

Bulletin

Agricultural

Agricultural Research Institute, Pusa

Agricultural Implements and Machinery at Pusa
Part IV

Power Implements and Machinery

BY

G. S. HENDERSON, N.D.A., N.D.D.

Imperial Agriculturist, Pusa

AND

ARJUN SINGH, L.Ag

Assistant to the Imperial Agriculturist, Pusa



CALCUTTA: GOVERNMENT OF INDIA
CENTRAL PUBLICATION BRANCH
1929

Price As. 12 or 1s. 3d.

**Government of India Publications are obtainable from the
Government of India Central Publication Branch, 3,
Government Place, West, Calcutta, and from
the following Agents:—**

EUROPE.

**OFFICE OF THE HIGH COMMISSIONER FOR INDIA,
42, GROSVENOR GARDENS, LONDON, S.W. 1.
And at all Booksellers.**

INDIA AND CEYLON.

Provincial Book Depôts:

MADRAS:—Superintendent, Government Press, Mount Road, Madras.
BOMBAY:—Superintendent, Government Book Depôt, Town Hall, Bombay.
SIND:—Library attached to the Office of the Commissioner in Sind, Karachi.
BENGAL:—Benzal Secretariat Book Depôt, Writers' Buildings, Room No. 1, Ground Floor, Calcutta.
UNITED PROVINCES OF AGRA AND OUDH:—Superintendent of Government Press, United Provinces of Agra and Oudh, Allahabad.
PUNJAB:—Superintendent, Government Printing, Punjab, Lahore.
BURMA:—Superintendent, Government Printing, Burmah, Rangoon.
CENTRAL PROVINCES AND BHERAR:—Superintendent, Government Printing, Central Provinces, Nagpur.
ASSAM:—Superintendent, Assam Secretariat Press, Shillong.
BIHAR AND ORISSA:—Superintendent, Government Printing, Bihar and Orissa, P. O. Gularbagh, Patna.
COORG:—Office of the Chief Commissioner of Coorg, Bangalore.
NORTH-WEST FRONTIER PROVINCES:—Manager, Government Printing and Stationery, Peshawar.

Thacker, Spink & Co., Calcutta and Simla.
W. Newman & Co., Ltd., Calcutta.
B. Cambridge & Co., Calcutta.
S. K. Lahiri & Co., Calcutta.
The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta.
Butekworth & Co. (India), Ltd., Calcutta.
Raj M. C. Sarkar Bahadur & Sons, 90-2A, Harrison Road, Calcutta.
Standard Literature Company, Limited, Calcutta.
Association Press, Calcutta.
Chuckerjerry, Chatterjee & Co., Ltd., 13, College Square, Calcutta.
The Book Company, Calcutta.
James Murray & Co., Ltd., Government Place, Calcutta. (For Meteorological Publications only.)
Raj Ghoshdary & Co., 68/5, Anutosh Mukherji Road, Calcutta.
Scientific Publishing Co., 9, Talbulla Lane, Calcutta.
Chatterjee & Co., 204, Cornwallis Street, Calcutta.
R. C. Bask, Esq., Proprietor, Albert Library, Basoa.
Mitra Brothers, Rajshahi.
Higginbothams, Madras.
P. R. Ramu Iyer & Co., Madras.
Bochouse and Sons, Madras.
G. A. Natson & Co., Publishers, George Town, Madras.
Theosophical Publishing House, Adyar, Madras.
Bright & Co., Trivandrum.
The Booklover's Bazaar, Talakad, Trivandrum, South India.
P. M. Gopalakrishna Kona, Pudukmandapam, Madras.
Central Book Depôt, Madras.
Vijapur & Co., Viragastalam.
Thacker & Co., Ltd., Bombay.
D. B. Taraporevala Sons & Co., Bombay.
Sunder Pandurang, Bombay.
Ram Chandra Govind & Sons, Kalbadevi Road, Bombay.
N. M. Tripathi & Co., Booksellers, Princess Street, Kalbadevi Road, Bombay.
New & Secondhand Bookshop, Kalbadevi Road, Bombay.
Mrs. Radhabhai Atmaram Sagoon, Kalbadevi Road, Bombay.
A. E. Wheeler & Co., Allahabad, Calcutta and Bombay.
S. Govind & Co., Sandhurst Road, Girgaum, Bombay.
Proprietor, New Khatikhana, Poona.
The Manager, Oriental Book Supplying Agency, 15, Shukrawar, Poona City.
Rama Krishna Bros., Opposite Vishrambag, Poona City.
S. P. Bookstall, 21, Bndhiwar, Poona.
Mangaldas & Sons, Booksellers and Publishers, Bhaga Talao, Surat.
The Standard Book & Stationery Co., 32-33, Arbab Road, Peshawar.
B. B. Unnikar & Co., The Bharat Book Depôt, Dharwar.

The Standard Bookstall, Karachi, Quetta, Delhi, Murree and Pawalpindi.
The Karachi Book Depôt, Elphinstone Street, Camp, Karachi.
The English Bookstall, Karachi.
The Standard Bookstall, Quetta.
U. P. Mathotra & Co., Quetta.
J. P. & Sons, 43 K. L., Edwardes Road, Rawalpindi, Murree and Lahore.
The Standard Book Depôt, Lahore, Nainital, Mussoorie, Dalhousie, Ambala Cantonment and Delhi.
N. B. Mathur, Supdt., Nazir Kanun Hind Press, Allahabad.
The North India Christian Tract and Book Society, 18, Chive Road, Allahabad.
Ram Dyal Agarwala, 124, Katra, Allahabad.
The Indian Army Book Depot, Judd, Cawnpore.
The Indian Army Book Depot, Jullundur City.
Manager, Newal Khabre Press, Lucknow.
The Upper India Publishing House, Ltd., Literature Palace, Amnuddaula Park, Lucknow.
Rai Sahib M. Gulab Singh & Sons, Mufti-Am Press, Lahore and Allahabad.
Rama Krishna & Sons, Booksellers, Anarkali, Lahore.
Puri Brothers, Booksellers and Publishers, Katcheri Road, Lahore.
The Tilak School Bookshop, Lahore.
The Standard Bookstall, Lahore.
The Proprietor, Punjab Sanskrit Book Depôt, Saldmitha Street, Lahore.
The Insurance Publicity Co., Ltd., Lahore.
The Punjab Religious Book Society, Lahore.
Manager of the Imperial Book Depôt, 63, Chandrey Chowk Street, Delhi.
Pono Book Agency, New Delhi.
Oxford Book and Stationery Company, Delhi.
Supdt., American Baptist Mission Press, Rangoon.
The Modern Publishing House, Ltd., 20, Phayre Street, Rangoon.
Burma Book Club, Ltd., Rangoon.
Manager, The "Hitavada," Nagpur.
Bhisey Brothers, Booksellers and Stationers, Sitabdi, Nagpur.
S. C. Talukdar, Proprietor, Students & Co., Cooch Behar.
The Manager, Ceylon Observer, Colombo.
The Manager, The Indian Book Shop, Benares City.
The Srivillipattur Co-operative Trading Union, Ltd., Srivillipattur (S. P. I.).
Raghunath Prasad & Sons, Patna City.
The Students' Emporium, Patna.
K. L. Mathur & Bros., Guzri, Patna City.
Dandekar Brothers, Indore City.
Pantakaya Sahayak Sakshari Ltd., Baroda.
The Hyderabad Book Depôt, Chaderghat, Hyderabad (Deccan).
Thakur & Co., Amraoti.

