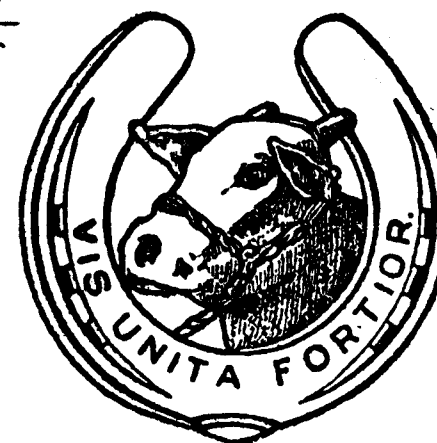


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(The Journal of the All-India Veterinary Association)

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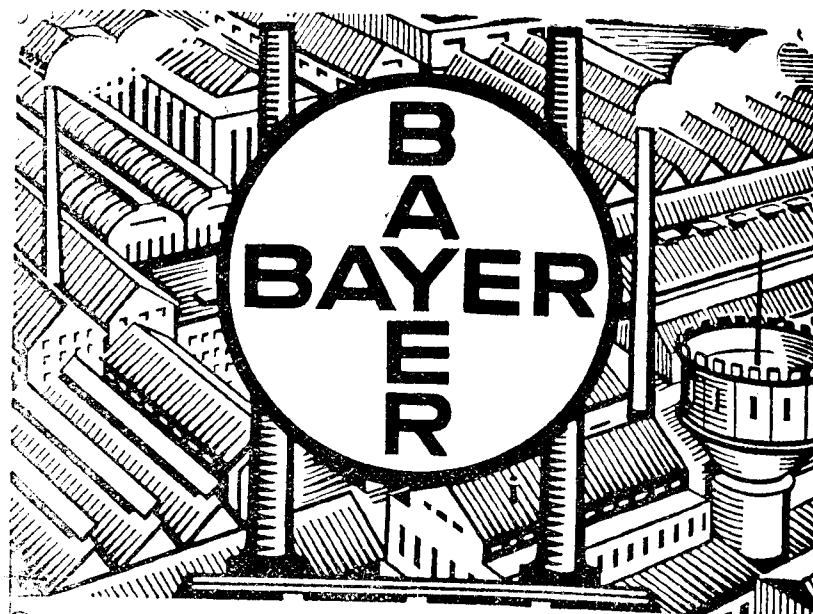
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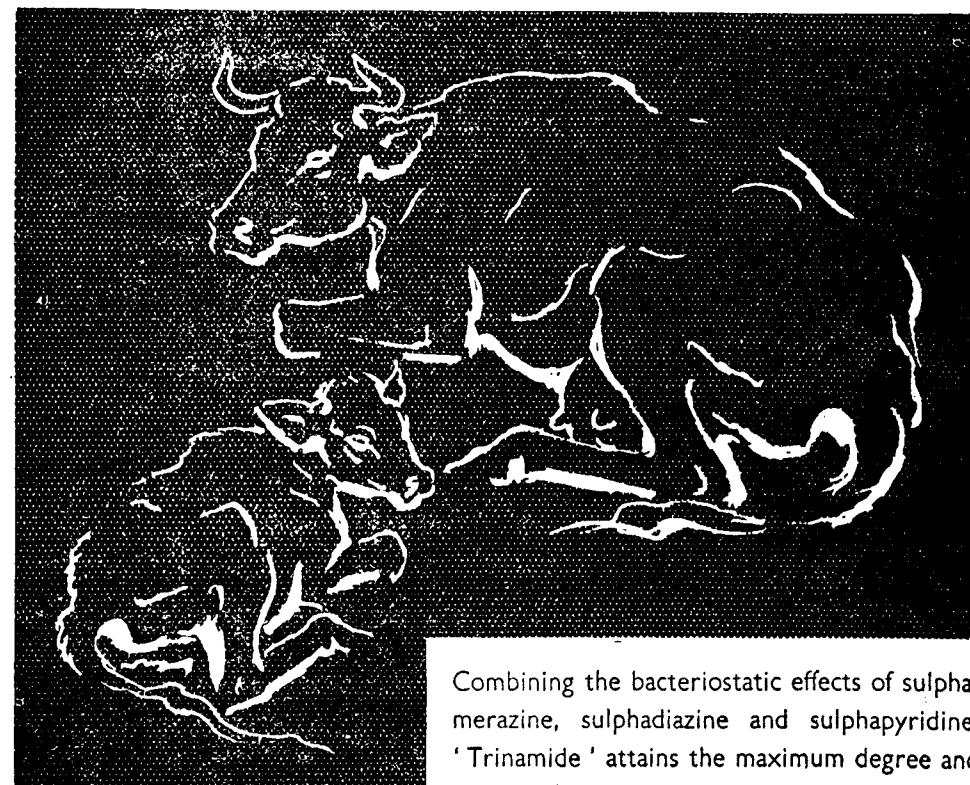
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Vol. XXXII

NOVEMBER, 1955

No. 3

CONTENTS

	PAGE
I. Editorial	
Re-orientation	163
Veterinarians and Livestock	166
Sinews of public administration	168
II. Original Articles	
The Anatomy of the foetal Indian Elephants—Part II The muscles, nerves and blood vessels of the fore-limb.—By D. Mariappa	170
Bovine Haematuria in Darjeeling District and its treatment.—By S. N. Nandi	202
III. General Articles	
Studies of some effects of Thyroprotein on growing chickens.—By Arcadio C. Gonzaga, and Rufino N. Nandadiego	207
Co-operative Extension Work in U. S. A.—By G. C. Juneja	218
An Investigation on Contagious Coryza in ducks in West Bengal.—By S. N. Nandi	225
Some observations on ovarian activity—Cornual pregnancy and sex ratio in the Indian Buffalo (<i>Bos Bubalis</i>).—By S. Damodaran	227
IV. Clinical Articles	
A Case of true Hermaphroditism in a goat.—By M. N. Jamdar	230
Occurrence of <i>Setaria Cervi</i> in the liver of cattle.—By T. Vasudev	233
V. I. C. A. R. Farm News Release	
Growing Mesquite—Good for Arid and Barren Lands	234
Poultry Diseases.—Early protection advised	234
Velvet Beans.—A new green fodder	234
Farm fillers	235
Groundnut Haulms.—A Good fodder	235
Perennial fodders.—Way to get better yield	235
Farm fillers	236
VI. Association News	
Madhya Pradesh Veterinary Association—Proceedings of the meeting held on 8th April 1955	236
VII. Extract	
Veterinarians are important to Agriculture in U. S.	237
VIII. Correspondence	
The place of sterilisation in mass vaccinations	239
The Interim Indian Veterinary Council	239
IX. Obituary	
Prof. D. H. Udall	239

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Editorial

RE-ORIENTATION

It does not require much effort to realise that changes all over the world in all fields of human activities in recent years, have been really phenomenal. India is no exception to these changes and they are particularly more marked after she has attained her independence.

Confining ourselves to the Veterinary Profession, we feel that no other department of the Government had undergone such tremendous changes as the old Civil Veterinary Department of the several States. The metamorphosis is so complete that its original identity is almost lost. Its basic education for the new entrants is changed; its professional course of studies is extended and much enlarged; its work is not now confined to control of contagious diseases alone but includes the vaster field of livestock development; several livestock farms have come into existence with their specialised nature of work; the extension work in the districts in way of mass development of livestock is so engrossing that it leaves little time to attend to other items of work; research has advanced in several fields and there is still greater urge in this direction; dairying is demanding the utmost attention of the profession; training of several grades of workers for the department is another big item of work; specialisation in different branches of science, though slow, is yet becoming more and more common; the need for a Veterinary Public Health service is fast asserting itself and with increase in the monetary value of livestock and their products, the public are more prone to appreciate the worth and importance of an efficient

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Veterinary Service. Such and more are the changes that have been brought about in the Veterinary profession within a space of barely five decades or so. These changes are still on the onward march and we therefore submit to the consideration of the profession and to all those concerned at Governmental level, that there ought to be a complete re-orientation of policy and programme, of methods and means, of efforts and enterprise to keep pace with such kalidoscopic changes. This is absolutely necessary if the profession is to live and if the nation is to improve.

Re-organisation of the existing machinery to suit the changed conditions, seems to be the need of the hour. But we realise the greatest impediment is the lack of required personnel. Even so, let the profession properly husband and suitably canalise all the available staff and plan for expansion on an approved pattern. It is this lack of appreciation of providing for the future on a planned basis that has led to the present acute shortage of Veterinary personnel. The profession was crying itself hoarse in the past to take steps to produce more and more Veterinary Surgeons. But it was the proverbial cry in the wilderness. It is only now that steps are afoot to open a few more Veterinary Colleges.

Several legitimate spheres of work of the Veterinary profession were allowed to be looked after by other departments, on the plea of lack of personnel. But the discerning public are not slow to note the difference between chalk and cheese. And there is a growing demand in the land, to entrust all aspects of livestock work to the Veterinary profession. The profession is therefore faced to-day with an ever increasing sphere of its highly responsible work. It is for the profession to stand up and face the situation boldly and well. In doing so, the profession needs specialists in the several branches of its work. Be it remembered that these are days of specialisation and nobody is more fitted for all such highly specialised livestock work than the Veterinarian, with his basic knowledge of animal anatomy, physiology, pathology, bacteriology, parasitology and hygiene. So let the profession branch out and specialise in dairying, in meat and milk

inspection, in sheep and wool industry, in poultry industry, in fundamental research, in genetics, in preventive medicine and all the rest of it. Then the field will be wide enough to select suitable personnel from for highly specialised work. It will then lead to high efficiency in every branch of our professional work and none can say with impunity that we are trying to pass the counterfeit for the genuine. Towards this specialisation the Government should plan and send out year after year for training suitable men to whichever place it is found necessary. With such increased responsibilities, it is but meet that the Government should re-orientate their conception of adequate wages.

Similarly young and purposeful men should cast off the old idea of not finding a living outside Government service; they should begin to think in terms of private practice in big Cities and towns and even in central rural areas. With the increase in the value of livestock and their products, and the growing love of animals at all levels of society and the interest evinced more and more by people in general in livestock farming, the scope for private practice is also rapidly on the increase. The shortage of good Veterinary practitioners is often felt in some of the cities and towns. The profession should come out to fill in this gap also.

It is this re-orientation of our work under the present changed conditions and requirements more particularly with regard to our education, specialisation, organisation, allocation and administration, that seems to us to be urgent, if the maximum benefit is to accrue both to the profession and the country. If this re-orientation is not effected in good time, we are afraid the profession would suffer a serious set back.

We therefore appeal to all those who are at the helm of affairs in different states to ponder over this matter in greater detail and take necessary steps.

VETERINARIANS AND LIVESTOCK

It is surprising how a few disgruntled people could keep alive from time to time, a thorny question that had been settled after careful consideration by the Government with the advice and guidance of a host of Experts on the subject. We refer to the question as to who is best suited for livestock work! We consider such men as anti-social elements who work against national progress.

The nicety of the pudding is in the eating. The practical work in the field in recent years in the matter of livestock development should leave no one in doubt as to who is best suited for this work. Then why keep on arguing? Then why allow this ugly mischief to raise its head from time to time? The Government should put down such tendentious attempts with a firm hand, if for nothing else at least in the interest of quiet and undisturbed work.

Let the world hear what Sir Thomas Dalling, Chief of the Animal Production Division of the F.A.O., has to say on the matter. Speaking at a Seminar on Veterinary Education at Bombay recently, he said:—"In many parts of the world it is freely acknowledged that it is to the Veterinary profession that we must look for activities towards increased livestock production. Gone are the days when the Veterinarian was expected and even commanded to confine his work to the treatment of sick animals. Our work must concern livestock production in all its phases, for every requirement of the animal is based on an accurate knowledge of the many factors associated with animal life and animal management, in other words, animal husbandry. India with its vast number of livestock and its need for these animals, has already shown a lead, as have some other few countries, on the necessity to centralise this vast subject in all its branches and aspects in the hands of specially trained personnel, viz. Veterinarians.

We Veterinarians have already accepted this responsibility and have pledged ourselves to so educate our young men

and women along lines which will increase their fitness to deal with this vast and entire subject. We are concerned to a marked extent with livestock health for we realise fully that maximum yields and results can be obtained only from the healthy animal; we are also concerned with the nutrition of livestock for we are fully conscious that faulty feeding may lead to ill-health and further that appropriate diets are required for any agreed state of production; we are also concerned with the breeding of animals for we know, from experience that increased animal production must rely, in part, on the breeding of the type of animal best suited for the purpose for which it is required and that healthy breeding is essential for satisfactory results.

Our object in convening this meeting and in bringing together veterinarians with experience of methods and subjects of veterinary education to discuss with the delegations present here, is to compare notes and ideas on veterinary education in order that some conclusions may be reached on what is best for this part of the world. As new responsibilities fall on the Veterinarian and as new techniques are evolved concerning the welfare and health of livestock, so must our teaching cope with these situations and vary accordingly.

The extensive plans which have been and are being made in this country for increased livestock production and for the part to be played by Veterinarians in their implementation, demand a supply of veterinary personnel trained along lines which will fit them to undertake and efficiently to carry out those duties. During the next few days, it is anticipated that, free and frank discussions will take place on the details of veterinary teaching in general and on the specific subjects in particular. It may be that differences of opinion will be expressed, that all cannot think alike. It is our earnest hope and desire, and in this I am satisfied we will succeed to arrive at conclusions which will be acceptable to all concerned and which will make for a thorough education of the coming veterinarians along lines which will go far to assist this extensive country and, incidentally, other countries, in extending its vital livestock production. FAO is intensely interested in this Seminar, the result of which will

assist us in planning future meetings on similar subjects in other parts of the world."

We also publish elsewhere an article that had appeared in a Bombay paper on this subject. Evidently it is from the pen of a lay-man who has seen the Veterinarians at work. Our prayer therefore is, let us bury the hatchet. Let not this subject be the bone of contention any more.

SINEWS OF PUBLIC ADMINISTRATION

Under the above caption, Mr. C. D. Deshmukh, Finance Minister, Government of India, gave utterance to a thoughtful address at the Institute of Public Administration, Patna University, recently. It is more than of passing interest and deserves the careful consideration of all, who have the purity and efficiency of the administration of the land at heart. We therefore make no apologies for extracting at some length some of his out-spoken statements. It would be seen that several ideas given expression to in our editorial on 'Re-orientation' are also touched upon by him with greater vehemence. Here is what he says:

"A public servant must have a soul. There must be a lively appreciation of duties and responsibilities and *the mental attitude to stall important measures—the attitude to resist any change—must go*".

"Attainment of independence", Mr. Deshmukh said "gave an altogether new content to the role of public administrators. Previously the country was mostly ruled by foreign administrators though there was some Indianisation of the public services. After freedom foreign administrators went away and there was a general watering down of efficiency due to accelerated promotions. The bureaucracy was subordinated to the chosen representatives of the people. Thus a complete change was brought about in the control exercised over public administration. There was devolution of authority. *This state of affairs necessitated a review of the whole situation.* The qualitative difficulties were there due to accelerated promotions. Ensuring a

proper mixture of talents—of the administrator and the expert—was also a problem. With a change in the system of education this difficulty might be obviated. But certain other factors also would have to be attended to for improving public administration. *Diversified training would be required for the new services.*" Many people who entered the public services were motivated by a spirit of service and not merely because of security. This missionary spirit in the public services because of its social significance should be encouraged."

Mr. Deshmukh deprecated "careerism in the services which prompted men to secure promotion to higher and higher posts irrespective of merit through intrigue and seeking protection of influential men. The attitude of the legislators was also sometimes not helpful. While many public servants did their duties to the best of their ability, some legislators tended to be more censorious than was necessary. This resulted in creating a class of file pushers who shirked their responsibility."

"The defects in public administrations were of sufficient importance to merit serious attention." Mr. Deshmukh said. To remedy the defects he suggested "(1) there should be an effective system of supervision. Fifteen per cent of the public servants were very good, fifteen per cent very bad and the rest were a plastic mass, who could be moulded into shape through proper supervision and leadership; (2) a human touch in the relationship of the ministers and the public servants. Public servants should be encouraged to say what they actually felt; (3) constant statistical examination of performance. It should be investigated to what extent public servants were falling short of improvement aimed at."

"The success of a public servant," he said, "should depend not only on his own efforts but also on his capacity to stimulate non-officials to work for the success of public utility schemes. The public servant calibre should be judged by the extent to which he could maximise public co-operation in social and welfare projects."

It is clear from the above how very necessary it is to adjust suitably to fast changing conditions.

Original Article

THE ANATOMY OF THE FOETAL INDIAN ELEPHANT

PART II

The Muscles, Nerves and Blood Vessels of the Fore-limb.

BY

D. MARIAPPA, G.M.V.C.,

Professor of Anatomy, Madras Veterinary College.

Introduction

The difficulties attending the dissection of so large a mammal and to keep the parts soft for longer duration for detailed study has hampered the efforts of early workers in giving a detailed account of the muscles, nerves and blood vessels. Reliable accounts of the soft structures of the Elephant are very few in number and some authors have merely compiled their descriptions from those of other writers. Of those that dissected the Elephant, many have prepared a description of parts only. Among the early workers, Peter Camper (1774) was the first to make a thorough investigation of the structure of the Elephant but died leaving the work incomplete in the form of drawings, for which his son wrote the text, naturally lacking accurate observations. Cuvier and Laurillard (1805) published the myology of the Elephant and again the authors left textless figures which were far more accurate and elaborate than those of Camper. Mayer (1847) figured the muscles of the fore-limb and back, but omitted to state that they were those of the Elephant and neither gave the origin nor the insertion of muscles. Good-sir (1868) gave an account of the limb muscles which was followed by Miall and Greenwood's memoir (1878) dealing with all the muscles and certain viscera. But innervation of muscles was omitted and no attempt at comparison with other mammals was made. Gunningham (1882) gave a detailed account of the plantar muscles of the foot of a foetal specimen in the possession of the Royal College of Surgeons. The first attempt at comparative myology was made by Leche (1892). He compared the muscles of ungulata, Cetacea, Sirenia and Proboscidea, giving much useful information. Windle and Parsons (1901 & 1903) have made comparative study of the muscles with those of other vertebrates and compiled facts from other workers. Eales (1926) has given a detailed account of the muscles and their innervation and has made comparison with other types of animals.

The Muscles of the Forelimb

1. *Cutaneous muscle*—(Panniculus Carnosus) of the trunk is partly dealt with here under, as it covers some of the muscles attaching the forelimb to the trunk. A fuller account will be rendered under the muscles of the trunk.

It is extensive and well developed. (figs. 1 & 2). It is very thick in its ventral part, gradually becomes thinner in its lateral part and finally aponeurotic in its dorsal part to be continuous with the dorsal fascia. The muscle fibres are longitudinal in its ventral part, and oblique being downward and forward in its lateral part from the point of the elbow upwards. The lateral part covering the latissimus dorsi is fairly thick and its oblique fibres are inserted to the lateral tendinous surface of the Caput magnum a little in front of its posterior border. The ventral part completely covers the posterior deep pectoral and is continuous with its fellow of the opposite side. In its posterior part it covers the subcutaneous abdominal vein and the posterior abdominal artery. The anterior part behind the point of the elbow has the subcutaneous thoracic vein, artery and nerve running on its deep face. The ventral part enters the axilla, blends with the tendons of the latissimus dorsi and the posterior deep pectoral and is partly attached by aponeurosis to the medial face of the Caput magnum.

The scapulo-humeral part seen as a vertical band in the ox and horse is absent and is well compensated by the long reach of the proboscis to drive away any offending material on this region.

Nerve supply—The subcutaneous thoracic nerve and the anterior series of perforating intercostal nerves (3-6)

Blood supply—The subcutaneous thoracic artery and the posterior abdominal artery.

The Muscles of the Shoulder Girdle

These muscles attach the fore limb to the head, neck and the thorax.

The *pectoral muscles*.—are in two layers, superficial and deep. The superficial layer consists of only one muscle and the deep layer has two distinct muscles.

2. *Superficial pectoral* (Figs. 2 and 16).

The muscle is small and triangular and very thick anteriorly. It arises from the lateral aspect of the manubrium and the ventrolateral aspect of the fore part of the sternum. It is inserted in common with the brachiocephalicus to the crest on the anterior face of the humerus.

In front of its anterior border the cephalic vein passes in the groove between the muscle and brachiocephalicus to the thoracic inlet.

Nerve supply—A pectoral nerve from the posterior part of the brachial plexus.

Blood supply—External thoracic artery.

3. *Anterior deep pectoral*—(Figs. 2 and 10).

The muscle is elongated, thin and ribbon like extending from the first rib to the supraspinatus. It arises from the anterior border of the lower and of the first rib, passes upward and forward on the deep face of the brachiocephalicus, partly covers the anterior face of the supraspinatus and is inserted to the fascia on its upper part. The cephalic vein passes below its origin to enter the thoracic inlet. Its extension over the supraspinatus is identical with the condition seen in the horse. The nerve trunks from the posterior part of the brachial plexus, axillary artery and the axillary vein emerge between the scalenus and this muscle.

Nerve supply—A pectoral nerve from the anterior part of the brachial plexus.

Blood supply—Inferior cervical artery.

4. *Posterior deep pectoral* (Figs. 2 and 16).

The muscle is extensive, thick and triangular, being the largest of the pectorals as in other domestic mammals. It arises from the ventrolateral aspect of the sternum behind the origin of the superficial pectoral X' phoid cartilage and the abdominal tunic. Its fibres are directed forward and upward. Anteriorly the muscle becomes very narrow by the convergence of its fibres, enters the axilla deeper to superficial pectoral where it blends with the cutaneous muscle and is inserted to the medial tuberosity of the humerus. Behind the olecranon, along its posterior border emerge the subcutaneous thoracic vein, artery and the nerve. At its junction with the superficial pectoral, it forms an elliptical fossa for the mammary gland. On its deep face, the subcutaneous abdominal vein runs forward with the pectoral venous plexus medially.

Nerve supply—A pectoral nerve from the posterior part of the brachial plexus.

Blood supply—External thoracic artery.

5. *Trapezius* (Figs. 1 and 14).

It is very extensive and triangular consisting of cervical and dorsal parts which are continuous with each other as in the ox. The

cervical part is small and thin with its fibres directed downward and backward. It arises from the ligamentum nuchae and by an aponeurotic tendon from the supraoccipital. The dorsal part is elongated and thick, arising from the supraspinous ligament as far back as the 15th or 16th dorsal spine. Its fibres are directed downward and forward. The fibres of both the parts converge and unite to form a narrow tendon which is inserted to the upper part of the scapular spine. The dorsal division of the spinal accessory nerve emerges between the brachiocephalicus and omotransversarius and passes on the deep face of the cervical part.

Nerve supply—Dorsal branch of the spinal accessory nerve.

Blood supply—Suprascapular artery.

6. *Omotransversarius* (Figs. 1 and 14).

A complete account of the muscle will be given under the structures of the neck. At this stage of dissection, only its insertion is examined.

