SUMMARISED REPORT

ON THE

BOMBAY PLAGUE RESEARCH LABORATORY,

FOR 1896–1902,

BY

W. M. HAFFKINE, C.I.E.,

DIRECTOR-IN-CHIEF.

[Indian Price—8 Annas.]
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No. $\frac{1}{\text{S. C.}}$ OF 1903.

FROM

W. M. HAFFKINE, ESQ., C.I.E.;

To

THE SECRETARY TO GOVERNMENT,
General Department.

Plague Research Laboratory,
Parel, Bombay, $\frac{4th}{21st}$ March 1903.

SIR,

I have the honour to forward, for Government's favourable consideration, attached Summarised Report on the working of this Laboratory from the 8th October 1896 till the 31st May 1901, and for the year following.

I have the honour to be,

Sir,

Your most obedient Servant,
W. M. HAFFKINE,
Director-in-Chief.

SUMMARISED REPORT

ON THE

BOMBAY PLAGUE RESEARCH LABORATORY,

FOR 1896–1902,

BY

W. M. HAFFKINE, C.I.E.,

DIRECTOR-IN-CHIEF.

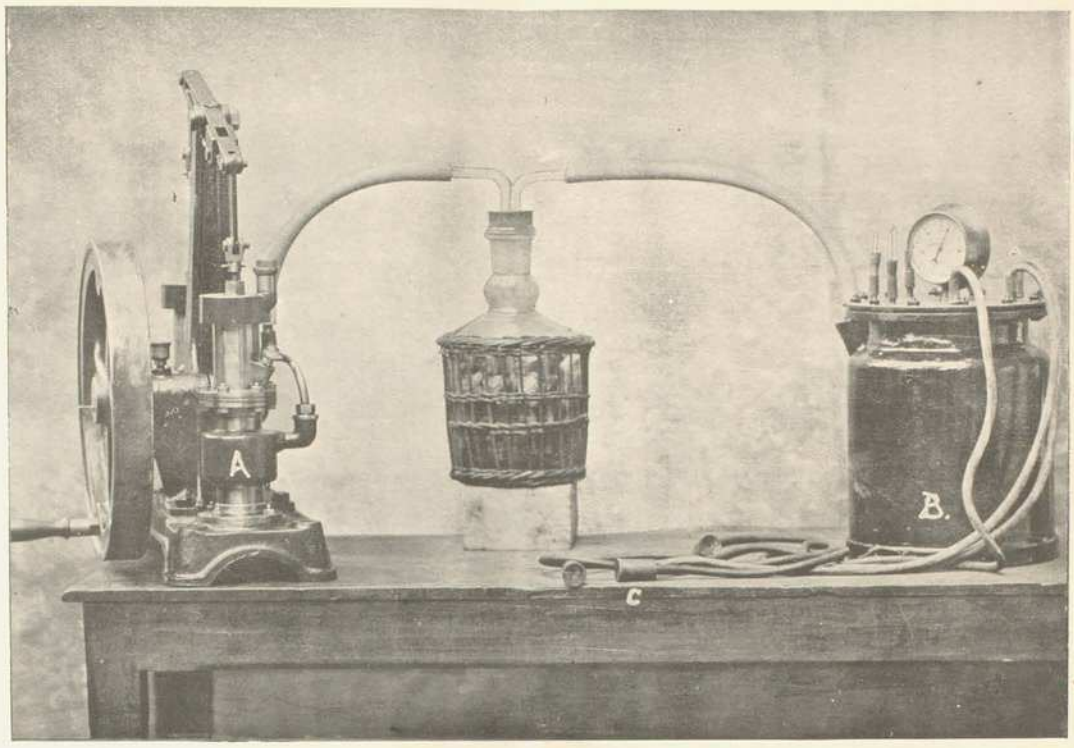

PLATE V.

PLATE VI.

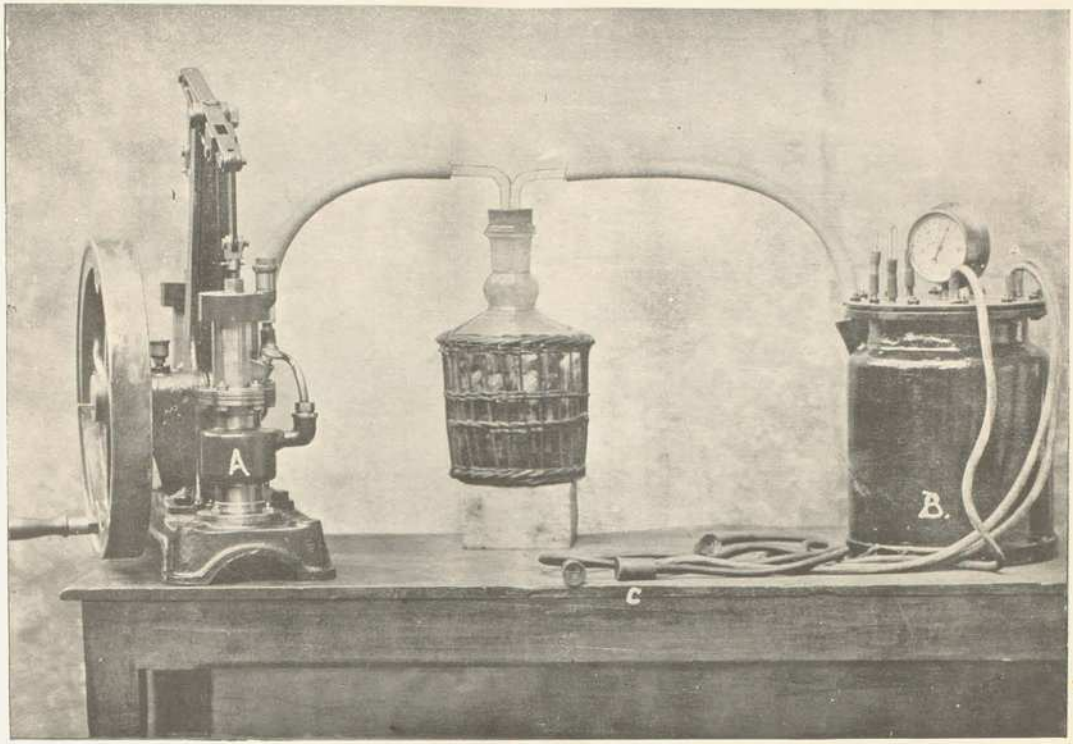

PLATE V.

SUMMARISED REPORT

OF THE WORK DONE IN THE

BOMBAY PLAGUE RESEARCH LABORATORY,

FOR 1896—1902.

I.

RESEARCH AND PRACTICAL WORK ON PLAGUE.

(1).—THE PLAGUE PROPHYLACTIC.

(A.)

During the first $4\frac{5}{12}$ years after the discovery of the plague inoculation, *i.e.*, up till 31st May 1901, 2,380,288 doses of prophylactic were manufactured and distributed throughout India and abroad. Of these 1,939,437 went to places in India and 440,851 to other countries.

Within India the largest consumers during that period were—

	Number of doses supplied.
The Bombay Presidency and Sind	935,139
The Punjab	571,328
The Native States	211,555
Bengal and Behar	75,332
The Madras Presidency	78,828
North-West Provinces and Oudh	32,413
The Portuguese Territory	10,703

Of the countries abroad—

214,247	doses went	to Africa,
128,956	„	to Australia,
55,315	„	to Europe,
35,835	„	to Asia outside India,
3,719	„	to Australasia, and
51	„	to America.

During the year following (1st June 1901 to 31st May 1902), 486,753 doses were sent out, *viz.*, 443,725 in India and 43,028 abroad. In India the largest amount was supplied to—

	Doses.
The Punjáb, *viz.*	260,211
The Native States	110,695
The Bombay Presidency	48,259
The United Provinces of Agra and Oudh ...	9,053

Of the countries abroad—

Australia took	27,368
Asia outside India	10,923
Africa	4,523
America	204

The total of prophylactic issued from the Laboratory up to 31st May last was therefore 2,867,041 doses, of which 2,383,162 went to India and 483,879 abroad. In India, the Bombay Presidency was, on the whole, the largest consumer (983,393 doses). Then followed the Punjáb (831,539 doses), Native States

(322,250), the Madras Presidency (85,461), Bengal and Behar (77,160), the United Provinces of Agra and Oudh (41,466), the Central Provinces (13,439), the Portuguese Territory (11,137), Rájputána (10,831), Burma (2,957), Assam (1,236), Central India (1,130), Berár (1,058), and the new North-Western Frontier Province (100 doses).

Outside India, Africa took 218,770 doses, Australia 156,043, Europe 55,315, Asia outside India 46,768, Australia 5,720, and America 1,263.

Subjoined are lists showing in detail—

(i) the geographical distribution of the plague prophylatic during the first four years and five months from the beginning of plague inoculation in January 1897 to the 31st May 1901; and

(ii) during the year of 1st June 1901 to 31st May 1902.

Statement showing the amount of Plague Prophylactic supplied to various places from the Research Laboratory, Bombay, between 10th January 1897 and 31st May 1901.

(Total 2,380,288 adult doses.)

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY.	
Bombay	10th January 1897 to 29th May 1901.	251,880
	Ahmednagar District.	
Ahmednagar ...	11th November 1898 to 3rd September 1900.	21,483
	Ahmedabad District.	
Ahmedabad ...	31st October 1899 to 8th April 1901.	1,503
Gogha	23rd April 1901	200
	Aden.	
Aden	30th November 1899 to 4th May 1900.	25,176
	Belgaum District.	
Belgaum	22nd December 1899 to 7th May 1901.	46,933
Rámdurg... ...	26th November 1899 to 12th October 1899.	1,743
	Bijápur District.	
Bijápur	9th November 1898 to 14th August 1899.	24,950
Hungund ...	28th August 1898	500
Ilkal	25th October 1898 to 12th November 1898.	3,000
	Broach District.	
Anklesvar ...	26th August 1898 to 26th November 1898.	581
Broach	12th March 1897 to 3rd October 1899.	6,544
Iláv	28th September 1898 ...	1,000
	Dhárwár District.	
Alnawar	8th February 1899	5,082
Dhárwár	29th July 1898 to 13th November 1899.	85,347
Gadag	3rd August 1898 to 18th December 1899.	51,461

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY —*continued.*	
	Dhárwár District—contd.	
Gadgiri	10th May 1899 to 15th June 1899.	1,568
Hubli	11th November 1897 to 28th November 1900.	155,406
Sávnur	18th November 1898 ..	1,001
	Kolába District.	
Alibág	2nd June 1897 to 9th March 1901.	8,563
Mora Uran ...	3rd May 1897 to 13th April 1901.	969
Pen	24th April 1899	150
	Kárwár District.	
Kárwár	24th February 1898 to 12th March 1899.	601
Sirsi	6th December 1899... ...	502
	Kaira District.	
Anand	10th March 1898 to 13th February 1899.	1,478
Borsád	27th February 1899 to 7th April 1899.	1,401
Kaira	24th January 1899 to 10th October 1899.	5,032
Umreth	8th November 1898 to 22nd February 1899.	5,323
Vásad	7th April 1899 to 30th September 1899.	6,350
	Khándesh District.	
Dhulia	22nd November 1897 to 11th June 1899.	2,203
	Násik District.	
Devláli	10th March 1898 to 3rd August 1900.	1,609
Igatpuri	28th September 1897 to 21st October 1899.	1,359
Manmád	9th October 1899	304
Násik	22nd October 1897 to 7th March 1900.	6,574

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY —*continued.*	
	Poona District.	
Khándála ...	28th April 1897 to 10th April 1899.	742
Kirkee	15th August 1897 to 26th September 1900.	6,384
Lonávli	23rd March 1897	560
Poona	14th March 1897 to 31st January 1901.	80,980
Yerrowda ...	9th October 1900 to 27th November 1900.	3,102
	Quetta District.	
Quetta	8th August 1900	101
	Panch Mahál District.	
Godhra	25th February 1898 to 29th November 1898.	75
	Ratnágiri District.	
Ratnágiri ...	29th January 1898 to 4th February 1898.	670
	Sholápur District.	
Sholápur	10th February 1897 to 24th April 1900.	12,152
	Surat District.	
Bulsár	27th March 1897 to 25th March 1901.	2,664
Bilimora	26th July 1898	500
Navsári	2nd May 1897 to 15th January 1900.	2,458
Párdi	22nd March 1901	204
Surat	24th February 1897 to 15th November 1899.	11,413
Udváda	7th January 1898 to 7th March 1899.	576
Undhera	9th February 1898	513
	Sátara District.	
Karád	28th August 1897 to 6th December 1897.	1,460
Mahábleshwar ...	24th February 1898 to 6th November 1900.	601
Pánchgani ...	3rd May 1897	100
Sátára	28th November 1897 to 14th December 1900.	8,704
Wái	21st December 1897 ...	400
	Thána District.	
Bándra	2nd February 1899 to 25th October 1899.	157
Bassein	21st May 1897 to 27th May 1899.	202
Bhiwndi	19th July 1898	125
Bhilád	18th March 1899 to 21st March 1899.	2,012
Boisar	19th January 1899	508
Mátherán... ...	9th February 1897 to 21st October 1899.	723

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY —*continued.*	
	Thána District—contd.	
Tárápur	25th March 1897 to 25th April 1897.	590
Thána	14th April 1898 to 5th November 1900.	1,660
	Sind Province.	
Hyderabad ...	30th April 1897 to 10th October 1899.	6,983
Karáchi	25th January 1897 to 23rd April 1901.	59,994
Sukkar	6th May 1897	50
	Total for Bombay Presidency	9,35,139
	ASSAM.	
Cacher	21st March 1900	53
Gauhati	17th May 1900	150
Shillong	19th May 1899 to 20th April 1900.	1,033
	Total for Assam ...	1,236
	BENGAL PRESIDENCY.	
Bharatpur ...	10th January 1899 to 11th April 1901.	107
Calcutta	16th February 1898 to 30th March 1901.	14,014
Chapra	23rd January 1901	1,000
Darjiling... ...	7th May 1898	100
Goalpara	23rd May 1901	51
Hazaribag ...	15th April 1901	24
Purulia	20th May 1898	100
Shirajgunj ...	1st May 1901	6
Shahabad ...	23rd February 1901 ...	1,004
	Bihar Province.	
Bankipur... ...	26th November 1900 to 13th February 1901.	7,208
Bhagalpur ...	8th April 1901	54
Durbhanga ...	6th April 1901	2,513
Dinapur	18th August 1900 to 16th February 1901.	202
Gaya	22nd February 1900 to 15th April 1901.	43,233
Monghyr... ...	8th February 1900 to 8th February 1901.	5,515
Muzafarpur ...	16th March 1901	201
	Total for Bengal Presidency.	75,332
	BURMAH.	
Mandalay ...	9th August 1900	102
Rangoon	20th May 1898 to 13th October 1900.	2,819
	Total for Burma ...	2,921