(a) St

(b) M

(c) Ce

(d) E

d
re
Pr
d
al
ed
la
F.
ire
m,
re,
ed
dt,
ey
fio
di,
ch
ty,
d,
ra

TABLE OF CONTENTS

	PAGE
(a) Steam Cultivating Tackle.	1
(b) Motor Tractors	3
(c) Centrifugal Pumps	6
(d) Farm Steading Machinery	6

LIST OF ILLUSTRATIONS

PLATE	I.	Fowler's Steam Plough Engine.
"	II.	Plough for Steam Tackle.
"	III.	Cultivator for Steam Tackle.
"	IV.	Disc Harrow for Steam Tackle.
"	V.	Roller for Steam Tackle.
"	VI.	McCormick Deering Tractor.
"	VII.	Fordson Tractor and Disc Plough.
"	VIII, FIG. 1.	Roderic Lean Disc Harrow.
"	VIII, ,, 2.	Orwell Cultivator.
"	IX.	Portable Steam Engine.

m
st

N
w
v
C
b
h
o

AGRICULTURAL IMPLEMENTS AND MACHINERY AT PUSA, PART IV.

POWER IMPLEMENTS AND MACHINERY.

(Received for publication on 26th November 1928.)

Pusa is very advantageously situated for working tests with power machinery. The following are the chief branches which have been studied at this Institute :—

- (a) Steam Cultivating Tackle (Fowler's Double Engine).
- (b) Motor Tractors.
- (c) Centrifugal Pumps.
- (d) Farm Steading Machinery.

(a) Steam Cultivating Tackle.

(Plates I—V.)

The set consists of Fowler's class K, 2 Compound Single Cylinder 8 N. H. P. Steam Engines, each with a cable drum having 450 yards steel wire rope. An anti-balance plough No. 11152, one spring tine cultivator No. 10672, a two-shaft concave disc harrow No. 11525 and double Crosskill rollers.

It was introduced at Pusa in the cold weather of 1913, the object being to study the economics of steam cultivation for large estates in India and to deal with the labour difficulties which arise in the carrying out of intensive cultivation of a large area.

Results of the working of this set for ten years are as follows :—

AGRICULTURAL IMPLEMENTS AND MACHINERY, PART IV.

COST OF VARIOUS OPERATIONS WITH FLOWER'S STEAM TACKLE FOR 10 YEARS.

Year	Labour		Fuel		OH		Renewal of implements & stores		FLOUCCING				GREETING				DISC HARROWING				ROLLING									
	Rs.	Acres	Rs.	Acres	Rs.	Acres	Rs.	Acres	Total work per day	Acres	Rs.	per acre	Work per day	Acres	Rs.	per acre	Total work	Acres	Rs.	per acre	Work per day	Acres	Rs.	per acre	Total work	Acres	Rs.	per acre		
1817-18	940	1,424	315	3,410	6,006	170	7	9	616	26	4	821	20	3	173	22	4	121												
1818-19	984	1,656	482	1,004	5,136	373	8	4	608	21	1	606	17	2	540	21	1	145												
1819-20	1,200	1,623	623	1,136	5,652	405	8	3	488	22	2	562	21	2	633	23	2	180												
1820-21	1,450	2,140	588	1,764	5,942	445	8	6	480	22	2	633	18	3	585	25	2	181												
1821-22	1,243	1,622	412	1,783	5,660	242	8	6	601	21	2	442	17	3	285	21	2	114												
1822-23	1,278	1,494	483	2,137	5,362	373	8	6	507	21	2	470	17	3	334	23	2	112												
1823-24	1,317	1,819	486	611	4,233	374	7	5	494	20	2	535	14	2	128	24	1	120												
1824-25	974	1,498	410	1,048	3,930	359	10	5	320	18	2	324	14	3	106	20	2	87												
1825-26	1,368	1,781	350	3,552	7,681	394	8	8	238	24	3	512	20	3	530	26	3	108												
1826-27	1,152	1,490	217	1,648	4,527	438	10	5	208	23	2	513	18	3	410	27	2	98												
Rs.	11,856	16,517	4,396	18,202	50,971	3,573	82	59	4,626	220	23	5,438	176	27	3,485	232	21	1,157												
Average Rs.	1,186	1,652	440	1,820	5,097	357	8	6	462	22	2	544	18	3	349	23	2	116												

col
th
stiof
m
w
m
ofa
e
o
R
d
s
e
t
e

No depreciation or interest have been taken in working out these columns, but spare parts as required have been bought and charged for. The set is in excellent conditions and seems good for many years' work still.

The original costs were as follows :—

	Rs.
Engines with steam cables	30,000
Disc plough and gang plough	5,750
Disc harrow	3,025
Grubber	3,227
Zigzag harrow	2,255
Roller	670

There is no difficulty in keeping the set up to concert pitch by means of local labour. The steam engine with its large factor of safety is a much sounder practical proposition than a high speed motor tractor which requires continual repairs and expert attention. The implements worked with this set are shown in the illustrations. The whole of the farm area is deeply ploughed, over 10", once in the year.

(b) Motor Tractors.

(Plates VI, VII and VIII.)

The motor tractors at Pusa are chiefly used for secondary work such as cultivating and disc harrowing. They are also employed to a certain extent for belt work. The following statements show the actual life of three makes of standard motors as they are now practically worn out. Results show that their working is very expensive owing to the heavy depreciation. Great difficulty has always been experienced in getting spare parts in India. Much delay and damage has been caused and the machines have had to be laid up frequently during busy times. Other tractors are still on trial of which the International Harvesting Company's 15-30 H. P. size seems to be very promising. The price is Rs. 4,850; the agents are Messrs. Macbeth Bros., Bombay. (Plate VI.)

AGRICULTURAL IMPLEMENTS AND MACHINERY, PART IV.

STATEMENT SHOWING THE CONSUMPTION OF FUEL, LUBRICATING OIL, ETC., IN DIFFERENT MOTOR TRACTORS USED ON THE PUSA FARM FROM THEIR DATE OF PURCHASE TO THE END OF 1927

Name of Tractor	Kind of work done	Total number of hours worked	KEROSENE OIL		PETROL		LUBRICATING OIL		GREASE	WASTE	Total cost of spare parts.
			Total consumed	Per hour	Total consumed	Per hour	Total consumed	Per hour	Total	Total	
			Gallons	Gallons	Gallons	Gallons	Gallons	Gallons	Ibs.	Ibs.	Rs.
Fordson 1919-27	Cultivation	1,726	2,851	1.6	87	0.05	375	.21	70	40	2,058
	Bit pulley	503	417	0.8	60	0.12	68	.18	10	8	
Austin 1920-27	Cultivation	2,207	2,876	1.3	130	0.06	376	.17	82	50	2,476
	Bit pulley	816	585	0.7	85	0.11	76	.09	39	20	
Chitac 1921-27	Cultivation	1,246	2,006	1.6	113	0.09	336	.27	239	44	4,089

STATEMENT SHOWING SUMMARY OF WORK DONE BY THE DIFFERENT TRACTORS USED ON THE PUSA FARM FROM

STATEMENT SHOWING SUMMARY OF WORK DONE BY THE DIFFERENT TRACTORS USED ON THE PUSA FARM FROM THEIR DATE OF PURCHASE TO THE END OF 1927

Name of Tractor	PLOUGHING		DISC-HARROWING		GRUBBING		ROLLING		REAPING		DRILLING		PLANKING	
	Hrs.	Acres per hour	Hrs.	Acres per hour	Hrs.	Acres per hour	Hrs.	Acres per hour	Hrs.	Acres per hour	Hrs.	Acres per hour	Hrs.	Acres per hour
Forlorn	430	0.21	42	0.94	112	0.15	107	1.30	83	1.01	2	1		
Kosch	271	0.16	1,905	1.296	7.2	1.366	63	0.92	108	1.34	3	1	22	0.7
Deere	168	0.092	736	8.7	583	1.18	113	1.65	51	1.24			2	4

The implements used with the above machines are :—

Mould Board Plough	Oliver No. 7	2 furrow self lift.
Mould Board Plough	Ransomes' R. S. L. D.	2 furrow self lift.
Mould Board Plough	Ransomes' R. S. L. D.	3 furrow self lift.
Disc Plough	Oliver D. 43A.	3 furrow self lift.
Disc Plough	Oliver D. 42.	2 furrow self lift.
Cultivator	Ransomes' Orwell K. S. L., 11 tines, (Plate VIII, fig. 2.)	8 ft. 3 in. wide.
Disc Harrow	Roderic Lean. (Plate VIII, fig. 1.)	23 discs.