At its insertion the muscle is very broad and thick. Its insertion is to the lower part of the scapular skin and scapular fascia. Its relation with the spinal accessory nerve is already noted.

Nerve supply—Dorsal branch of the spinal accessory nerve.

Blood supply—Inferior cervical artery.

7. *Brachiocephalicus* (Figs. 1, 2, 5 and 16.) The origin of the muscle will be given under the structures of the neck. Only the lower part of the muscle in front of the shoulder is available at this stage for inspection.

The lower part of the muscle is divisible into dorsal and ventral parts above the shoulder. The dorsal part is small and narrow. The ventral part is large and thick. The fibres of both the parts are nearly vertical. Both the parts blend below the shoulder and unite with the superficial pectoral for insertion to the crest on the anterior surface of the humerus. The cephalic vein passes in the groove between the muscles.

Nerve supply—The circumflex nerve and the dorsal branch of the spinal accessory nerve.

Blood supply—The inferior cervical and the external thoracic arteries.

8. *Latissimus dorsi* (Figs. 1, 2, 4 and 17).

This is a wide fan shaped muscle covering the lateral wall of the thorax. It is completely covered by the lateral part of the cutaneous

muscle. The dorsal part of the muscle arises by aponeurosis from the dorsal spines and its fibres are nearly vertical descending along the posterior border of the Caput magnum. The fibres of the lateral part are downward and forward arising from the lateral faces of ribs (4-14) in the form of 9-10 digitations. The fibres of the ventral part are longitudinal arising from the abdominal tunic. The posterior border of the muscles corresponds to a vertical line about the middle of the chest wall.

Most of the fibres of the dorsal and lateral parts are attached to the posterior border of the Caput magnum and the rest pass into the axilla. The remaining fibres of the dorsal part blend with the *teres major*. The narrow tendon separates itself from the *teres major* and is inserted to the medial face of the neck of humerus above that of the *teres major*. The fibres of the lateral part are attached by aponeurosis to the medial face of the Caput magnum. The ventral part of the muscle enters the axilla and blends with the cutaneous muscle. On the deep face of the muscle ramifications of the thoracodorsal nerve, artery and veins are seen. The muscle has numerous tendinous intersections.

Nerve supply—The thoracodorsal nerve.

Blood supply—The thoracodorsal artery.

9. *Rhomboidens* (Figs. 3 and 14).

The muscle has two distinct parts—cervical and dorsal. (a) Cervical rhomboideus is elongated and thick, covering the splenius and levator anguli scapuli, extending from the apex of the scapula to the occipital. It arises from the ligamentum nuchae and by an aponeurotic tendon from the supraoccipital. It is inserted to the lateral aspect of the apex of the scapula. (b) Dorsal rhomboideus is small and triangular. It arises from the supraspinous ligament and is inserted to the scapular cartilage.

10. *Serratus magnus* (Figs. 2, 3 and 15).

The muscle is small and quadrilateral, confined to the upper part of the chest wall and is completely covered by the latissimus dorsi. Its fibres run downward and backward arising from the lateral faces of the upper parts of ribs (4-11) in the form of 7-8 digitations. The muscle is inserted to a rough oval area on the costal face of the scapula behind the insertion of the levator anguli scapuli. The muscle has numerous tendinous intersections.

11. *Levator anguli scapuli* (Figs. 2, 3, 14 and 15).

A full account of the muscle will be given under the muscles of the neck. At this stage the insertion of the muscle is available for inspection.

The terminal part of the muscle covers the upper part of the supraspinatus. It is inserted partly to a rough oval area at the proximal part of the supraspinous fossa and mostly to a rough quadrilateral area on the costal face of the apex of the scapula.

The Muscles of the Shoulder Medial Group.

12. *Subscapularis* (Figs. 2, 15 and 16).

The muscle consists of two large fleshy masses intersected by abundance of tendinous tissue in their lower parts. The anterior part extends beyond the anterior border of the scapula to contact the supraspinatus. The two parts arise from the subscapular fossa and unite to form below a flat wide tendon which is inserted to the medial tuberosity of the humerus. The tendon is crossed over by the tendon of origin of the coracobrachialis. Lower part of the muscle is related to the brachial plexus and the nerve trunks arising from it, axillary artery and the axillary vein.

Nerve supply—Subscapular nerves—three from the anterior part of the brachial plexus and two from the posterior part of the plexus.

Blood supply—Subscapular and suprascapular arteries.

13. *Teres major* (Figs. 2, 4, 15 and 16).

The muscle is thick and rounded, placed behind the subscapularis and overlying the medial face of the caput magnum. It arises from a rough triangular area on the costal face of the posterior angle of the scapula. The tendon of the muscle first blends with that of the latissimus dorsi, then separates itself and expands to be inserted to a rough elliptical depression on the medial face of the humerus.

Nerve supply—A muscular branch from the posterior part of the brachial plexus.

Blood supply—The subscapular and posterior circumflex arteries.

Fascia of the Shoulder.

The deep fascia covering the lower parts of the supraspinatus, infraspinatus and deltoideus is very thick and is attached to the scapular spine and cartilage. A thick fascial band arises from the acromian process and fascia over the supraspinatus and descends in the arm in front of Biceps brachii which will be described later.

Lateral Group.14. *Supraspinatus* (Figs. 2, 3, 4, 5, 14 & 17).

The muscle fills the supraspinous fossa and extends in front of the scapula to contact the subscapularis. It is covered by thick aponeurosis to which the anterior deep pectoral is inserted. The tendon of the muscle is inserted to the anterior part of the lateral tuberosity of the humerus. The tendon of origin of coracoradialis passes down the bicipital groove medial to it.

Nerve supply—The suprascapular nerve.

Blood supply—The suprascapular artery.

15. *Deltoideus* (Figs. 5, 14 and 17).

The muscle overlies the lower part of the infraspinatus, teres minor and triceps. It has two heads of origin—acromial and scapular. The former arises from the acromian and uncinat processes of the scapula and the latter from the scapular fascia. The two heads unite below to form a tendon which is long and fleshy on its superficial face and short, thick and tendinous on its deep face. The superficial fleshy tendon is inserted to the anterior face of the humerus below the deltoid tuberosity and the deep tendon to the tuberosity,

Nerve supply—The circumflex nerve.

Blood supply—The posterior circumflex artery.

16. *Infraspinatus* (Figs. 3, 5, 6 and 17).

The muscle is very large and massive occupying the dorsal 2/3 of the infraspinous fossa. It is covered by thick aponeurosis from which the scapular head of the deltoideus arises. The tendon of the muscle divides into two parts—superficial and deep. The superficial division is a thick flat tendon which passes over the convexity of the lateral tuberosity of the humerus and is inserted to a rough oval area below it. The deep division is a fleshy tendon which is inserted to the medial face of the convexity of the lateral tuberosity.

Nerve supply—The suprascapular nerve.

Blood supply—The suprascapular and posterior circumflex arteries.

17. *Teres minor* (Figs. 6 and 17).

The muscle is small and fusi form and is completely covered by the deltoideus and lies on the Caput magnum. Its narrow tendon of origin arises from the lower part of the infraspinous fossa close to the oblique ridge. The muscle is inserted by a thin and narrow tendon to a rough area behind the deltoid tuberosity.

Nerve supply—The circumflex nerve.

Blood supply—The posterior circumflex artery.

18. *Capsularis anterior* (Figs. 4 and 15).

The muscle is small and triangular being about a cm. in length placed between the tendons of origin of coracohumeralis and radialis. The muscle fibres arise from the sides of the coracoid process and are inserted over the capsule of the shoulder.

Nerve supply—The pectoral nerve supplying the anterior deep pectoral!

Blood supply—The posterior circumflex artery.

The Muscles of the arm.

The *deep fascia of the arm* is very thick containing numerous bundles of white and elastic fibres. The fascial band descending from the acromian process referred already, passes in front of the arm (figs. 5 and 6) as a broad band of considerable thickness covering the brachiocephalicus. Below the deltoideus it splits into two layers which enclose the brachioradialis and furnishes origin to the muscle fibres of its anterior head. The outer layer spreads over the triceps and the extensors of the forearm and is attached to the lateral epicondyle of the humerus and the olecranon. The inner layer extends over the medial face of the arm and forearm covering the flexors of the forearm. The medial and lateral faces of caput magnum are covered by the two layers of fascia which furnish origin to some of its fibres.

19. *Coracohumeralis* (Figs. 4, 15 and 16).

It lies on the medial aspect of the arm. The muscle has a thin aponeurotic tendon of origin attached to the coracoid process of the scapula. The tendon crosses obliquely over the tendon of subscapularis and is succeeded by a thin, flat fleshy belly which is inserted to the medial face of the humerus down to its medial condyle. The brachial vessels median and ulnar nerves pass over the muscle.

Nerve supply—The musculo cutaneous branch of the median nerve.

Blood supply—The anterior humeral artery.

20. *Biceps brachii* (Coracoradialis) (Figs. 4, 14 and 18).

The muscle has a fusi form belly lying in front of the arm. It arises by a flat tendon from a depression lateral to the coracoid process of the scapula. The tendon passes down the bicipital groove bounded by the transverse humeral ligament and is succeeded by a long fusiform

belly lying in front of the preceeding muscle. About the medial aspect of the elbow it is related to the medial face of brachialis anticus. Below the elbow it is succeeded by a tendon which is inserted to the bicipital tubercle of the radius and the upper part of the anterior face of the ulna at its medial aspect.

Nerve supply—The musculo cutaneous branch of the median nerve.

Blood supply—The anterior humeral and median arteries.

21. *Triceps brachii* (Figs. 4, 5 6 and 20).

This muscle is large and massive having three heads of origin.

- (a) *Caput magnum* (long head). This head is triangular, large and powerful with abundance of tendinous tissue in its structure. It arises from the lower third of the infrapinnous fossa and the posterior border of the scapula. The muscle is enveloped in a thick fascial sheath derived from the deep fascia of the arm. The lateral part of the cutaneous muscle of the trunk is inserted over the aponeurosis on its lateral face. Most of the fibres of the lateral and dorsal parts of latissimus dorsi are inserted over its posterior border and the rest to the aponeurosis on its medial face, in front of which lies the scapuloulnaris having its origin and insertion on this face of the muscle. The muscle has a thick tendon which is inserted to the medial aspect, summit and the lateral aspect of the olecranon.

Nerve supply—The radial nerve.

Blood supply—The deep humeral artery.

- (b) *Caput medium* (lateral head). It is thick and quadrilateral, lying on the lateral aspect of the arm. Its tendon of origin is narrow and fleshy attached to the lateral face of the humerus below the head covering the origin of brachialis anticus. The muscle covers most of the brachialis anticus and part of anconeus. Its tendod of insertion blends with that of caput magnum.

Nerve supply — The radial nerve.

Blood supply — The deep humeral artery.

- (c) *Caput parvum* (medial head). It is small and elongated covering the medial face of the arm behind coracobrachialis. It arises from the middle of the posterior face and the lower 2/3 of the medial face of the humerus behind the insertion of coracobrachialis. The ulnar and radial nerves pass over the muscle. Its tendon of insertion blends with that of scapuloulnaris and caput magnum.

Nerve supply — The radial nerve.

Blood supply — The deep humeral artery.

22. *Scapuloulnaris* (tensor fascia antibrachii) (Fig. 4).

This is an elongated flat muscle lying on the medial face of Caput magnum behind the parvum. Its aponeurotic tendon of origin is attached to the medial face of magnum in front of the insertion of latissimus dorsi. Its fleshy tendon of insertion blends with the tendons of parvum and magnum.

Nerve supply — The radial nerve.

Blood supply — The deep humeral artery.

23. *Brachialis anticus* (Figs. 7, 16, 17, 18, & 19.)

The muscle arises by two heads from the upper part of the posterior face of humerus. Capsularis posterior descends between the two heads for its insertion to the humerus. (fig. 7 of part I). The two heads unite to form a flat belly which runs down the musculospiral groove attached to it, turns in front of elbow between brachiocephalicus and brachioradialis, runs obliquely medial to the tendon of biceps and is inserted to the radius below the bicipital tubercle and a rough triangular area on the upper part of the anterior face of the ulna below the insertion of biceps.

Nerve supply—The radial nerve.

Blood supply—The collateral radial artery.

24. *Capsularis posterior* (Figs. 14, 16, 17 and 7 of Part I).

This is a long ribbon shaped muscle about 5 cms, long and 1 cm. wide, placed on the posterior aspect of the capsule of the shoulder. It arises from a rough oval area above the posterior part of the glenoid rim of the scapula blending with the fibres of origin of caput magnum. The belly gradually widens below and is inserted to the posterior face of the humerus between the two heads of origin of brachialis anticus.

This muscle is far better developed than in the equidae.

Nerve supply—The circumflex nerve.

Blood supply—The posterior circumflex artery.

25. *Anconeus* (Figs. 5, 6, 7, 17 and 20).

The muscle is entirely confined to the lateral aspect of the humerus above the epicondyle and consists of dorsal and ventral parts, the latter being larger. The ventral part arises from the posterior face of the lateral epicondyle of humerus and is inserted to the lateral aspect

of the olecranon and the proximal half of the lateral face of ulna under cover of the extensor carpi ulnaris. The dorsal part arises from the posterior face of humerus above the lateral epicondyle, passes under caput medium and is inserted to the lateral aspect of the olecranon.

Nerve supply—The radial nerve.

Blood supply—The deep humeral, brachial and median arteries.

26. *Brachioradialis*. (Supinator longus) (Figs. 6, 7 and 17).

The muscle has two heads of origin—anterior and posterior. The anterior head arises from the thick fascial band from the acromian process. The posterior head arises from the lateral face of humerus below the origin of caput medium and the fascia over brachialis anticus. The two heads unite below deltoideus and form a conical belly which covers the brachialis anticus. The muscle then passes down in front of extensor carpi radialis in the forearm. Its tendon of insertion is very narrow which passes outward under extensor pollicis and is inserted to the anterior face of the lunar.

Nerve supply—The radial nerve.

Blood supply—The deep humeral artery.

The Muscles of the Forearm and Manus.

The *fascia of the forearm* is greatly strengthened by the *superficial fascia* which is thick with bundles of elastic fibres. The *deep fascia* is very thick with abundance of elastic fibres. It furnishes septa which pass between the muscles enclosing them in fascial sheaths. It forms an oblique band of considerable thickness extending from the lateral epicondyle of humerus to the distal end of ulna separating communis digitorum and extensor digiti quinti.

The *Carpal fascia* forms the *anterior* and *posterior annular ligaments* of the carpus. The former binds down the extensor tendons with their synovial sheaths on the anterior aspect of the carpus. The latter stretches from the pisiform to the medial carpal ligament to form the *carpal canal* in which lie the flexor tendons.

Extensors.

The extensors are arranged on the anterolateral aspect of the forearm. They are from before backwards.—

27. *Extensor carpi radialis* (Figs. 7, 17 & 21).

The muscle lies behind and lateral to brachioradialis. It has a wide fleshy tendon of origin from the anterior part of the crest of the lateral epicondyle and adjacent lateral face of humerus. The belly of the muscle is wide and flat above which becomes narrow about the

middle of the forearm. About the lower third of the forearm it is succeeded by a narrow tendon which with the tendon of brachioradialis passes down the carpus under the belly of extensor pollicis and the tendon of extensor communis digitorum and divides into two branches which are inserted to the upper part of the anterior faces of the II and III metacarpals. The radial nerve passes down over the muscle.

Nerve supply—The radial nerve.

Blood supply—The collateral radial artery.

28. *Extensor communis digitorum* (Figs. 7 & 17).

It lies behind the preceeding muscle. The muscle arises by a wide fleshy tendon from the middle half of the crest of the lateral epicondyle of humerus. The belly of the muscle expands about the middle of the forearm and gradually becomes narrow below. It covers the extensor pollicis and extensor indicis et pollicis for most of their extent excepting their lower parts. Over the carpus it is succeeded by a wide flat tendon which expands over the metacarpus and divides into four branches which pass over the II, III, IV & V digits and are inserted to the anterior faces of their third phalanges. The radial nerve passes down over the muscle.

Nerve supply—The radial nerve.

Blood supply—The collateral radial artery.

29. *Extensor digiti quinti* (Figs. 7, 17 & 21).

This is a thick round muscle placed behind the preceeding from which it is separated by a thick wide fascial band. It arises by a narrow fleshy tendon from the posterior part of the crest of the lateral epicondyle of humerus, the lateral ligament of elbow and upper half of the medial border of ulna. The muscular belly is thick and rounded which becomes narrow below terminating in a round tendon that passes in the groove of the ulna, turns backward and runs over the tendon of extensor carpi ulnaris, passes over the V digit, expands below and is inserted to the medial borders of its proximal and terminal phalanges.

Nerve supply—The radial nerve.

Blood supply—The collateral radial artery.

30. *Extensor carpi ulnaris* (Figs. 7, 17 & 21).

It is a large rounded muscle placed behind the preceeding. It arises by a narrow tendon from the lateral condyle of humerus. The muscular belly expands and becomes wider about the middle of the forearm and covers the lower half of anconeus. The belly becomes narrow terminating in a round tendon which passes down the groove of

ulna enclosed in a synovial sheath. It runs over the V digit by passing under the tendon of extensor digiti quinti and is inserted about the middle of the anterior face of the V metacarpal.

Nerve supply—The radial nerve.

Blood supply—The collateral radial artery.

31. *Extensor pollicis* (Fig. 7, 18, 19 & 21).

This is a large muscle greater part of it being covered by extensor communis digitorum and the lower part appearing between communis digitorum and brachioradialis. It arises from the anterior and lateral faces of radius and the anterior face of ulna at its junction with radius. The muscular belly is large and rounded. Above the carpus it is succeeded by a tendon which passes over the tendons of extensor carpi radialis and brachioradialis, turns inward and passes over the I digit, unites with a branch of the tendon of the succeeding muscle and is inserted mostly to the anterior face of the I metacarpal and by a small branch to the I phalynx of the I digit.

Nerve supply—The radial nerve.

Blood supply—The collateral radial artery.

32. *Extensor indicis et pollicis* (Figs. 7 and 19).

It is a narrow elongated muscle placed behind the preceeding under cover of communis digitorum. It arises from the proximal half of the lateral border of ulna. The lower part of the muscle appears in front of communis digitorum above the carpus where it is succeeded by a tendon which turns inward and divides over the metacarpus into two divisions. The medial division is small which joins the tendon of the preceeding muscle. The lateral division is large which joins the branch of communis digitorum to the II digit.

Nerve supply—The radial nerve.

Blood supply—The collateral radial artery.

33. *Dorsal interossei* (Fig. 21).

There are four muscels arising from the deep face of the tendon of communis digitorum and are inserted to the anterior faces of II, III, IV and V metocarpals. They are thin oblique bands diverging below from their origin. Each band lies in the corresponding inter-metacarpal space and attached to the adjacent faces of two metacarpals.

Nerve supply—The radial nerve (?)

Blood supply—The dorsal metacarpal arteries.

Flexors.

The flexors are placed on the posterior aspect of the forearm. Their arrangement from within outwards.—

34. *Pronator teres*. (Figs. 8, 16 and 18).

This muscle is large and well developed and blended with the medial ligament of elbow. The muscular belly is a thin wide sheet of about 2 cms. width which becomes wider below covering the medial face of radius. It arises by a thin wide fleshy tendon from the anterior part of the medial epicondyle of humerus. Along the posterior border of the belly the medial ligament of the elbow is blended. The belly is inserted to the medial and posterior faces of radius below its middle. The median nerve and vessels pass obliquely under the muscle.

Nerve supply—The median nerve.

Blood supply—The median artery.

35. *Flexor carpi radialis*. (Figs. 8 and 16).

It is a large round muscle placed behind the preceeding. The muscle is strengthened by numerous fibrous septa in its belly. It arises by a large fleshy tendon from the medial epicondyle of humerus. The muscular belly passes down the medial face of radius between pronator in front and palmaris longus behind, covering the median nerve and vessels. At the lower third of the forearm it is succeeded by a narrow round tendon which expands at its insertion to the posterior face of trapezium.

Nerve supply—The median nerve.

Blood supply—The median artery.

36. *Palmaris longus*. (Figs. 8 and 16).

This is a large round muscle placed behind the preceeding. Its origin is by a large fleshy tendon from the medial epicondyle of humerus. The large muscular belly divided about the middle of the forearm into two parts. The posterior part blends behind with the flexor carpi ulnaris. The anterior part is succeeded by a large flat tendon above the carpus. The tendon passes behind the carpus under the *volar annular ligament*, runs under the metacarpus covered by the *digital cushion*, to which it is intimately adherent. The tendon expands and divides into five thin divisions which are connected by a thin layer of tendinous tissue forming a web. The five divisions of the tendon pass under the corresponding digits and are inserted to the posterior faces of the terminal phalanges of the five digits.

Nerve supply—The median nerve.

Blood supply—The median artery.

37. *Flexor carpi ulnaris*. (Figs. 8, 16 and 20).

This is a large rounded muscle placed behind and lateral to the preceeding. The muscle has two heads of origin—humeral and ulnar. (a) The humeral head is small which arises from the medial condyle of humerus. (b) The ulnar head is large which arises from the medial and posterior aspects of the olecranon. Between the two heads pass the ulnar nerve and the collateral ulnar artery. The two heads unite to form a large rounded belly which blends with the posterior part of the preceeding about the middle of the forearm. Above the carpus it is succeeded by a wide thick tendon which is inserted to the dorsal border of the pisiform. The ulnar nerve passes under the muscle and later passes down along its lateral border.

Nerve supply—The ulnar nerve.

Blood supply—The collateral ulnar artery.

38. *Flexor communis digitorum* (Figs. 8, 9, 16 & 20).

This is a large muscle placed behind the ulna under the preceeding muscles. It has three distinct heads of origin, of which the ulnar head is superficial placed between the extensor and flexor carpi ulnares below the olecranon. The other two are humeral heads, one small and the other large, both deeply placed under the preceeding muscles.

(a) *Ulnar head* arises from the posterior aspect of the olecranon between the attachments of anconeus and flexor carpi ulnaris. It is succeeded by a small fusiform belly which terminates above the middle of the forearm in a fine tendon, which passes down between the extensor and flexor carpi ulnaris in company with the deep division of the ulnar nerve along the lateral border of the large humeral head and unites with its tendon above the carpus.

(b) *Large humeral head* arises from the posterior aspect of the medial condyle of humerus under cover of palmaris. It is succeeded by a wide flat belly which has in its middle a fibrous band extending from the condyle to the lower part of the muscle. The belly is widest about the middle of the forearm, below which it becomes narrow and is succeeded by a flat tendon above the carpus, where it receives the tendons of other two heads.

(c) *Small humeral head* arises from the medial condyle of humerus covered by the large head. It is succeeded by a small conical belly which is continued by a fine tendon about the middle of the forearm, passing along the medial border of the preceeding and unites with its tendon above the carpus.