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	CENTRAL PROVINCE.	
Amraoti	27th February 1899 ...	103
Chanda	29th November 1898 ...	102
Hinghanghat ...	22nd November 1898 to 11th January 1899.	1,562
Jubbalpur ...	29th March 1898 to 9th August 1900.	302
Khándwa ...	13th April 1898	100
Kampti	9th February 1900 to 11th August 1900.	56
Nágpur	10th March 1898 to 9th January 1901.	8,801
Ráipur	11th May 1898 to 1st December 1898.	74
Saugor	17th August 1900 to 20th August 1900.	92
Wardha	10th December 1898 to 20th August 1900.	1,104
Yeotmahal ...	1st December 1898	30
	Total for Central Provinces.	12,326
	CENTRAL INDIA.	
Neemuch... ...	14th August 1900	100
Nowgong... ...	15th August 1900	20
	Total for Central India ...	120
	FRONTIER DISTRICT.	
Malakand ...	8th April 1900	100
	MADRAS PRESIDENCY.	
Madras	10th October 1897 to 19th March 1901.	63,268
	Coimbatore District.	
Coimbatore ...	2nd September 1898 to 9th November 1898.	626
	Coonur District.	
Coonur	28th September 1898 to 12th October 1898.	1,452
	Chickmaglore District.	
Chickmaglore ...	4th February 1899	100
Cananoor ...	17th October 1899 to 11th November 1899.	2,024
Devangiri ...	8th September 1899 to 18th September 1899.	4,030
	Canara District.	
Haliyál	29th September 1900 to 26th October 1900.	1,361
	Koppa District.	
Koppa	5th October 1898	50
Mercarra	18th November 1898 to 5th May 1900.	973

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	MADRAS PRESIDENCY —*continued.*	
	Nellore District.	
Nellore	30th August 1898	50
Rayapuram ...	8th October 1898	102
	South Canara District.	
South Canara ...	10th September 1898 ...	25
	Salem District.	
Ootacamand ...	26th August 1898 to 31st October 1898.	1,064
Tirrupatur ...	3rd August 1898	90
	South Coorg.	
Sidapur	2nd September 1899 to 16th November 1900.	755
	Tinnevelly District.	
Birur	26th October 1898	200
Kadar	26th October 1898	100
Palamkotta ...	27th October 1898	300
Shrivillyputur ...	6th October 1898	150
Tinnevelly ...	8th October 1898 to 31st October 1898.	1,200
Tuticorin... ...	28th September 1898 to 17th November 1898.	1,500
	Tellicherry District.	
Tellicherry ...	1st November 1898 to 18th November 1898.	88
	Total for Madras Presidency.	79,508
	THE PUNJAB.	
Attock	21st August 1900	100
Abbottabad ...	13th August 1900	100
Almora	16th August 1900	100
Amritsar	11th April 1899	504
Banga	14th March 1898 to 26th March 1901.	202,526
Chitral	21st May 1898	20
Cambellpore ...	17th August 1900	52
Delhi	9th May 1898 to 16th April 1901.	1,054
Dehra Ismailkhan.	9th August 1900	1,002
Dalhousie ...	14th August 1900	400
Edwardesabad ...	9th August 1900	1,002
Ferozepore ...	10th May 1901	5,020
Garhshanker ...	18th April 1899	1,065
Gurdaspur ...	26th March 1901 to 22nd April 1901.	10,016
Jullundur ...	31st March 1900 to 4th April 1901.	9,218
Lansdown Cantonment.	9th August 1900	5
Ludhiana ...	30th May 1901	501
Lahore	28th February 1898 ...	2,996
Murree	20th July 1899	100
Navashahr ...	17th May 1899 to 21st December 1900.	299,781
Peshawar ...	13th August 1900	100
Phagwara ...	23rd October 1897	21,348

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	PUNJAB—*continued.*	
Rawalpindi ...	6th August 1900	1,002
Simla	25th May 1898 to 25th April 1901.	2,956
Sialkot	21st August 1900 to 11th March 1901.	10,224
Umballa	13th August 1900 to 2nd May 1901.	136
	Total for the Punjab ...	5,71,328
	RA'JPUTANA.	
Abu Road ...	9th June 1898 to 25th November 1898.	307
Falna ...	29th March 1901 to 11th April 1901.	6,015
	Total for Rájputána ...	6,322
	UNITED PROVINCES OF AGRA AND OUDH.	
Agra ...	16th October 1899 to 17th April 1901.	3,373
Aligarh ...	27th September 1899 ...	506
Allahabad ...	25th August 1899 to 17th April 1901.	8,494
Azamgarh ...	28th September 1899 to 20th April 1901.	514
Ballia ...	27th October 1899 to 28th October 1899.	1,000
Badaun ...	20th October 1899 ...	507
Bareilly ...	9th October 1899 to 9th August 1900.	600
Bulandshahar ...	5th October 1899 ...	500
Benares ...	28th September 1899 to 9th March 1901.	3,590
Basti ...	27th September 1899 ...	506
Chaubattia ...	13th August 1900	100
Cawnpore ...	9th October 1899 to 4th August 1900.	704
Dilkhusha ...	13th August 1900	500
Dehra Dun ...	27th September 1899 ...	507
Fatehgarh ...	16th August 1900	500
Etawah ...	21st October 1899	514
Farakhabad ...	25th November 1899 ...	500
Fyzabad	9th October 1899 to 10th August 1900.	530
Gazipur	27th September 1899 to 17th April 1901.	1,088
Gorakhpur ...	27th September 1899 to 17th April 1901.	507
Hurdwar... ...	13th October 1897	63
Jaunpur	28th September 1899 ...	507
Jhánsi	9th October 1899	512
Lucknow... ...	15th March 1897 to 4th August 1900.	1,210
Muttra	11th October 1899	501
Moradabad ...	10th October 1899	501
Meerut	28th September 1899 to 9th May 1901.	753
Mussoorie ...	28th September 1899 to 9th May 1901.	502
Muzaffarnagar ...	27th September 1899 ...	504
Naini Tal ...	6th August 1900 to 17th April 1901.	122
Pratabgarh ...	9th January 1900	507
Ranikhet... ...	10th August 1900	52
Roorkee	28th September 1899 to 5th August 1900.	550
Sitapur	2nd February 1900 to 13th August 1900.	284
Shahajahanpur ...	9th October 1899	504
Shaharanpur ...	28th September 1899 ...	501
	Total for United Provinces of Agra and Oudh ...	32,413
	NATIVE STATES.	
	Baroda State.	
Baroda	13th November 1897 to 29th April 1899.	14,587
	Bhor State.	
Bhor	19th November 1898 ...	48
	Bundelkhand Agency.	
Bhagalkhand ...	27th September 1899 to 6th May 1901.	200
Indore	13th July 1899 to 11th March 1901.	124
	Cutch-Bhuj Agency.	
Bhuj	19th April 1897 to 26th March 1900.	2,207
	Kolhápur Agency.	
Kolhápur ...	6th July 1898 to 10th October 1899.	1,103
Miraj	16th February 1898 to 10th October 1899.	5,774
Sángli	16th March 1898 to 2nd October 1899.	926
Shapur	10th March 1898 to 5th October 1899.	3,259
	Káthiáwár Agency.	
Bhávnagar ...	5th April 1900 to 8th November 1900.	320
Jámnagar ...	13th September 1898 to 25th November 1898.	1,472
Junágad	28th June 1897 to 2nd October 1899.	2,919
Porbandar ...	26th August 1898 to 7th March 1900.	773
Rájkot	25th February 1898 to 21st September 1898.	432
	Kashmir.	
Jammu	3rd December 1900 to 12th December 1900.	5,417
Kashmir	3rd April 1901	1,206
	Mahi Kántha Agency.	
Sádra	5th May 1899	25

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	NATIVE STATES—*contd.*	
	Mysore State.	
Bangalore ..	24th March 1897 to 5th November 1900.	1,16,764
Mysore	17th September 1898 to 2nd November 1899.	19,486
Kistna	5th October 1898	200
Oorgaum... ...	17th October 1898 to 17th July 1899.	10,421
	Nizám's Dominions.	
Aurangabad ...	5th November 1900 to 30th November 1900.	502
Hyderabad ...	11th August 1898 to 13th July 1899.	17,375
Kopbal	11th May 1899	1,133
Secunderabad ...	18th April 1899 to 28th January 1901.	500
Lingsagar (Raichur District).	24th January 1899	101
	Pálanpur Superintendency.	
Deesa	16th August 1900	100
Pálanpur ...	15th October 1897	36
	Eastern Rájputána States.	
Bharatpur ...	15th April 1897	20
	Western Rájputána States.	
Jodhpur... ...	4th January 1900 to 25th March 1901.	1,560
	Sávantvádi States.	
Sávantvádi ...	21st October 1898 to 7th October 1899.	71
	Travancore State.	
Cochin	27th October 1898	40
Travancore ...	29th October 1898 to 14th December 1898	2,454
	Total for Native States ...	2,11,555
	FOREIGN TERRITORY IN INDIA.	
	Portuguese Territory.	
Damaun	10th June 1897 to 16th April 1901.	10,137
Goa	2nd February 1898	1,000
	Total for Foreign Territories in India ...	11,137
	COUNTRIES OUTSIDE INDIA, ASIA.	
	British Dominions.	
	Arabia.	
Muscat	7th May 1900 to 2nd May 1900.	1,010

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	COUNTRIES OUTSIDE INDIA, ASIA—*continued.*	
	Ceylon.	
Colombo	23rd April 1897 to 3rd May 1901.	14,031
Galle	15th May 1899	200
	China.	
Hongkong ...	27th April 1898 to 28th April 1899.	2,806
Shanghai ...	22nd May 1901	1,001
	Cyprus Island.	
Cyprus	17th November 1900 to 18th January 1901.	216
Nicosia	8th June 1899	50
	Sychelles Island.	
Sychelles... ...	12th April 1899 to 22nd May 1901.	1,004
	Straits Settlements.	
Negri Sembilan ...	6th February 1900.... ...	501
Singapore ...	9th March 1901	592
	OTHER COUNTRIES IN ASIA.	
	Japan.	
Delivered to the Japanese Consul for Japan in Bombay.	25th January 1900 ..	2,304
	Phillipine Islands.	
Manilla	20th January 1900	402
	Asiatic Russia.	
Port Arthur ...	11th September 1899 to 30th November 1899.	10,562
Samarkand ...	1st November 1898	1,061
	Turkey in Asia.	
Smyrna	29th June 1900	597
	Total for Countries in Asia outside of India ...	36,337
	EUROPE.	
	England and Great Britain's Possessions.	
London	9th April 1897 to 4th November 1899.	44,185
	Malta.	
Malta	22nd September 1899 ...	1,010

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	EUROPE—*continued.*	
	OTHER COUNTRIES IN EUROPE.	
	HOLLAND.	
	The Hague.	
The Hague ...	10th February 1900... ...	12
	RUSSIA.	
	St. Petersburgh.	
St. Petersburgh ...	26th September 1899 ...	108
	Total for Europe ...	55,315
	AFRICA.	
	BRITISH POSSESSIONS.	
	East Africa.	
Mombasa... ...	17th February 1898 to 18th January 1900.	6,096
Mauritius ...	16th February 1899 to 23rd February 1900.	110,621
Zánzibár	21st February 1899 ...	5,059
	FRENCH EAST AFRICA.	
Madagaskar ...	27th January 1899 ...	200
	GERMAN POSSESSION.	
Dare-es-Salam ...	25th April 1901	503
	PORTUGUESE EAST AFRICA.	
	Mozambique.	
Mozambique ...	4th September 1899 ...	1,008
	BRITISH POSSESSIONS.	
	South Africa.	
Cape Town ...	14th February 1899 to 14th March 1901.	20,762
Natal	13th March 1899 to 20th February 1900.	51,294
Pietermaritzburg .	18th January 1899	102
	Transvaal.	
Johannesburg ...	19th January 1899 to 20th February 1899.	18,100
	Total for Africa ...	213,745
	AMERICA.	
	WEST INDIES.	
	BRITISH POSSESSIONS.	
	Barbadoes.	
Barbadoes ...	3rd January 1900	51
	Grenade.	
Grenada	12th September 1900 ...	1,008
	Total for America ...	1,059
	AUSTRALASIA.	
	BRITISH POSSESSIONS.	
Auckland (New Zealand).	20th January 1900 to 18th March 1901.	4,109
Tasmania ...	14th March 1900 to 10th April 1900.	1,311
Wellington ...	2nd May 1900	300
	Total for Australasia ...	5,720
	AUSTRALIA.	
Adelaide	19th January 1900 to 14th May 1901.	2,311
Brisbane	12th January 1900 to 1st June 1900.	11,528
Fiji Island ...	26th January 1900 to 20th April 1900.	4,064
Melbourne ...	12th January 1900 to 25th May 1900.	31,599
New Caledonia ...	2nd May 1900	1,003
Perth	9th February 1900 to 23rd March 1901.	37,463
Queensland ...	21st April 1900	204
Sydney	6th November 1899 to 15th May 1900.	40,503
	Total for Australia ...	1,28,675
	Grand Total ...	2,380,288

Statement showing the amount of Plague Prophylactic supplied to various places from the Research Laboratory, Bombay, between 1st June 1901 and 31st May 1902.

(Total 486,753 adult doses.)