The 2-furrow ploughs were used with the Fordson and Austin Tractors and 3-furrows with Cletrac.

Among the ploughs, none have been found satisfactory. The Cultivator and Disc Harrow have been considered the most suitable implements for Pusa conditions.

(c) Centrifugal Pumps.

Any of the standard makes give satisfactory work especially when driven by a portable steam engine. In pumping from a river it is better to allow plenty of size in order to get all irrigation performed during day-light. One hundred and thirty acres are under irrigation here and are provided with a ten inch and an eight inch pump. Care should be taken to get low lift type pumps when the static head is under 30 ft.

POWER UNITS.

For general agricultural purposes there is nothing to beat Portable Steam Engines. They are almost fool-proof, simple to understand and easy to repair. A set suitable for general agricultural purposes is Ransomes, Sims & Jefferies' Single Cylinder Portable engine No. 8, 8 N. H. P., 10" cylinder, 12" stroke, working at 150 revolutions per minute, and when new, the steam pressure will be 120 lb., per square inch. Price, Rs. 5,000 (Plate IX).

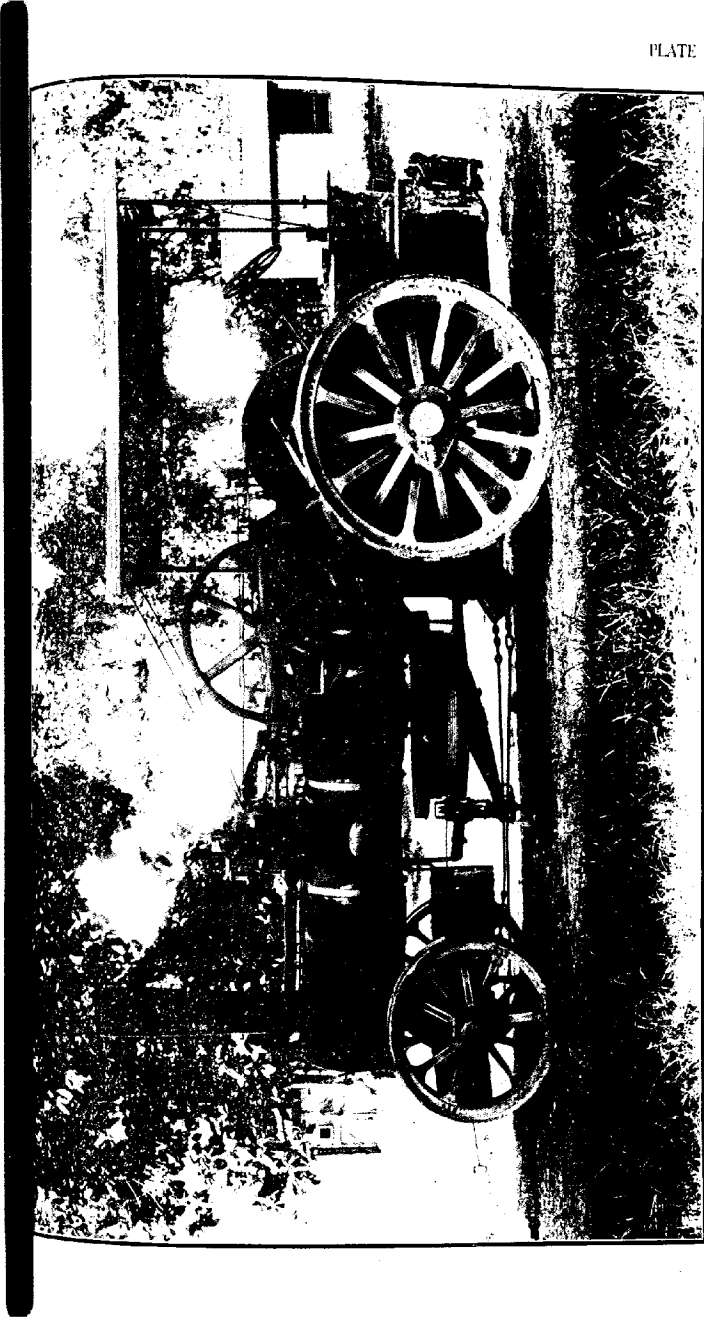
(d) Farm Steading Machinery.

It is useful to have an oil or other engine and a driving range of shafting at the farm steading. This can be used for grinding and chaff-cutting and also to drive workshop machinery. Where there is much

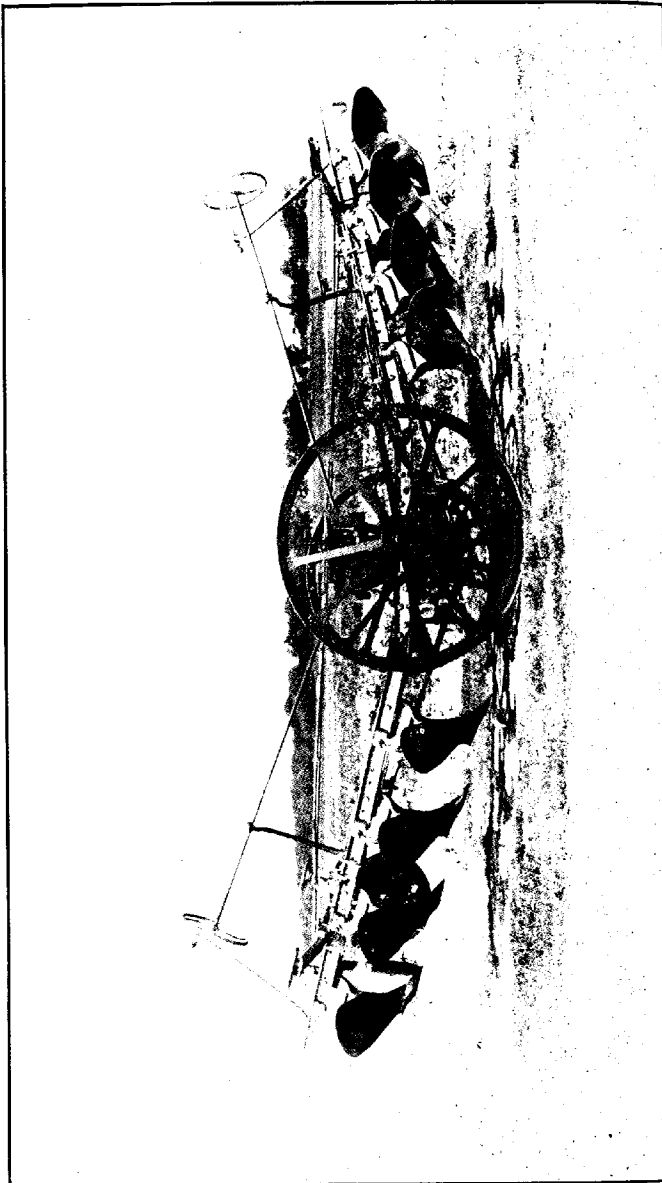
pc
be
su
ch
su
als
de

power machinery, a small workshop is essential. The workshop should be provided with a small lathe, a drilling machine and a grinder. A small circular saw is useful and a band-saw is a great economy for all classes of wood work. A small shop of this nature and having a blacksmith or two can deal with most classes of running repairs and should also be able to turn out small brass castings which are constantly in demand.