The common tendon expands below the pisiform and divides below the metacarpals into five round tendons which pass through fascial sheaths over the sesamoidean pulleys and run under the corresponding digits and are inserted to the volar faces of the terminal phalanges of the five digits. The tendon of the I digit is the thinnest and the tendons of II, III and IV digits are the thickest. The palmar digital nerves lie along the tendons.

Nerve supply—The median nerve to humeral heads and the ulnar nerve to the ulnar head.

Blood supply—The median artery

39. *Abductor digiti quinti* (Fig. 9).

This is a small muscle with a fusiform belly. It arises by a thin fleshy tendon from the medial and of pisiform and fascia over the unciform. The muscular belly lies obliquely directed outward below the pisiform and is inserted to the sesamoids of the V digit.

Nerve supply—The ulnar nerve.

Blood supply—The median artery.

40. *Flexor digiti quinti* (Fig. 9).

It is placed medial to the preceeding being identical in shape and size. It arises by a narrow tendon from the fascia over the unciform. The belly is directed outward and is inserted to the sesamoids of the V digit.

Nerve supply—The median and ulnar nerves.

Blood supply—The median artery.

41. *Opponens digiti quinti*.

This is a small conical muscle placed deeper to the abductor. It arises from the fascia over the unciform and is inserted to the posterior aspect of the distal end of the V metacarpal in front of the preceeding.

Nerve Supply—The ulnar nerve.

Blood supply—The median artery.

42. *Lumbricales*.

There is only one muscle which is very fine and fusiform about 4 cms. long under the flexor digiti quinti. It arises from the common tendon of the flexor communis digitorum in front of the pisiform and is inserted to the fascial sheath of its tendon of the IV digit.

Nerve supply—The median nerve.

Blood supply—The median artery (?)

43. *Palmar interossei* (Fig. 22).

There are four muscles in the form of thick bands on the posterior faces of I, II, III & IV metacarpals. They arise from the fascia over the carpus and the proximal parts of the metacarpals. The I & II interossei are the largest. The II muscle detaches a narrow bundle which accompanies the fascial sheath of the flexor tendon of the II digit and is inserted to the web of palmaris between II & III digits. The muscles are inserted to the distal parts of the metacarpals. Each muscle lies in the corresponding intermetacarpal space having attachments on the adjacent faces of the two metacarpals.

Nerve supply—The ulnar nerve to the IV muscle.

The median nerve (?) to other muscles.

Blood supply—The recurrent branches of the palmar arch.

Digital cushion

This is identical with the digital cushion of the *equidae* both in structure and function. It is a large oval mass, fibro fatty in structure with predominance of elastic fibres. It is soft, filling up the space between the sole and the palmar aspects of the digits. It is intimately adherent to the tendons of the palmaris above and the prepollex medially. It serves to diffuse concussion.

The Nerves of the Forelimb.**The Brachial Plexus** (Figs. 2 and 10.)

The *brachial plexus* consists of two parts—anterior and posterior, both covered by the scalenus. Each part is a flat fasciculus formed by the convergence of the ventral primary rami of two spinal nerves. The posterior part is formed by the union of 8th cervical and 1st dorsal nerves in front of the proximal end of the 1st rib. The anterior part is formed by the union of 6th and 7th cervical nerves about 2" in front of the former. Both the parts are connected by dorsal and ventral communicating trunks. The *axillary artery* emerges out of the thoracic inlet below the posterior part of the plexus and the *axillary vein* enters the thoracic inlet below and behind the artery close to the 1st rib.

The anterior part of the plexus supplies the *suprascapular nerve*, three *subscapular nerves*, and a *pectoral nerve* to the anterior deep pectoral.

The posterior part of the plexus detaches, two *subscapular nerves*, *nerve to teres major*, *circumflex nerve*, *thoracodorsal nerve*, two *pectoral nerves*, *subcutaneous thoracic nerve*, *radial nerve*, *ulnar nerve* and *median nerve*.

Pectoral Nerves, (Fig. 2).

There are *three pectoral nerves*. One arises from the anterior part of the plexus and supplies the anterior deep pectoral. Two others arise from the posterior part of the plexus, one supplying the superficial pectoral and the other supplying the posterior deep pectoral.

Suprascapular Nerve. (Fig. 2).

The *suprascapular nerve* arises from the anterior part of the plexus, passes upward and forward with the artery and the vein of the same name between the subscapularis and the supraspinatus, winds round the anterior border of the scapula, supplying branches to the supraspinatus, passes across the supraspinous fossa, enters the infraspinous fossa by passing under the acromion process and terminates in the infraspinatus.

Subscapular Nerves (Fig. 2).

There are *five subscapular nerves*, three arising from the anterior part of the plexus to supply the anterior part of subscapularis and two arising from the posterior part of the plexus to supply the posterior part of the muscle.

Nerve to Teres Major (Fig. 2).

The *nerve to teres major* arises from the posterior part of the plexus and ramifies on the deep face of the muscle.

Thoracodorsal Nerve (Fig. 2)

The *thoracodorsal nerve* arises from the posterior part of the plexus, and ramifies on the deep face of the latissimus dorsi along with the artery and the vein of the same name.

Subcutaneous thoracic Nerve (Figs. 2 & 13).

The *subcutaneous thoracic nerve* arises from the posterior part of the plexus, passes back on the deep face of the tendon of latissimus dorsi, emerges from the axilla along the dorsal border of the posterior deep pectoral behind the olecranon and passes on the deep face of the cutaneous muscle of the trunk in company with the artery and the vein of the same name. The nerve breaks off into numerous branches to supply the muscle.

Circumflex Nerve

The *circumflex nerve* arises from the posterior part of the plexus, passes between teres major and subscapularis, winds round the posterior aspect of the shoulder in company with the *posterior circumflex artery* and gains the deep face of the deltoideus. It supplies muscular branches to teres minor, both the heads of deltoideus and divides into two terminal branches—anterior and posterior. The anterior branch

passes forward under the acromial head of deltoideus and terminates in the lower part of the brachiocephalicus. The posterior branch passes backward and downward under the scapular head of deltoideus and passes subcutaneously as the *lateral cutaneous nerve of the arm* to supply the skin on the lateral aspect of the arm and continues down the forearm.

Radial Nerve (Figs. 6 & 7).

The *radial nerve* arises from the posterior part of the plexus, runs deeply under the ulnar nerve, crosses over the tendon of teres major, supplies branches to scapuloulnaris, caput parvum, caput magnum and caput medium, disappears between caput magnum and medium, runs in the musculospiral groove along the posterior border of brachialis anticus, supplies a branch to anconeus and detaches a large muscular branch which passes outward under the origin of the extensors of the forearm and digits supplying them, viz. extensor carpi radialis, extensor communis digitorum, extensor digiti quinti, extensor carpi ulnaris, extensor pollicis and extensor indicis et pollicis. The nerve then emerges under caput medium to appear in the forearm over extensor carpi radialis, supplies a branch to brachioradialis, detaches the *anterior and lateral cutaneous nerves of the forearm* to supply the skin of the forearm and descends on the extensor communis digitorum and its tendon to reach the IV digit, unites with a branch of the superficial division of the ulnar nerve to form one of the IV *dorsal digital nerves* which runs subcutaneously over the IV digit.

Ulnar Nerve. (Figs. 4, 7, 8 and 9).

The *ulnar nerve* arises from the posterior part of the plexus, runs down behind the *brachial vein* between caput parvum and coracohumeralis, reaches the medial aspect of the olecranon, passes under caput parvum and disappears between the ulnar and humeral heads of flexor carpi ulnaris accompanied by the *collateral ulnar artery*, supplying branches to them and the ulnar head of the common digital flexor and detaches *two posterior cutaneous nerves of the forearm* which emerge between the flexor carpiulnaris and palmaris longus to supply the skin. The nerve then passes backward obliquely under flexor carpi ulnaris and ulnar head of common digital flexor, runs along the postero-external border of the forearm between extensor carpi ulnaris and flexor carpi ulnaris and divides about the middle of the forearm into *superficial and deep divisions*. The *superficial division* passes behind the flexor carpi ulnaris and divides below the carpus into *anterior and posterior terminal branches*. The *anterior terminal branch* winds round the tendon of the extensor carpi ulnaris, gains the dorsal aspect of the digits, runs over the tendon of extensor digiti quinti and divides into three branches. The anterior branch unites with the radial nerve to

form one of the IV *dorsal digital nerves*. The middle branch also passes over the IV digit as the second IV *dorsal digital nerve*. The posterior branch passes over the V digit as the V *dorsal digital nerve*.

The *posterior terminal branch* passes down as the V *palmar (volar) digital nerve* on the volar aspect of the V digit.

The *deep division* of the ulnar nerve passes along the posterior border of the common digital flexor passes on the deep face of the pisiform, detaches muscular branches to supply *abductor, flexor and opponens digiti quinti* and the III and IV palmar interossei.

Median Nerve (Figs. 4, 8 & 9).

The *median nerve* arises from the posterior part of the plexus runs down the arm covering the *brachial artery* on the medial face of coracohumeralis, passes under the *musculocutaneous vein* and runs in front of the *brachial vein*, reaches the posterior border of coracohumeralis below and disappears at the medial aspect of the elbow by passing deeply under pronator teres and flexor carpi radialis along the medial face of radius. It gradually crosses under flexor carpi radialis and passes behind its tendon with the vein and artery of the same name in front, winds over the tendon of common digital flexor and runs on the tendon and divides below the carpus into four terminal branches which accompany the tendons of the common digital flexor to digits I, II, III & IV as their *palmar digital nerves* which are deeply placed in the foot covered by the digital cushion.

In its course the median nerve detaches a number of collateral branches in the arm, forearm and the manus. They are —

1. A large *musculocutaneous nerve* (Figs. 4 & 7) which arises from the median above the shoulder, passes between the vein of the same name in front and the median nerve behind, supplies branches to coracohumeralis and biceps, passes under biceps, reaches the deep face of brachialis anticus supplying branches to it, passes over the insertion of brachialis and biceps and continues down as the *medial cutaneous nerve of the forearm* in front of the flexors of the forearm supplying branches to the skin. The nerve then winds over the tendon of brachioradialis and gains the dorsal aspect of the carpus and divides below the carpus into three terminal branches which run down as I, II and III *dorsal digital nerves* subcutaneously over the corresponding digits.

2. Below the shoulder it detaches from its posterior border the *medial cutaneous nerve* of the arm, which passes over the brachial vein and runs down to the olecranon supplying the skin,

3. As it passes under pronator teres, it supplies muscular branches to the pronator, flexor carpi radialis, palmaris longus and the humeral heads of common digital flexor.

4. As it winds over the tendon of common digital flexor at the carpus, it supplies branches to flexor digiti quinti, the lumbricales (II) and II and III palmar interossei (?).

Blood Vessels of the Forelimb.

Arteries.

Axillary Artery. (Figs. 2 and 10).

The *axillary artery* emerges from the thoracic inlet by winding round the medial face of the proximal end of the first rib below the scalenus and ventral to the posterior part of the brachial plexus, passes downward and outward into the axilla, crosses the tendon of subscapularis and reaches the medial face of the humerus where it is continued as the *brachial artery* below the tendon of teres major.

Its collateral branches are :

1. *Inferior cervical artery* arises from the anterior face of the axillary artery at the medial face of the first rib, passes forward between the ventral cervical muscles and detaches the suprascapular artery and a pectoral branch to supply the anterior deep pectoral. The *suprascapular artery* passes upward with the nerve and vein of the same name and accompanies it in its course in the supra and infraspinous fossae to supply supraspinatus, infraspinatus and trapezius.

2. *External thoracic artery* arises from the medial face of the axillary artery above the shoulder, detaches the subcutaneous thoracic artery and divides into two pectoral branches, one supplying the superficial pectoral and shoulder joint and the other supplying the posterior deep pectoral. The *subcutaneous thoracic artery* passes backward on the deep face of the cutaneous muscle of the trunk in company with the nerve and vein of the same name along the posterior border of the posterior deep pectoral. It breaks off into numerous branches to supply the cutaneous muscle.

3. *Subscapular artery* arises from the lateral face of the axillary artery an inch below the preceeding, passes upward and backward between the teres major and subscapularis. It detaches the posterior circumflex artery and the thoracodorsal artery and continues its course to the posterior angle of the scapula. In its course it supplies, teres major, subscapularis, caput magnum, serratus magnus and infraspinatus. The *thoracodorsal artery* accompanies the nerve and vein of the same name and ramifies on the deep face of latissimus dorsi. The *posterior circumflex artery* passes between teres major and subscapularis, winds

round the posterior aspect of the shoulder in company with the circumflex nerve, gains the deep face of deltoideus and supplies branches to deltoideus, caput magnum and a dorsal branch which passes along the posterior border of teres minor (Fig. 6) supplying it and terminating in infraspinatus.

Brachial Artery. (Fig. 4)

The *brachial artery* is the continuation of the axillary artery below the tendon of teres major in the arm. It is deeply placed over coracobrachialis on the medial face of the arm under cover of the brachial vein and median nerve. It passes down the medial aspect of the elbow covered by the median nerve as the median artery in the forearm.

Its collateral branches in the arm are :

1. *Deep humeral artery* arises from its posterior border in the upper part of the arm, passes backward between the ulnar and radial nerves and supplies branches to caput magnum, scapuloulnaris, caput parvum, caput medium and anconeus.

2. *Anterior humeral artery* arises from its anterior face about the middle of the arm and supplies coracobrachialis and biceps.

3. *Nutrient artery* of the humerus arises from its medial face about the middle of the arm, supplies a branch to biceps and reaches the anterior face of humerus and enters the nutrient foramen of the bone.

4. *Collateral ulnar artery* arises from its posterior border at the lower third of the arm and accompanies the ulnar nerve between the ulnar and humeral heads of flexor carpi ulnaris to supply them.

5. *Muscular branch* arises from it at the lower third of the arm, passes backward between coracobrachialis and caput parvum and supplies anconeus and the capsule of elbow.

6. *Collateral radial artery* arises from its lateral face above the elbow, passes outward under the biceps, supplies branches to brachialis anticus and passes deeper to it in front of humerus and reaches the deep face of the extensors of the forearm and digits and supplies them, viz. brachioradialis, extensor carpi radialis, extensor communis digitorum, extensor digiti quinti, extensor carpi ulnaris, extensor pollicis and extensor indicis et pollicis.

Median Artery. (Fig. 8).

The *median artery* is the continuation of the brachial artery in the forearm. It passes down the medial aspect of the elbow covered by the median nerve and vein, crosses over the insertion of biceps,

passes back obliquely under pronator teres, runs down between the medial face of the radius and flexor carpi radialis. It gradually gains the posterior border of the tendon of flexor carpi radialis and runs behind the median nerve and passes below the carpus as the metacarpal artery.

Its collateral branches in the forearm are :

1. *Muscular branches* to supply pronator teres, flexor carpi radialis and palmaris longus.

2. *Interosseous artery* arises below the tendon of biceps and detaches a branch which supplies palmaris, common digital flexor and flexor carpi ulnaris, passes across the medial face of radius and reaches the olecranon fossa and supplies anconeus and the capsule of the elbow. The interosseous artery then descends into the radio ulnar groove under the periosteum. At the lower third of the forearm it detaches a branch which passes forward through the interosseous ligament and supplies the anterior ligaments of the carpus. A little below, it gives off a descending branch which supplies the distal radio ulnar joint. The artery then continues its course obliquely outward and descends over the pisiform and supplies an articular branch to the posterior ligaments of the carpus and descends along the lateral aspect of the V metacarpal as the V *dorsal metacarpal artery* and is continued down the digit as the V *dorsal digital artery*.

Metacarpal Artery. (Figs. 11 and 12).

The *metacarpal artery* turns laterally under the tendon of common digital flexor and detaches a descending branch which passes down the palmar aspect of the I metacarpal as the I *palmar metacarpal artery* and continues down the digit as the I *palmar digital artery*. The metacarpal artery then passes deeply under the palmar interossei across the middle of the metacarpals describing an arch the *deep palmar arch* with the concavity facing upward and the convexity of the arch facing downward. From the arch three sets of branches are detached.

1. *Recurrent branches* from the concavity of the arch pass upward and supply the interossei and the carpal joint. There are four arteries of which the fourth supplies abductor, flexor and opponens digiti quinti.

2. *Descending branches* arise from the convexity of the arch and pass down as the II, III, IV and V *palmar metacarpal arteries* which supply the interossei and continue downward as the II, III, IV and V *palmar digital arteries*.

3. *Perforating branches* arise from the anterior face of the arch, pass through the inter metacarpal ligaments, gain the dorsal aspect of

the metacarpals as the *dorsal metacarpal arteries*, supply the dorsal interossei and continue down the digits as the *dorsal digital arteries*. From the medial half of the arch two such branches arise and pass through the I and II intermetacarpal spaces (ligaments) and gain the dorsal aspect as the I and II *dorsal metacarpal arteries* and continue down as the I and II *dorsal digital arteries*. The metacarpal artery after describing the medial half of the arch, bifurcates into two large trunks of equal calibre, one of them perforates the III intermetacarpal ligament and gains the dorsal aspect as the III *dorsal metacarpal artery* and continues down the digit as the III *dorsal digital artery*. The other branch continues laterally to complete the lateral half of the palmar arch, passes through the IV intermetacarpal ligament and gains the dorsal aspect as the IV *dorsal metacarpal artery* and continues down the digit as the IV *dorsal digital artery*.

The *venous palmar arch* lies above the arterial arch. (fig. 11).

Veins.

Axillary Vein. (Figs. 2 and 10).

The formation of the *axillary vein* is by the satellites of the collateral branches of the axillary artery. The vein enters the thoracic inlet close to the anterior border of the first rib below and behind the artery, ventral to scalenus.

Cephalic Vein. (Figs. 10 & 13).

The *cephalic vein* is formed on the medial face of the forearm as in other large domestic mammals. It passes upward and inward in the groove between the superficial pectoral and brachiocephalicus. It passes deeply to the thoracic inlet, receives the tributaries of the *pectoral venous plexus* and the subcutaneous abdominal vein, crosses under the origin of the anterior deep pectoral and enters the thoracic inlet above the manubrium sterni.

Subcutaneous Abdominal Vein. (Fig. 13).

The *subcutaneous abdominal vein* is very large. From the inguinal region it passes forward on the deep face of the cutaneous muscle of the trunk and receives the subcutaneous thoracic vein. It then runs lateral to the pectoral venous plexus on the deep face of the posterior deep pectoral and joins the cephalic vein at the thoracic inlet.

Pectoral Venous Plexus. (Fig. 13).

It is an intricate plexus formed on the deep face of the posterior deep pectoral. The main trunk of the plexus is the subcutaneous abdominal vein, which runs forward about 2' lateral to the umbilicus on the deep face of the cutaneous muscle and continues its course on the

deep face of the posterior deep pectoral. It receives the subcutaneous thoracic vein laterally and medially numerous veins arise from the ventral abdominal and thoracic walls and form angular anastomoses with it and among themselves. This plexus continues on the deep face of the posterior deep pectoral into the axilla and it partly appears between it and the superficial pectoral. Here the plexus receives two veins from the posterior end and two veins from the anterior end of the mammary gland. The plexus finally joins the cephalic vein before it enters the thoracic inlet.

Deep Palmar Arch. (Fig. 11).

The *venous palmar arch* lies above the arterial arch across the metacarpals deeper to the palmar interossei.

Axillary Haemolymph Glands. (Fig. 2)

They are two *haemolymph glands* placed behind *teres major* above the subcutaneous thoracic nerve on the deep face of the tendon of *latissimus dorsi*. The anterior one is elongated— $1\frac{1}{2}$ " long and $\frac{1}{2}$ " broad and the posterior one is round—about $\frac{3}{4}$ " in diameter.

Discussion.

It is proposed to discuss the modifications of the musculature in the Elephant by comparison with other larger domestic animals and explain if possible their significance. Comparison with the human subject as done by others is specially avoided for obvious reasons, as the pectoral limbs are adapted for different functions in man from those of the quadrupeds, where they are primarily for bearing the weight of the body.

1. Muscular Attachments in General.

Muscular attachments given by MIALL AND GREENWOOD being brief are lacking in details. EALES, though giving details of attachments, admits that the specimen being small, the great difficulty in the identification of the dissected muscles, since the foetal muscles had not always acquired their final attachments to bones or other structures. The present specimen being a large one, having very nearly attained the conditions approximating to those of the adult, it has been an easy task to note their attachments with greater degree of accuracy. The muscular attachments were cut and immediately the areas of their attachment on bones were marked on the outlines of bones. Hence the present record is more complete in clarity and accuracy of details as the reader would find in the case of not few, but several muscles in general in comparison with those recorded by others.

2. Certain Important Muscles.

(i) *Cutaneous muscle of the trunk* :

EALLES states that the abdominal portion—*abdomino-humeralis* is not well developed in the foetus and the dorsal part—*dorsohumeralis* is absent. There is thus no pronounced twitching muscle in the Elephant unlike in the ungulata where it is extensive. One would not expect to find a pronounced twitching muscle in an animal with such thick, loose skin as the Elephant.

MIALL & GREENWOOD observe that the muscle forms an extensive sheet upon the sides of the body, increasing in thickness below, where it is continued into the fasciae of the fore and hind limbs. A tolerably distinct scapular portion may be traced.

WINDLE & PARSONS believe from records of CUVIER, LAURILLARD & ANDERSON that the *abdominohumeralis* must be better developed in the Elephantidae.

In the present specimen it is very extensive and well developed as in ungulata. *Abdominohumeralis* is very thick and extensive. *Dorsohumeralis* is present and developed though it gradually becomes aponeurotic when traced to the spine. Though no *scapulohumeral* part in the form of a vertical band as in the ox and horse is present, the extension of the oblique fibres of the lateral part for insertion on the lateral surface of arm in front of its posterior border, represents it, which perhaps is the same referred by MIALL AND GREENWOOD. Hence it is very evident that, inference by EALES that one would not expect to find a pronounced twitching muscle in the Elephant based on the incompletely developed condition of the muscle in the small foetus is wrong. The Elephant, like the ungulata has an extensive well developed twitching muscle for its protection.

(ii) *Pectorals*.

EALLES describes three pectorals—*anterior* and *posterior superficial* and *anterior deep*, the *posterior deep pectoral* being absent. The *posterior superficial pectoral* is larger, behind the *anterior* one, arising from the posterior part of the sternum.

The fibres cross the *anterior superficial pectoral* obliquely and deep to it, for insertion to the humerus. The elephant bears a closer resemblance to the human arrangement than to that of lower mammals.

MIALL AND GREENWOOD describe *Pectoralis major* consisting of two distinct parts—the *superficial*, arising from the fore-part of the sternum and the *deep* portion arising from the posterior two

thirds of the sternum and passing beneath the former for insertion to the greater tuberosity of the humerus.

