages, etc., coming from registration are mostly inaccurate biased, mileading and unsuitable from the statistical analytical registeraview point. While analysing the available information for morbidity, mortality and mig- ration, etc., in Pakistan, we should be very careful and should not take these values as free from bias.

In municipalities, the local authority and in rural a areas village headman (Chowkidar) are the usual reporting agencies, In those areas where police is responsible for the registration and the reporting of vital events the information obtained from the villages falling under the jurisdiction of a particular Thana, is limited to some days of the month, weeks or fortnights. Moreover if the policeman collecting informaton is not properly entertained with 'Nazrana', birth will seldom be registered. The result being that birth, death, and cases of infectious diseases are frequently registered much later than the actual date of occurrence. The Chowkidar's records of birth, death are often incomplete. Usually the registers are not maintained by the Chowkidars themselves but are got done by literate villagers, and the chances of false informaton creeping in are too great. Registers so maintained cannot be relied upon to give complete records of annual births and deaths on the following grounds :—

(1) Not all Chowkidars are conscientious in recording all births, nor all fathers always notify the birth of a child who dies almost immediately.

(2) Some women come from other villages to their mothers for child-birth and these are also entered in the register. Some women going out to their mothers for child birth are not recorded. The discrepancy is great.

In the absence of life table we do not know the average duration of life enjoyed by a person and the expectation of life. Computation of life table generally take 80 to 90 years, but in Pakistan even in this period it will not be possible to frame an accurate life table, because the reporting of the age is mostly inaccurate.A life table for the population Lahore is about to be relaased but this life table based on census figures will not be free from criticism. Life table is the-back-bone for the successful operation of insurance companies and many other commercial enterprises.

Taking into consideration the ambiguities and discrepancies of the vital events; question arises as to what line of action should be channelised in order to get maximum possible accurate and reliable statistical figures.For this purpose, the following few suggestions are put forward and it is hoped a considerate approach will certainly bring good results.

I. Chowkidar (as vital events reporting agent) may be replaced by more efficient reporting agency. The following can be useful alternatives :—

(i) Employment of health officials, i. e., sanitary inspector or health visitor for

birth registration.

(*ii*) Prescribing certain minimum qualification for the persons holding the post of Registrar.

(*iii*) These duties of the Chowkidar may be transferred to the Basic Democrats because they can collect much better information than Chowkidars. This system will be of greatest benefit. The living example of marriage registration and the efficient manner in which this business is being conducted calls for the Basic Democrats to share this vital issue as well.

II. At the time of each birth and death a certificate may be issued. This certificate of birth must be produced whenever it is required or asked for. Record of these certificates may be retained in the Union Councils Offices. This certificate will be of material value while determining age, etc.

III. Birth registration should include two new items in respect of each birth : (*i*) age of mother (*ii*) number of pregnancy. The first is required for calculation of "fertillity" and the second for the study of maternal and child mortality.

IV. Voluntary registration Act of Births and Deaths must be replaced by compulsory registration Act and for that the new legislation is warranted.

V. Private Medical Practitioners if join hands and supervise the reporting of vital events with special reference to cause of death things can be improved considerably without any burden on the national exchequer.

VI. Question of transference of vital events record to the places to which certain persons or groups of persons belong requires consideration.

VII. Another important factor is that well concerted and ceaseless battle need be fought by all ranks of people jointly to rid the country of illiteracy. With the percentage of literacy coming up quite a few problems get automatically solved.

VIII. The role of useful and proper publicity, too, can be of far reaching importance. All the available means of propaganda to enlighten the laity about the inherent virtues of the programme be exploited and untiring efforts be made that the message reaches most of the public. Any lacuna in the programme means failure to get near the targets.

IX. The training and quality of the field workers, is still another very vital factor which needs considerate attention. After all the entire outcome of any programme is significantly dependant upon the way, the field workers take their jobs. Here we require people of high moral integrity and selfless devotion. The behavioural pattern of people' their socio-cultural and religious biasis should be carefully viewed before attempting to elicit any information. The approach must differ with every different individual for each individual is an institution in itself.

To overcome these difficulties in Pakistan, an effective welfare programme has to be launched. For this purpose constant hardwork, co-operation from all members of society, good planning and sound leadership is required.

The impact of this information on the national projects is very very great indeed. It is thus ripe time that an all-out attempt is made to get reliable vital statistics. It is only

then and then alone that we can think of ushering in an era of real happiness, joy, satisfaction and patriotism, through well-planned and scientifically calculated projects of nation-building.

I am confident this article will contribute in its own humble way to the benefit of motherland.

Book Review

CLINICAL PHYSIOLOGY edited by Campbell, E. J. M., Dickinson, C. J., Slater S. D. H. (Pp. xiii 605, 57s 6d), and Ed, 1963. Oxford: Blackwell Scientific Publications.

This book has been throughly revised and brought up to date. It is a well written book and well prove to be useful companion for these who wish to understand 'physiology gone wrong'. Lists of useful references have been appended at the end of each chapter. It is recommended to both undergraduates and General practitioner.

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VOL. XIII, No. 4

WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR THE
EASTERN MEDITERRANEAN
P. O. B. 1517 ALEXANDRIA

The 10th March 1964

Leading Pakistani Malariologist awarded the Darling Prize

Colonel Manowar Khan Afridi, Honorary Consultant in Malariology to the Ministry of Health, Pakistan, has been awarded the Darling Foundation Medal and Prize for his contribution to the control and eradication of Malaria over the past 30 years and for his laboratory and field studies in many aspects of practical malariology. The recommendation of the award, which was made by the Darling Foundation Committee,was endorsed by the WHO Executive Board during its 33rd session, held in Genava early this year.

This is the ninth award of the Foundation, created by private funds to honour the memory of Dr. Samuel Taylor Darling killed in an automobile accident in 1955 during a study mission of the League of Nations, Malaria Commission. It consists of a bronze medal and a fixed sum of one thousand Swiss francs.

Colonel Afridi, the first Darling Laureate from an Eastern Mediterranean country, is a leading contributor to malaria control and research work. He began his career with the Indian Army Medical Corps in 1924 and later specialized in bacteriology and serology. After the Second World War, Dr. Afridi was appointed Director of the Malaria Institute of India, and then of the Malaria Institute of Pakistan. Later he served as Director of Health Services of the North-Western Frontier Province until his retirement in 1955.

In 1958, Colonel Afridi was appointed Vice-Chancellor of Peshawar University and served in that capacity until 1962 when he became the Honorary Consultant to the Ministry of Health, Government of Pakistan.

A holder of high degrees from Pakistan and United Kingdom Universities, and a former WHO Deputy Regional Director for the Eastern Mediterranean, Colonel Afridi is a member of the WHO Advisory Panel on Malaria. He has held a number of consultantships for the World Health Organization, was elected Chairman of its Executive Boards 30th Session in May 1962, and is presiding over the 17th World Health Assembly, currently meeting in Geneva.

The laureate will receive the Darling Foundation Medal and Price during a plenary meeting of the Assembly.