FOWLER'S STEAM PLOUGHING ENGINE.



PLUGH FOR STEAM TACKLE.

PLOUGH FOR STEAM TACKLE.

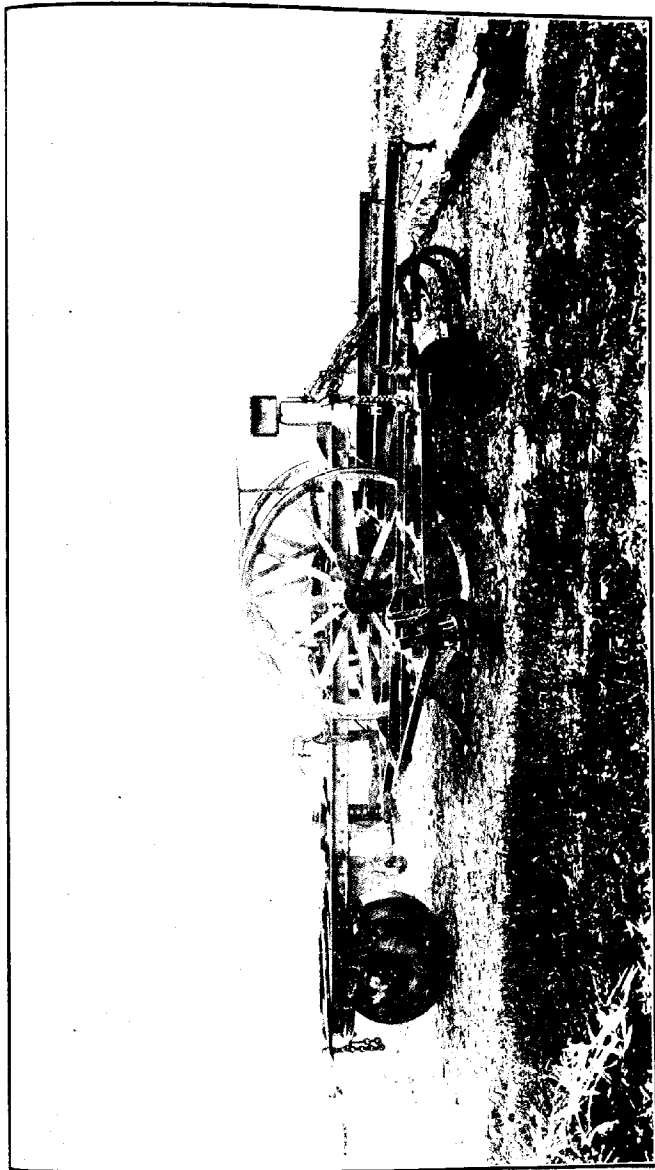
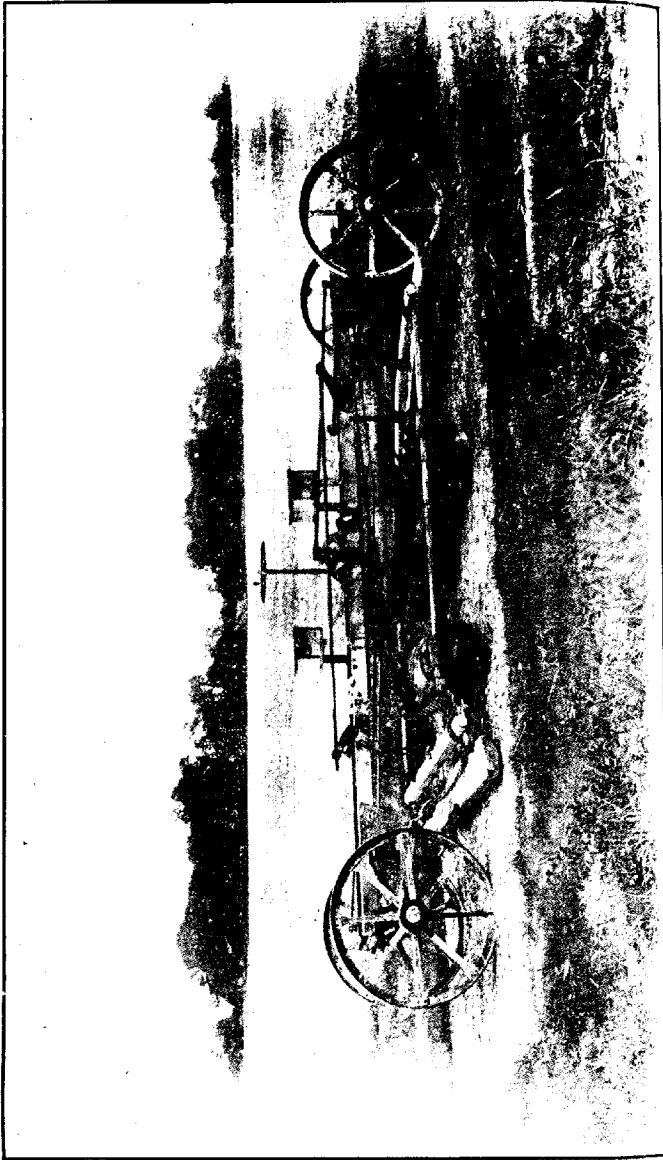


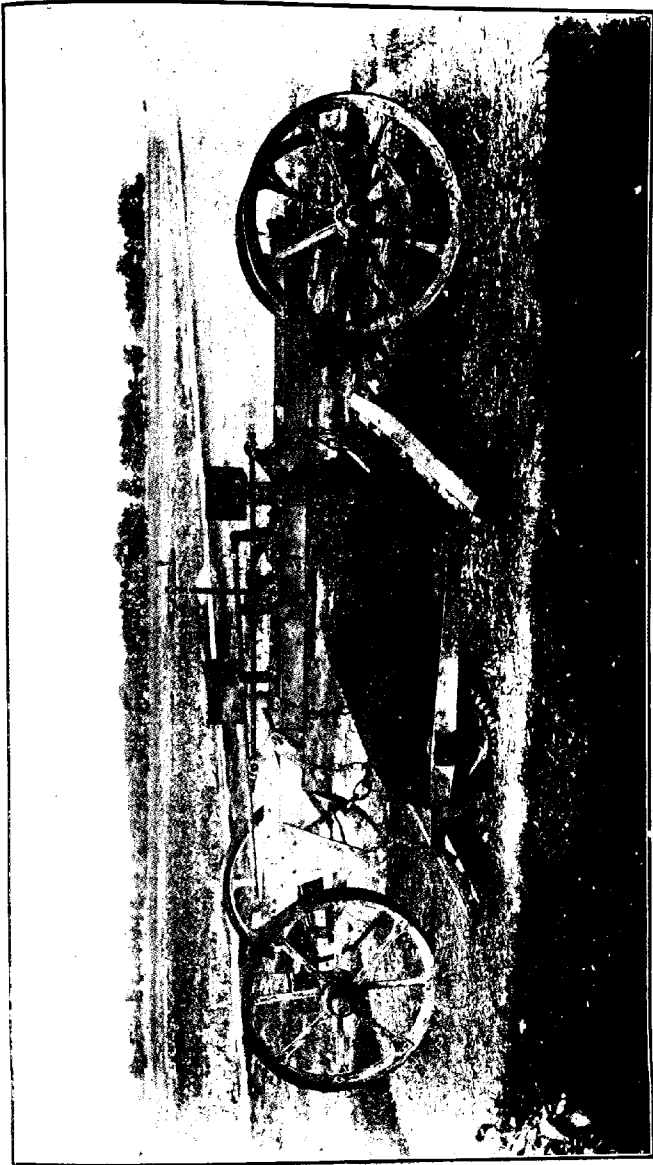
PLATE III.