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY.	
Bombay	3rd June 1901 to 22nd May 1902.	4,298
	Ahmednagar District.	
Ahmednagar ...	7th October 1901 to 7th December 1901.	3,005
	Ahmedabad District.	
Ahmedabad ...	24th October 1901 to 12th March 1902.	1,072
	Aden.	
Aden	17th May 1902	2,005
	Belgaum District.	
Belgaum	19th July 1901 to 3rd May 1902.	3,217
	Bijápur District.	
Bijápur	23rd May 1902	204
	Broach District.	
Anklesvar ...	18th September 1901 ...	100
Broach	27th August 1901 to 28th October 1901.	1,532
	Dhárwár District.	
Dhárwár ...	13th November 1901 to 14th May 1902.	2,317
Gadág	26th September 1901 to 13th November 1901.	1,506
Hubli	25th June 1901 to 21st October 1901.	5 514
	Kolába District.	
Alíbág	31st January 1902	48
	Kaira District.	
Anand	11th and 26th February 1902.	1,008
Nadiád	17th October 1901	1,001
	Khándesh District.	
Dhulia	1st February 1902	501
	Násik District.	
Násik	12th December 1901 ...	503
	Poona District.	
Kirkee	18th December 1901 ...	1,001
Poona	7th June 1901 to 2nd December 1901.	11,725
Yerrowda ...	8th October 1901	2,002
	BOMBAY PRESIDENCY —*continued.*	
	Panch Maháls.	
Godhra	22nd March 1902	200
	Sholápur District.	
Sholápur	2nd December 1901 to 2nd January 1902.	600
	Surat District.	
Bulsár	18th October 1901 to 5th November 1901.	36
Khergam... ...	19th October 1901	276
Navsári	8th October 1901	200
Surat	16th December 1901 ...	52
Udváda	26th April 1902	54
	Sátára District.	
Sátára	13th November 1901 to 10th December 1901.	402
	Thána District.	
Mátherán	31st October 1901	102
Thána	15th March 1902 to 26th 1902.	268
	Sind Province.	
Hyderabad ...	23rd July 1901	502
Karáchi	8th August 1901	3 008
	Total for Bombay Presidency and Sind.	48,259
	BENGAL PRESIDENCY.	
Bháratpur ...	10th April 1902	12
Calcutta	6th February 1902	350
Chupra	21st October 1901 to 8th April 1902.	1,108
Gházipur	8th April 1902	102
Hazáribagh ...	11th November 1901 ...	204
	Bihár Province.	
Bhágalpur ...	19th October 1901	52
	Total for Bengal Presidency and Biáhr.	1,828
	BERÁR PROVINCE.	
Akola	8th March 1902	506
Wun	1st March 1902	50
Mulkapur ...	4th March 1902	502
	Total for Berár Province ...	1,058

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BURMA.	
Rangoon	20th January 1902	36
	CENTRAL PROVINCES.	
Burhánpur ...	17th December 1901 ...	106
Saugor	8th April 1902 to 24th April 1902.	1,007
	Total for Central Provinces .	1,113
	CENTRAL INDIA.	
Nowgong... ...	28th February 1902 ...	1,010
	MADRAS PRESIDENCY.	
Madras	11th July 1901	5,151
	Canara District.	
Háliyal	8th October 1901	200
Mangalore ...	9th May 1902	502
	Madura District.	
Madura	2nd December 1901 ...	100
	Total for Madras Presidency.	5,953
	THE PUNJAB.	
Amritsar	3rd March 1902 to 1st May 1902.	4,144
Bikáneer	14th March 1902	1,005
Dehra-Ismail Khan	4th February 1902	990
Dehra Basi ...	29th and 30th April 1902 ...	1,007
Dalhousie ...	26th February 1902... ...	504
Edwardesabad ...	20th June 1901	12
Ferozepore ...	5th April 1902	1,003
Gurdaspore ...	5th February 1902 to 29th March 1902.	26,250
Gujarát	28th December 1901 to 30th April 1902.	2,204
Gujránwalla ...	18th March 1902 to 20th May 1902.	1,209
Hoshiárpur ...	24th December 1901 to 1st May 1902.	34,130
Jullunder ...	27th February 1902 to 13th March 1902.	10,662
Jhelum	18th February 1902... ...	204
Kasar	19th February 1902... ...	1,007
Kasauli	1st March 1902	247
Karnal	6th March 1902	100
Láhore	13th November 1901 to 23rd May 1902.	17,076
Ludhiána... ...	1st January 1902 to 21st April 1902.	43,713
Lyallpur	2nd April 1902	1,006
Mean Mir ...	28th November 1901 to 3rd May 1902.	559
Mooltán	3rd February 1902	752
Moga	5th April 1902 to 12th May 1902.	8,546
Nahán	6th May 1902	16
Phágwára ...	14th April 1902 to 12th May 1902.	8,023
Rupar	29th March 1902	5,028
Ráwalpindi ...	18th March 1902	100
Siálkot	11th December 1901 to 24th December 1901.	23,051
Sháhápur ...	27th February 1902 to 26th April 1902.	530
Simla	3rd March 1902	500
Sabathu	26th May 1902 ...	54
Umbálla	13th December 1901 to 20th May 1902.	66,579
	Total for the Punjáb ...	260,211
	RA'JPUTA'NA.	
Ajmere	20th March 1902	1,003
Somesar	29th March 1902	2,006
Ulwár	10th March 1902	1,500
	Total for Rájputána ...	4,509
	UNITED PROVINCES OF AGRA AND OUDH.	
Agra	24th June 1901 to 18th April 1902.	577
Aligarh	22nd June 1901	501
Allahabad ...	7th January 1901 to 25th March 1902.	1,711
Benáres	9th October 1901 to 18th March 1902.	532
Bulandsháhr ...	10th June 1901	502
Balia	21st September 1901 ...	36
Bareilly	24th October 1901	120
Básti	3rd June 1901	20
Chaubattia ...	18th October 1901	150
Cáwnpore ...	10th February 1902 to 26th April 1902.	655
Dehra-Dun ...	1st March 1902	128
Dhuri	21st April 1902	48
Fatehgarh ...	10th June 1901	502
Fyzábád	27th June 1901	504
Fatehpur... ...	10th February 1902... ...	503
Gorákhpur ...	16th January 1902	100
Lucknow... ...	10th June 1901 to 23rd May 1902.	126
Morádabad ...	3rd June 1901 to 15th April 1902.	512
Muttra	1st August 1901	24
Mirzápur... ...	27th January 1901	600
Mussooree ...	4th April 1902	502
Pratábgarh ...	30th December 1901 ...	48
Roorki	10th June 1901	502
Sháhájáhanpur ...	10th March 1902	50
Sháháranpur ...	14th March 1902.	100
	Total for the United Provinces.	9,053
	NATIVE STATES.	
	Baroda State.	
Baroda	25th March 1902 to 4th April 1902.	607
	Bundelkund Agency.	
Indore	30th April 1902	6
	Jeypore State.	
Jeypore	4th March 1902	100

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	NATIVE STATES—*contd.*	
	Jhind State.	
Jhind	17th May 1902	504
	Káthiáwár Agency.	
Bhávnagar ...	8th October 1901	108
Navánagar ...	14th April 1902	402
Rájkot	21st April 1902 to 30th April 1902.	1,004
	Kapurthála State.	
Kapurthála ...	29th March 1902	1,007
	Kashmir.	
Jammu	22nd December 1901 to 31st January 1902.	15,039
	Kolhápur Agency.	
Kolhápur ...	8th October 1901	232
Miraj	30th August 1901 to 26th November 1901.	305
	Mysore State.	
Bangalore ...	9th August 1901 to 14th December 1901.	2,805
	Nizam's Dominions.	
Aurangabad ...	4th November 1901... ...	174
Secunderabad ...	3rd December 1901	502
	Nabha State.	
Nabha	19th December 1901 to 28th April 1902.	17,043
	Patiála State.	
Patiála	18th February 1902 to 23rd May 1902.	70,857
	Total for Native States ...	1,10,695
	Total for India ...	4,43,725
	COUNTRIES OUTSIDE INDIA.	
	ASIA.	
	BRITISH DOMINIONS.	
	Andaman Islands.	
Port Blair ...	20th June 1901	30
	Ceylon.	
Colombo	7th June 1901 to 10th January 1902.	4,014
	China.	
Amoy	6th June 1901	1,003
Chefoo	5th September 1901... ...	1,002
Foochow	4th November 1901... ...	504
Hongkong ...	17th December 1901 ...	4,011
	Straits Settlements.	
Selángore ...	6th June 1901	153
Singápore ...	15th June 1901	216
	Total for Asia outside India .	10,933
	AFRICA.	
	BRITISH DOMINIONS.	
	British East Africa.	
Mombassa ...	26th May 1902	2,010
Zanzibár	11th July 1901 to 14th March 1902.	2,009
	GERMAN EAST AFRICA.	
Tanga	13th August 1901	504
	Total for Africa ...	4,523
	AMERICA.	
	BRITISH POSSESSIONS.	
	West Indies.	
Trinidad	3rd June 1901 to 11th July 1901.	204
	AUSTRALIA.	
Adelaide	13th June 1901 to 10th March 1902.	2,217
Sydney	10th March 1902 to 25th April 1902.	25,151
	Total for Australia ...	27,368
	Total for Countries outside India.	43,028
	Grand Total ...	486,753

(B.)

The activity of the Plague Research Laboratory has been from the beginning of the outbreak in Bombay, concentrated on the preparation of a fluid protective against plague, and I think it important to explain the reason for this to Government and to the Medical authorities. I may quote in this connection my letters to the Secretary to the Government of India in the Home Department, dated Hardwar, 20th November 1897, and Bombay, 21st June 1898, as well as my addresses of the 3rd January 1898, in the Poona Cantonment Magistrate's Office, under the Presidentship of Major-General Duncan ("*Times of India*" Press, Bombay), and of the 8th June 1899, at the Royal Society, London (Proceedings, Vol. LXV).

The studies made for working out a protective treatment against plague comprise preliminary experiments in the Laboratory, the details of which cannot, unfortunately, be published so far, and a long and difficult series of investigations in communities affected with plague.

The discovery of the protective vaccine was reported to the Secretary to the Government of India, in the Home Department, in this office letters dated 16th January, 15th February and 14th July 1897 (*vide* Mr. Nathan's "The Plague in India in 1896-1897," Vol. II, pages 32—39), and published in the "*British Medical Journal*," May 1897; the "*Indian Medical Gazette*," June of same year; the Proceedings of the Royal Society, London, 1899, Vol. LXV; and in the "Minutes of Evidence taken by the Indian Plague Commission," Vol. I, Calcutta, 1900, pages 4 *et seq.*

Since my first publications the following are the alterations introduced in the method of manufacturing the prophylactic.

Lieut.-Colonel C. J. H. Warden, I. M. S., started the manufacture, in the Laboratory, of peptone from goat's meat, so as to avoid the necessity of buying the material in Europe. The result of his work was reported to the Secretary to the Government of India, Home Department, in this office letter No. 260A of 7th June 1898.

Dr. Charles Balfour Stewart's experiments made in the Laboratory on the effect of different degrees of alkalinity upon the growth of the plague bacillus, and on its cultivation in peptonised cheese and in certain other albuminous substances were referred to in that officer's evidence to the Indian Plague Commission, Vol. III, page 16 of their Report. The experiments of Dr. A. Mayr, at the time serving in this Laboratory, on the effect of the addition of gelatine, glycerine, sugar, with varying degrees of alkalinity, were mentioned in his evidence to the same Commission, Vol. III, page 18; those by Dr. E. L. Marsh, on the effect of nitrogen and carbonic acid gas, in his evidence, Indian Plague Commission's Report, Vol. III, pages 72 and 73; and lastly, the experiments by Dr. F. M. Gibson, on the preparation of a peptonised medium from wheat flour, were reported to Government in this office Nos. 6092 of 29th November, and 6216 of 15th December 1899, to the address of the Chief Secretary to the Government of Bombay (*vide* also *Bombay Government Gazette*, December 14th, 1899, page 1857).

In 1899 Dr. Charles Balfour Stewart and Captain Milne, I. M. S., made a series of experiments in the Laboratory in order to verify the existence of immunising properties in the fluid and solid parts of the prophylactic. The former subsequently published his observations in the "*British Medical Journal*," 1899.

The following technical modifications have not yet been put on record:

The method of peptonising meat employed by Lieut.-Colonel Warden consisted in heating a mixture of goats' meat with hydrochloric acid for 6 hours, at a T of 144° C., the proportion used being 150 c.c. of acid to a kilo of meat.

At the end of the process, the acid, which would otherwise be antagonistic to the culture, has to be neutralised. 150 c.c. of hydrochloric acid, acted upon,

for this purpose, with caustic soda, gets transformed into some 80 grammes of common salt. This must now be largely diluted, as the amount of salt compatible with the growth of microbes does not exceed, as a rule, ½ per cent. to ¾ per cent. of the solution. The nourishing elements obtained from the kilo. of meat and containing the 80 grammes of salt must therefore be mixed with water up to 12 to 16 litres, in order to reduce the proportion of salt to the desired amount. The salt is thus sufficiently diluted, but the nourishing elements of the liquid are much diluted also.

If the amount of acid be reduced, so as to avoid the formation of large quantities of salt, the meat will be digested only if that reduction in acid is compensated by an increase in heating. At temperatures above 144° C., however, and even at that temperature, meat, like other organic matter, begins to decompose, gets charred, and communicates to the fluid a dark brown colour, due to various decomposition products such as tar, naphtha, creosote, carbolic acid, and kindred substances, which act as antiseptics and inhibit microbial growth.

To obviate these difficulties, Dr. Gibson has introduced the plan of reducing the amount of acid and increasing the heating in *length* instead of in *degree*. At present a kilo. of meat is treated in this Laboratory with 80 c. c. of hydrochloric acid, instead of 150, and kept for six days at 80° C. and three hours at 144° C., instead of six hours at 144° C. The reduction of the amount of acid permits, as explained above, of subsequently diluting the produce of 1 kilo. of meat by some 6 litres of water only, and gives a cultivation medium twice as concentrated as that used before.

For cultivating the prophylactic, flasks are filled with broth to a lower level than before, so as to provide a more abundant aeration of the fluid. This plan, very beneficial in itself, involves an increase in the number of flasks, and consequently in the labour required for inseminating, testing and sterilising, which are applied to each flask individually. The flasks are inseminated with a much larger amount of microbes than before, in order to accelerate the maturing of the culture. The cultivation flasks are only slightly vibrated for the periodical dislocation of surface growth, instead of being shaken up. The cultures, when mature, are sterilised by heating for 15 minutes only, at 50° to 55° C., instead of an hour at 65° C. An additional test for effective sterilisation is applied. In determining the thickness of growth, Dr. Gibson takes account of the light in which examination is made, as he found that the liquid appears more opaque in a well lighted, than in a darkened room.

An important alteration is now being tried in the method of preparing the prophylactic, in accordance with the ideas explained in this office letter to the Home Secretary, No. 260A. of 7th June 1898, and which consists in combining, for the formation of the prophylactic, agar and broth cultivations. A four days growth on 300 sq. centimetres of agar surface is emulsified in 400 c.c. of a two months old broth cultivation. The addition of a young growth of microbes may further reduce the case incidence of the disease in those inoculated.

The prophylactic is now decanted into special laboratory phials made for the purpose, instead of in medicine bottles. These phials have their necks at one corner instead of in the middle. The whole of their contents can, without pouring the latter out into an open vessel, be absorbed into a hypodermic syringe. The packing of the bottles with economy in space and in a safe way, the rubber stoppers serving as buffers, is also facilitated. India-rubber stoppers have now been substituted for ordinary corks, which could not be sterilised with certainty.

A number of patterns of inoculation syringes were tested in the Laboratory and distributed to workers, whose experience was recorded. The pattern to which preference has been given is the 20 c.c. syringe perfected by Roux and manufactured by Collin-Charrière in Paris. After several attempts, an excellent article has been evolved by Mr. Eyres, of the Government Medical Stores, Bombay. Unfortunately the workshops of the latter have provision for only a limited outturn.