In this specimen the pectorals are arranged in two layers. The superficial layer consists of only one muscle. The deep layer consists of two muscles—anterior and posterior deep pectorals. The anterior deep pectoral is ribbon-like, arising from the anterior border of the distal end of the first rib and lies deeper to the *Brachial plexus* resembling the *scalenus ventralis* of ox and horse. It passes upwards for insertion to the scapular fascia over the *supraspinatus*, resembling the condition in the horse. The *posterior deep pectoral* is the largest as in the ox and horse having similar attachments and relations with the subcutaneous thoracic nerve, vein and artery. The posterior superficial pectoral described by EALES and the deep part of *pectoralis major* described by MIALL & GREENWOOD is really the posterior deep pectoral judged by its attachments, position and relations with cutaneous muscle of the trunk, subcutaneous thoracic nerve, vein and artery. One familiar with the pectorals of the ox and horse will see the striking resemblance of the posterior deep pectoral of the elephant with the same muscle of the two types of animals. Thus, pectorals of the elephant resemble those of the ox and horse, though the superficial layer consists of only one muscle.

(iii) *Relation of triceps with latissimus dorsi.*

Others have not laid any emphasis regarding the relations of these two muscles. EALES specially emphasises their extent of development and their relations. *Latissimus dorsi* is enormously developed. The muscle blends with triceps and with the latter runs towards olecranon for insertion by a long tendon. Its connection with triceps is strong which condition is unknown in any other mammal. The firm fixation of *latissimus dorsi* to triceps strengthens the attachment of the limb to the body to assist in the support of the huge body on the pillar-like limbs.

In this specimen the attachments of the muscles and their relations are far more extensive and different from those observed by others. The origin of *caput magnum* is not only from the axillary (posterior) border of scapula but also from the lower third of *infraspinous fossa* indicating the strong connection between the scapula and olecranon not seen in other mammals. The origin of *latissimus dorsi* is very extensive from ribs 4-14. The insertions of the muscle are very many. Most of the fibres of its dorsal and lateral parts are inserted to the posterior border of *caput magnum* and other fibres enter the axilla, blend with the tendon of *teres major* and inserted to the neck of humerus. Remaining fibres of the lateral part are inserted to the

aponeurosis on the medial face of *caput magnum*. Fibres of the ventral part blend with the cutaneous muscle of the trunk. Such extensive attachments of *latissimus dorsi* are not seen in any other mammals except the ox where they are much less than in the elephant. The intimate relation of *latissimus dorsi* with triceps is like a door bolted and locked both inside and outside for serving two important purposes. The one is to strengthen the attachment of the limb to the body for bearing the huge weight of the animal on pillar-like limbs and the other is to effectively check any tendency to abduction of the limb which is for the safety and well being of the elephant.

(iv). *Capsularis.*

PATERSON & DUN (cited by WINDLE & PARSONS) noticed in the Indian Elephant *subglenoid muscle* arising from the axillary part of the subscapular fossa in front of triceps, which passed below shoulder capsule for insertion to the posterior surface of humerus below the head. EALES states that it is not present in the foetus. MIALL & GREENWOOD have missed it in the adult Indian Elephant they dissected.

In this specimen, two *capsularis* muscles were observed over the capsule of the shoulder. (a) *Capsularis anterior*, being very small and vestigial on the anterior aspect of the capsule, appears to be of no consequence. (b) *Capsularis posterior*, is well developed, arising from the posterior part of the glenoid rim, blends with the capsule and is inserted to the posterior face of humerus below the head. This muscle in this foetus is much better developed than its homologue in the adult equine and is the same as *subglenoid muscle* of Patterson and Dun.

(v) *Anconeus.*

EALES states that the muscle is small and fleshy, set very low so that its position in the elephant recalls that in the human subject. It arises close to the condyloid ridge of humerus. Some fibres pass straight to the upstanding olecranon, but do not, as in many mammals fill the fossa. The bulk of the muscle however, is wrapped round the lateral face of the joint and is attached to the ulna at the root of the olecranon covered by *extensor carpi ulnaris*.

MIALL & GREENWOOD observe that it arises chiefly from the back of the external condyloid ridge, some of the upper fibres taking origin from the posterior border of the elastic ligament of the forearm and some of the deeper fibres from the superior tendon of *extensor carpi ulnaris*. From this origin the muscle spreads out and is inserted into a triangular surface on the outer side of the ulna, immediately beneath olecranon, apex of the triangle situated nearly half way down the shaft.

WINDLE & PARSONS note its presence. They with EALES cite TESTUT as the only one to find *Epitrochleo anconeus* which was missed by others.

In this specimen it is described as having two parts—dorsal part small and ventral part being larger. Dorsal part and its attachments agree with those recorded by EALES. The ventral part appears to correspond to *Epitrochleo-anconeus* of TESTUT, whose insertion extends as low as about the middle of the ulna. TESTUT does not give attachments, though he was the only one to note its presence.

(vi). *Pronator teres*.

EALLES states that it is absent in the foetus. MIALLE & GREENWOOD observe that a strong ligament which may represent this muscle, springs from the inner side of the internal condyle of humerus about the level with flexor carpi radialis but in front. This passes obliquely over muscles and vessels and inserted to the middle of radius for about two inches, expanding greatly. Beneath it, towards the radial extremity, are some muscle fibres, which spread out towards their insertion as a small triangular muscle, continuous with the ligament and covered by it superficially.

WINDLE & PARSONS observe that there is always a strong fibrous band running from the internal condyle to the middle of radius, but this is usually reinforced by some fleshy fibres. CUVIER says that this fleshy part is only found close to the flexor carpi radialis; but ANDERSON, PATERSON & DUN describe it as lying deep to the fibrous band, and having an attachment to radius about 5" long. The specimen in the Royal College Museum agrees with Anderson's description.

In this specimen the muscle is well developed. The fibrous band referred by others is the medial ligament of elbow which is blended along its posterior border. The extent of medial and posterior faces of radius covered indicates its great development and this finding agrees with those of Anderson, Paterson and Dun.

(vii). *Fasciae*.

The fascia of the limb is remarkable in the Elephant having abundance of elastic fibres. In the arm, the deep fascia is very thick, forming a thick strong band descending from the acromian process and covering the brachiocephalicus and brachioradialis. In the forearm both the superficial and deep fascia are in the form of thick aponeurosis containing numerous elastic fibres and forming strong investments to support the muscles. The deep fascia forms an oblique band of

considerable thickness extending from the lateral epicondyle of humerus to the distal end of ulna. Such remarkable development of fascia rich in elastic fibres is not seen in any other mammal except the tunica abdominalis of larger herbivorous mammals as ox and horse to support the abdominal muscles for sustaining the weight of bulky digestive viscera.

3. Nerves.

The nerve muscle relations are identical with those seen in other mammals—radial nerve supplying extensors, ulnar and median nerves supplying flexors on the postero-lateral and postero medial aspects of the of limb respectively. The dorsal digital nerves run subcutaneously. The musculo-cutaneous nerve (median) of the forearm contributes I, II and III dorsal digital nerves. The radial nerve furnishes fibres to form one the IV dorsal digital nerves with fibres from the ulnar. The ulnar nerve furnishes the V dorsal digital nerve, a IV dorsal digital nerve and fibres to unite with those of radial nerve to form the other IV dorsal digital nerve. Thus, the radial nerve in the elephant contributes the least number of fibres for the dorsal digital nerves, unlike in Man and other Mammals as ox and horse where it contributes greater number of fibres.

As in Man and other Mammals, the (palmar) volar digital nerves derive fibres mostly from the Median nerve and few from the ulnar nerve. The Median nerve forms I, II, III and IV volar digital nerves and the ulnar nerve forms the V volar digital nerve. Unlike the dorsal digital nerves, the volar digital nerves run deeply along the tendons of the deep flexor.

4. Arteries.

The *Deep palmar arch* from which three sets of branches arise, is identical with the condition in the human subject which is not seen in any other animal. Dorsal digital arteries are the perforating branches from the arch and the palmar or volar digital arteries are the descending branches from the arch.

The vascular relations with the muscles is the same as seen in other Mammals.

5. Veins.

The veins in general are very large forming intricate plexuses at frequent intervals. The pectoral venous plexus is very remarkable which is not seen in other animals.

6. Lymphatics and Lymphatic Glands.

They are absent. Only haemolymph glands—two in number were found in the axilla and none lower down in the limb.

Summary.

1. The cutaneous muscle of the trunk is very extensive and well developed as in ungulata having *abdominohumeralis* and *dorsohumeralis*.
2. The pectorals resemble those of the ox and horse though the superficial layer has only one muscle. The posterior deep pectoral is the largest.
3. The great development of triceps and latissimus dorsi with their intimate relation by attachments serves two important purposes—to strengthen the attachment of the limb to the trunk for bearing the huge weight of the animal on the pillar-like limbs and to effectively check any tendency to abduction of the limb to ensure its safety and well being. Such condition is not seen in any other mammal.
4. Two capsularis muscles are observed. Capsularis anterior though small and vestigial has not been observed by the previous workers. Capsularis posterior is very well developed which has escaped the notice of previous workers except Patterson and Dun who described it as subglenoid muscle under subscapularis.
5. Pronator teres is greatly developed.
6. Anconeus consists of two parts-dorsal part is small and the ventral part is larger corresponding to *Epitrochleoanconeus* of testut.
7. Lumbricales - only one for the IV digit is developed.
8. Interossei - Dorsal interossei are 4 thin slips, poorly developed. Palmar interossei are 4 thick bundles, well developed.
9. There are 7 muscles acting on the V digit - 2 extensors, 3 flexors, 1 abductor and 1 opponens. There are 4 muscles acting on the I digit - 2 extensors and 2 flexors.
10. The fasciae are remarkably developed with abundance of elastic fibres to form strong fascial bands in the arm and forearm. In the forearm both the superficial and deep fasciae are thick elastic membranes forming investments for muscles to support them. This feature is not seen in any other mammal.
11. In the available literature only the nerves supplying the muscles are noted. Details of the formation of brachial plexes and the nerves arising from it, their course and relations with muscles, cutaneous nerves and formation of digital nerves and their disposition is described.
12. Regarding the arteries of the limb there is hardly any information in the available literature. Details of arteries, their

The Anatomy of the Foetal Indian Elephant.

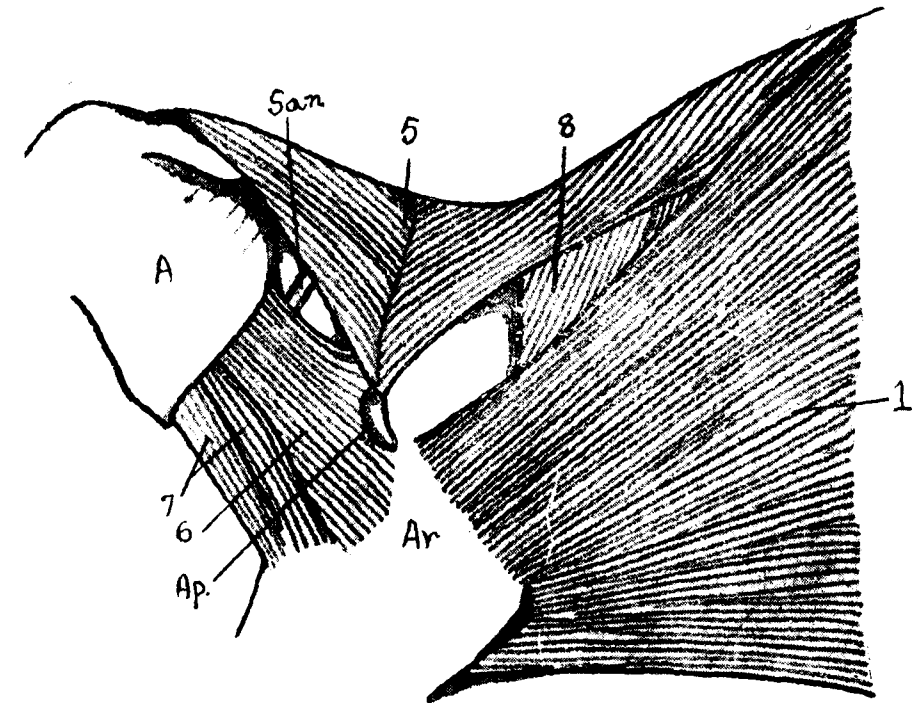


Fig. 1

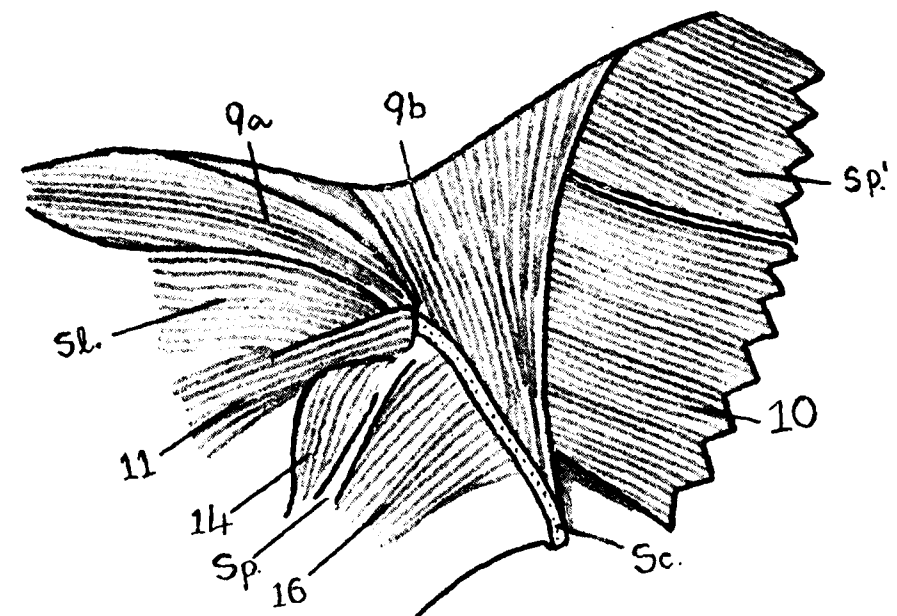


Fig. 3

The Anatomy of the Foetal Indian Elephant.

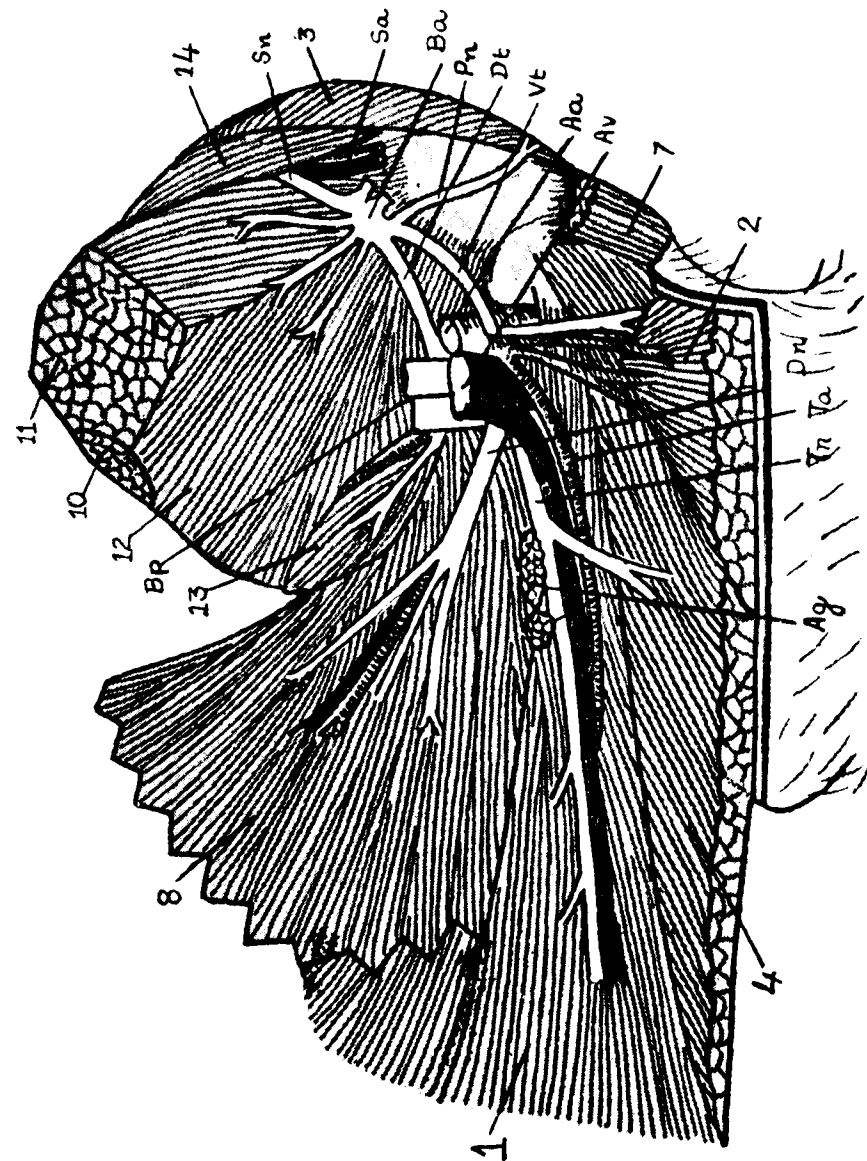


Fig. 2

The Anatomy of the Foetal Indian Elephant.