CULTIVATOR FOR STEAM TACKLE.

PLATE IV.



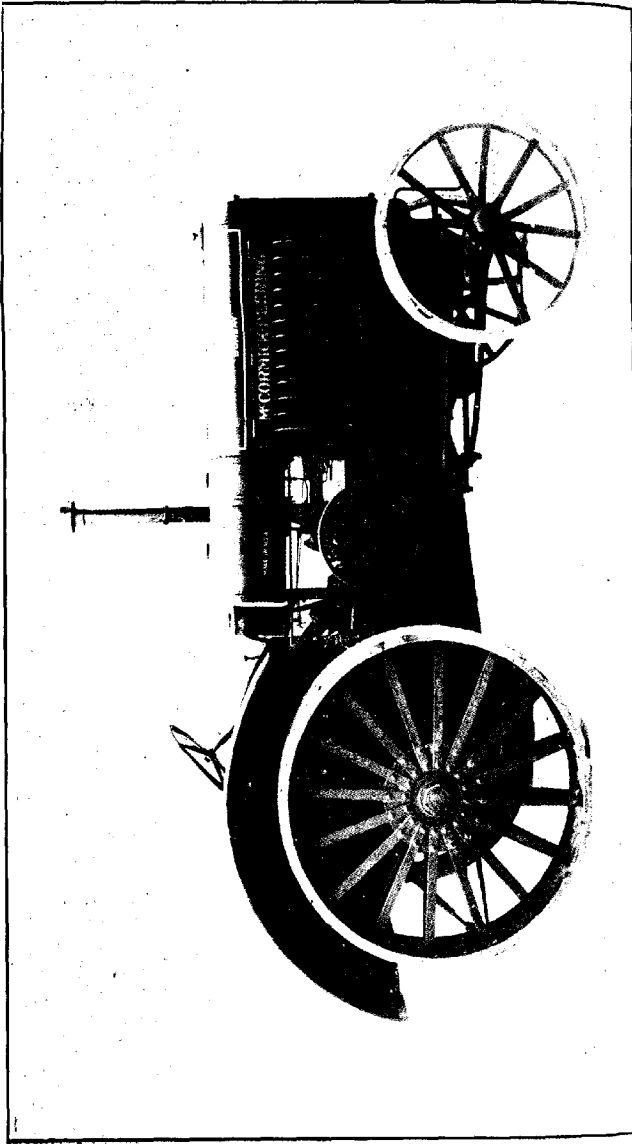
THE C. THOMPSON ENGINE WORKS, W. MASS.



ROLLER FOR STEAM TACKLE.

THE C. H. BARROW FOR STEAM TACKLE.

PLATE VI.



McCORMICK REAPING TRAY FOR

MCCURDY & CO. BOSTON, MASS. U.S.A.

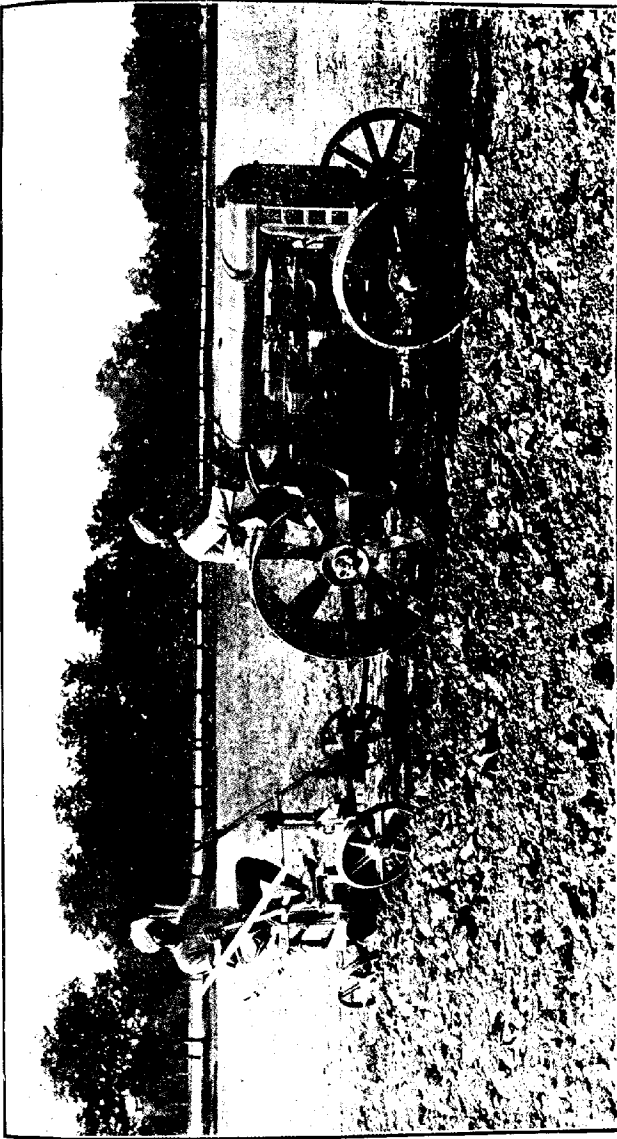
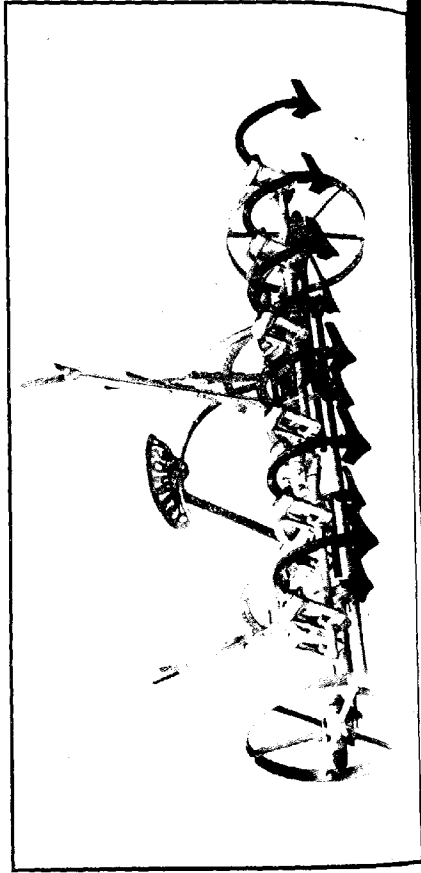


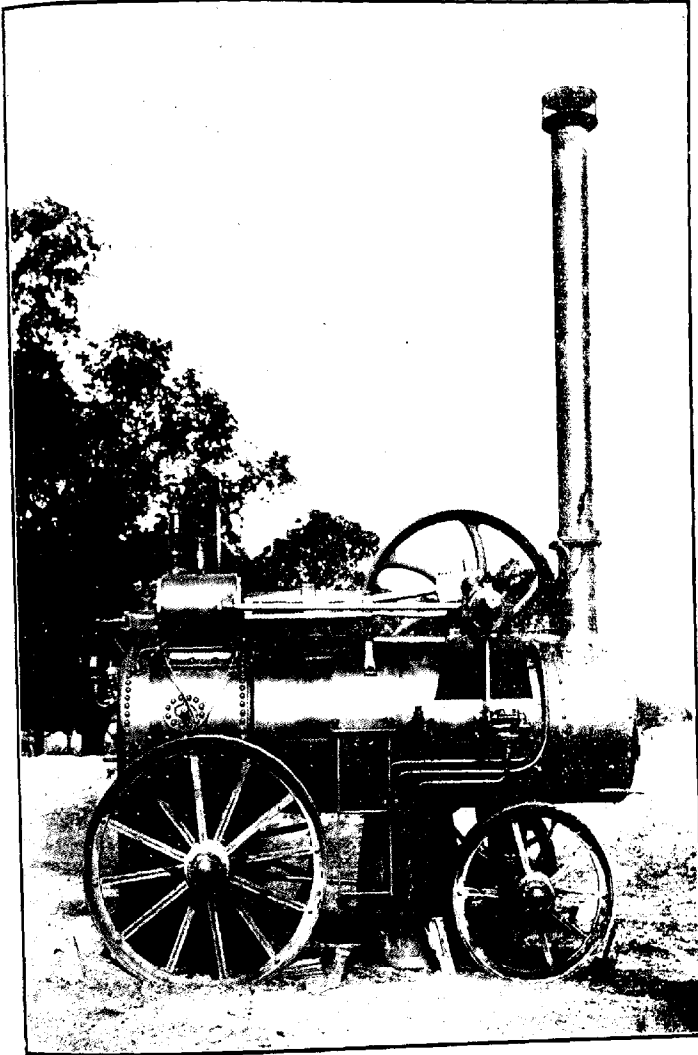
PLATE VII.