During the period of $5\frac{5}{12}$ years under record 1,783 hypodermic syringes of the approved patterns were distributed by the Laboratory to operators intending

to take up inoculation; of the above number 929 were sold and 854 given on loan (*vide* Government of Bombay Resolution, General Department, Plague, No. $\frac{5778}{5870}$-P. of 17th October 1898). According to the two periods here adopted, the figures were:

During the $4\frac{5}{12}$ years, from January 1897 to 31st May 1901.	697	syringes sold, and
	775	„ lent.
Total ...	1,472	
During the year 1st June 1901 to 31st May 1902.	232	syringes sold, and
	79	„ lent.
Total ...	311	

In the *technique* of the inoculation operation, an improvement has been effected in accordance with Government of Bombay Resolutions No. 2230-P. of 4th April 1900, and No. 3836-P. of 21st June 1900, by the designing of a special lamp and oil boiler for sterilising hypodermic syringes and needles. Government Resolution No. 3109-P. of 23rd July 1901 directs the lamp to be designated as Hunt's sterilisation lamp, after the name of the officer of the Laboratory who carried out the work.

(C.)

The general effect of the prophylactic on man, as distinct from its *specific* immunising properties, has been studied in two ways, *viz.*:

(1) by observing the reaction following inoculation in a few hours. The significance of these observations was explained, amongst others, in the "Evidence" to the Plague Commission, Volume I, pages 10, 11 and 17, and Volume III, pages 349—351, of their Report, and in this office Report to the Government of Bombay, General Department, Plague, No. 1269 of 9th August 1900, pages 2—18, as well as in my address referred to below "On the health of the inoculated." Tens of thousands of such observations have been made, and their results taken into account in varying the preparation of the prophylactic and determining the doses prescribed. The assistances of a number of medical officers having special opportunities for such observations is gratefully acknowledged here.

And (2), by tracing the subsequent history of the inoculated. This was done on an extensive scale among the Khojas of Bombay; in the general population of Dhárwár, Hubli and Gadág; in the Poona Cantonment; among the Parsis of Bombay; in the Nágpur and Thána Jails; in Undhera (Baroda táluka); and elsewhere. The result of the enquiry among the Khojas for the year 1897-98 has been published in this office report to Government, dated 10th May 1898. The enquiry for the year subsequent (1898-99) was made in a much more complete fashion, by the late Surgeon-General Harvey, I. M. S., Major Bannerman, I. M. S., Dr. F. M. Gibson, Captain Charles Robertson Milne, I. M. S., Dr. Marsh and myself, and gave results in every way analogous to those of the first year. The result of the Poona enquiry has been recorded in a report by Lieutenant-General C. J. Burnett, C.B., then Commanding the Forces, Madras, of 11th June 1901, to the Government of Bombay (published according to Government Resolution No. 600-P. of 17th February 1902). The Parsi enquiry, probably the most elaborate and complete ever done, is being concluded now, and the results will be reported to Government.

The above enquiries were summarised in an address delivered by me in Poona under the chairmanship of His Excellency the Governor on the 29th June 1901. ("*Times of India*" Press, Bombay 1901).

Very accurate observations on the matter are also being carried out in the Thána Special Prison, and will be reported upon subsequently.

(D.)

The methods of finding out the immunising properties of a vaccine on man are not nearly so simple as might appear at first sight; the reason being that the crucial test of submitting the immunised subject to a dose of lethal virus is inadmissible in his case. The methods in question were worked out by me, first, in connection with anti-cholera inoculation in Bengal and Upper India, 1893-94 (*vide* "Anti-cholera Inoculation in India," *Transactions of the first Indian Medical Congress, Calcutta, 1894*, and "*Indian Medical Gazette*," January and February 1895), and further developed in my studies on anti-plague inoculation in Lonávla and Kirkee in 1897-98. The information given in 1898-99 to the Indian Plague Commission (*vide* Volume 1 of their Report, page 7 *et seq.*) had been collected in accordance with these methods. (The methods were discussed by them in Volume V of their Report, pages 203—205). The matter was further analysed in my notes on the investigations of the Dhárwár Committee and those in the Poona Cantonment, and reported to Government in this office letters Nos. 363 of 8th March 1901, and 2095 of 4th and 5th November 1901 (*vide* "Appendices" to the Report of the Dhárwár Inoculation Investigation Committee and to that of General Burnett quoted above, Government Central Press, Bombay). A variety of questions connected with these studies has further been considered by the Parsi Inoculation Investigation Committee.

In accordance with the principles laid down in the above publications, officers of the Laboratory studied the protective effect of anti-plague inoculation in the following outbreaks: in the Byculla House of Correction; in the Bombay general population; in Uran, Mora Municipality, Bombay Harbour; in Damaun; Lonávla; Kirkee; the Belgaum Cantonment; in the Umarkhádi Common Jail, Bombay; in Undhera, Baroda Táluka; in the Khoja and Parsi communities of Bombay; in Colaba; in Kárachi, among the Khojas (by Dr. Gibson); and in the Poona Cantonment.

The most extensive studies by officers not belonging to the Laboratory were carried out in Hubli, Dhárwár, Gadág, Ahmednagar, Mauritius, Bulsár, Aden, in the Punjáb villages, and elsewhere.

Most of the above investigations were embodied in the following reports and publications:—

Report dated Bombay, 16th February 1897, to the Secretary to the Government of India, Home Department, on the anti-plague protective inoculation in the Byculla House of Correction.

Report of 14th July 1897, to the same authority, on anti-plague inoculation in the Bombay general population.

"On the epidemic of plague in Lower Damaon and on the effect of preventive inoculation there", joint Report to Government by Mr. W. M. Haffkine and Major Lyons, I. M. S., dated Bombay, 1st November 1897, "*Times of India* Press", forwarded to the Secretary to the Government of India, Home Department, with letter dated Hardwar, 19th November 1897.

"Protective inoculation against plague", public address delivered under the presidency of Major-General Duncan, in the Cantonment Magistrate's Office, Poona, 3rd January 1898 (Bombay, "*Times of India* Press.")

"Experiment on the effect of protective inoculation in the epidemic of plague at Undhera, táluka Baroda, February and March 1898." Report dated 10th April 1898, Bombay (*locus cit.*)

"Report on the preventive inoculations against plague in the Khoja community of Bombay during the epidemic of 1897-98," Bombay, 10th May 1898 (Government Central Press, Bombay).

Report No. 1269 of 9th August 1900, to Government, on the manufacture of plague prophylactic in the Plague Research Laboratory, Bombay, containing an account of an investigation in Colaba (Government Central Press, Bombay).

Amongst the Reports published on the subject by officers not belonging to the Laboratory may be mentioned:

"Report on plague and inoculation in Hubli", by E. L. Cappel and Surgeon-Captain B. M. F. Leumann, I. M. S., 19th October 1899 (Government Central Press, Bombay).

"Report on Anti-plague Inoculation work in the Dhárwár District", by Miss Alice Corthorn, M.B., B.S., June 1899 (Government Central Press, Bombay).

"Statistics relating to inoculation round about Nagar. Report to the Collector, Ahmednagar", by F. G. H. Anderson, Esquire, I. C. S., dated Nagar, 22nd October 1899 (Government Central Press, Bombay).

"Ahmednagar Inoculation Statistics, by C. Hudson, Esquire, I. C. S., 24th July 1900" (Government Central Press, Bombay).

"Inoculation and Plague Operations in Ahmednagar and district during the epidemic of 1899", by Major C. J. Sarkies, I. M. S., 27th June 1900 (Government Central Press, Bombay).

"Report of the Dhárwár Inoculation Investigation Committee", June 1900.

"Extract of Report on the effects of Inoculation among the Jewish community at Aden with Haffkine's anti-plague vaccine", by Assistant Surgeon S. M. Mehta, published by the General Department, Bombay Government, 9th March 1901 (Government Central Press, Bombay).

"Report on the Plague Operations carried out in Poona Cantonment for the half-year ending 31st December 1900", by Lieutenant-General C. J. Burnett, Commanding the Forces, Madras (Government Central Press, Bombay).

"Anti-plague Inoculation among the Parsis of Bombay", by the Parsi Inoculation Investigation Committee, March 1902.

A certain amount of other information on the matter was communicated to the Indian Plague Commission by various officers in India in 1898 and 1899 (*vide* their Report, *passim*.)

An enquiry may also be mentioned which was made with reference to the Secretary of State's telegram to the Governor of Bombay, dated 2nd February 1897, on the possible protection against plague to be derived from small-pox vaccination. The order was conveyed to the Laboratory by the Municipal Commissioner of Bombay, with his memorandum No. 23345 of 4th February 1897, and a report based upon a study of the outbreak in the Byculla House of Correction, 1897, and dated 15th February 1897, was sent to him and forwarded to His Excellency the Governor. A copy was sent also to the Secretary to the Government of India, Home Department.

(E.)

Difficulties which were met with in introducing preventive inoculation among the races in India were referred to in my address quoted above to the first Indian Medical Congress, Calcutta, 1894. I must acknowledge the great help rendered to me during the first and most difficult stages of these efforts by Mr. E. H. Hankin, M.A., Chemical Examiner and Bacteriologist to the Governments of the then North-West Provinces and Oudh, and the Central Provinces. The problem was solved, in every instance, in the way described in my evidence to the Indian Plague Commission, Volume I, page 11 of their Report. A number of officers who assisted me in my operations were successful afterwards in adopting the same plan. As exceptionally good instances may be quoted: the work of the late Captain Leumann, I. M. S., with whom I introduced the inoculation in Lonávla, in 1897, and who, in the year following, applied it on a large scale in the Southern Marátha Country. Together with his assistants, he inoculated, for the first time, whole populations of towns, notably in Hubli, Dhárwár and Gadag. In 1893, Captain C. H. James, I. M. S., worked with me in many of the places in the Punjáb, in which I was carrying on anti-cholera inoculation (Sanawar, Kasauli, Dagshai, Simla, Patiala, Sangrur, Rawalpindi, Murree, Abbottabad,

Nowshera, Peshawar, Amritsar, Dharamsala, Kapurthala, Wazirabad, Lahore, Mian Mir, Sialkot, and other places and villages adjacent to them). He and Captain E. Wilkinson, I. M. S., who was deputed by the Government of the Punjáb to study inoculation work in the Bombay Laboratory in 1897, at the time when many hundreds of people were daily operated on there, were afterwards phenomenally successful in the Punjáb inoculation work of 1900-1901. The latter officer must be mentioned as having inoculated with his own hand the largest number of people ever done in a day by a single operator, *viz.*, 3,200. Major Bannerman, I. M. S., was sent to the Laboratory by the Government of Madras to learn the procedure, at the same time as Captain Wilkinson; and on returning to his Presidency introduced inoculation in various places, long before any plague appeared there, as well as in the plague-stricken cantonment of Belgaum. Professor A. E. Wright, of Netley, during his visit to India in 1898-99, applied anti-typhoid inoculation for the first time to large numbers of people here, and was good enough to acknowledge, in the discussions at the Royal Society, of the 8th June 1899, that the work done by him "had been facilitated by the fact that wherever he went, Mr. Haffkine had been previously." (*British Medical Journal*, July 1st, 1899.)

Amongst the vast number of other Commissioned and subordinate medical officers and private practitioners, European and Native, who attended at the Laboratory to study the inoculation work, may be mentioned Lieutenant-Colonels J. Arnott, H. Boyd and Barker, I. M. S., and Dr. (Miss) Benson (Bombay Government Resolution No. $\frac{1592-P.}{1047}$ of 20th March 1897); Lieutenant-Colonels Dimmock, Lyons, Majors Childe, Herbert, Hojel and A. Street, I. M. S., Bombay; Captain Dawson, I. M. S., deputed by the Government of the (then) North-Western Provinces; Captain Dove, deputed by the Principal Medical Officer, Bombay Command; Dr. H. Markes Fernando, deputed by the Government of Ceylon; Assistant Surgeon Kantak, sent by the Sanitary Commissioner, Bombay; a deputation of Doctors sent by H. H. the Nizám's Government, Hyderabad (Deccan); Dr. M. Shrinivasarao, deputed by the Mysore Government; Assistant Surgeon G. Chitnis, deputed by the Government of Baroda, as well as Drs. S. M. Daulatjada, D. H. Mehta, N. D. Desai, G. B. Paranjpe, C. D. Dewanji and S. M. Dave, instructed, for the same Government, in Baroda itself; Dr. R. Unwalla, deputed by the Bhávnagar State; Dr. Nizamudin Pirally Bawa, recommended for instruction by the Political Agent, Káthiáwár; Dr. Ranade, recommended by the Diván of Wadhwán State; Drs. Shroff, Murphy, de Quadros, Miss Bradley, and a number of others, sent by the Health Officer of Bombay; Drs. McCabe Dallas, K. S. Engineer, D. M. deSilva, A. W. Dyer, Patel, S. B. Pocha, V. S. Trilokekar, S. B. Naik, Sorabji Aderji Doctor, and very many others. Those who afterwards assisted these operators in their work contributed to spread the inoculation over the territory of the country.

(F.)

In the lists given above, *viz.*, on pages 6, 7 and 10, the countries outside India have been enumerated in which the plague inoculation was introduced and prophylactic supplied for it by the Laboratory during the years 1897—1902. Several Institutions abroad have now taken over the manufacturing of the material. Amongst these may be mentioned the Laboratory at the St. Bartholomew's Hospital and College, London, under Professor E. Klein; the Jenner Institute of Preventive Medicine, London; the Thomson Yates Laboratories, University College, Liverpool, from which the War and Colonial Offices have been supplied; the Imperial Institute of Experimental Medicine in St. Petersbourg, where the material is prepared for use in European and Asiatic Russias; the Swiss Bacterio-therapeutic and Vaccinal Institute, Bern; the Government Plague Laboratory, in Pianosa, Italy; the Laboratory of the Insular Board of Health, Manila, Philippine Islands. Some druggists' firms, like Messrs. Rebman, Limited, London, are manufacturing and dispensing it on a commercial basis, on their own behalf.

(2).—STUDIES ON STERILISATION AND DISINFECTION.

The work on plague preventive inoculation absorbed unavoidably the largest part of the Laboratory's energies, in view of its great urgency. Our studies on the plague comprised, further, the following :—

Pathological studies ;

Studies on the antitoxic serum treatment ;

Experiments in serum diagnosis ;

Examination of plague suspected animals, stuffs, cultures and patients ;

Researches on the plague bacillus in Nature ; and

Studies in disinfection.

This work is recorded below in the order of its practical significance.

The following Laboratory reports under the head of sterilization and disinfection were published by Government :—

Letter No. 105 of 21st April 1898, to the Surgeon-General with the Government of Bombay, forwarding report on experiments made in the Laboratory by Drs. E. L. Marsh and W. W. Pitchford, on the Equifex Disinfection Stove.

Letter No. 399 of 23rd July 1898, forwarding report on experiments made by Dr. E. L. Marsh on the Bowman Steam Disinfector.

(The two printed in accordance with Bombay Government Resolution No. $\frac{4808}{5091\text{-P.}}$ of 27th April 1898).

Letter No. 21 of 18th February 1898, to Surgeon-General with the Government of Bombay, forwarding report of experiments on liquid sulphur dioxide and carbolic fumes as carried out in the Plague Research Laboratory by Major Bannerman, I. M. S.