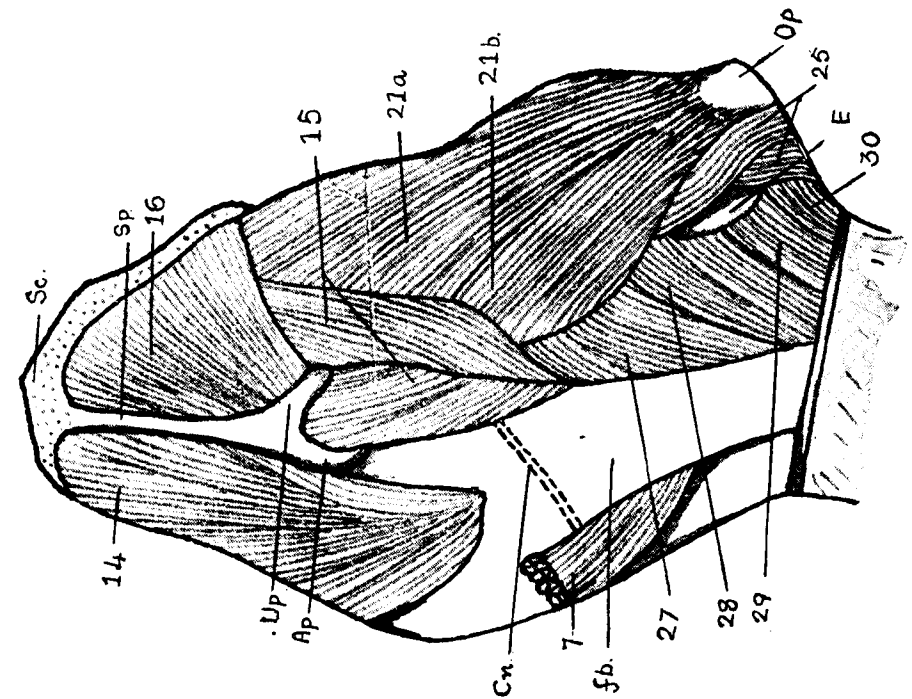


Fig. 3

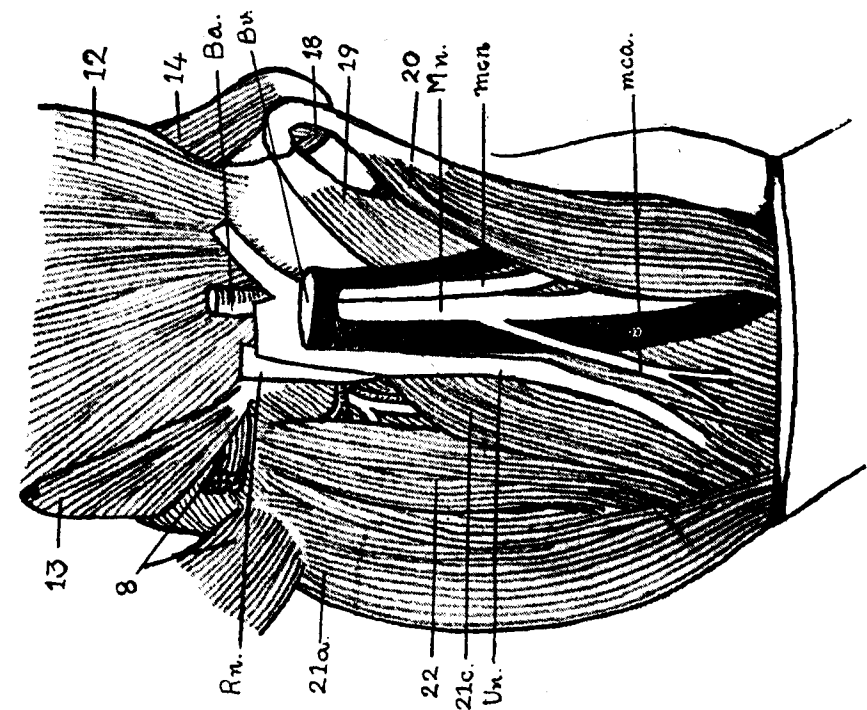
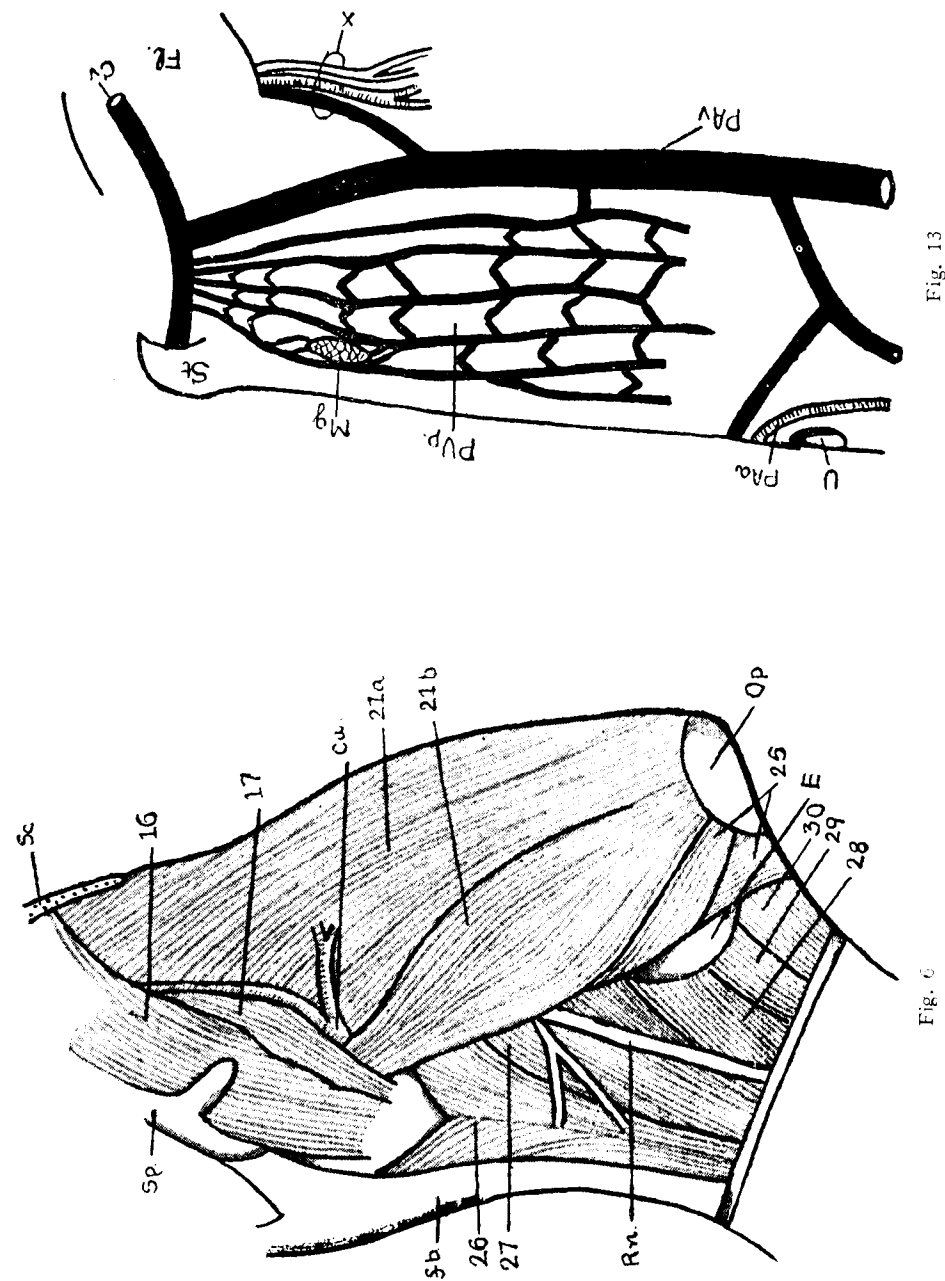
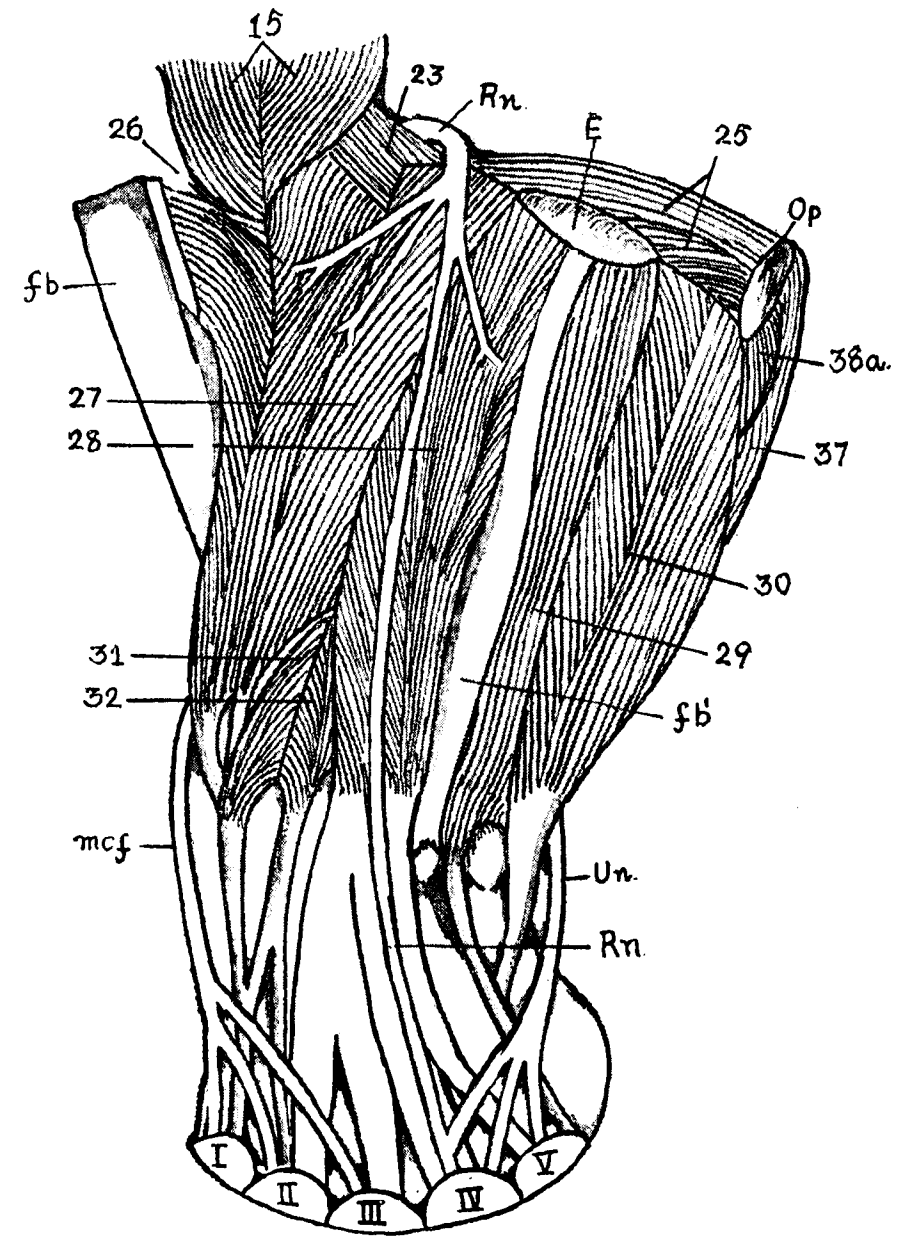


Fig. 4

The Anatomy of the Foetal Indian Elephant.



The Anatomy of the Foetal Indian Elephant.



The Anatomy of the Foetal Indian Elephant.

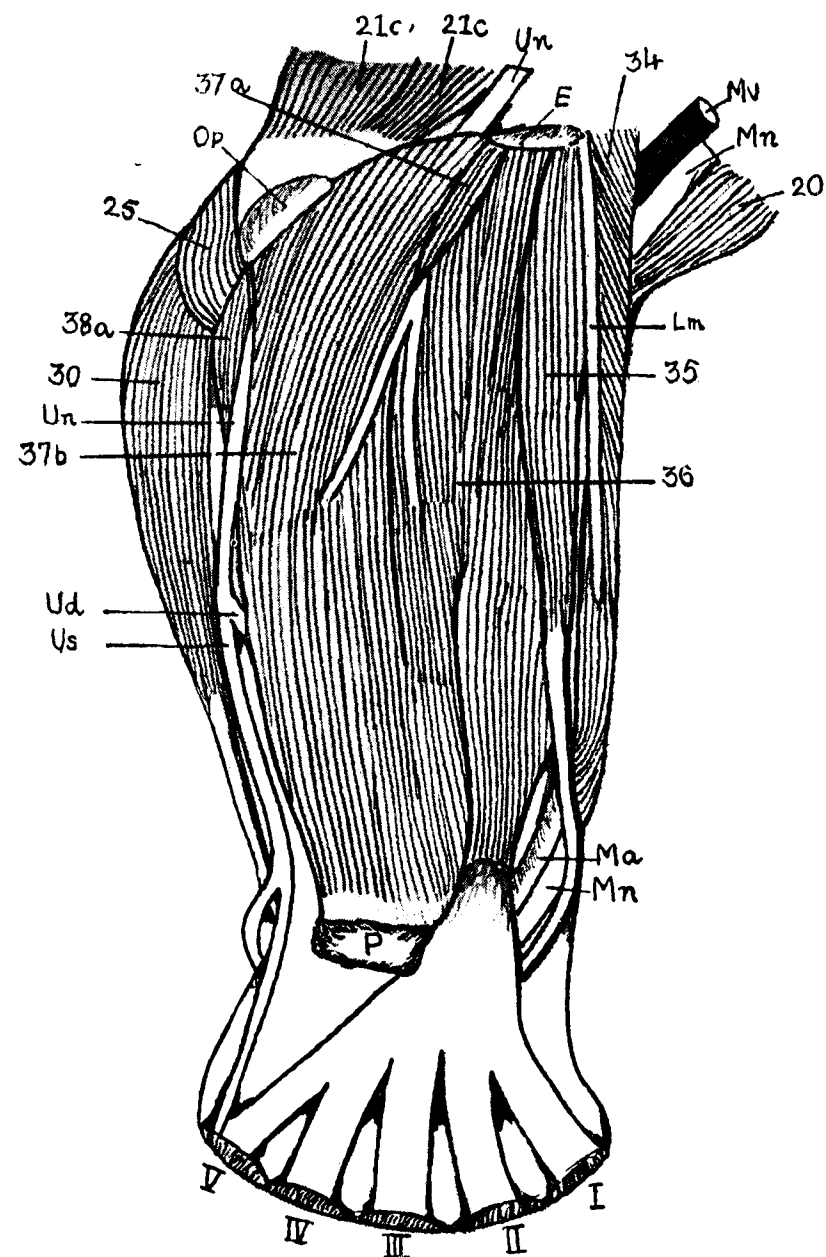


Fig. 8

The Anatomy of the Foetal Indian Elephant.

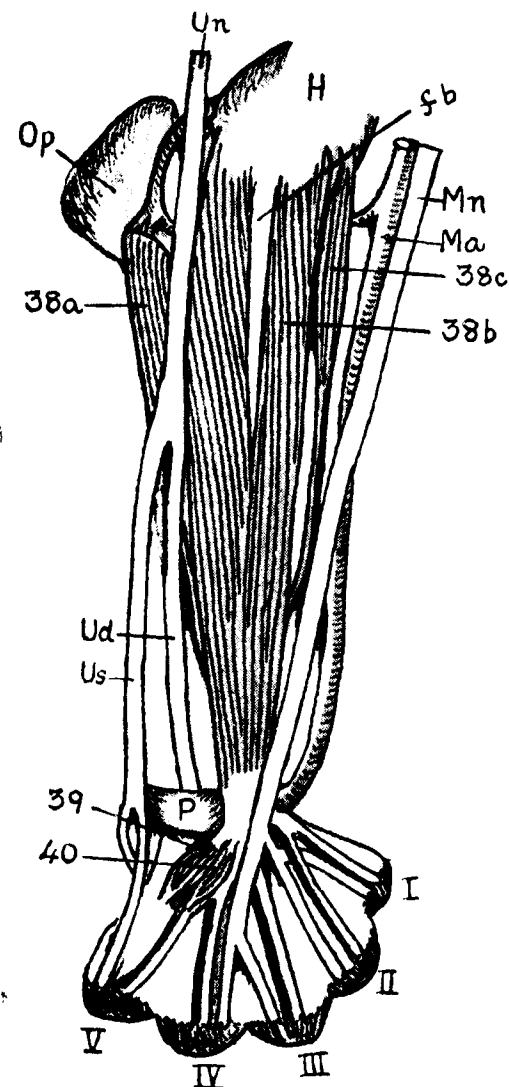


Fig. 9

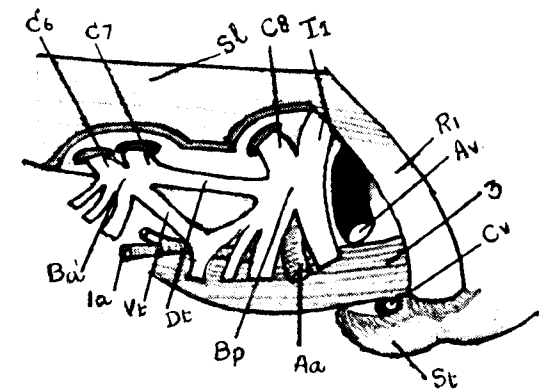


Fig. 10

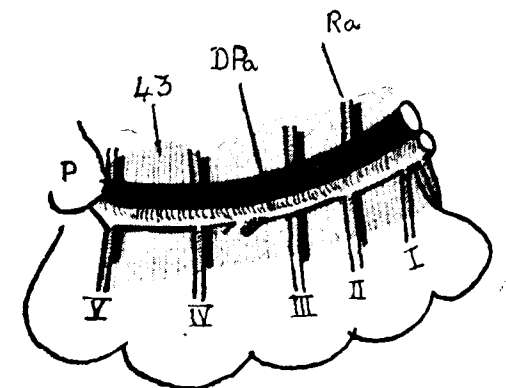


Fig. 11

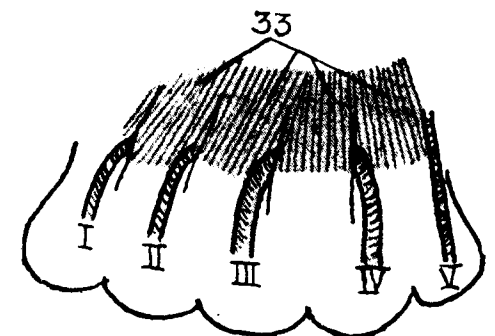


Fig. 12

The Anatomy of the Foetal Indian Elephant.

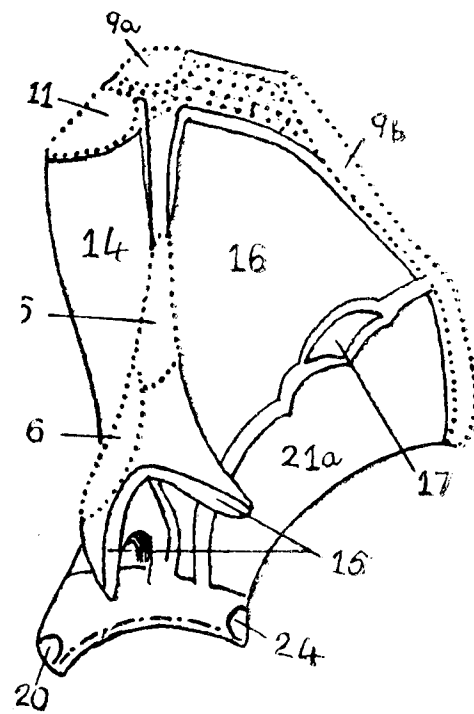


Fig. 14

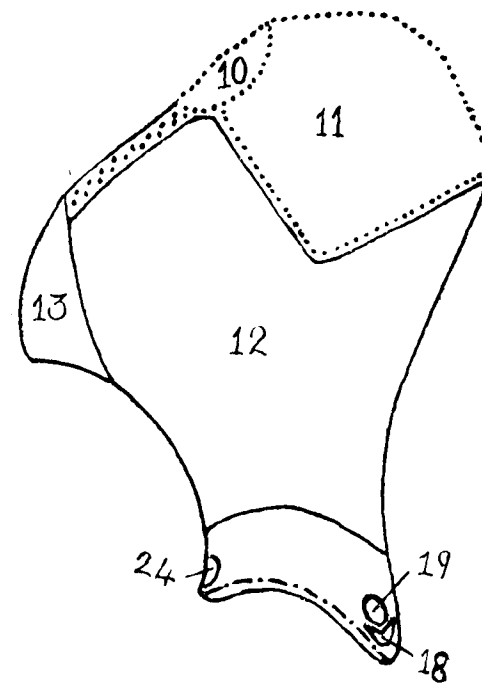


Fig. 15

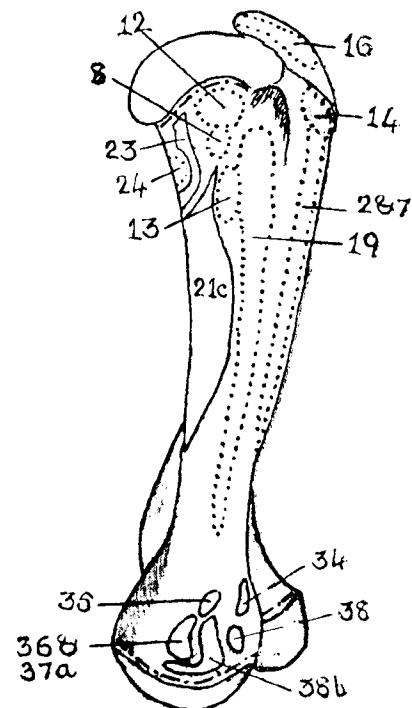


Fig. 16

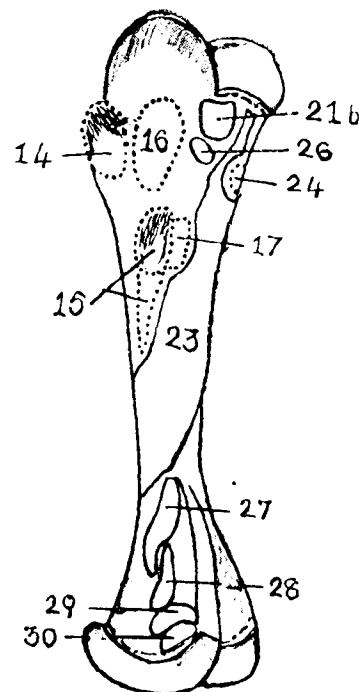


Fig. 17

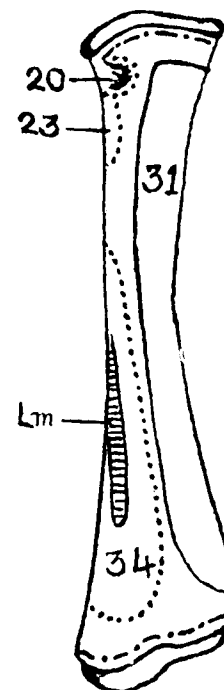


Fig. 18

The Anatomy of the Foetal Indian Elephant.

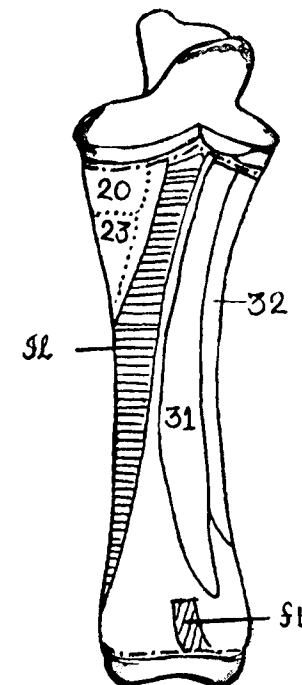


Fig. 19

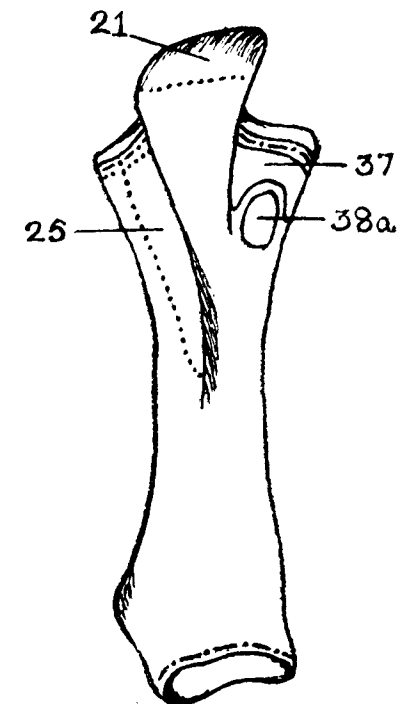


Fig. 20

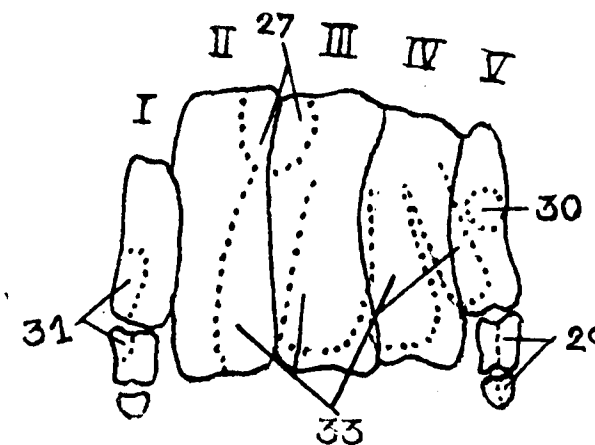


Fig. 21

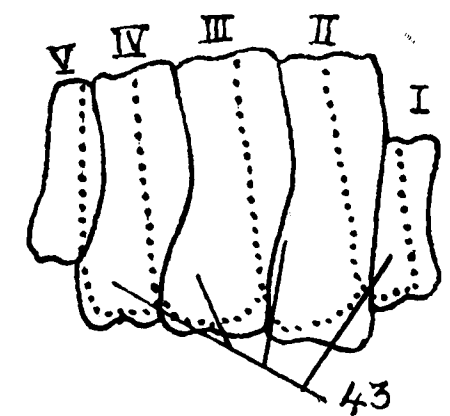
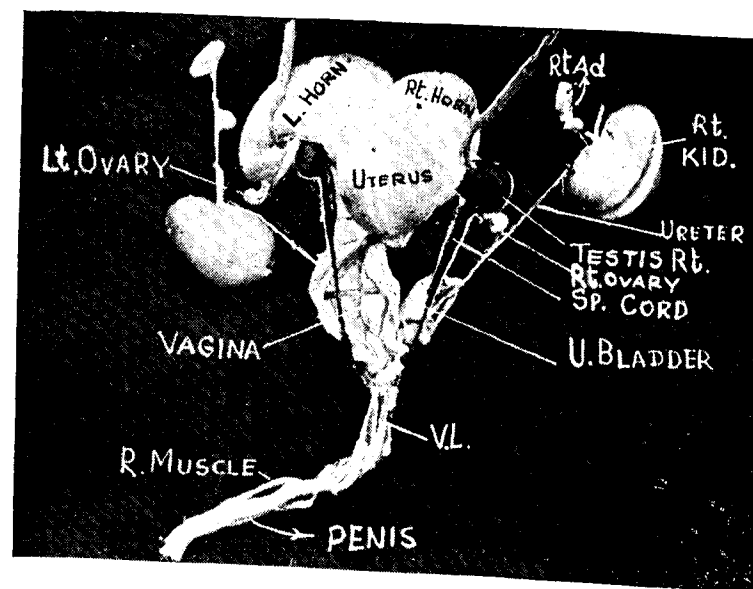


Fig. 22

A Case of True Hermaphroditism in a Goat

By

M. N. JAMDAR, G.B.V.C.



Key to Plate

Urino-genital organs of a goat showing hermaphroditism.
 Rt-Kid:—Right Kidney. Rt. ad:—Right adrenal. Sp. cord:—
 Spermatic cord. Rt. ovary:—Right ovary. V. L.:—A portion of
 the pelvic urethra opened up. R. Muscle:—Retractor muscle of
 the penis. Lt. ovary:—Left ovary. Testis Rt.:—Right testis.

[Vide article on page 230.]

Occurrence of *Setaria Cervi* in the Liver of Cattle

By

T. VASUDEV, M.Sc.



[Vide article on page 233.]

muscular supply, formation of Deep Palmar arch, dorsal digital arteries and palmar digital arteries are described.

13. Great development of veins and venous plexuses that are peculiar to the elephant are recorded.

14. Lymphatics and lymph glands are practically absent in the Elephant. Instead there are haemolymph glands. In the axilla two haemolymph glands are noted on the course of the subcutaneous thoracic artery.