FORDSON TRACTOR AND DISC PLOUGH.



FIG. 1. Poderic Lean Disc Harrow.





PORTABLE STEAM ENGINE.

PUBLI

THE MANA
SEC

THE O

A comple
tained on ap

These public

1. The *Agric
economy
tion, in
ments, 1
promine
India, a
ed. incl*

2. The *Jour
dealing
and ethi
ment of*

3. Scientific

4. Review o

5. Proceedi

6. Proceedi

7. Memoirs

(a)

(b)

(c)

(d)

(e)

8. Bulletins

9. Books.

The fo

Scientific R

Dairy

Bureau

Scientific F

Dairy

Bureau

Review of

Review of

Proceeding

days ('

PUBLICATIONS OF THE IMPERIAL DEPARTMENT OF AGRICULTURE IN INDIA

TO BE HAD FROM

THE MANAGER, GOVERNMENT OF INDIA CENTRAL PUBLICATION BRANCH, IMPERIAL
SECRETARIAT BUILDING, 3, GOVERNMENT PLACE, WEST, CALCUTTA;

THE OFFICE OF THE AGRICULTURAL ADVISER TO THE GOVERNMENT OF
INDIA, PUSA, BIHAR;

AND

ALL AGENTS FOR SALE OF GOVERNMENT PUBLICATIONS.

A complete list of the publications of the Imperial Department of Agriculture in India can be obtained on application from the above-mentioned.

These publications are:—

1. *The Agricultural Journal of India*. A Journal dealing with subjects connected with agricultural economics, field and garden crops, economic plants and fruits, soils, manures, methods of cultivation, irrigation, climatic conditions, insect pests, fungus diseases, co-operative credit, farm implements, and other agricultural matters in India. Illustrations, including coloured plates, form a prominent feature of the Journal. It is edited by the Agricultural Adviser to the Government of India, and is issued once every two months or six times a year. *Annual subscription*, Rs. 6 or 9s. *Ed.* including postage. *Single copy* Rs. 1-8 or 2s.
2. *The Journal of the Central Bureau for Animal Husbandry and Dairying in India*. A quarterly dealing with cattle-breeding, dairying, cultivation and storage of fodder crops, animal nutrition, and other aspects of animal husbandry. It is edited by the Agricultural Adviser to the Government of India. *Annual subscription*, Rs. 2-8. *Single copy* As. 10
3. *Scientific Reports of the Agricultural Research Institute, Pusa*
4. *Review of Agricultural Operations in India.*
5. *Proceedings of the Board of Agriculture in India.*
6. *Proceedings of Sectional Meetings of the Board of Agriculture.*
7. *Memoirs of the Imperial Department of Agriculture in India.*
 - (a) Botanical Series.
 - (b) Chemical Series.
 - (c) Entomological Series.
 - (d) Bacteriological Series.
 - (e) Veterinary Series.
8. *Bulletins issued by the Agricultural Research Institute, Pusa.*
9. *Books.*

The following are the publications of the last two years:—

- Scientific Reports of the Agricultural Research Institute, Pusa* (including the Reports of the Imperial Dairy Expert, the Physiological Chemist, Government Sugarcane Expert, and Secretary, Sugar Bureau), for the year 1926-27. Price, Rs. 1-14 or 3s. 3d.
- Scientific Reports of the Agricultural Research Institute, Pusa* (including the Reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugarcane Expert, and Secretary, Sugar Bureau), for the year 1927-28. Price, Rs. 2-6 or 4s. 3d.
- Review of Agricultural Operations in India, 1925-26.* Price, Rs. 2-6 or 4s. 3d.
- Review of Agricultural Operations in India, 1926-27.* Price, Rs. 2 or 3s. 6d.
- Proceedings of the Board of Agriculture in India, held at Pusa on 7th December, 1925, and following days* (with appendices). Price, Rs. 1-14 or 3s. 3d.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA

Botanical Series

- Vol. XIV, No. IV. Studies in Gujarat Cottons, Part IV: Hybrids between Broach-desbi and Godari varieties of *Gossypium herbaceum*, by M. L. PATEL, M.A.G., and S. J. PATEL, B.A.G. Price, As. 14 or 1s. 6d.
- Vol. XIV, No. V. The Indigenous Cotton Types of Burma, by T. D. STOOK, B.Sc., D.I.C., A.R.C.S. Price, As. 9 or 10d.
- Vol. XIV, No. VI. A Study of *Fusaria* common to cotton plants and cotton soils in the Central Provinces, by JIWAN SINGH, M.Sc. Price, As. 5 or 6d.
- Vol. XIV, No. VII. The *Kolamba* Rice of the North Konkan and its Improvement by Selection, by R. K. BHIDE and S. G. BHALERAO, B.A.G. Price, Rs. 1-4 or 2s.
- Vol. XIV, No. VIII. *Pennisetum typhoides*: Studies on the Bajri Crop. I. The Morphology of *Pennisetum typhoides*, by S. V. GODBOLE, M.Sc., B.A.G. Price, As. 12 or 1s. 3d.
- Vol. XV, No. I. Studies in Khandesh Cotton, Part I, by S. H. PHAYAG, M.A.G. Price, Rs. 1-4 or 2s. 3d.
- Vol. XV, No. II. The Indian Types of *Lathyrus sativus* L. (Khesari, Lakh, Lang, Teora), by GABRIELLE L. C. HOWARD, M.A., and K. S. ABDUR RAHMAN KHAN. Price, Rs. 1-8 or 2s. 6d.
- Vol. XV, No. III. Fruit-Rot Disease of Cultivated Cucurbitaceae caused by *Phythium aphanidermatum* (Eds.) Fitz., by M. MITRA, M.Sc., F.L.S., and L. S. SUBRAMANIAM, F.L.S. Price, As. 6 or 8d.
- Vol. XV, No. IV. Colour Inheritance in Rice, by S. K. MITRA, M.Sc., Ph.D., and S. N. GUPTA M.A. P. M. GANGULI. Price, As. 6 or 8d.
- Vol. XV, No. V. *Asteria* spp. from India determined by DR. RUTH RYAN and *Meliola* spp. from India and one from Malay determined by Prof. F. L. STEVENS. Price, As. 4 or 5d.
- Vol. XV, No. VI. Studies on Rice in Sind, Part I, by K. I. THADANI, M.Sc., and H. V. DURGA DUTTA, B.Sc. Price, Rs. 1 or 1s. 9d.
- Vol. XV, No. VII. Variability in certain economic characters particularly in seed weight and weight of lint per seed in pure strains of Broach Deshi Cotton, by MAGANLAL L. PATEL, M.A.G., and HAROLD H. MANN, D.Sc. Price, As. 14 or 1s. 6d.
- Vol. XV, No. VIII. Studies in the Shedding of Mango Flowers and Fruits, Part I, by P. V. WAGLE, M.A.G. Price, As. 11 or 1s. 3d.
- Vol. XVI, No. I. Studies in the *Jowars* of Gujarat: I. The *Jowars* of the Surat District, by M. L. PATEL, M.A.G., and G. B. PATEL, B.A.G. Price, Rs. 1-6 or 2s. 3d.
- Vol. XVI, No. II. Studies in Indian Chillies. I: The Types of Capsicum, by F. J. F. SHAW, D.Sc., A.R.C.S., F.L.S., and KHAN SAHIB ABDUR RAHMAN KHAN. Price, Rs. 1-5 or 2s. 6d.
- Vol. XVI, No. III. Foot-rot and wilt of Antirrhinums caused by *Phytophthora pini* var. *antirrhini* n.v., by S. SUNDARARAMAN, M.A., and T. S. RAMAKRISHNAN, M.A. Price, Rs. 1 or 1s. 9d.
- Vol. XVI, No. IV. Further studies of Indian Grasses and Grass-lands, by W. BURNS, D.Sc. (Edin.), L. B. KULKARNI, M.A.G. (Dom.), and S. R. GODBOLE, B.Sc. (Dom.). Price, Rs. 1-4 or 2s. 3d.
- Vol. XVI, No. V. Studies of Sugarcane roots at different stages of growth, by RAO BHADRAT S. VENKATRAMAN, B.A., and R. THOMAS. Price, As. 13 or 1s. 6d.
- Vol. XVI, No. VI. Studies in Indian Pulses: I. Lentil (*Eryum lens* Linn.), by F. J. F. SHAW, D.Sc., A.R.C.S., F.L.S., and RAHMAT DAS BOSE, B.Sc. Price, Rs. 1-10 or 2s. 6d.
- Vol. XVI, No. VII. *Phythium aphanidermatum* (Eds.) Fitz. on *Opuntia Dillenii*, Haw., by T. S. RAMAKRISHNA AYYAR, M.A. Price, As. 8 or 10d.
- Vol. XVII, No. I. Non-dehiscence of anthers in Punjab American Cottons by TREVOR THORNTON, M.A. Price, As. 4 or 5d.
- Vol. XVII, No. II. Studies in the Wilt Disease of Cotton in the Bombay Kamatak, Series I, by G. S. KULKARNI, M.A.G., and B. B. MUNDKUR, M.A.; with an Introduction by DR. H. H. MANN. Price, As. 9 or 1s.