Letter No. 79 of 2nd April 1898, to Surgeon-General, forwarding a summarised report on experiments with sulphur dioxide and the bacillus of plague, by Dr. E. L. Marsh of this Laboratory.

Letter No. 316 of 30th June 1898, to Surgeon-General, forwarding report by Drs. E. L. Marsh and W. Watkins Pitchford on the efficiency of vaporised carbolic acid as a disinfectant, with special reference to the bacillus of bubonic plague.

Further report on the action of liquefied sulphur dioxide as a disinfectant, with special reference to the bacillus of bubonic plague, by the same officers, with Mr. Haffkine's summary and conclusions.

Report dated 30th June 1898 on the efficiency of nitric fumes as a disinfectant, with special reference to the bacillus of bubonic plague, by the same officers of the Laboratory.

The five last mentioned reports were printed by Government Resolution No. $\frac{4740\text{—P.}}{5007}$ of 24th August 1898.

Report on the efficiency of perchloride of mercury in disinfectant solution, as an application to cowdung floors ; and on the utility of saturating cowdung (or simply mud) floors with sea water before spraying them with perchloride of mercury, by Dr. E. L. Marsh, 14th March 1899 (Bombay Government Central Press).

Report on the disinfection of Native Dwellings by Formaldehyde Vapour, with special reference to the utility of the apparatus of Lingner, by Dr. E. L. Marsh, 14th September 1899. (Printed in the Bombay Government Central Press.)

Dr. Marsh's experiments included also an investigation on the number of microbes in general found in houses roofed and unroofed, disinfected

and not disinfected; and also on the relation of the plague bacillus to water, earth, sterilised and unsterilised, also on plague cultures exposed to the effect of sub-soil air, &c. A reference to these experiments was made in his evidence to the Plague Commission, Volume III, page 68.

Letter No. 1541 of 28th August 1901 and letter No. 2412 of $\frac{23rd}{24th}$ December 1901, to Government forwarding reports on the experiments made by Captain Liston, I. M. S., of the Plague Research Laboratory, on the effect of the addition of "New Green Crystals" to perchloride of mercury and on the disinfecting and staining properties of that dye, printed in preamble to Government Resolution No. 1346-P. of 15th April 1902.

Letter No. 1880 of 14th October 1901 on the cheapest disinfectants; forwarding report on experiments made by Captain Liston, I. M. S., printed in the preamble to Government Resolution No. 4805 of 10th December 1901.

The following may also be mentioned:—

"The procedure adopted in the Plague Research Laboratory for stoppering the plague prophylactic bottles, and on the sterilisation of India-rubber and ordinary corks", by Mr. M. K. Pansare, L. M., Supervisor, Plague Research Laboratory, published in the "*Indian Medical Gazette*", December 1900.

Some other Laboratory studies and reports on disinfectants are mentioned below, on page 38.

A special formalin disinfecting machine, for disinfecting boots and shoes of native crews serving on out-going vessels, has been constructed and supplied to the Port Health Officer, Bombay (*vide* letters to Government, Nos. 1510 of 23rd August 1901, 242 of 12th February 1902, and 526 of 24th February 1903). In the course of the investigations connected with this matter, it was found that it is much easier to deprive the plague bacillus of its power of growing in artificial media than to make it harmless to rats; that the latter possess the power of revivifying an apparently disinfected plague culture; suffer from it a fatal disease, and restore it, during this process, to its primitive vigour.

(3).—EXAMINATION OF PLAGUE-SUSPECTED PATIENTS, ANIMALS AND STUFFS.

The number of living and dead animals, rats, mice, monkeys, squirrels, dogs, cats, birds, examined in regard to plague, for Government officers, the Municipality, and private applicants, amounts to a very large number, but cannot be given in accurate figures.

In 1897 the Laboratory investigated an outbreak of plague among monkeys in Hardwar (*vide* Report to the Secretary to the Government of India, Home Department, dated Hardwar, 25th November 1897).

Cases of plague among monkeys and squirrels in Dhárwár were further studied by Dr. (Miss) Corthorn and Captain Ch. Robertson Milne, I. M. S., then of this Laboratory, and the result published in the *Bombay Government Gazette*.

The infectiveness or otherwise of food-stuffs was tested in a number of instances, always with negative results.

Only on one occasion did it happen that a number of rats inoculated with flour and farinaceous articles, removed from a plague infected shop, died. No plague microbes were detected in their bodies, and the cause of their deaths could not be ascertained, the samples having been inadvertently destroyed. This was in connection with 15 articles of food-stuffs sent for investigation by the Medical Adviser to His Highness the Mahárája of Patiala, with his letter No. 946 of 7th February 1902.

Experiments on milk and ghi were referred to in my evidence to the Indian Plague Commission, Vol. I., p. 15.

(4).—PATHOLOGICAL STUDIES.

Dr. F. M. Gibson and Captain Ch. Robertson Milne, I. M. S., studied the infectiveness of secretions from plague infected rats (*vide* Captain Milne's evidence to the Indian Plague Commission, Vol. III, p. 24).

The Laboratory examined a number of samples of blood and pathological products and tissues from plague stricken patients.

Thus in March to May 1898 Dr. C. H. Cayley, then of this Laboratory, investigated discharges from plague patients, their saliva, epidermis of tongue, sputum in pneumonia cases, and demonstrated in all of these the presence of plague bacilli, but found them absent in perspiration and urine. Reference to these experiments was made in his evidence to the Indian Plague Commission, Vol. III, p. 294 of their report.

The same officer made also an enquiry into the length of time during which plague bacilli are recoverable in the sputum and other products of people sick and recovering from plague pneumonia. For results *vide* evidence given by him to the Indian Plague Commission, Vol. III, pages 293-294 of their report.

In February to March 1902, Captain Greig, I. M. S., of this Laboratory, made a study of the presence or otherwise of bacilli in the blood of plague-stricken patients, as observed in the epidemic of that season. These studies were made partly in connection with Dr. Costello's investigation on the effect of Lustig's serum in the Poona General Plague Hospital, in February to March 1902 (*vide* that officer's report No. 2297, dated 29th April 1902, and Government of Bombay, General Department, letter No. 1877-P. of 16th June 1902).

The question as to the possibility of conveying plague by food was studied on a considerable scale, by Dr. F. M. Gibson. Notwithstanding the great variation of conditions, in no instance could the disease be communicated even to such animals as showed themselves very susceptible when inoculated afterwards under the skin. The materials experimented with included grain freshly and abundantly infected with virulent plague cultures. The same officer studied also the communicability of plague from rat to rat.

Certain pathological studies made by me in 1896 and 1897 remain still unpublished.

(5).—RESEARCHES ON THE PLAGUE BACILLUS IN NATURE, OUTSIDE THE HUMAN AND ANIMAL BODY.

Dr. C. H. Cayley, M.A., M.B., was first put on this investigation, in 1898. Various methods proposed by investigators and others suggested by us, for recovering plague bacilli from soil and other materials, were tested by him in March to May of that year, and attempts made to detect the bacilli in articles which were likely to be naturally infected, such as clothes from patients, earth in infected rooms and from plague grave-yards, cotton matting, hangings in patien's rooms, etc. No plague microbes were found, except on one occasion, on a piece of matting directly soiled by a plague patient. In the same year and in 1899 Dr. Ransome and Captain Milne were put on to test articles removed from infected rooms. In a large number of attempts made, only on one occasion, again, was a plague culture obtained, *viz.*, in a sample of dust sweepings collected by Dr. Ransome, a result which may have been due to some accidental contamination.

Ultimately Dr. F. M. Gibson was deputed to carry out a series of experiments First in Bombay, and afterwards (June to September 1898) in Karáchi (*vide* Government Resolution, No. 3572 of 4th June 1898). His experiments were made upon soil, clothing, bedding, furniture, food-stuffs, gunny-bags, grain and other articles which were likely to have been infected by plague rats. In no instance could the plague microbe be detected.

The method used for searching for these microbes was described in my evidence to the Indian Plague Commission, Vol. I, page 15 of their report.

(6).—EXPERIMENTS ON SERUM DIAGNOSIS IN PLAGUE.

These were made by Dr. Gibson and, under his guidance, by Dr. (Miss) Alice Corthorn.

The object was to ascertain whether serum separated from clotted blood of patients sick or convalescent, and of persons inoculated against the plague, had an effect on an emulsion of plague microbes, similar to that observed in enteric, Malta fever, and some other diseases.

Difficulties that so far have not been overcome were met with in the preparation of a satisfactory emulsion of the plague bacillus. An emulsion prepared by shaking up a 48 hours' growth off agar with distilled water and sand, seemed satisfactory, but was found to be precipitated by normal human serum as well as by that of persons inoculated against the plague. This may have been due to the omission of $\frac{3}{4}$ per cent. of salt in the preparation of the emulsion. Later attempts at making an emulsion on that plan proved abortive, possibly for want of proper sand. As regards plague patients a further difficulty was met with in the fact that in acute cases the blood could not be got to clot. A clear serum could not therefore be obtained. Whether this reaction can be profitably applied to plague, with improved methods or not, remains for the present undecided.

(7).—EXPERIMENTS ON A CURATIVE SERUM FOR PLAGUE.

Dr. Yersin, previously of the Pasteur Institute in Paris, who had been investigating the plague in Hongkong, in 1894, and since then pursued his studies in his laboratory, in Indo-China, and in the Pasteur Institute, in Paris, published in 1896, shortly before the outbreak in Bombay, the results of his experiments on a curative serum for treating that disease. According to this publication, serum of horses treated with plague cultures, upon the same lines as it had been done for the preparation of an anti-diphtheritic serum by Behring and Kitasato, obtained the property, when injected in plague patients, of reducing their mortality from some 90 per cent. down to 7 per cent.

On my arrival in Bombay, in the beginning of the outbreak here, I undertook experiments on small Laboratory animals, on a limited scale, with the object of, first, carrying out a tentative study on the properties described by Yersin. It was however known from experiments on diphtheria and tetanus, that the preparation of such serum, whether in small or large quantities, required many months of continued treatment of animals from whom the serum was to be obtained. On the strength of Dr. Yersin's statements, the Health Department of the Municipality asked that the preparation of such serum should be undertaken at once on a scale adequate to the outbreak in the city.

The preparation on a plan similar to that announced by Dr. Yersin, began in November 1896, and towards the middle of April 1897, 52 horses, 14 cattle and 119 goats and sheep were under treatment. In October 1897, I had collected an amount of serum sufficient for submitting the treatment to a conclusive test, and carried out this in the Poona Plague Hospital, with the assistance of Dr. W. J. Simpson and Major Bannerman, I. M. S. My results were of an entirely negative character. By the end of the same month I reduced the number of animals to 9 horses, 3 cattle and 3 sheep, on which certain further studies were carried on. The animals were finally disposed off upon my letter to the Municipal Commissioner, No. 62 of 25th March 1898 (*vide* this office letter to the Executive Health Officer, Bombay Municipality, No. 1048 of 10th December 1898).

The method of testing the serum which I adopted, and which I consider the only accurate one, as well as the general results of my experiments, were

explained to the Indian Plague Commision, Vol. I of their Report, pages 13—15. During my experiments, I found the serum of sheep more promising than that of other animals. This serum will be again experimented with in this Laboratory.

The above experiments decided the question of anti-toxic treatment in plague in a way which has not been controverted since. In addition to this, the following facts were for the first time established in the course of those studies :—

(1) That none of the larger domestic animals, cows, horses, bulls, sheep, goats, contract plague ; only goats waste gradually away under the effect of the artificial infection (*vide* p. 38, Vol. I, of Mr. Nathan's "The Plague in India in 1896-1897").

(2) In man hardly any difference in re-action is observed if he be re-inoculated a few days after a first inoculation, and only a slightly lesser re-action is observed if he be inoculated a long time after the first. Nevertheless a continued series of inoculations tried on animals shows that they get more and more insensible to the virus. Thus a horse which re-acted at first violently to, say, 5 c.c. of a plague culture, may after several months of treatment, show only slight fever subsequent to an injection of some 1,600 c.c. ; and

(3) That there exist such a thing as local immunity, as explained to the Indian Plague Commission, Vol. I, page 13.

A detailed enquiry into the results obtained from sera prepared by Professor Lustig, Florence, and Professor Terni and Dr. Bandi, Messina, was carried out in the Laboratary, with results similar to those observed in 1897.

B 1523—6

II.

STUDIES IN DISEASES OTHER THAN PLAGUE.

As stated above, the activity of the Laboratory has been, during the years under report, connected mainly with work on plague. As far, however, as circumstances permitted, a certain amount of work has been done also in other directions, namely in connection with Cholera, Typhoid, Malta or Mediterranean fever, Relapsing fever, Scurvy, Snake venom and antivenene, Diphtheria, Leprosy, Variola and Vaccinia, Malarice, Epizootic lymphangitis, and Surra.

A.—PRACTICAL AND RESEARCH WORK ON CHOLERA.

This comprised :

(1) Studies on the distribution of cholera bacilli in nature, carried out in the following places :—

In Bombay : *vide* this office report dated 4th August 1897, in reply to letter from Municipal Commissioner, No. 10512 of 28th July 1897, asking for the examination of Bombay waters.

In Gujarát, during the 1900 famine : Report to Government of Bombay, No. 1191 of 25th July 1900.

In the Ahmednagar Boer Camp, undertaken upon the request of the Principal Medical Officer, Bombay, wire dated 29th May 1901, and continued till 25th October 1901. Results reported to the Senior Medical Officer in charge of the Camp.

Apart from the above, a large number of samples of cholera suspected waters were examined in the Laboratory on application from various sources.

(2) Study of the effect on man of various forms and doses of cholera vaccine, carried out by Major A. Buchanan, I. M. S., Superintendent, Nágpur Central Jail, and Captain G. Lamb, I. M. S., of this Laboratory. Contributed to the Scientific Memoirs edited on behalf of the Government of India by the Director-General, Indian Medical Service, with this office letter No. 2356 of 14th December 1901 and summarised in that officer's Annual Report for 1900.

(3) Experiments in Baroda, by Captain Lamb, I. M. S., and myself, on the effect on men of a comma bacillus not agglutinating with the serum of animals immunized to the cholera comma bacilli.

(4) A certain number of officers were also taught the *technique* of anti-cholera inoculation, upon the request of the Surgeon-General with the Government of Bombay, dated 11th June 1901.

B.—PRACTICAL AND RESEARCH WORK ON ENTERIC FEVER.

(1).—Preparation and Despatch of Anti-Typhoid Vaccine.

(*a*)

One hundred and fifty doses of this vaccine were prepared and distributed to applicants in 1900-1901, and one hundred and sixty-nine in 1901-1902, as detailed in the lists below.

Statement showing the amount of Anti-Typhoid Vaccine supplied to various places from the Research Laboratory, Bombay, between 1st June 1900 and 31st May 1901.

(Total 150 adult doses.)