LIST OF ABBREVIATIONS USED IN FIGURES

A.	auricula.	Op.	Olecranon process.
Ar.	arm.	P.	Pisiform.
Ap.	acromian process.	PAV.	Posterior abdominal vein.
Aa.	axillary artery.	PVP.	Pectoral venous plexus.
Av.	axillary vein.	PAa.	Posterior abdominal artery.
Ag.	axillary haemolymph glands.	Rn.	Radial nerve.
Ba.	Brachial artery.	Ra.	Recurrent artery.
Bv.	Brachial vein.	RI.	I Rib.
Bp.	Brachial plexus — posterior part.	San.	Spinal accessory nerve.
Ba.	Brachial plexus — anterior part.	Sp.	Scapular spine.
Cn.	circumflex nerve.	Spl.	Serratus posticus.
Ca.	Posterior circumflex artery.	Sc.	Scapular cartilage.
C6.		Sn.	Suprascapular nerve.
C7.		Sa.	Suprascapular artery.
C8.		Sl.	Splenius.
Cv.	Cephalic vein	Sl'	Scalenus.
Dt.	dorsal communicating trunk.	St.	Sternum.
Dn.	Thoraco-dorsal nerve.	Ta.	Subcutaneous thoracic artery.
Dpa.	Deep palmar arch.	TI.	I Thoracic spinal nerve.
E.	Epicondyle.	Un.	ulnar nerve.
Fl.	fore-limb.	Ud.	Deep division of ulnar nerve.
fb.	Fascial band.	Us.	Superficial division of ulnar nerve.
H.	Humerus.	Up.	uncinate process.
Ia.	Inferior cervical artery.	U.	umbilicus.
Lm.	Medial ligament of elbow.	Vt.	ventral communicating trunk.
Mn.	Median nerve.	X.	Subcutaneous thoracic nerve, artery and vein.
mcn.	Musculocutaneous nerve.		
mcf.	Musculocutaneous nerve of forearm.	I	
mca.	Medial cutaneous nerve of arm.	II	
Ma.	Median artery.	III	
Mv.	Median vein.	IV	
Mg.	Mammary gland.	V	

EXPLANATION TO FIGURES

Muscular origin is marked by continuous line.
 Muscular insertion is marked by dotted line.
 Attachment of joint capsule marked by dash and dot.
 Nerves and arteries not traced (?)

- Fig. 1. Lateral view of left shoulder, neck and trunk.
 Numbers in the figures correspond to those given to muscles in the text.
 Fig. 2. Medial view of the left shoulder and arm.
 Fig. 3. Lateral view of the left shoulder, neck and trunk-deeper layer.
 Fig. 4. Medial view of the left shoulder and arm.
 Fig. 5. Lateral view of the left shoulder and arm.
 Fig. 6. Lateral view of the left arm and forearm deeper layer.
 Fig. 7. Lateral view of the left forearm and manus.
 Fig. 8. Medial view of the left forearm and manus.
 Fig. 9. Volar aspect of the left forearm and manus - deeper layer.

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- Fig. 10. Left view of the base of neck at the thoracic inlet.
 Fig. 11. Volar view of the left manus.
 Fig. 12. Dorsal view of the left manus.
 Fig. 13. Left side of the trunk - deeper layer.
 Fig. 14. Lateral face of the left scapula.
 Fig. 15. Costal face of the left scapula.
 Fig. 16. Medial face of the left humerus.
 Fig. 17. Lateral face of the left humerus.
 Fig. 18. Anterior face of the left radius.
 Fig. 19. Anterior face of the left ulna.
 Fig. 20. Posterior face of the left ulna.
 Fig. 21. Dorsal view of the left metacarpus and digits.
 Fig. 22. Volar view of the left metacarpus and digits.

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BOVINE HAEMATURIA IN DARJEELING DISTRICT AND ITS TREATMENT

By

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Since Kerr (1925) pointed out the existence of the disease in Darjeeling district, there have been many attempts to identify the actual etiology of the disease on the one hand, and to effect a cure on the other by many workers.

McGregor (1934) and later Datta (1934 and 1952) incriminated a hypothetical protozoon to be the cause of the disease, and Datta (1934) having, identified a round body, constantly present both in the affected urine samples as well as in histopathological materials, christened it "Entamoeba Kamala new Spp," and he held these round bodies as the etiological agent of the disease, while compiling a thesis on it. Clinical workers often reported about the incidence of this disease, characterised

by passage of entire blood-corpuscles in urine, to occur in many other damp and hilly districts of India characterised by acid soil, and by the chronic nature of the disease which failed to respond to any specific treatment, but which nevertheless yielded to temporary abatement of symptoms under varied therapeutic measures which were difficult to account for on scientific lines.

Sen (1951) drew attention to the wide spread incidence of this disease in Darjeeling district causing serious economic loss and drew attention of the authorities for immediate necessity of scientific work in order to dispel the incurable nature of the disease and stop the huge economic loss incurred by the incidence of this disease. Forsyth (1952) repeatedly pointed at the acidcreeper "Oxalis corniculata" growing wild within the district, as having a possible connection with the etiology of the disease.

Nandi (1954) having investigated the disease in its home district, successfully isolated pure cultures of only two organisms constantly present both in the affected urine as well as in the morbid materials collected from postmortem examinations. One was identified as 'conyne-bacterium renale,' isolated, and agreed fully with the typical description of the same organism in literature.

The saprophytic contaminant was unfortunately rather deceptive, and in wet urine smears these large sized motile bacteria exhibited a sharp flagellate movement always easily seen under the oil immersion lens. What actually was responsible for this sharp flagellate movement, could not be identified at first, however, as these bacteria did not withstand flame fixation, and could not be traced after such treatment, and for the demonstration of these bacteria osmic acid vapour fixation of urine smears mixed with serum had to be taken recourse to.

Besides these two bacteria certain round bodies of variable size were constantly present in 24 hour old urine samples and in cultures made from fresh urine. Datta (1934) described these round bodies as amoebae and a motility seen by him in wet urine smears was attributed to these round "occult bodies" and he described their movement as "amoeboid" movement. The present author came across these "Entamoebae" of Datta in old urine samples, cultures of fresh urine, as well as those superimposed on histopathological sections.

These round bodies grew in millions on any solid or fluid medium when inoculated with haematuria urine, and failed completely to show the existence of a nucleus or a kineto nucleus, and as such they could not be classed as protozoons, like entamoebae. Besides, these were found to be non-motile entities and hence these bodies were considered

not to be responsible for exhibiting the sharp flagellate movement so clearly seen in wet smears under oil immersion.

Certain pathological slides accidentally revealed these round bodies in a stage of formation by segmentation from very large, thick, gram positive rod shaped organisms superimposed on sections stained by Gram Weigert's method.

Moreover, while studying the invitro effects of various antibiotics and soluble sulpha drugs on the main bacteriae it was clearly seen that these round bodies were being continuously produced from very large bacterial bodies which were the main contaminants of *C. renale* in urine samples. Besides, these large sized bacteriae in pure culture when made into wet smear under the oil immersion with irrigated stain, exhibited the same sharp flagellate movement as a fresh urine sample made into a smear. Hence, the motility attributed to the round bodies by Datta, and described as amoeboid movement is actually due to motile flagellated bacteria. Culturally these motile bacteria proved to be aerobic, gram positive, rod shaped bacteria and the inseparable round bodies proved to be spores of these organisms, of which sporulation occurred in contact with air. In pure culture these bacteriae turned out to be completely non-pathogenic even after intravenous inoculation to rabbits and intraperitoneally to guineapigs in very large doses. Hence, the organisms turned out to be non-pathogenic members of the genus bacillus as are all saprophytic aerobic motile spore-forming rod shaped organisms.

Their constant presence in Haematuria Urine in the Himalayas has been further explained by the fact that chronic haematuria is characterised by a chronic suppurative type of nephritis as one of the symptoms and these bacteria have been shown, during the present investigations, to be present in almost any chronic nephritic Urine containing pus, obtained whether from carnivores or herbivores. They make up a constant feature of pus whether that be derived, from kidney or from any other organ or site. Finally, as a saprophytic contaminant of nephritic urine these large motile bacilli as well as their spores do not seem to have any bearing on the etiology of Bovine Haematuria.

Having thus eliminated one organism, the only other organism of which the constant presence was statistically supported was "*Corynebacterium renale*". This organism, it will be recalled, has been shown by Weitz (1947) to be a commensal of the Urinary tract in many bovines and is not necessarily pathogenic in every case.

Lovell (1951) has shown that for *C. renale* to assume pathogenicity, a "Subsidiary factor" is invariably necessary, in the nature of a kidney irritant. Moreover, the findings of Ernst (1905), Feenstra (1945, 1949), Morse (1947), Lovell (1951), Lovell and Cotchin (1952),

all strongly support the views of Lovell regarding the feasibility of *C. renale* to assume pathogenicity under these conditions.

A search for the subsidiary factor (or factors) in the Indian hills show that, in the area where the disease is enzootic, as a custom the cattle are not given any grass fodder or rice straw as roughage, but the roughage these animals get, is whatever they can get by grazing on wild vegetation or are stall fed with cut weeds, ferns and wild plants which are abundant in the acid soil of the hills, a flora rich in essential oils, exalic acid, tannins, and glucosides, in various species enumerated previously (Nandi 1954). These ingredients in large quantities being mostly toxic to the kidneys and bladder, enroute to their excretion, their uninterrupted use would easily act as a subsidiary factor of Lovell to enable the kidney commensal *C. Renale* to assume a pathogenic role and bring about toxic degeneration and final necrosis of the excretory tubules as well as complete erosion of the Transitional Epithelium in isolated patches showing haemorrhage.

Histopathology revealed toxic damage of the kidney tubules and pelvis with gram positive diptheroids clearly visible in situ within the lesions. This also revealed complete erosion of the bladder epithelium in many areas, exposing blood sinuses of the submucosa, which remain patently open and account for the continuous outpour of entire red blood corpuscles and serum in the urine.

The very fact of *C. renale* being its main etiological agent as well as the Histopathology as seen in some very extreme cases, hinted at the possibility of the Indian cattle Disease under investigation, being similar to "Bovine Cystitis and Pyelonephritis" of Europe and America, which is also characterised by the passage of entire red blood corpuscles in urine.

Treatment

Accordingly, this problematic disease which was up to 1954 regarded as incurable in India, demanded an honest attempt to cure it. Temporary abatement of the disease has been achieved by many workers by the use of urinary antiseptics, and in other cases by the use of calcium therapy and tartar emetic by injection, and other preparations only to see recrudescence of the trouble in the same animal at a later date.

Affected animals have all been known to die in about three years' time in a very emaciated and debilitated condition, apparently because no treatment had so far proved specific to bring about a cure.

In vitro treatment of a pure culture of *C. renale* obtained from fresh haematuria-urine when treated with soluble sulphamezathine,

penicillin, and with streptomycin separately, revealed clumping, of the organisms in all cases, with the best effect by penicillin or a combination of penicillin and streptomycin.

A reference to the successful treatment of bovine cystitis and pyelonephritis with penicillin by Arthur (1949) in the field station of Liverpool Veterinary College, and those by Morse (1947) and Fox (1947) in America, as well as from the views expressed by Lovell (1951) regarding the invitro behaviour of *C. renale* towards penicillin, it was thought encouraging to use penicillin in haematuria cases in the Darjeeling district. Accordingly, penicillin in oil was applied in judiciously determined doses according to the advanced nature of the disease, and it was found that the antibiotic stopped haematuria in a remarkably short time of ten days, each animal requiring a sum total of eight to twelve million units of penicillin in oil, given parentally, with an average of one million units daily.

By this treatment urine has been rendered free from blood corpuscles on the sixth day and free from corynebacteria by the ninth day, approximately.

Very advanced cases, however, where kidney damage is thought to be beyond repair, have not been selected yet, on account of the valuable nature of the antibiotic concerned.

Summary

1. *Corynebacterium renale* along with a subsidiary kidney irritant factor present in wild fodder plants, is held to be responsible for the etiology of the disease. The irritant subsidiary contains oxalic acid, essential oils, tannins and Gluco-sides etc. which cause primary kidney damage enroute to excretion, when cattle are allowed to consume those wild plants, as fodder continuously and without a break.
2. *Corynebacterium renale* proves pathogenic after the toxic plants have caused primary damage, allowing the bacteria to cause extensive tubular degeneration and erosion of bladder epithelium and consequent bleeding.
3. In vitro and invivo treatment of *C. renale* with penicillin in oil in large doses prove to be specific and the antibiotic can be successfully used to cure the disease now rampant not only in Darjeeling district, but also in Nepal, Sikkim, Nilgiri hills etc.

Acknowledgment

Sincere thanks are due to Dr. A. A. Forsyth, M.R.C.V.S., F.A.O. Technical Expert to West Bengal Government (1951-53) for valuable help.

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General Articles

STUDIES OF SOME EFFECTS OF THYROPROTEIN ON GROWING CHICKENS

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Among the many problems confronting poultrymen, those relating to growth, egg production, development and maturity of chickens have rightfully deserved much attention recently. While disease control, feeds and feeding, proper management and breed qualities are equally important considerations, it seems that vital adjuncts in the solution of these problems are being sought in other fields. The use of hormones, vitamins and antibiotics is the latest resort that appears to have given encouraging results.

In recent years, the thyroid gland, as well as its hormone thyroxine, was one of those that received considerable study on its effects upon growth and development of chickens. Desiccated thyroid gland and thyroxine were used separately in various feeding experiments. However, the expense involved in the preparation of the natural hormone has been prohibitive, so that attempts have been made to produce the synthetic product. In 1942, Reineke and Turner

(5) developed the commercial thyroprotein (iodinated casein), which is claimed to have practically the same actions as thyroxine.

Before the development of synthetic thyroprotein, numerous experiments have been conducted to determine the effects and uses of thyroid materials. Reineke and Turner (5) reported that the thyroid is essential for maximum egg production, and that this can be regulated by feeding synthetic thyroprotein in definite amounts in the feed throughout the year. Irwin and his co-workers (1) produced slightly heavier chicks in the treated group than the controls, at the age of twelve weeks, and observed that the growth of feathers was improved as the level of thyroprotein in the mash was increased. Parker (4), working independently on similar experiment, noted the same results and claimed further that thyroprotein-fed chicks utilized their feed more efficiently than did the controls.

Turner, Irwin and Reineke (7) made the observation that a higher level of iodinated casein, when fed to Barred Plymouth Rock cockerels, caused them to grow slightly slower than those in the control group. They found later that thyroprotein had beneficial effects when fed to young chicks, and during the summer months, when fed to laying hens. Wheeler, Hoffmann and Graham (8), using thyroprotein on Rhode Island Red chicks, improved the growth and caused slight feathering at the age of twelve weeks.

Todd (6) claimed that a mild hyperthyroid condition brought about by feeding thyroprotein aided chicks to overcome the effects of worm infestation and induced a more rapid recovery from loss of weight. Moreng and Shaffner (3) combined this preparation with thiouracil in a feed mash for a period of four to six weeks to reach an optimum degree of hyperthyroidism for growth and fattening. According to Kumaran and Turner (2) the role of thyroxine in reproduction in mammals has been studied considerably, especially in the female, and in poultry its effect has been confined chiefly to the problems of growth and egg production.

The object of the present study is to determine some effects of thyroprotein (iodinated casein) on growing chickens, New Hampshires and White Leghorns, from one day to twenty-four weeks old, under local conditions.

Materials and Methods

Sixty one-day old chicks, thirty New Hampshires and thirty White Leghorns, were used in this study to start with. These chicks were purchased from the poultry project of the Alabang Stock Farm, of the Bureau of Animal Industry at Alabang, Rizal.

Each bird was provided with a numbered wing band for identification. On the first day of the experiment, the individual chicks were weighed before they were given their first feed. Then, ten New Hampshires and ten White Leghorns were separated to serve as controls, while the remaining forty were the experimental.

During the first five weeks; the chicks were kept in an improvised brooder in one room of the College building, with two 70-watt electric light bulbs serving as the sources of heat. They were taken out in the morning for one hour whenever there was bright sun, for the much needed sunshine. On the sixth week, they were transferred to a poultry house with separate pens and yards for the control and the experimental birds.

Feed hoppers and drinking fountains were provided in each pen. The basic feed used in this study was "Ful-O-Pep" manufactured by the Quaker Oats Company, Portland, Oregon, U.S.A. During the first twelve weeks, chick starter of this brand was used.

The thyroprotein (iodinate casein) used in the experiments had a potency of 3.0 per cent thyroxine. It was prepared by the Cerophyl Laboratories, Inc., Kansas City, Missouri, U.S.A.

The experimental group was fed mash daily containing 0.02 per cent thyroprotein, or 10 grams of the drug for every 100 pounds of feed, while the control group received the same brand of feed mash but without the drug.

During the first five weeks, cod liver oil in the proportion of 500 ml. to 100 pounds of feed was supplemented. Sulfaguanidine and, sulmet, both prepared by the Lederle Laboratories, Inc., New York N.Y., U.S.A., were also given. The former drug was mixed with the feed in the amount of 0.02 per cent, while the latter was added to the drinking water in the proportion of 4 ml. to one liter of water. Vaccination with fowl pox vaccine prepared by the Bureau of Animal Industry, Manila, was instituted when the birds were threatened with fowl pox infection.

From the eighth week, both groups were given scratch feed in addition to the regular ration. After the first twelve weeks, "Ful-O-Pep" growing mash was used as the basic feed of the two groups.

In the course of the experiment, observations were made on the behaviour of the birds, growth of feathers, and on individual weekly gain in weight. From time to time, pictures of average sized representatives of the control and experimental groups were taken in order to show the comparison in general appearance. On the second, fourth,

sixth and eighth weeks, observations on growth of feathers particularly on the wings, tail and back were recorded.

At the end of the twelfth week three males, two from the treated group and one from the control, were killed and posted to see and compare some changes in the internal organs that might have been due to the action of the drug. Six weeks later, four males—two from each group, were again killed and posted and, on the twenty-fourth week, another two cockerels—one from each group, were similarly examined. In all these post-mortem examinations particular attention was given to dressed weight, abdominal fat, size of the testicles and development of the combs.

Result and Discussion

The data obtained in this study are given in Tables 1, 2 and 3, and graphically presented in Figures 1, 2, 3 and 4. It will be seen in Table 1 that the treated birds had a slightly faster rate of growth of feathers than those of the control group as judged by the growth of feathers on the wings, tail, back and on the body as a whole. At the end of the second week when the first observations on feather growth were made, 53.8 per cent of the treated birds had feathers on the wings only; 30.7 per cent had small tail feathers but without back feathers, and 15.3 per cent had fine feathers on the back with large tail; while 58.8 per cent of the control birds had feathers on the wings only; 29.4 per cent had small tail feathers but without back feathers, and 11.7 per cent had fine feathers on the back with large tail.

At the end of the fourth week, 28.0 per cent of the treated group were well feathered on the whole body with long tail, while among the controls, only 25.0 per cent were well feathered. On the sixth week, 71.3 per cent of the treated birds were well feathered compared with 46.6 per cent of the controls. On the eighth week, although both groups were practically equally well feathered, there were still 6.6 per cent of the controls that had feathers on the wings only.

The differences in the rate of feather growth between the two groups were not very great, because the amount of 0.02 per cent thyroprotein in the feed as used in the present work was below the stimulating dose for the growth of feathers. According to Reineke and Turner (5), higher levels of thyroprotein in the feed are more effective than lower levels for stimulating feather growth, and that such growth can be stimulated at the expense of body weight. Similarly, Parerk (4) claimed that a higher level (0.1—0.2 per cent) of this drug is necessary to stimulate the growth of feathers.

Plate I

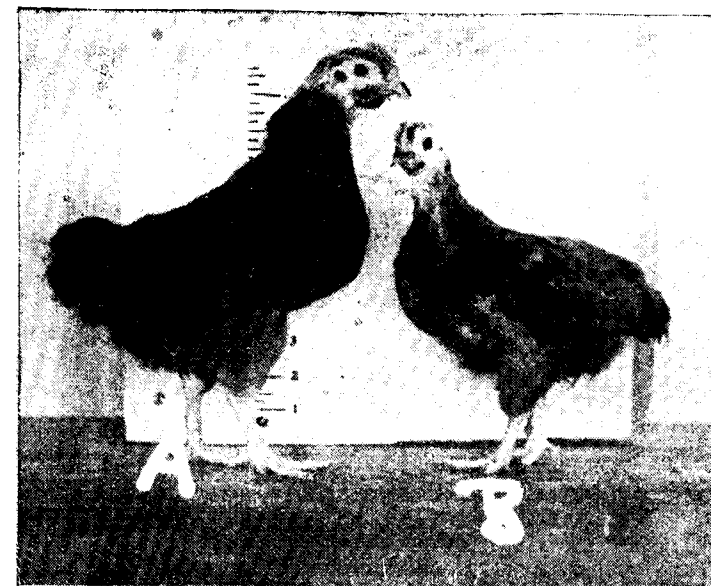


Fig. 1.

Showing the comparison in size between the treated bird (A) and the control bird (B) on the seventh week.

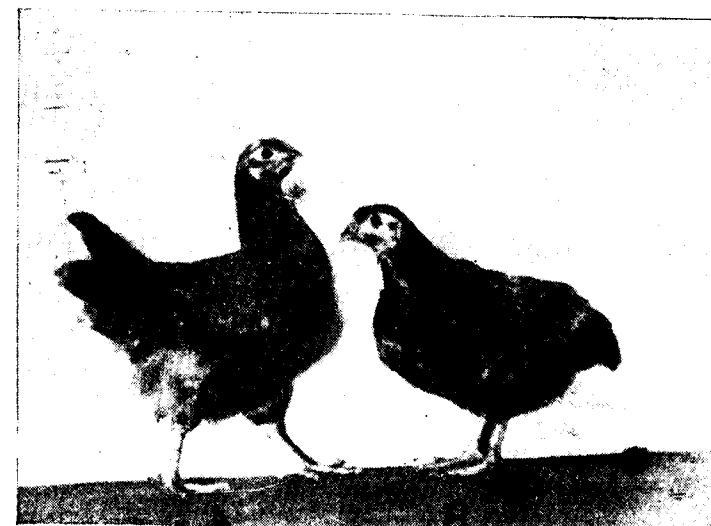
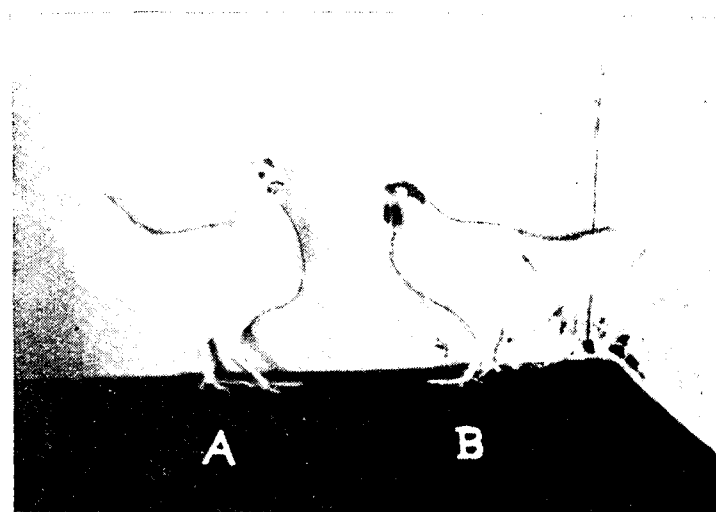


Fig. 2.