Chemical Series

- Vol. IX. No. III. Some Digestibility Trials on Indian Feeding Stuffs, II, by P. E. LANGER, M.A., D.Sc., A.I.C., and PANDIT LAL CHAND DHARMANI, Lag., B.Sc. (Ag.) Price, As. 19 or 1s.
- Vol. IX. No. IV. The Effect of Manuring a Crop on the Vegetative and Reproductive Capacity of the Seed, by B. VISWANATH, F.I.C., and M. SUBANARAYANA, B.Sc. Price, As. 14 or 1s. 6d.
- Vol. IX. No. V. Experiments on the Feeding of Sorghum silage and concentrate to Scindi calves by F. J. WARTH, M.Sc., and SHARI KANT MISRA. Price, As. 9 or 10d.

Vol. IX

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

Vol. I

No.

No.

No.

No.

No.

No.

Chemical Series—contd.

- Vol. IX, No. VI. Losses and gains of Nitrogen in an Indian Soil studied in relation to the seasonal composition of well waters, and the bearings of the results on the alleged deterioration of soil fertility, by HAROLD E. ANNETT, D.Sc., F.L.C., M.Sc., B.A.C., A. PADMANABHA AYYAR, B.A., and RAM NARAYAN KAVASTHI, M.Sc., B.Ag. Price, Rs. 2 or 3s. 6d.
- Vol. IX, No. VII. Some Digestibility Trials on Indian Feeding Stuffs, Part III: Some Punjab Hays, by P. E. LANDER, M.A., D.Sc., A.L.C., and PANDIT LAL CHAND DHARMANI, L.A.G., B.Sc. (Ag.). Price, As. 5 or 6d.
- Vol. IX, No. VIII. The determination of the Electrical Conductivity of the aqueous Extract of Soil as a rapid means of detecting its probable Fertility, by ASHUTOSH SEN, M.Sc. Price, As. 4 or 6d.
- Vol. X, No. I. Feeding Experiments at Karnal, by F. J. WARTH, M.Sc., and F. J. GOSWAMI, Price, As. 8 or 10d.
- Vol. X, No. II. Soils of the Punjab, by Dr. P. E. LANDER, M.A., D.Sc., A.L.C., DR. RAMJI NARAIN, D.Sc., and MERTA MORAND LAL, B.Sc., L.A.G. Price, Rs. 3-14 or 6s. 9d.

Entomological Series

- Vol. X, Nos. I. & II. Four New Indian Gall Midges, by Dr. E. P. FELT: The Citrus Psylla (*Diaphorina citri*, Kuw.), by M. AFZAL HUSAIN, M.Sc., M.A. Price, Re. 1-2 or 2s.
- Vol. X, No. III. Braconids of South India, by T. V. RAMAKRISHNA AYYAR, B.A., F.E.S., F.Z.S. Price, As. 14 or 1s. 3d.
- Vol. X, No. IV. Some New Indian Midges (Cepidæ), by E. PARLARD, B.A., F.E.S. Price, As. 8 or 8d.
- Vol. X, No. V. The use of Hydrocyanic Acid Gas for the Fumigation of American Cotton on import into India. Experiments on its lethal power for the Mexican Boll- weevil (*Anthonomus grandis*) and for the Grain-weevil (*Strophilus oryzae*); on the extent to which it is absorbed by Cotton and Jute respectively; and on a practical method for satisfactory fumigation on a large scale, by A. JAMES TURNER, M.A., B.Sc., and D. I. SEN, M.Sc., FUCH., M.Sc., with a Foreword by B. C. BURR, M.B.E., B.Sc. Price, Rs. 2 or 3s. 9d.
- Vol. X, No. VI. Studies on *Polydora poeyiella*, Saunders (Pink bollworm), in the Punjab, by SOHAN SINGH BHIRRA, M.Sc. Price, Re. 1-4 or 2s. 6d.
- Vol. X, No. VII. A Contribution to our knowledge of the Thysanoptera of India, by T. V. RAMAKRISHNA AYYAR, Ph.D., F.E.S., F.Z.S., Price, Re. 1-9 or 2s. 6d.
- Vol. XI, No. I. A List of the Generic Names used for Microlepidoptera, by T. BAINBRIDGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S. (*In the press.*)

Bacteriological Series

- Vol. II, No. II. A Bacterial Soft Rot of Garden Poppy, by C. S. RAM AYYAR, B.A. Price, As. 5 or 6d.
- Vol. II, No. III. Nitrification of Calcium Cyanamide in some Indian Soils, by J. H. WALTON, M.A., M.Sc. Price, As. 10 or 1s.

Veterinary Series

- Vol. IV, No. I. The Chemotherapy of Surra (*Trypanosoma evansi* Infections) of Horses and Cattle in India, by J. T. EDWARDS, D.Sc., M.R.C.V.S. Price, Rs. 4-2 or 5s.
- Vol. IV, No. II. Studies in Bovine Lymphangitis, by V. KRISHNACHARI AYYAR. Price, Re. 1-2 or 2s.
- Vol. IV, No. III. Trypanblues and certain dilute-aniline derivatives: their efficacy in the treatment of Dirofilariosis and other affections in the Central Provinces, by Major R. F. SPURLING, F.R.C.V.S., D.V.S.M., F.Z.S., I.V.S. Price, As. 3 or 4d.
- Vol. IV, No. IV. Nasal Granuloma in Cattle in Bihar and Orissa, by RAI SAHIB P. N. DAS, Price, As. 3 or 4d.