Date of despatch.	To whom and where sent.	Number of doses.
	BOMBAY PRESIDENCY.	
	BOMBAY.	
16th October 1900 ...	Medical Storekeeper to Government, Bombay Command	72
	DEOLA'LI.	
22nd December 1900 ...	Senior Medical Officer	78
	Total ...	150

Statement showing the amount of Anti-Typhoid Vaccine supplied to various places from the Research Laboratory, Bombay, between 1st June 1901 and 31st May 1902.

(Total 169 adult doses.)

Date of despatch.	To whom and where sent.	Number of doses.
	BOMBAY PRESIDENCY.	
	ADEN.	
	Sheik Ottaman.	
20th December 1901 ...	Dr. J. C. Young	8
	MAHA'BLESHWAR.	
21st May 1902	Superintendent	12
	POONA.	
20th August 1901	Lieut.-Colonel G. H. Bull, I. M. S.	27
21st August 1901	Principal Medical Officer	50
	Total for Bombay Presidency ...	97
	CENTRAL INDIA.	
	NEEMUCH.	
26th May 1902	Senior Medical Officer	48
	THE PUNJA'B.	
	MUSSOOREE.	
21st May 1902	Civil Surgeon	6
	SIALKOT.	
13th March 1902 to 21st May 1902.	Civil Surgeon	6
	Total for the Punjáb ...	12
	NATIVE STATES.	
	HYDERABAD (DECCAN).	
23rd May 1902	The Plague Commissioner	12
	Grand Total ...	169

(*b*)

The typhoid vaccine issued from this Laboratory was prepared in accordance with the ideas explained in this office letter No. 260-A of 7th June 1898, to the Government of India.

The strength of the bacillus was kept up by the same method of passages through guinea pigs as I introduced in cholera. A richly sown broth culture of virulent typhoid bacilli in broth was prepared and left to stand for 10 days. The typhoid bacillus grows much more rapidly than that of plague, and a richer cultivation is obtained within the above time than can be had from plague bacilli in a corresponding number of weeks.

Twenty-four hours before the cultivation is completed, an agar growth of the bacillus is started. On the tenth day of growth the liquid culture is introduced into the vessel containing the 24th hours' agar culture, and the surface growth of the latter is washed off and mixed with the broth culture. The mixture is sterilised by heating for 20 minutes at 60° C. In this way a young, one day old, vigorous mass of bodies of bacilli, taken off the agar, is combined with the products accumulated in the ten days' old liquid cultivation.

(*c*)

The following references show the connection of the typhoid vaccine with that of cholera and plague: Professor E. A. Wright and Surgeon-Major D. Bruce, A.M.S, "On Haffkine's method of vaccination against Asiatic Cholera," *British Medical Journal*, February 4th, 1893; Dr. Tamamcheff "Expériences sur les vaccins phéniqués de Haffkine," Annales de l'Institut Pasteur, 1892, p. 713; and Dr. G. Iawein, "Observations sur des cobayes immunisés par les vaccins anti-cholériques vivants," same volume, p. 708; Surgeon-Captain C. C. Manifold, M.B., I. M. S., "Report of a case of inoculation with carbolised anti-choleric vaccine (Haffkine)," *Indian Medical Gazette*, April 1893, p. 101; E. H. Hankin, "Annual Report of the Chemical Examiner and Bacteriologist to the Governments of the North-Western Provinces and Oudh and of the Central Provinces for the year 1894," Allahabad, Government Press, 1895; Professor R. Pfeiffer and Dr. W. Kolle, "Experimentelle Untersuchungen Zur Frage der Schutzimpfung des Menschen gegen Typhus abdominalis," in the *Deutsche Medicinische Wochenschrift*, No. 46, 1896, and in the *Indian Medical Gazette*, 1897; A. E. Wright, M.D., and Surgeon-Major D. Semple, M.D., I. M. S., "Remarks on vaccination against typhoid fever," *British Medical Journal*, January 30th, 1897, p. 256; W. M. Haffkine, "Inoculation against Plague," *British Medical Journal*, May 18[illegible]7; and letter to the Secretary to the Government of India, Home Department, dated 14th July 1897 in Mr. Nathan's "The Plague in India in 1896-1897," Volume II, p. 36; W. M. Haffkine, "On Preventive Inoculations," Proceedings of the Royal Society, London, Volume LXV above quoted; "Discussion of Preventive Inoculation," *British Medical Journal*, July 1st, 1899; Professor A. E. Wright, letter in the *British Medical Journal*, July 8th, 1899, p. 199; and Indian Plague Commission, page 183, Volume V of their Report.

(2).—Investigation of Typhoid Suspected Waters.

A number of samples of water were examined at the Laboratory for the presence of typhoid-like bacilli and those of the *coli* class. This was done, amongst others, on the waters of the Ahmednagar Boer Camp in September 1901, upon an application from Lieutenant-Colonel Lane, R.A.M.C. A note referring to these studies was forwarded to the Director-General, Indian Medical Service, with this office No. 2413 of 24/25th December 1901.

(3).—Serum Diagnosis of Enteric.

The Laboratory manufactured and supplied materials for the diagnosis of the disease by means of Widal's method, which consists, as has been mentioned above in making a drop of serum, obtained from the blood of a suspected patient, act upon the microbes of that disease suspended in a saline solution. A lecture explaining the method was delivered by Captain Lamb, I. M. S., of this Laboratory, in the Bombay Medical and Physical Society and subsequently published in their proceedings, as well as in the *Indian Medical Gazette* and also by the Director-General, Indian Medical Service.

By means of this method rather numerous cases of the disease were detected in Natives of India, *viz.* in Bombay and in Poona. A report on the matter by Captain Lamb, I. M. S., was submitted to the Government of Bombay with this office letter No. 49 of 10th January 1901 and published in the *Bombay Government Gazette Extraordinary* of 7th May 1901, page 797 and following. Another report was sent to the Sanitary Commissioner with the Government of India for publication in the Scientific Memoirs, with this office No. 1155 of 29th May 1902.

In 1900-1901, 825 blood capsules, 885 sedimentation tubes, 138 capsules of microbial emulsion, and 38 special lamp collars and tubes, were issued to various officers for the diagnosis of typhoid and Malta fevers by means of the method in question. In 1901-1902 the figures were 1,007, 1,164, 151 and 8.

A certain number of officers were admitted to the Laboratory and taught the method personally.

The apparently wide distribution of the disease amongst the Natives of India must now be taken into account whenever measures are discussed for the prevention of enteric. Formerly the British troops and the general European population in India were supposed to be the main, if not the only, sufferers from, and disseminators of, this disease.

C.—MALTA FEVER.

By means of Widal's re-action applied to Malta (or Mediterranean) fever a number of cases were diagnosed among Europeans and Natives of India. The recognition of indigenous cases out here has an interest from the point of the geographical distribution of the disease, so far only very imperfectly known. A report by Captain Lamb, I. M. S., of this Laboratory "On the occurrence of Mediterranean fever in Bombay," was published in the Government Central Press, Bombay, 1900.

D.—RELAPSING FEVER.

In connection with the outbreak of the disease in one of the Bombay Jails, Captain G. Lamb made a series of experiments on Relapsing fever in Monkeys. A paper by him on the subject has been published in the "Scientific Memoirs of Medical Officers of the Army in India," Part XII, 1901, pp. 77—102.

E.—SCURVY.

Experiments by the same Officer were carried out with the object of testing theories so far advanced as to the manner of propagation of this disease. These experiments were published in the "Lancet," London, January 4th, 1902, pp. 10—14.

F.—SNAKE VENOM AND ANTIVENENE.

(1).—Testing Samples of Antivenene.

In order to test the efficacy and keeping properties of Calmette's antivenene, samples collected in Bombay, Nasik, Indore, Agra, Berar were examined by Captain Lamb and Dr. Hanna of this Laboratory. The samples had been kept in the respective places from 2 months to 5 years. It was found that the efficacy of the material when tested on animals injected with cobra poison is undoubted, that its power gets gradually reduced, and that the latter process is quicker in hotter parts of the country. After some three years the serum seems to lose its power entirely. A report on these results was forwarded to the Government of India through the Government of Bombay with this office letter No. 689 of 19th April 1901, and appeared in the Scientific Memoirs edited by the Sanitary Commissioner with the Government of India, New Series, No. 1, 1902.

(2).—Collection of Snake Venom.

An arrangement was made, by the sanction of Government, with Dr. Calmette Lille, the discoverer of antivenene, for the exchange of his serum for dry venom, which he required for his preparations. For this purpose 772 snakes (Cobras, Russell's Vipers, Echis carinata and Bungarus Fasciatus) (686 live and 86 dead) were collected by the Laboratory. The districts and officers who contributed this large number of reptiles are given in the attached lists. Over 1,000 grammes of dry cobra venom, 50 grammes of dry daboia venom, 5 grammes of that of bungarus fasciatus and about 5 milligrammes of that of echis carinata was collected from these snakes.

Statement showing the number of Snakes received at the Plague Research Laboratory, Bombay, up to 31st May 1900.

(Total No. 3.)

Name of Town.	Presidency, etc., Sender's Name and designation.	Date.	Cobras.	Total.
	Bombay Presidency.			
Bombay	Purchased by Laboratory ...	10th April 1900 to 23rd May 1900.	3	3

Statement showing the number of Snakes received at the Plague Research Laboratory from 1st June 1900 to 31st May 1901.

(Total No. 19.)

Name of Town.	Presidency, etc., Sender's name and designation.	Date.	Cobras.	Russell's Vipers.	Total.
	Bombay Presidency.				
Bombay ...	Purchased by Laboratory .	27th June 1900 to 16th April 1901.	9	10	19

Statement showing the number of live Snakes received at the Plague Research Laboratory, Bombay, from different parts of India between 1st June 1901 and 31st May 1902.

(Total No. 671.)

Name of Town.	Presidency, &c., Sender's Name and Designation.	Date of receipt.	Designation of Snake.				Total number of Snakes received.
			Naja Tripudians.	Daboia Russellii.	Echis carinata.	Bungarus Fasciatus.	
	Bombay Presidency.						
Bombay	Purchased by Laboratory ...	1st June 1901 to 20th May 1902.	3	6	...	...	9
Thána	Assistant Surgeon F. A. Moos, Khán Bahádur, Acting Civil Surgeon.	30th August 1901 ...	...	1	...	...	1
	Total for Bombay Presidency ...		3	7	...	...	10
	Bengal Presidency.						
Alipore	C. J. Stevenson Moore, Esq., C. S., Officiating Magistrate, 24-Parganas.	20th February 1902 to 17th May 1902.	8	6	...	1	15
Balasore	Captain W. A. Williams, I. M. S., Civil Surgeon and Superintendent of Vaccination.	9th November 1901 .	10	...	...	...	10
Bankura	B.De, Esquire, C. S., Magistrate.	7th January 1902 ...	11	...	...	...	11
Barisal	Lieut-Colonel R. Cobb, I. M. S., Civil Surgeon.	29th November 1901 .	3	...	...	...	3
Hooghly	T. Inglish, Esquire, C. S., Magistrate.	6th December 1901 to 28th January 1902.	10	...	...	...	10
Howrah	F. W. Duke, Esquire, C. S., Magistrate.	5th November 1901 to 16th December 1901.	13	11	...	...	24
Jessore	A. G. Hallifax, Esquire, C. S., Magistrate.	26th February 1902 .	5	...	...	...	5
Midnapore ...	W. A. Marr, Esquire, C. S., Magistrate.	18th November 1901 .	48	...	...	...	48
	Total for Bengal Presidency ...		108	17	...	1	126
	Central Provinces.						
Bhandara ...	E. J. Murphy, Esquire, Civil Surgeon.	19th October 1901 to 25th January 1902 .	...	4	...	...	4
Damoh	T. W. Quinn, L.R.C.P., &c., Civil Surgeon.	5th October 1901 to 28th April 1902 ...	27	7	...	...	34
Hoshangabad ...	Major A. G. Hendley, I. M. S., Civil Surgeon.	4th October 1901 to 16th October 1901 .	3	...	...	...	3
Jubbulpore ...	Lieut-Colonel H. K. McKay, I. M. S., C.I.E., Civil Surgeon.	14th October 1901 to 14th February 1902.	14	2	...	...	16
Nágpur	Major A. Buchanan, M.D., I. M. S., Civil Surgeon.	14th October 1901 ..	1	...	...	...	1
Narsinghpur ...	Captain G. Murphy, I. M. S., Civil Surgeon.	9th October 1901 to 13th May 1902 ...	23	8	1	...	32
Khandwa ...	Major H. E. Banatvala, I. M. S., Civil Surgeon.	23rd October 1901 to 20th May 1902 ...	323	40	6	...	369
Raipur	Captain P. F. Chapman, I. M. S., Civil Surgeon.	27th December 1901 to 25th March 1902.	4	...	...	2	6
Sambalpur ...	Assistant Surgeon D. O'Connall Murphy, Civil Surgeon.	9th October 1901 to 31st March 1902 ...	19	...	...	...	19
Saugor	Captain W. D. Sutherland, M.B., I. M. S., Civil Surgeon.	4th October 1901 to 30th December 1901.	13	4	...	...	17
	Total for Central Provinces ...		427	65	7	2	501

Name of Town.	Presidency, &c., Sender's Name and Designation.	Date of receipt.	Designation of Snake.				Total number of Snakes received.
			Naja Tripudians.	Daboia Russellii.	Echis carinata.	Bungarus Fasciatus.	
	Madras Presidency.						
Anantapur ...	Bannatyne Macleod, Esq., M.A., Barrister-at-Law, Collector.	25th October 1901 to 6th February 1902.	3	...	...	...	3
Vizagapatam ...	Captain W. Vichers, I. M. S., District Medical and Sanitary Officer.	15th October 1901 to 4th November 1901.	6	...	...	...	6
	Total for	Madras Presidency ...	9	...	...	...	9
	United Provinces of Agra and Oudh.						
Gorakhpur ...	Major G. H. Baker, I.M.S., Civil Surgeon.	18th February 1902 to 6th May 1902.	12	...	...	...	12
Mirzapur	Major R. J. Marks, I. M. S., Civil Surgeon.	16 December 1901 ...	7	...	...	...	7
	Total for	United Provinces ...	19	...	...	...	19
	Native States, Nizám's Dominion.						
Bolarum	Honorary Lieut. Mahoney, I. S. M. D.	5th August 1901 ...	3	1	...	...	4
	Orissa.						
Barumba	Babu Madan Mohan Patnaill, Manager, Barumba State.	25th March 1902 ...	2	...	...	...	2
		Total for Native States	5	1	...	...	6
		Grand Total ...	571	90	7	3	671

(3).—Supply of Antivenene to Hospitals and Dispensaries.