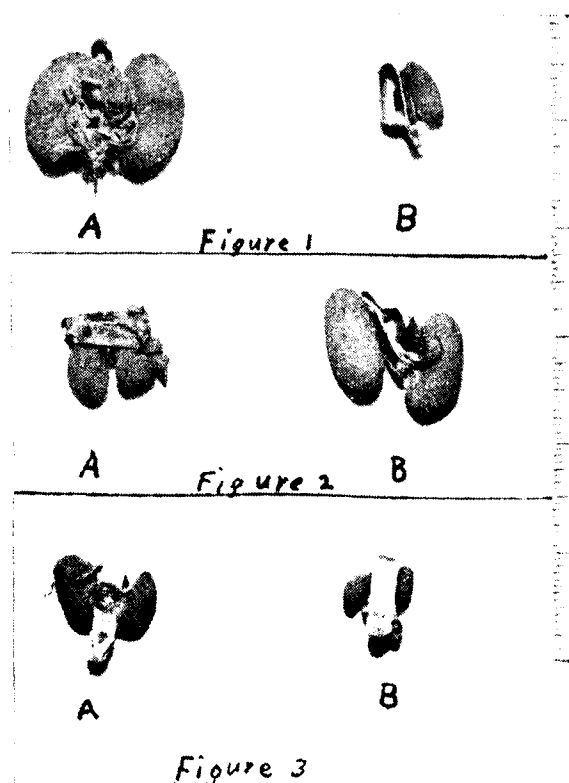
Showing the comparison in size between the treated bird (A) and the control bird (B) on the eighth week.

Plate II



Showing the development of the comb of the treated bird (B) and that of the control bird (A) on the twenty-fourth week.

Plate III



Showing the comparison in size of the testes.

Fig. 1
Testes on the twenty-fourth week.
A—Experimental.
B—Control.

Fig. 2
Testes on the eighteenth week.
A—Experimental.
B—Control.

Fig. 3.
Testes on the twelfth week.
A—Control.
B—Experimental.

SOME EFFECTS OF THYROPROTEIN ON GROWING CHICKENS 211

The rate of growth based on the average weekly weight and average weekly gain in weight of the two groups graphically presented in Figure 1 and 2. It will be seen in Figure 1 that during the first two weeks, the control birds had a greater increase in weight than the experimental. This slow gain of the treated birds may be attributed to roup which affected more number in this group than in control. This infection resulted in "off feed" hence, a slow increase in weight. Following the control and eradication of the disease, both groups started to put on greater weight. From the third to the last weeks of the experiment, the treated birds had greater average weekly weight than the controls as shown in Figure 1.

The 10 grams of thyroprotein per 100 pounds (0.02 per cent) of mash as used in the present study, was claimed by Wheeler, Hoffmann and Graham (8) to be the best amount to stimulate the growth of chickens. Parker (4), using different levels from 0.025 to 0.2 per cent thyroprotein on Rhode Island Red chicks, observed that those receiving 0.025 and 0.04 per cents made greater gain and required less feed per gram of gain than did the controls. On the other hand, Turner, Irwin and Reineke (7) claimed that 45 grams of the drug per 100 pounds of mash caused the experimental Barred Plymouth Rock cockerels to grow slightly slower than the controls up to twelve weeks.

The difference in the rate growth based on the gross appearance of the birds may be seen in Plates I and II. It will be noticed that at the age of seven and eight weeks, the treated birds were much bigger than those of the control. On the twenty-fourth week, the difference in gross appearance between the two groups was quite marked. In Plate II will be seen the development of the comb of the treated bird.

During the experiment, there was a great variation in the average weekly gain in weight as shown in Figure 2. This variation was attributed to various external environmental factors. On the first few weeks, the rainy cold weather favoured the appearance of roup in the flocks, causing adverse effects on the growth of the affected birds. The effects of fowl pox infection and vaccination might be blamed also for the variation in weekly gain between the tenth and fourteenth weeks. Another factor that resulted in decreased gain was the annoyance caused by pythons which gained access into the pen on the fifteenth and nineteenth weeks. On the seventeenth week, the sudden drop of the gain in weight of the birds in both groups was due to the failure of caretaker to provide the birds with feed for two days when he was taken ill.

Figure 3 presents graphically the average weekly weight and Figure 4, the average weekly gain in weight of the New Hampshires and White Leghorns of the treated group.

At the end of the experiment, the New Hampshires had an average weight of 2.055 kilograms, while the White Leghorns, 1.428,

kilograms. This difference in the average weight was not surprising because of the fact that the White Leghorn is naturally a lighter breed than the other. The New Hampshires had a heavier weight than the White Leghorns from the ninth to the last week of the experiment. It was observed that at the end of the experiment the White Leghorns of the control group had an average weight of 1.571 kilograms, while those of the experimental averaged 1.428 kilograms. The difference may be explained in the light of the observations of Reineke and Turner (5) that the average growth of various breeds and strains of chickens varies a great deal. They claimed that 0.01 per cent thyroprotein in complete ration supplied sufficient hormone to about equal the White Leghorn and Plymouth Rock chickens' own thyroid secretion and stopped its activity. Hence, the 0.02 per cent thyroprotein used in the present work might have been too much for the White Leghorns, causing them to have less weight on the twenty-fourth week than their corresponding controls. In the case of the New Hampshires, the experimental birds had higher average weight than the controls in the same period.

Table 2 shows the effects of thyroprotein on dressed weight, abdominal fat, comb and testes at the twelfth, eighteenth and twenty-fourth weeks. On the twelfth week, the treated birds had a greater percentage of dressed weight than the controls with a difference of 8.26 per cent. There was not much effect upon the abdominal fat, comb and testes.

On the eighteenth week, there was a great increase in weight of abdominal fat of the treated birds, while the combs and testes of the control cockerels were slightly heavier. The dressed weight of the treated birds had only a difference of 2.09 per cent over that of the control.

The abdominal fat, comb and testes of the treated birds were much heavier on the twenty-fourth week than those of the control with a difference of 9.5, 5.4 and 6.2 grams respectively.

Plate 4 shows the comparison of the size of the testes of the treated and of the control birds at the age of twelve, eighteen and twenty-four weeks.

The observations herein presented did not confirm the findings of Wheeler, Hoffmann and Graham (8) that at the age of twelve weeks, the size and weight of the comb and testes of the treated birds were greatly reduced. The results obtained on the twenty-fourth in the present study were similar to those of Turner, Irwin and Reineke (7) who claimed that the size and weight of the comb and testes of the treated birds were greatly increased.

Wheeler, Hoffmann and Graham (8) made the observation that treated cockerels showed feminine characteristics, that crowing was not noted and the comb was smaller than that of the control at the age

of twelve weeks. Observations in the present investigation did not confirm this. On the contrary, the treated cockerels in the present study had the tendency to run after females at this age and that crowing was observed from both pens although it was observed earlier in the control group.

It had been noted that, based on the external appearance, the males had more uniform size than the females among the New Hampshires. Uniformity in size and in weight was not well observed among the White Leghorns probably due to the fact that the 0.02 per cent thyroprotein in the feed used in this study was slightly more than the stimulating dose for this breed for growth.

It may be mentioned that the use of 0.02 per cent thyroprotein in the ration produced early maturing birds as evidenced by laying of eggs of some pullets on the twenty-fourth week, while the rest showed tendency to lay eggs by being restless, cackling for mates, and flying under the roof looking for nests. The drug also improved the quality of the meat as indicated by increased tenderness and increased deposition of fat in the entire body.

The mortality rate throughout the experiment is given in Table 3. It will be seen in this Table that the experimental birds had a higher rate of mortality than the control. The death during the first week of the experiment may be attributed to over-crowding and to the wet and cold weather conditions. The mortality recorded on the succeeding weeks were due to roup. Thyroprotein did not seem to afford protection against this disease. The death on the fifteenth week of one White Leghorn in the control and of another in the experimental flock on the nineteenth week was caused by pythons that were able to gain access into the pen.

Summary and Conclusion

Studies of some effects of thyroprotein (0.3 per cent thyroxine) on growing chickens -- New Hampshires and White Leghorns -- are herein reported.

The amount of 0.02 per cent thyroprotein in the mash slightly stimulated the growth of feathers on the second, fourth, sixth and eighth weeks.

Body growth was not much stimulated during the first five weeks because of roup but, after recovery from the disease, the average weekly gain of the experimental birds was more than 100 grams during the ninth to the nineteenth week.

The control group obtained the highest gain of 144.3 grams on the fifteenth week, while the treated group registered its highest gain of 138 grams on the nineteenth week. The lowest gain of the experi-

mental group was 22 grams which was recorded on the seventeenth week when feeding the birds was neglected.

The amount of thyroprotein used in the present study stimulated growth of the body of the treated New Hampshires, while that of the White Leghorns was evidently hampered, so that the control White Leghorns registered greater average weight than the corresponding experimental birds from the seventeenth to the last week of the observation.

The dressed weight was increased on the twelfth week but, on the eighteenth and twenty-fourth weeks, it was not much increased.

The abdominal fat was greatly increased on the eighteenth and twenty-fourth weeks. The comb and testes were slightly lighter in weight on the twelfth and eighteenth weeks but, on the twenty-fourth week, they were both heavier and bigger than those of the control.

The amount of 0.02 per cent of thyroprotein in the ration improved the quality of the meat and stimulated early maturity but did not seem to afford protection against roup.

Acknowledgment

The writers wish to thank Dr. Antonio C. Murriel for giving them the thyroprotein used in this study, and those who kindly extended help during the progress of the work.

TABLE I
Showing the Effect of Thyroprotein on Feathering.

	Experimental	Control
Number of Birds	40	20
Rate of Feathering : 2nd Week		
Feather Grade (per cent) { W	53.8	58.8
T	30.7	29.4
B	15.3	11.7
F	0	0
4th Week		
Feather Grade (per cent) { W	36.0	37.5
T	20.0	18.7
B	16.0	18.7
F	28.0	25.0
6th Week		
Feather Grade (per cent) { W	14.2	26.6
T	9.5	13.3
B	4.7	13.3
F	71.3	46.6
8th Week		
Feather Grade (per cent) { W	0	6.6
T	4.7	6.6
B	9.5	13.3
F	85.7	73.3

Note : Feather grade was scored as follows :

- W Feathers on wings only.
- T Tail small, no back feathers.
- B Back with fine line of feathers, tail large.
- F Well feathered on entire body with long tail.

TABLE II
Showing the Effect of Thyroprotein on Dressed Weight, Weight of Abdominal Fat, Comb and Testes of 12-Week Old, 18-Week Old and 24-Week Old Cockerels.

Age		No. of Birds	Live Weight	Dressed Weight	Abdominal Fat	Comb	Testes
Weeks			gm.	gm.	gm.	gm.	gm.
12	Experimental	2	1102.2	78.24	3.25	2.9	1.19
	Control	1	837.3	69.98	2.40	2.8	1.30
	Difference		264.9	8.26	0.85	0.1	0.11
18	Experimental	2	1858.1	66.70	25.3	5.25	1.85
	Control	2	1510.4	64.61	13.7	6.95	3.50
	Difference		347.7	2.09	11.6	1.70	1.65
24	Experimental	1	2253.0	72.96	30.0	18.2	8.4
	Control	1	2169.0	72.04	20.5	12.8	2.2
	Difference		84.0	0.92	9.5	5.4	6.2

TABLE III
Showing the Mortality Rate of the Birds Throughout the Experiment.

Breed	Week	Control	Experimental	Cause of Death
New Hampshire	1st	1	5	Over crowding ; bad weather
	2nd	0	2	Roup
	3rd	1	1	do.
	4th	0	1	do.
	5th-13th	0	0	Unknown
	14th	1	0	
	15th-24th	0	0	
White Leghorn	1st	2	3	Over crowding ; bad weather
	2nd	0	2	Roup
	3rd	0	1	do.
	4th	0	0	Roup
	5th	0	1	
	6th	1	3	
	7th-14th	0	0	Eaten by a python
	15th	1	0	
	16th-18th	0	0	
	19th	0	1	Eaten by a python
	20th-24th	0	0	
	Total	7	20	
	Percentage	35	50	

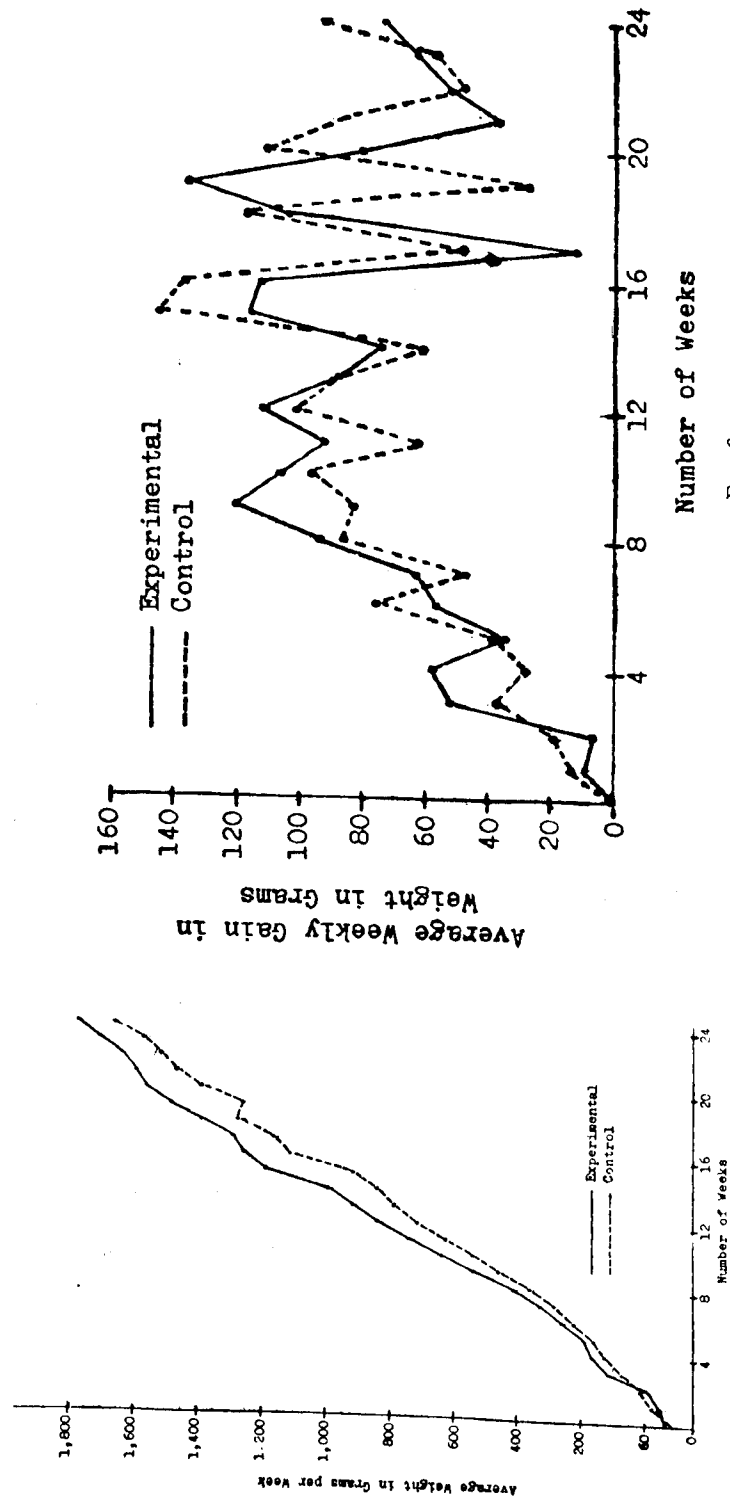


Fig. 1
Showing the Average Weekly Weight of the Experimental and the Control Birds.

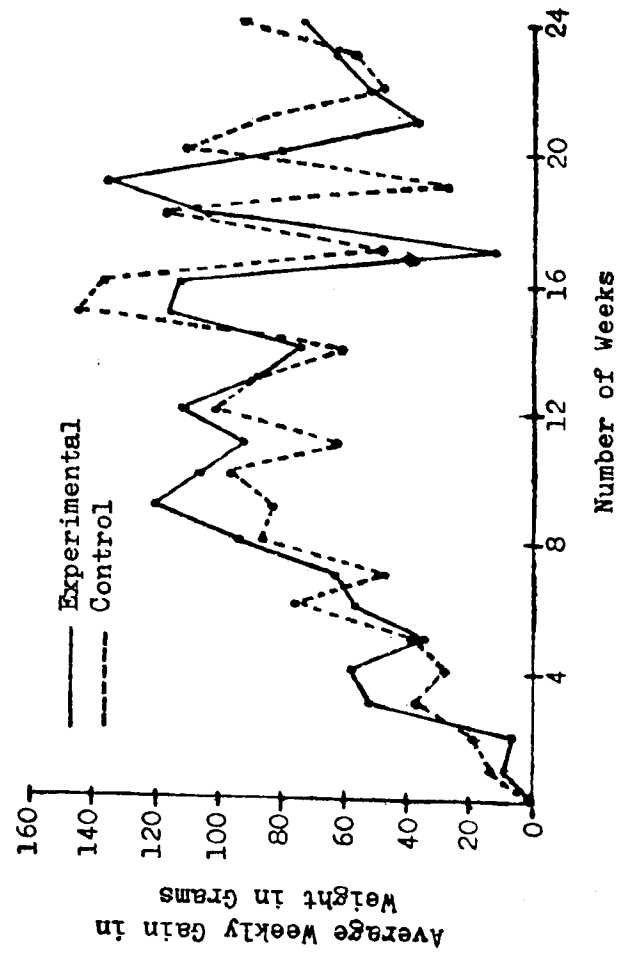


Fig. 2
Showing the Average Weekly Gain in Weight of the Experimental and the Control Birds.

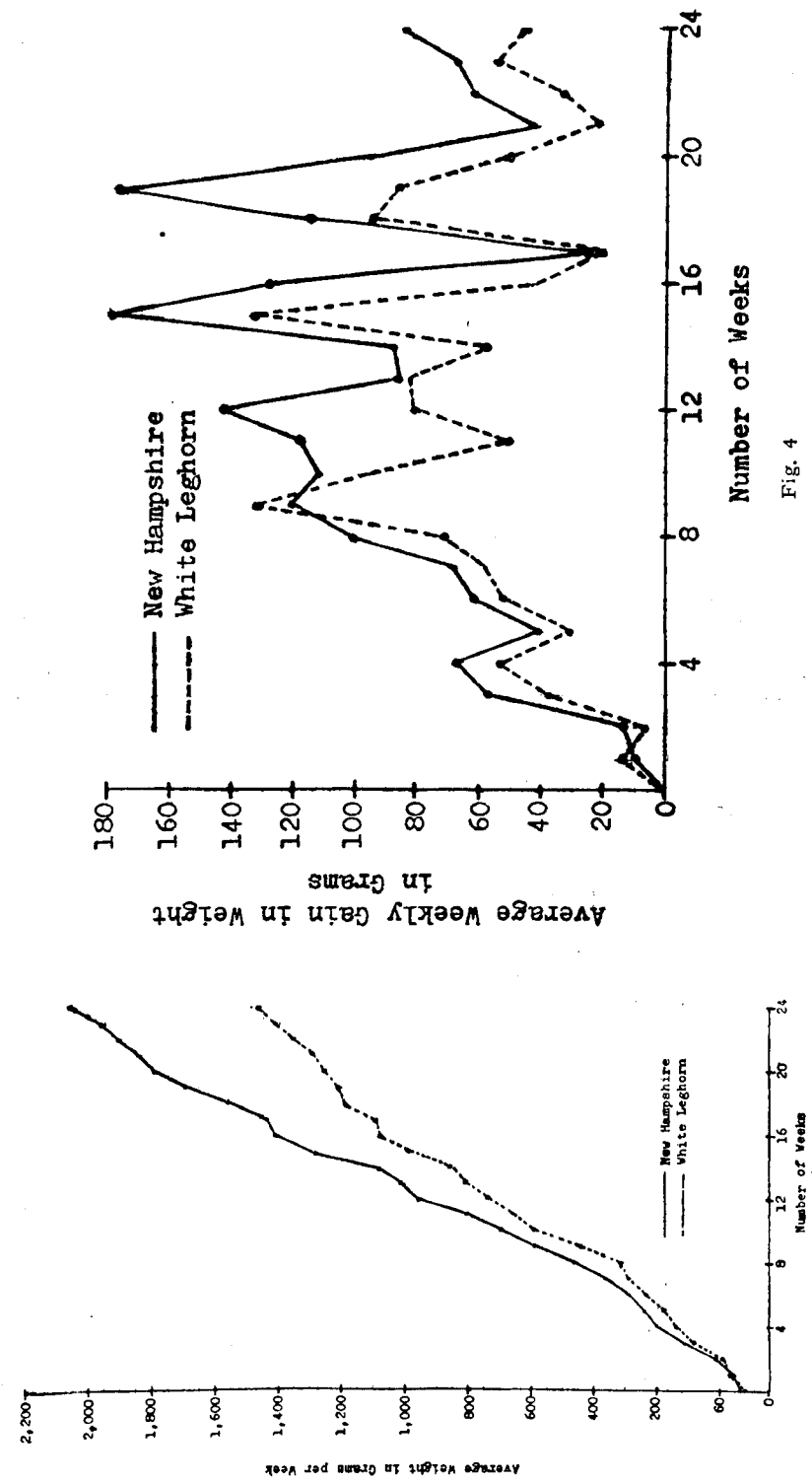


Fig. 3
Showing the Average Weight of New Hampshire and White Leghorns of the Treated Group.