Bulletins issued by the Agricultural Research Institute, Pusa.

- No. 166. Sampling for Rice Yield in Bihar and Orissa, by J. A. HUBBACK, F.O.S. Price, As. 7 or 9d.
- No. 167. A Scheme of Classification of the Varieties of Rice Found in Burma, by R. A. BEALE, Price, As. 6 or 8d.
- No. 168. List of Publications on Indian Entomology, 1926 (compiled by the Offg. Imperial Entomologist and the Imperial Entomologist). Price, As. 10 or 1s.
- No. 169. The Stem-bleeding Disease of Aracanut (*Arca cateska*) caused by *Thielaviopsis paradoxa* Von Hon., by S. SUNDARARAMAN, M.A., C. KRISHNAN NAYAR and T. S. RAMAKRISHNAN, M.A. Price, As. 9 or 1s.
- No. 170. Seasonal Variations in the Germ Content of Milk at Pusa, by J. H. WALTON, M.A., M.Sc. Price, As. 6 or 8d.

Bulletins issued by the Agricultural Research Institute, Pusa—*contd.*

- No. 171. The Improvement of Indian Wheat. A Brief Summary of the Investigations carried out at Pusa from 1905 to 1924, including an account of the new Pusa Hybrids, by ALBERT HOWARD, O.F.E., M.A., and GABRIELLE L. C. HOWARD, M.A. Price, As. 8 or 10d.
- No. 172. The Mechanical Analysis of Tropical Soils, by J. CHARLTON, M.Sc., F.L.C. Price, As. 3 or 4d.
- No. 173. Occurrence of Trichomonad Flagellates in the blood stream of Fowls, by HUGH COOPER, M.R.C.V.S., and AMAR NATH GULATI, M.Sc. Price, As. 3 or 4d.
- No. 174. Unit System for Farm Buildings, by G. S. HENDERSON, N.D.A., N.D.D. Price, As. 5 or 6d.
- No. 175. A Comparative Study of the methods of preparation of the Soil for the Mechanical Analysis, with a Note on the Pipette Method, by AMAR NATH PURI, Ph.D., and B. M. ANTI, B.A. Price, As. 4 or 5d.
- No. 176. A Method of increasing the Manurial Value of *Mahua* Cake, by N. D. VYAS, L.A.G. Price, As. 4 or 6d.
- No. 177. Root-rot and Sclerotial Diseases of Wheat, by L. S. SUBRAMANIAM, F.L.S. Price, As. 4 or 5d.
- No. 178. A Study of the Locular Composition in Cambodia Cotton, by V. RAMANATHAN, L.A.G. Price, As. 7 or 9d.
- No. 179. A Leaf Spot and Blight Disease of Onions, caused by *Alternaria palandui* nov. sp., by C. RANGASWAMI AYYANGAR. Price, As. 6 or 8d.
- No. 180. Stem-rot of Berseem, caused by *Rhizoctonia Solani* Kühn, by M.D. TAREM, Price, As. 8 or 9d.
- No. 181. Life History, Bionomics and Control of *Myllocerus maculosus*, Desb. (Curculionidae: Coleoptera), by KIDAR NATH TRIHAN, M.Sc. Price, As. 14 or 14.6d.
- No. 182. Investigations in the Bacteriology of Silage (1926-27), by J. H. WALTON, M.A., M.Sc. Price, As. 5 or 6d.
- No. 183. A Milk Fermenting Yeast, by C. S. RAM AYYAR, B.A. Price, As. 5 or 6d.
- No. 184. List of Publications on Indian Entomology, 1927. (Compiled by the Imperial Entomologist.) Price, As. 6 or 9d.
- No. 185. The Cultivation of Lac in the plains of India, *Laccifera lacca*, Kerr., by C. S. MISRA, B.A. (Revised Edition.) Price, Rs. 1 or 6s. 9d.
- No. 186. A Preliminary Note on the Rice crop in the United Provinces, by R. L. SETHI. Price, As. 7 or 9d.
- No. 187. The Production of Cigarette Tobacco by Flue-Curing, by F. J. F. SHAW, D.Sc., A.R.C.S., F.L.S., and KASHI RAM. Price, Rs. 1 or 1s. 9d.
- No. 188. Designs for Farm Buildings, by G. S. HENDERSON, N.D.A., N.D.D. Price, As. 6 or 8d.
- No. 189. The Improvement of Dharwar-American Cotton by Hybridization, by R. K. KULKARNI, B.A., and T. R. KHADILKAR, B.A.G. Price, Rs. 2-2 or 4s.
- No. 190. Description of a New species, *Dipylidium catus* n. sp., with a Note on the Genus *Dipylidium* Leuckart, 1863, by AMAR NATH GULATI, M.Sc. Price, As. 6 or 8d.
- No. 191. Agricultural Implements and Machinery at Pusa, Part I: Cultivation Implements and Machinery, by G. S. HENDERSON, N.D.A., N.D.D., and ARJUN SINGH, L.A.G. Price As. 12 or 1s. 3d.
- No. 192. Agricultural Implements and Machinery at Pusa, Part II: Harvesting and Threshing Implements and Machinery, by G. S. HENDERSON, N.D.A., N.D.D., and ARJUN SINGH, L.A.G. Price, As. 6 or 8d.
- No. 193. Agricultural Implements and Machinery at Pusa, Part III: Special and Miscellaneous Implements and Machinery, by G. S. HENDERSON, N.D.A., N.D.D., and ARJUN SINGH, L.A.G. Price, As. 9 or 1s.
- No. 194. Agricultural Implements and Machinery at Pusa, Part IV: Power Implements and Machinery, by G. S. HENDERSON, N.D.A., N.D.D., and ARJUN SINGH, L.A.G. Price As. 12 or 1s. 3d.

Books

- Wheat in India, by ALBERT HOWARD, M.A., A.R.C.S., F.L.S., and GABRIELLE L. C. HOWARD, M.A. Price, Rs. 5 or 7s. 6d.
- A Description of the Imperial Bacteriological Laboratory, MUMBAI; Its Work and Products, by MAJOR J. D. E. HOLMES, M.A., D.Sc., M.R.C.V.S. Price, As. 8 or 9d. Hindi and Urdu Editions, Rs. 2-4 each.
- Agriculture in India, by JAMES MACKENNA, M.A., L.C.S. Price, As. 4 or 5d.
- Some Diseases of Cattle in India. A Handbook for Stock-owners. (Revised in 1927.) Price, Rs. 1-4 or 2s.
- Report on the Diseases of Silkworms in India, by A. PRINGLE JAMESON, D.Sc. Price, Rs. 3.
- The Importance of Bacterial Action in Indigo Manufacture, by C. M. HUTCHINSON, B.A. Price As. 2.

Notice

All new publications are included in the above list and are regularly posted to all on the mailing list as soon as issued. Unless complaints of non-receipt of any publication are received by the Manager, Government of India Central Publication Branch, Imperial Secretariat Building, 3, Government Place, West, Calcutta, within six months of the date of issue, duplicate copies can be supplied only on payment of cost and postage.

d out
BEEF

or 4d.
OFFER,

or 6d.
Ana-
AMIN,

L Ag.

or 5d.
L Ag.

D. by

or 4d.
nika :

M. So.

DMOIC-

A, B.A.

, Aa. 7

.R.C.S.,

KARNI,

Nidus

ts and
Aa. 12

reshing
SINGH,

aneous
SINGH,

fachin-
or 1a.

Price,

cts, by
d Urdu

Re. 1-4

e Aa. 2.

mailing
e Mana-
rument
ed only