Between October 1901 and 21st April 1902, 632 bottles of Calmette's antivenene were distributed to hospitals and dispensaries in the Bengal Presidency, Central Provinces, the Punjáb, Rájputána, the United Provinces and Káshmir. Considerable orders from Burma, United Provinces, Central Province and the North-West Frontier Province are awaiting compliance. The arrangements with Dr. Calmette fell through, as he declared himself unable to make use of large quantities of venom. The preparation of his antivenene, according to the method published by him and very kindly supplemented by details communicated by him to the Laboratory, has therefore been started in this Laboratory. Certain promising modifications are being attempted, and these will be in due time reported on, and published.

Statement showing the amount of Antivenene supplied to various places from the Research Laboratory, Bombay, between the 16th October 1901 and 21st April 1902.

(Total number of bottles, 632).

Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
	BENGAL PRESIDENCY.	
	Bhagalpur.	
25th February 1902 ...	Civil Surgeon	6
	Burdwan.	
25th February 1902 ...	Civil Surgeon...	6
	Champaran.	
25th February 1902 ...	Civil Surgeon	24
	Cuttack.	
25th February 1902 ...	Civil Surgeon	5
	Darbhunga.	
10th March 1902 ...	Civil Surgeon	10
	Faridpur.	
10th March 1902 ...	Civil Surgeon	10
	Gaya.	
25th February 1902 ...	Civil Surgeon	12
	Hazaribagh.	
10th March 1902 ...	Civil Surgeon	12
	Howrah.	
25th February 1902 ...	Civil Surgeon	6
	Hugli.	
10th March 1902 ...	Civil Surgeon	4
	Midnapur.	
10th March 1902 ...	Civil Surgeon	12
	Monghyr.	
25th February 1902 ...	Civil Surgeon	24
	Murshidabad.	
10th March 1902 ...	Civil Surgeon	10
	Muzaffarpur.	
1st April 1902 ...	Civil Surgeon	4
	Mymensingh.	
10th March 1902 ...	Civil Surgeon	6
	Patna.	
10th March 1902 to 1st April 1902.	Civil Surgeon	24
	24-Parganahs.	
25th February 1902 ...	Civil Surgeon	6
	Puri.	
25th February 1902 ...	Civil Surgeon	6
	BENGAL PRESIDENCY—*continued.*	
	Ranchi.	
10th March 1902 ...	Civil Surgeon	10
	Saran.	
10th March 1902 ...	Civil Surgeon	6
	Total, Bengal Presidency ...	203
	CENTRAL PROVINCES.	
	Nagpur.	
10th January 1902 to 18th April 1902.	Administrative Medical Officer.	290
	THE PUNJAB.	
	Amritsar.	
1st April 1902 ...	Civil Surgeon	4
	Delhi.	
1st April 1902 ...	Civil Surgeon	4
	Ferozepore.	
1st April 1902 ...	Civil Surgeon	4
	Gurdaspur.	
1st April 1902 ...	Civil Surgeon	4
	Gujarát.	
1st April 1902 ...	Civil Surgeon	4
	Hoshiarpur.	
1st April 1902 ...	Civil Surgeon	4
	Jullunder.	
1st April 1902 ...	Civil Surgeon	4
	Karnal.	
1st April 1902 ...	Civil Surgeon	4
	Lahore.	
1st April 1902 ...	Civil Surgeon	4
	Ludhiana.	
1st April 1902 ...	Civil Surgeon	4
	Lyallpur.	
1st April 1902 ...	Civil Surgeon	4
	Multan.	
1st April 1902 ...	Civil Surgeon	4
	Muzaffarnagar.	
1st April 1902 ...	Civil Surgeon	4

Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
	THE PUNJAB—*continued.*	
	Peshawar.	
1st April 1902 ...	Civil Surgeon	4
	Rawalpindi.	
1st April 1902 ...	Civil Surgeon	4
	Rohtak.	
1st April 1902 ...	Civil Surgeon	4
	Sialkote.	
1st April 1902 ...	Civil Surgeon	4
	Shahapur.	
1st April 1902 ..	Civil Surgeon	4
	Simla.	
16th October 1901 ...	Surgeon to His Excellency the Viceroy.	3
	Umballa.	
1st April 1902 ...	Civil Surgeon	4
	Total for the Punjab ...	79
	RAJPUTANA.	
	Ajmere.	
2nd April 1902 ...	Civil Surgeon	4
	UNITED PROVINCES OF AGRA AND OUDH.	
	Lucknow.	
27th January 1902 ..	Inspector-General of Civil Hospitals.	48
	NAINITAL DISTRICT.	
	Haldwani.	
21st April 1902 ...	Assistant Surgeon, Haldwani Dispensary.	4
	Kashipur.	
21st April 1902 ...	Assistant Surgeon, Kashipur Dispensary.	4
	Total for the United Provinces.	56
	Grand Total ...	632

(4).—STUDIES ON SNAKE VENOM AND ANTIVENENE.

In the course of the work, an officer of the Laboratory (Captain Lamb, I. M. S.), and the snake man serving here for manipulating snakes, pricked their fingers against cobras' fangs. They were injected immediately with antivenene and thus became subjects for observing the effect of the latter. A report on the first case mentioned, drawn up by Dr. Hanna and Captain Lamb, was submitted to Government with this office No. 130 of 24th/25th August 1901 (published in the *Lancet*, January 5th, 1901). These cases, as well as others observed in India, tend to prove the efficacy of Calmette's serum for cobra bites in man. Experiments made on animals by Captain Lamb and Dr. Hanna show, however, that the serum has no effect against the venom of Russell's viper.

A paper by Captain Lamb, "On the action of snake venom on the coagulability of the blood," appeared in the *Indian Medical Gazette*, December 1901; a report "On some observations on the poison of Russell's viper," by Captain Lamb and Dr. Hanna, was forwarded for publication to the Sanitary Commissioner with the Government of India, with this office No. 2136 of 12th November 1901 and another, "On the action of the venoms of the Cobra and Daboia on the red blood corpuscles and the blood plasma," by Captain Lamb, with this office No. 3461 of 3rd October 1902. A paper "Standardization of Calmette's antivenomous serum," by the same officer, appeared in the "Scientific Memoirs," New Series, No. 1.

G.—DIPHTHERIA.

Upon the request of the Director-General, Indian Medical Service, expressed in letter No. 1118 of 26th February 1902, an investigation into the value of old antidiphtheritic serum was carried out, and a report on the matter sent to him subsequently with this office No. 4377 of 23rd December 1902.

H.—LEPROSY.

Vide paper by Dr. Hanna forwarded to Government (and transmitted for publication to the Sanitary Commissioner with the Government of India) with this office No. 657 of 17th April 1901.

I.—VARIOLA AND VACCINIA.

A certain number of experiments were made in the Laboratory by Captain Lamb, I. M. S., and Assistant Surgeon Kantak, Superintendent of Vaccination.

J.—EPIZOOTIC LYMPHANGITIS.

In accordance with Government Resolution No. 6698 of 25th September 1901, Revenue Department, Captain Liston, I. M. S., investigated, together with Veterinary-Major Brodie-Mills, Principal, Bombay Veterinary College, an outbreak of Epizootic Lymphangitis in Bombay cattle. The report on this matter was incorporated in the Bombay Government Resolution, Revenue Department, No. 1262 of 22nd February 1902.

K.—SURRA.

A paper on the studies made by Captain Liston, I. M. S., in this Laboratory, "On the structure, scission and conjugation of Trypanosomum Evansi," was forwarded for publication to the Sanitary Commissioner with the Government of India with this office letter No. 2137 of 12th November 1901.

A certain amount of correspondence has also taken place on the manner of destroying rats—*vide* this office letter to Chief Medical Officer, Baroda, No. 1318 of 1st August 1901; letter from Fred. Pratt, Esquire, I. C. S., Ahmedabad, dated 12th January 1902; Government Resolution No. 7929 of 14th October 1901 (Revenue and Agriculture Department). No practical work on the subject could, however, be done for want of the necessary facilities.

III.

OTHER WORK OF PRACTICAL UTILITY CARRIED OUT BY THE LABORATORY.

The above summary refers to the researches carried out in the Laboratory and to such practical benefits as resulted from the Laboratory's studies.

In addition to this, the Laboratory has done a certain amount of other work of practical utility which may be mentioned under the following heads :—

(1) Diagnosis of obscure diseases in men and animals; examination of pathological specimens; study of mosquitoes; investigation of food-stuffs, drinking-water, and of the atmospheric and subsoil air.

(2) Instruction in bacteriological work and research; facilities given to experienced investigators admitted to work at the Laboratory; supplying references, books, apparatus, bacteriological preparations and specimens to institutions and workers outside the Laboratory.

(3) Delivering lectures and publishing papers on the Laboratory's studies; and

(4) Giving expert opinion in reply to official and unofficial enquiries.

(1).—DIAGNOSIS OF DISEASES.

(*a*).—During the famine of 1900 the Laboratory investigated, by Government order contained in letter No. $\frac{39\ M.}{P}$ of 26th May 1900, the question of prevalence of relapsing fever in the Gujarát Famine Camps. A report on the matter was submitted to Government with this office No. 1084 of 6th July 1900.

(*b*).—Upon the request of the Inspector-General of Jails, Bombay Presidency and of the Superintendents of Jails, relapsing fever outbreaks were investigated in the Umerkhadi Common Prison, Bombay, in December 1899; in the Thána Special Prison, in December of same year (letter from Inspector-General of Prisons, No. 7867 of 9th December 1899), and specimens of blood were examined for relapsing fever during an outbreak in the Bijápur Jail in 1901 (letter from the Medical Officer of the Jail, No. 84 of 29th November 1901; this office report No. 2282 of 4th December 1901).

(*c*).—Specimens were examined microscopically and cultures made of the microbe of cerebrospinal meningitis, from material received from the Ahmedabad prison.

(*d*).—Apart from epidemic outbreaks, in a large number of individual cases the Laboratory officers examined specimens and gave advice to medical officers and private practitioners in connection with the diagnosis of obscure diseases in men and animals. Accurate figures cannot be quoted.

(*e*).—Examination of dog's brains for rabies and studies on the disease.

The Bombay Veterinary College forwarded suspected dogs' brains for examination on the following dates :

17th August 1901,
2nd September 1901,
3rd November 1901,
30th January 1902, and
21st March 1902.

That of 30th January 1902 was proved to contain the virus of hydrophobia; the brains, in the remaining cases, were infected by other microbes and the examination for hydrophobia was impossible, the rabbits inoculated succumbing a day or two after injection.

Studies on the virus of hydrophobia were carried out, for several months upon a special plan, in 1901, but had to be gradually abandoned, on account of the animals operated upon getting infected and succumbing rapidly, under the climatic conditions prevailing in Bombay, to other brain infections.

(*f*).—Anthrax suspected blood was examined for the Principal, Bombay Veterinary College, on his letter of 21st February 1902.

(*g*).—The first cases of epidemic dropsy observed in Bombay were diagnosed by Captain E. D. W. Greig, I. M. S., and reported to the Municipal Commissioner.

(*g*).—Examination of Mosquitoes.

A number of applications were received and complied with by the Laboratory for the examination of species of mosquitoes. This work was done mostly by Captain Liston, I. M. S., also by Captains Lamb and Greig, I. M. S., of this Laboratory. The assistance of Mr. E. H. Aitken, the well-known Bombay Naturalist, must also be acknowledged here.

(*h*).—Water and Food Examination.

(1) Under instructions from the Commissary-General, Bombay Command, Poona, the following officers sent tinned-meat for examination in the Laboratory:

Chief Commissariat Officer, Aden, with letter No. $\frac{SK\ 6}{1256}$ of 18th November 1899;

Chief Commissariat Officer, Karáchi, with letter No. $\frac{ST}{1351}$ of 15th November 1899; and

Commissariat Storekeeper-General, with letter No. $\frac{SK}{1502}$ of 17th November 1899, and subsequent.

A report on the above examinations was sent to the Commissariat Storekeeper-General, under No. 999 of 20th June 1900.

(2) Examination of food-stuffs from plague-infected shops in Patiala has been referred to above (February 1902).

(3) Water samples, apart from those referred to on preceding pages under "Cholera" and "Typhoid Fever", were examined for the Station Hospital, Deesa, in regard to the water-supply intended for the use of the officers of the Oxfordshire Light Infantry, upon letter of $\frac{15th}{17th}$ December 1901; for Plague Officer, Ambur; for the Ajmere Municipality; and others.

Advice on water examination was given to several Municipal Engineers, and directions for collecting and forwarding by rail of samples of water for Laboratory examination were drawn up and communicated to a number of correspondents, as well as sterilised vessels for collecting samples distributed among them.

(*i*).—Investigation of atmospheric and sub-soil air in Bombay was undertaken upon an application from the Chairman, Bombay City Improvement Trust, *vide* his letter dated 16th of May 1899, and was carried out by Dr. Taylor, working in this Laboratory. A report on this investigation was published by Government (Government of Bombay Resolution No. 1483 of 14th March 1901), and copies sent to the Government of India and departments concerned.

(2)

(a).—Teaching work and facilities for research given at the Laboratory.

In addition to those who came to study the inoculation work carried on at the Laboratory, the following scientists and medical officers were admitted for research, or for a course of practical study in bacteriology :—

Upon orders of the Government of India :—

Professor Axel Holst, Christiania, and with him Dr. Ustwedt, Sanitary Inspector, City of Christiania (letter No. 988 of 1st July 1901 from Secretary to Government of India, Home Department).

Upon orders from the Government of Bombay :—

Dr. T. G. Gloster (Bombay Government letter No. 4382—P of 5th November 1901). Worked at the Laboratory from 8th November 1901 to 17th January 1902.

Dr. J. Kerr Muir (Bombay Government Resolution No. 1038—P of 19th March 1902). Worked till 19th April 1902.

Dr. A. Foy (Government Resolution No. 1403—P of 21st April 1902). Worked till 10th July 1902.

Surgeon-Major Omar Chowki Effendi and Surgeon-Captain Nehad Reshed Effendi, Surgeons of the Ottoman Army (Bombay Government Resolutions No. 3608—P of 2nd September 1901 and No. 1075—P of 25th March 1902).

Upon the recommendation of the Surgeon-General with the Government of Bombay :—

Dr. (Miss) Alice Corthorn (letter from Surgeon-General, No. 8706 of 20th June 1898). Worked during June and July 1898.

Lieutenant Madock, I. M. S.

Lieutenant Hooton, I. M. S.

Upon the application of the Principal Medical Officer, New South Wales :—
Dr. Tidswell, Government Bacteriologist.

The following tutors of the Grant Medical College were admitted for study upon the application of the corresponding Professors of the College :—

Mr. Kalapesi, L.M. & S., upon the application from Major Childe, I. M. S., Professor of Pathology.

Mr. Banker, L.M. & S., application from Major Meyer, I. M. S., Professor of Medicine.

Mr. Bardi, L.M. & S., application from Major Collis Barry, Professor of Chemistry and Legal Medicine.

A prolonged course of work was done also at the Laboratory by Assistant Surgeon S. V. Kanthak, Superintendent of Vaccination, referred to already, and recommended by the Sanitary Commissioner, Bombay. This officer assisted very effectively in various branches of the Laboratory work.

The following applied on their own accord for work at the Laboratory and were received :—

Lieutenant-Colonel G. H. D. Gimlett, I. M. S. (his letter of 11th February 1902), who studied the anti-cholera inoculation *technique*.

Lieutenant-Colonel Wilkins, I. M. S., Special Medical Officer, Plague Operations, Bombay, and

Dr. Christie, on Hospital-visiting duty, Bombay.

(b).—Affording Facilities to workers outside the Laboratory.

Cultures of microbes, various Laboratory apparatus and cultivation media (some of special composition) were supplied to Dr. Calmette, Director, Pasteur Institute, Lille ; Captain Pridmore, I. M. S. ; the Sanitary Commissioner, United Provinces, Agra and Oudh ; Professor Terni, Messina ; the Colombo Pasteur Institute ; Dr. Dean, in charge of the Serum Department, Jenner Institute,

London; Lieutenant-Colonel Lyons, I. M. S.; Major Herbert, I. M. S.; Dr. Arthur Powell, Coroner's and Police Surgeon, Bombay; Civil Surgeon, Moradabad; Medical Officer in charge, Station Hospital, Umballa; Civil Surgeon, Dhárwár; Drs. Hahn and Duerck of the Munich University, recommended by a Government Resolution; Medical Storekeeper, Bombay Command; Civil Surgeon, Jhilam; Captain Bruce Barnett, R.A.M.C., Jubbulpore; the Royal Society's Malaria Commission in India; the Bombay Municipal Laboratory; the Superintendent of Vaccination, Bombay; Dr. (Miss) Corthorn, on Plague duty, Karáchi and Poona; the Purulia anti-cholera inoculation station, and to others.

Apparatus was got out from Home for equipping the Laboratory of the Port Health Office, Rangoon, in November 1901.

Books, and also reports embodying the results of our studies, were supplied to a large number of Medical Schools, Laboratories, Scientific Societies and Scientists in India and abroad.

(3)

(*a*).—The following publications were issued by the Laboratory and distributed to Medical Schools, Laboratories, Libraries, Scientists and Government and Medical Officers:—

Name of Author.	Title of Pamphlet or Report.	Date of publication.
W. M. Haffkine	"The Plague Prophylactic" (British Medical Journal and Indian Medical Gazette).	May and June 1897.
W. M. Haffkine and Surgeon-Major Lyons, Bombay.	Joint Report on the epidemic of plague in Lower Damaun and on the effect of preventive inoculation there. "Times of India" Press, Bombay; also "Indian Medical Gazette."	1st November 1897; January 1898.
W. M. Haffkine	The Protective Inoculation against Plague (a lecture in the Cantonment Magistrate's Office, Poona, Major-General Duncan in the chair). "Times of India" Press, Bombay.	3rd January 1898.
Do.	Experiment on the effect of protective inoculation in the epidemic of plague at Undhera, in February and March 1898. "Times of India" Press, Bombay.	April 1898.
Do.	Report on the preventive inoculations against plague in the Khoja Community of Bombay, during the epidemic of 1897-98.	10th May 1898.
W. B. Bannerman, M.D., Surgeon-Major, I. M. S.	"Experiments on Sulphur Dioxide as disinfectant for rooms."	1st September 1897.
E. L. Marsh, M.B., D.P.H. (Oxon.).	"Effect of Sulphur Dioxide on the Bacillus of Plague."	31st March 1898.
E. L. Marsh, M.B., D.P.H. (Oxon.), and Wilford Watkins Pitchford, M.B. (Lond.), F.R.C.S. (Eng.).	"Effect of Vaporised Carbolic Acid on the Bacillus of Plague."	7th June 1898.
Do. ...	"Further report on the action of compressed Sulphur Dioxide as a disinfectant."	30th June 1898.
Do. ...	"Nitric fumes as a disinfectant" ...	Do.
W. M. Haffkine ...	Covering letter to above five papers ...	Do.
E. L. Marsh, M.B., D.P.H. (Oxon.), S. M. O. attached to the Plague Research Laboratory.	Report on the efficiency of Perchloride of Mercury, in disinfecting solution, as application to cowdung floors, etc., Government Central Press, Bombay.	14th March 1899.
W. M. Haffkine	On preventive inoculation (Proceedings of the Royal Society, Volume 65). (Also "Lancet," June 1899.)	1899.

Name of Author.	Title of Pamphlet or Report.	Date of publication.
	Discussion on Mr. Haffkine's discourse on Preventive Inoculation at the Royal Society, British Medical Journal.	1st July 1899.
E. L. Marsh, M.B., D.P.H., Special Plague Medical Officer attached to the Plague Research Laboratory.	Report on the efficiency of Formaldehyde vapour for the disinfection of native dwellings, etc., Government Central Press, Bombay.	14th September 1899.
W. M. Haffkine	"On the Inoculation Statistics as reported from large towns." Appendix to the report of the Dhárwár Inoculation Investigation Committee. Separate reprint, Government Central Press, Bombay.	8th March 1900.
George Lamb, M.B. (Glasgow), Captain, I. M. S.	The occurrence of Mediterranean or Malta Fever in Bombay. Government Central Press, Bombay.	1900.
George Lamb, M.B. (Glasgow), Captain, I. M. S.	Typhoid Fever in the Natives of India: its diagnosis by means of sedimentation reaction. Government Central Press, Bombay.	1900.
W. M. Haffkine, Esq., C.I.E.	The present condition of manufacture of the plague prophylactic in the Plague Research Laboratory. Government Central Press, Bombay.	9th August 1900.
W. B. Bannerman, M.D., B.Sc., Major, I. M. S., Superintendent, Plague Research Laboratory, Bombay	Statistics of Inoculations with Haffkine's Anti-plague Vaccine, 1897—1900. Government Central Press, Bombay.	1900.
W. Hanna, M.A., M.B., R.U.I., D.P.H. (Cantab.), and George Lamb, M.B. (Glasgow), Captain, I.M.S.	A case of cobra poisoning treated with Calmette's anti-venom. "The Lancet."	5th January 1901.
W. M. Haffkine	"The Health of the Inoculated." "Times of India Press, Bombay."	29th June 1901.
George Lamb, M.B. Captain, I. M. S.	Some observations on Spirillum Fever as seen in the monkey (Macacus radiatus). "Scientific Memoirs by the Medical Officers of the Army of India," Part XII, Simla.	1901.
W. M. Haffkine	Appendix to General Burnett's Report on 4th September 1901. The Inoculation in the Poona Cantonment.	4th September 1901.
W. B. Bannerman, M.D., B.Sc., Major, I. M. S.	"Inoculation and the incubation stage of Plague." "British Medical Journal," 14th September 1901, also "Centralblatt fuer Bacteriologie," 24th June 1901.	
George Lamb, M.B. (Glasgow), Captain, I. M. S.	On the action of Snake Venom on the Coagulability of the Blood. "Indian Medical Gazette," Vol. XXXVI, No. 12, December 1901.	December 1901.
Do. ...	"Snake Venoms: their Physiological action and antidote," lecture delivered at Nagpur, January 4th, 1902. Central Jail Press, Nagpur.	January 1902.
Do. ...	"On the Etiology and Pathology of Scurvy." "Lancet."	4th January 1902.
Do. ...	Serum sedimentation with special reference to the diagnosis of Typhoid and Malta Fevers. Government Central Press, Bombay.	1902.
Do. ...	Typhoid Fever in the Natives of India: its diagnosis by means of the serum sedimentation reaction.	

Name of Author.	Title of Pamphlet or Report.	Date of publication.
George Lamb, M.B. (Glasgow), Captain, I. M. S.	"A further note on the occurrence of Typhoid Fever in the Natives of India." "Indian Medical Gazette," Vol. XXXVII, Feb. 1902.	February 1902.
George Lamb, M.B. (Glasgow), Captain, I.M.S., and W. Hanna, M.A., M.B., R.U.I., D.P.H. (Cantab.).	Some observations on the poison of Russell's Viper (*Daboia Russellii*). Journal of Pathology and Bacteriology, 1902, Vol. I.	
George Lamb, M.B. (Glasgow), Captain, I. M. S.	Standardisation of Calmette's anti-venomous serum with pure cobra venom: the deterioration of this serum through keeping in India. "Scientific Memoirs," New Series, No. I.	1902.
W. B. Bannerman, M.D., B.Sc., Major, I. M. S., Superintendent, Plague Research Laboratory, Bombay.	Description of the Plague Research Laboratory. Proceedings of the Royal Society of Edinburgh. Vol. XXIV, Part II.	1902.

(*b*).—*Lectures delivered by Laboratory Officers.*

On inoculation against the plague, by W. M. Haffkine, Poona, under the Chairmanship of Major-General Duncan, Commanding Poona District, on 3rd January 1898.

On preventive inoculation, by W. M. Haffkine. Delivered before the Royal Society, London, June 1899.

Lecture by Captain G. Lamb, on a Small Tumour removed from Scrotum, read before the Bombay Medical and Physical Society on 18th January 1901.

Lecture by Captain G. Lamb on Correspondence between Cholera and the Prevalence of Comma-shaped Bacteria in Well Waters of Gujarát, as observed during the Famine of 1900, read before the Bombay Medical and Physical Society on 18th January 1901.

The Plague Research Laboratory, delivered by Major Bannerman before the Royal Society, Edinburgh, 1901.

On the Health of the Inoculated, delivered under the Chairmanship of His Excellency the Governor of Bombay, by W. M. Haffkine in Poona on 29th June 1901.

Lectures by Captain G. Lamb: "On the Action of Snake Venom on the Coagulability of the Blood," "On Snake Venoms, their physiological action and Antidote," and "On the action of the Venom of the Cobra and of the Daboia on the red blood corpuscles and on the blood plasma," delivered on the 4th October 1901, and 21st January and 2nd May 1902, before the Bombay Medical and Physical Society and the Bombay Natural History Society.

Lectures delivered by Captain Lamb, M.D., I. M. S., at the Malaria Conference held at Nagpur in January 1902:

"Snake Venoms: their physiological action and Antidote";

"Serum diagnosis of Typhoid fever by sedimentation method"; and

"Romanowskey's Stain."

Lectures delivered by Captain Liston, M.D., B.Sc., I. M. S., at the same Conference:

"The basis for the classification of Indian Anopheles"; and

"How to collect and identify Anopheles."

(3).—EXPERT OPINION GIVEN IN REPLY TO OFFICIAL AND UN-OFFICIAL ENQUIRIES.

The duties and correspondence connected with this work formed a large part of the Laboratory's transactions. It is practically impossible to give a summary of this matter. Some of the replies necessitated prolonged enquiries, experiments in different directions, and researches in scientific publications and periodicals. The following recorded instances are taken from the subject of disinfection.

Letter to the Municipal Commissioner, Bombay, dated 15th October 1896, in reply to his enquiry on disinfection by sunlight.

On chemical and steam disinfection: Remarks made, on the invitation of the President, Plague Research Committee, upon certain papers ("Instructions to the people") sent for consideration by the Executive Health Officer, Bombay, dated 17th December 1896.

On steam sterilisers: Letter, dated 14th January 1897, in reply to the Municipal Commissioner's enquiry.

Remarks on the directions to Disinfecting officers issued by the Bombay Municipality: Letter, dated 14th January 1897, in reply to Executive Health Officer's enquiry.

On disinfection of Railway Carriages: Letter in reply to President, Plague Research Committee, dated Bombay, 26th April 1897.

Letter, in reply to Surgeon-General, No. 587 of 23rd September 1898, forwarding (1) Report on the experiments made in the Laboratory, by Dr. C. H. Cayley, upon the effect on the plague bacillus of 10 samples of disinfectants forwarded by the Executive Health Officer, Bombay, and submitted for test by Messrs. Kemp and Company, and (2) Report on the experiments made in the Laboratory, by Dr. E. L. Marsh, on the effect upon decomposition and upon the vitality of the plague bacillus of certain chemicals forwarded by the Surgeon-General and supplied by the Lowes Chemical Co., Limited., London.

Letter No. 1784 of 18th April 1899, in reply to the Municipal Commissioner, Bombay, on the experiments made by Captain Milne, I.M.S., of the Plague Research Laboratory, on the disinfecting power of the Atlas A Preservative Fluid.

Letter No. 213 of 30th/31st January 1900, in reply to the Director-General, Indian Medical Service, Calcutta, forwarding report on experiments made in the Plague Research Laboratory by Dr. G. Taylor on the Atlas A Disinfecting Fluid as regards its germicidal action on the plague bacillus, compared with solution of 1 in 1000 perchloride of mercury.

Letter No. 1344 of 27th August 1900, in reply to the Plague Commissioner, Bombay, and letter No. 2376 of 21st December 1900, in reply to Secretary to Government, Bombay, on the disinfection of native boots and shoes by formaldehyde gas.

Letter No. 1978 of 21st November 1900, in reply to Surgeon-General, Bombay, supplemented by letter No. 2026 of 23rd November 1900, on acid perchloride and other methods of disinfection to be used in plague.

Letter No. 1510 of 23rd August 1901, forwarding report by Dr. W. Hanna, and No. 212 of 12th February 1902, to Government of Bombay, *re* disinfection of native boots and shoes by formaldehyde vapour.

Letter No. 1525 of 26th August 1901, in reply to an enquiry by Government *re* disinfection of native houses by gaseous disinfectants and the extent to which formaldehyde gas can be applied in plague disinfection. And various others.

The Officers of the Plague Research Laboratory.

The officers who contributed the largest amount of initiative and labour in connection with the preparation of the plague prophylactic were the late Lieutenant-Colonel C. J. H. Warden, I. M. S., Drs. F. Maitland Gibson, A. Mayr and N. F. Surveyor, and Assistant Surgeons R. J. Kapadia and J. P. Pocha. The disinterested help given by Lieutenant-Colonel R. W. S. Lyons, I. M.S., then Professor of Medicine, Grant Medical College, Bombay, and Major H. Herbert, I. M. S., Professor of Opthalmalogy in the same College, must also be acknowledged here.

The names of the officers who contributed to other parts of the Laboratory's work have been given in the text above and are the following :—Major W. B. Bannerman, Captains C. J. R. Milne, G. Lamb, W. G. Liston, and E. D. W. Greig, I. M. S. ; Drs. C. H. Cayley, E. L. Marsh, W. W. Pitchford, Miss Alice Corthorn, William Hanna, C. Balfour Stewart, G. Taylor, and E. L. Hunt ; and Mr. Pansare.

The hard and devoted work of a number of subordinate officers must also be mentioned, amongst them especially that of Messrs. H. Blenman, Dattatrya Narayen Rege, Framji Rustomji Mistri, A. T. Martin, Ganesh Govind Subnis, and others.

W. M. HAFFKINE,

Director-in-Chief,

Plague Research Laboratory.

Bombay, 21st March 1903.