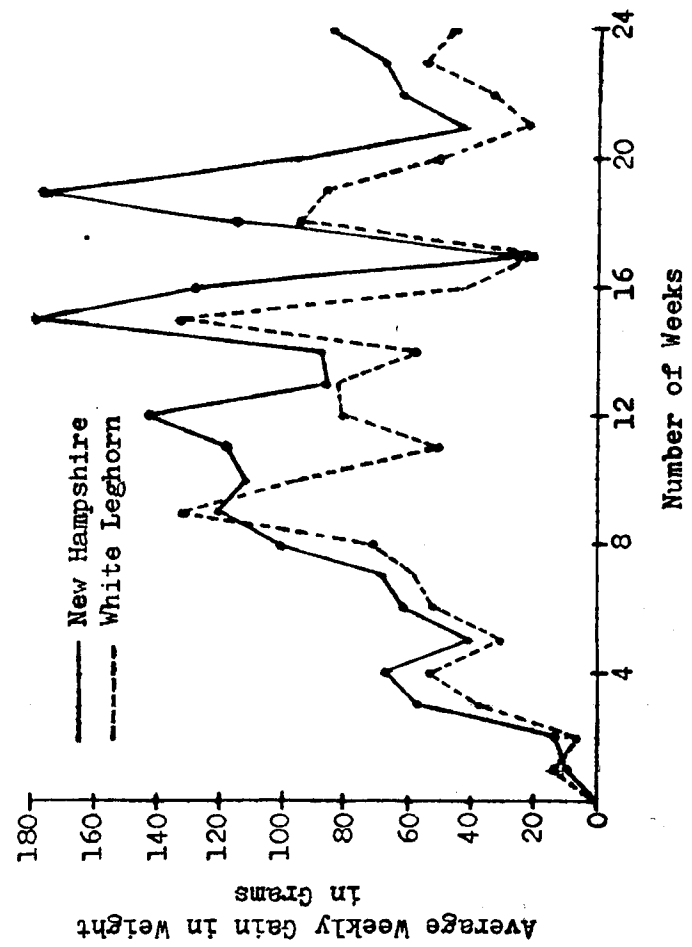


Fig. 4
Showing the Average Weekly Gain in Weight of New Hampshire and White Leghorns of the Treated Group.

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CO-OPERATIVE EXTENSION WORK IN U.S.A.

By

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Out of 160 million people in U.S.A. only about one-sixth of them live and work on the farms. With the modern means of mechanisation one man is now producing food for about 18 people. The average size of a farm in U.S.A. is 250 acres. There are a little less than 5 million farms and two-third of these farms produce about 95% crop of the country's requirements.

History.—It is necessary to go back into its old history in order to understand the development and the present set-up of the extension service in U.S.A. About 100 years ago there was little education in agriculture or home economics. People desired to have more education in agricultural subjects in the colleges. The Federal Government was asked financial assistance so that the States could take up the teaching

agriculture and home economics subjects to the boys and girls in the colleges. The Federal Congress had little money at the time but it had much public land and so in 1862 the Land Grant Colleges Law (Morrill Act) was passed. By this law 30,000 acres of land was given to each State so that the income from the land could be used to promote agriculture, animal husbandry and home economics education in the colleges of that State.

Gradually such colleges were established in each State and now every State has at least one such college called Land Grant College. It was soon realised that if these colleges were to properly teach men and women, then it was necessary to have research carried out in agriculture, animal husbandry and home economics subjects. Hence in 1887 the Federal Congress passed another law called the Experimental Station Law (Hatch Act). This law gave the states more funds for establishing experimental stations for carrying out research in agricultural subjects in order to accumulate research information for teaching in the Colleges. As time went on, it was realised by the colleges that little use was being made of the accumulating research information. Few men and women went to college. The great masses of farmers live on the farms and had no way of learning about new information in better agriculture, livestock production and home economics. They called meetings of the farmers at the colleges but even then, due to their multifarious occupations, only a small number of farmers came to the colleges for discussion. The Land Grant colleges then thought of sending out trained persons from the colleges to work with the farmers as it was felt that if the people won't come to the college, then let the college extend to the people. That is how extension work started. It was soon realised that money was needed for this type of work. The States appealed to the Federal Government for gain and in 1914 the Congress passed the Extension Law (Smith-Lever Act). This Act gave each State money for extension work to be radiated from the college to the people.

Since 1914 the extension work has been steadily growing. It still is a part of the Land Grant Colleges and its work, therefore, continues to be entirely educational. It can suggest, advise, recommend and demonstrate to the farmers, who then can do as they please. Extension work is non-political and plays no part in regulatory, police, or inspection work of the Federal, State or the Local Governments. Federal Extension Office is the educational arm of the U.S. Department of Agriculture.

Present Organisation.—There are 69 Land Grant Colleges in U.S.A. at present with at least one Land Grant College in each State including Hawai Islands. The experimental stations are located at these

Colleges. In addition each Experimental Station has several sub-stations located in different parts of the State.

At present there are about 13,000 professional employees in the extension organisation. This does not include laboratory workers, and other clerical staff. Out of the above number about 10,000 professional men and women are working in counties as County Agents, Home-demonstration agents and 4-H Club agents. Negro agents are employed in 355 counties in the Southern States of U.S.A. where there is a heavy negro farm population. About 2,500 professional workers are working in different State Offices in administrative and supervisory jobs and as Subject-matter specialists in livestock, crops, clothing, health, poultry, insects, disease and other specialised fields. Nearly 75 officers are working in the Federal office of the United States Department of Agriculture as Subject-matter specialists.

Each State has a Director for Extension in the Land Grant College. A State is divided into a number of counties like districts in India. Under the State Director of Extension are supervisors for different regions of the State to look after work in the counties in their jurisdiction. Each county has then one or more extension agents depending upon the resources of the county as well as the stage of development of extension in that county. With a little over 3,000 Counties in U.S.A. and about 10,000 County Agents in them, there is an average of three agents in a county who represent the three lines of work—Agriculture extension which includes animal husbandry, Home Demonstration work and 4-H Club work. One of the county extension agents is a man trained in agriculture and animal husbandry and works with farm men, another is a woman trained in home economics who works with women and the 3rd is either a man or a woman who works with boys and girls in 4-H Club work. This takes care of the whole family—father, mother and children.

Three agents per county is a rough average. There are some counties with many more agents and some with even less. In one particular county in California which I visited, there were 12 extension agents. Four of these were men, each one a specialist for each of the four main agricultural enterprises of that county—dairying, poultry, fruits and vegetables. Three agents were women in home demonstration work who help the women in the county in home-economics and better home and community living. Five agents were men and women, who work with the boys and girls in promoting 4-H Club work. Some counties in progressive States like California, have as many as 20 county agents and assistant agents while a few backward counties in some States have only one Extension agent who is usually a man. He is a generalist who

must be able to help the people of county on almost everything. He does Agricultural work with the men, home economics work with the women and the 4-H Club work with the boys and girls. It is evident that more agents there are in a county, the more specialised they become in their knowledge but the efforts of all are directed towards improvement of the economy and welfare of the individual family and the community.

Cooperation between Federal and State Organisations:—In the history of U.S.A. there has always been a strong feeling that the States should be autonomous. The people have been afraid of a strong centralised Government. That feeling has persisted. When the States got money from the Federal Government for Extension work they were not willing to accept the money if there would be control on it from the Federal Government. Consequently an agreement was drawn up between each Land Grant College and the U. S. Department of Agriculture which said that the two would agree to co-operate together. This means that the U. S. Department of Agriculture cannot tell what the Land Grant College should do and how it should spend the money. All the U. S. Department of Agriculture could do was to suggest, advise and recommend. This relationship in Extension work between the U. S. Department of Agriculture and the State Land Grant Colleges still continues. The Extension Service is known as Co-operative Extension, because co-operation is one of the fundamental principles of extension.

Conditions in various States of U. S. A. are different—agriculture, soil, climate, livestock breeding and management and the customs of people are all different. Hence it has been wiser to depend upon the intelligence and co-operation of the Land Grant Colleges to work out the application of general principles according to the conditions in different States. Just as there is co-operation between the U. S. Department of Agriculture and the State Land Grant College, similarly there is co-operation between the State Land Grant Colleges and the different counties in that State. A fundamental principle of extension is helping people to help themselves. It is true that if people make an honest effort to help themselves, they are better off than if they depend all the time upon someone else to help them. When the Federal Government first gave financial aid to the Land Grant Colleges for extension work, the Congress said that they will roughly give a dollar for every dollar that the State provides. It generated the self help idea and this method avoided the development of psychology of depending solely on Federal Government for aid.

Extension Budget:—In 1953 about 84,000,000 dollars were spent in U.S.A. on Extension work. This amount includes the funds of Federal,

State and the County Governments. Taking the county as a whole, the Federal Government contributes about 40% of the cost, the State Government 36% and the County Administration 24%. The proportion of funds varies from year to year but generally speaking about half the amount comes from Federal Government and other half from the State resources. Some States and Counties have greater resources. Each county may support extension work to the extent that it wishes. In some progressive counties their contribution to the Extension budget is greater than that of the State or the Federal Government while in poor counties the Federal contribution is greater than that of the State and the county.

Educational Qualifications and functions of extension staff:—The Extension agents generally have had 8 years of primary education, then four years in High School and four years in College to receive the degree of B.Sc. Some have followed higher studies in the Universities. They understand the conditions of the people with whom they have to work and their customs. Generally speaking the extension agent in a county belongs to that county or generally that State. The subject matter specialists have had much higher education.

The extension service is an interpreter of research made. The research worker has a technical language of his own and many farmers, therefore, cannot understand the research workers. Unless the research worker adopts the language of the farmer, the latter cannot understand him. The subject-matter specialist is the connecting link between research and extension. He or she becomes informed of the latest research in agriculture, animal husbandry or home economics and translates into practical things which people can do on the farms and in their homes. The subject matter specialist is a man trained in the production and marketing or consumption of crops, livestock, poultry etc. or a woman trained in nutrition, clothing, home management and food preservation etc. The 10,000 persons working in the communities as County agents in U.S.A. are the ones who really get the work done with the people in helping the people to help themselves. The job of about 2,500 State extension workers, which includes the subject-matter specialists, is to help the county extension agents to do a better job. Their job is to pick out the cargo to be sent out after proper packing and the extension agent then does the delivery and distribution to the people at the right time and in a suitable manner. The responsibility of the Federal Extension Workers is to help the State Extension workers in the development and improvement of extension.

Selection of Extension Agents:—When a qualified man or woman applies for the post of a County agent to the State Director of Extension,

his or her qualifications are examined and if satisfactory, the name is placed on the list of approved applicants. Now when a place for a County extension agent falls vacant in the County, the County Extension Committee request the State Extension Director at the Land Grant College to provide a new agent indicating the type of development work that is needed in their county. The Extension Director through the Extension Supervisor of the Region in which the county is located sends information about 3-4 suitable applicants to the County Extension Committee. This Committee then interviews each applicant personally and selects the one which they consider best suited for their work. The Extension Supervisor of the region is generally a co-opted member of this Committee. In this way the Land Grant College assures the selection of only qualified agents and the people in the county have also a voice in choosing the personality they like.

Programme of Work:—The type of programme conducted in any county is largely determined by the situations that exist and by what the people of that county think is important. Often 4-5 counties have a Programme Planning Committee made up of representative men, women and young people, to decide upon their programme of work for a year. It then becomes the responsibility of the Extension Agents in the county to carry out this programme in the best possible manner. The State Land Grant College and the Subject-matter Specialists in the College act in an advisory capacity and help in making this programme more useful and successful. According to Federal Law the extension agents are in general charged with the responsibility "to aid in diffusing among the people of the United States useful and practical information on subjects relating to Agriculture and home economics and to encourage application of the same."

Although the problems may be different from State to State or even in adjoining counties, there is however uniformity in the educational methods used. Extension workers use such methods as demonstrations, meetings, farm and home visits, leader training meetings, telephone calls, letters, distribution of bulletins, press releases, films, film strips, colour slides, radio programmes, television programmes and every imaginable form of visual aid. At the back of the County agent are the subject-matter specialists in the State and Federal offices who work closely with the different experimental stations and keep the extension workers constantly informed on research results which can be easily applied and also help the agents with urgent technical problems.

Use of local leaders:—There are a number of progressive farmers, farmers' wives, daughters, business men, who help in the extension work in each county but do not receive any remuneration. They

have special pride, a community spirit and like to be of service. On an average there are about one lakh such local leaders who help in the extension work in U.S.A. Special training camps for local leaders are held in each State. It has been found that on an average local leaders spend equivalent to about 15 days a year in helping the extension work in their communities. This amounts to 15 lakh days of free help which, if turned into money, is equivalent to the entire Extension Budget of U.S.A. Extension agents make maximum use of local leadership for help in improving the welfare of the people in their county.

Farm family approach.—Fruitful extension educates the whole family. Extension work in U.S.A. is now for the whole farm family. Although extension work among farmers, farm women and youth appears to be separate at first glance, there is much over lapping and integration in the family approach of extension work. There are over 15 lakh women enrolled in the home demonstration clubs in different States of U.S.A. One of the outstanding projects in extension work deals with the children of the family through 4-H Clubs. The 4-H's stand for Head, Heart, Hand and Health. 4-H Club work for boys and girls of 10 to 21 years of age is for the all round development of young people and there are special extension agents for this work with young boys and girls. Nearly one-third of the time of all the Extension agents in U.S.A. is given to work with rural youth and it is the most popular phase of extension work. There are 20 lakh boys and girls enrolled in the 4-H Clubs, whose different projects in Agriculture, Animal Husbandry and home making are designed to develop leadership and to create interest and favourable attitudes toward the use of scientific information. By the "learning by doing method" the boys and girls gain much satisfaction and knowledge, develop initiative and in later years have great confidence in scientific information.

Adaptability.—Extension is continuously faced with problems and the job of extension workers is to solve these problems. The type and quality of problems vary from year to year and although the purpose and general principles of extension are the same, yet the methods vary from time to time in order to be effective. In each State in U.S.A. the methods of extension work are adopted according to the conditions in the State and the customs of its people and each State does extension work a little different from the others. Farmers are conservatives the world over. Till a generation ago, farmers had little faith in the county agent and his scientific methods of agriculture and animal husbandry. To day every one finds that majority of farmers in U.S.A. have a high respect for their County extension agents and have faith and belief in their methods. This change has come about due to the persuasive

perseverance of the extension workers, the personal service they have been rendering to individual farm families, the practical technique and demonstration methods adopted by them and spirit of co-operation imbibed in the extension service which has a high degree of flexibility in adapting itself to varying local needs and problems.

AN INVESTIGATION ON CONTAGIOUS CORYZA IN DUCKS IN WEST BENGAL

By

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Work in the Diagnostic Laboratory of Bengal Veterinary College Pathology Department revealed that a large percentage of death in ducks occurring during winter months and often wiping out entire flocks in the Gangetic West Bengal is often difficult to ascribe to any specific disease particularly in the absence of Pasteurella Organisms in heartblood smears or organ smears, and cultures. Nor do they fit into the typical picture of nutritional roup.

Curiously enough it has been recorded that a good many carcasses of ducks may arrive at the Laboratory when there is an out-break of Ranikhet disease in fowls. The latter being out of the question in ducks and true Pasteurellosis being rare in West Bengal, Mittra (1954) opined a majority of such cases to be due to salmonellosis in ducks. But pending further confirmation of the same on accurate data, the following observations can be recorded in support of Elliot and Lewis's views as quoted by Hutyra, Marek and Manninger.

Two different outbreaks of duck mortality of obscure etiology were examined in the Pathology Laboratory of Bengal Veterinray College, Belgachia, Calcutta during January 1955. Clinical cases revealed the presence of clear ropy catarrhal discharge from the nose, and yellowish diarrhoea in about fifteen percent of ducks on the farm affected and history of spread of infection, and short duration of the disease for 24 to 48 hrs. Post-mortem revealed no outstanding lesion except slight congestion of intestines and empty heart. Smears of impressions from endocardium of heart, liver and lungs revealed complete absence of bipolars. Faeces examination did not reveal anything notable. Examination of the Farm conditions, revealed that the birds were huddled up in a place exposed to the cold north wind of January, in improvised hutments the temperature of which was the same as the chilly outside.

As a precautionary measure the clinically sick ones were isolated and the healthy ones, numbering eighty, were carried to a nearby room protected from cold wind. They were given sulphamezathine soluble in 15% strength in drinking water as an antiseptic, and kept on clean floor. Warmth was provided by two protected lanterns hung up from the ceiling at night. And, boiled minced meat up to 5% was incorporated in the food of unaffected birds. Similar hygiene measures were taken for the sick ones, which as well as the suspected sick ones were given Penicillin in 50,000 units subcutaneously and repeated the next day. The result was a miraculous cure of the affected ones, as also the epidemic was, brought under control. Three untreated controls died in 36 hrs. time.

Summary

Outbreak of infectious coryza in ducks originating from common cold with symptoms of nasal as well as intestinal catarrh and negative heart blood is being reported to occur in West Bengal during winter months with often high mortality.

The cause is considered to be due to exposure to cold and reduced body resistance from lack of proper nutrition. Hygienic control with cleanliness, warmth and food, when provided, along with Penicillin therapy helped to control the outbreak. Expenditure on Penicillin therapy was about three to four annas per bird in all.

The disease bears similarity to infectious coryza in birds as it occurs in Germany and Russia reported earlier. It is likely that following neglect and exposure to cold wind in Winter and lack of nourishment ordinary commensals in the respiratory tract, of the *Haemophilus* group, assume a pathogenic role in Infectious coryza.

Acknowledgment

Thanks are due to Sri K. Sen, I.C.S. for affording Laboratory and research facilities in B.V. College and Sri A.M. Bose, the farm owner for all co-operation.

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SOME OBSERVATIONS ON OVARIAN ACTIVITY CORNUAL PREGNANCY AND SEX RATIO IN THE INDIAN BUFFALO (*BOS BUBALIS*)

By

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Review of literature.—A perusal of the literature revealed several observations on the relative activity of the ovaries, situation of the foetus in the uterine cornu and sex ratio of progeny in the cow, but little data was available in other species of domesticated animals.

Stalfors (1916) found the right horn to be gravid in 62.5% of the 923 pregnant cows examined and in all of them ovulation had taken place in the corresponding ovary. While making a random examination of 100 pregnant cows, Palmer (1926) observed the foetus in the right horn in 60% of the cases with ovulation taking place in the ovary of the same side; 56% of the bull calves and 64.7% of the heifer calves developed in the right horn and the rest in the opposite horn. There were, in all, 50 bull calves and 51 heifer calves (one cow produced twins) giving an approximately equal sex ratio. Of the ova produced in the left ovary, 55% developed into males and 45% into females. Runge (1932) regularly observed corpus luteum in the right ovary of pregnant cows. Ovulation was noticed in the right ovary in 58% of the 704 pregnant cows examined by Clark (1936). He found the sex incidence of males and females to be 52% and 48% respectively; 42% of the males and 40% of the females developed in the left uterine cornu and the rest in the right cornu. Of the ova produced in the left ovary, 53% developed into males and 47% into females and from the right ovary 51% developed into males and 49% into females. The incidence of twin pregnancy in cows was found to be 3.0%. Schramm (1937) found the right horn to be gravid in 60.5% of 1213 cows examined and the ovum had come from the corresponding ovary in all the cases. Nigg (1944) believed that the right ovary was dominant and the left ovary functioned less efficiently in the cow. Asdell et al (1949) found recent ovulation in the right ovary in 10 out of 18 heifers (55.6%). Melton et al (1951) examining 18 heifers and cows found the right ovary to be active in 68% of the cases.

Curson (1934 a,b,) reporting on 48 pregnant Merino ewes found the incidence of twin pregnancy to be 10.4%. The right ovary was active in 53.3% and the left in 46.7% of the cases. In single pregnancies, the embryo developed in the right cornu in 60.5% and in the opposite cornu in 39.5% of the ewes. The disparity in ovarian activity and

cornual pregnancies, in these pregnant ewes, was due to migration of ovum. Iwanoff (1941) recording his observations on 3871 pregnant native ewes, stated that the right ovary functioned more efficiently as 55.2% of the Corpora lutea were present in it and the incidence of twin pregnancy was 2.17%.

Hefeez (1954) reporting on the ovarian activity in she buffaloes stated that the most recent corpus luteum was present in the right ovary in 75% of the cases.

Parker (1914) recording the sex incidence in pigs found that 50.2% were males and 49.8% females giving an almost equal distribution of the sexes.

Materials and Methods

The female genital organs were collected from buffaloes slaughtered at the Bareilly abattoir. The ovaries were examined for the presence of corpus luteum of the last inter-ovulation period and the uterus for the presence of the foetus. In gravid cases, the location and sex of the foetus were also noted.

Observations

In the course of the investigation, 2705 uteri were examined of which 306 were found to be gravid, giving a pregnancy incidence of 11.3% in she buffaloes slaughtered for food. The corpus luteum graviditatis was found in the right ovary in 155 cases (50.7%) and in the left ovary in 151 cases (49.3%). In the remaining 2399 non-pregnant she buffaloes, the ovaries were found to be functional in 1872 cases, (78.1%) as judged by the presence of a developing or regressing corpus luteum in one of the ovaries, and non-functional in the rest (21.9%) either due to immaturity, senility or pathological causes. In non-pregnant, she buffaloes with functional ovaries ovulation was observed in the right ovary in 990 animals (52.9%) and in the left ovary in 882 cases (47.1%)

In pregnant she buffaloes the embryo was found to develop in the right cornu in 154 cases (50.3%) and in the left cornu in 152 cases (49.7%). A single case of migration of ovum was noticed, wherein the embryo was situated in the left cornu while corpus luteum graviditatis was present in the right ovary (Damodaran 1955). All the gravid uteri examined were uniparous and twin pregnancy was not noticed in she buffaloes.

The sex of the foetus could be recognised definitely in only 188 cases (61.4%) out of 306 fetuses examined. Of these, males were 91 (48.4%) and females 97 (51.6%). The left cornu carried 42 males (46.2%) and the right 49 (53.8%) while 50 females (51.5%) developed in the left

and 47 (49.5%) in the right cornu. Of the ova produced in the left ovary, 45.7% developed into males and 54.3% into females while from the right ovary 51.1% developed into males and 48.9% into females.

Discussion

In she buffaloes, ovulation was observed in the right ovary in 1145 cases (52.6%) and in the left ovary in 1033 cases (47.4%). This indicated that the right ovary was more active than the left as has been observed in cows and ewes. In non-pregnant buffaloes, the right ovary was found to be more active than in pregnant buffaloes. This was perhaps due to the small number of pregnant buffaloes examined.

The buffalo embryo developed in the right cornu in 50.3% and in the left cornu in 49.7% of the cases. Though there was a slight increase in the right cornual pregnancies, it was not as significant as in cows and ewes because of the small number of gravid buffalo uteri available for examination.

The sex incidence of the progeny in buffaloes was 48.4% males and 51.6% females. In view of the small number of sex-recognisable fetuses examined, the slight increase in females was insignificant and the distribution of the sexes might therefore, be considered to be more or less equal as observed in cows and sows.

Seligson (1895) said that in mammals, males developed from the right ovary and females from the other ovary. But in she buffaloes, both ovaries produced individuals of either sex as has been noticed in cows. She buffaloes, like cows, are uniparous animals. While the incidence of twin pregnancy varied in cows from 1-3% (Palmer 1926, Clark 1936) not a single case was noticed in the 306 pregnant buffaloes examined. This indicated that twinning was much more rare in she buffaloes than in cows.

Summary

1. The right ovary was found to be more active than the left ovary in buffaloes.
2. There was a slight increase in the right cornual pregnancy.
3. The sex ratio of the progeny was more or less equal.
4. Both ovaries produced ova which developed into individuals of either sex.
5. Twin pregnancy was not noticed.

Acknowledgment

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Clinical Articles

A CASE OF TRUE HERMAPHRODITISM IN A GOAT

By

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The object of this article is to record a rare instance of true hermaphroditism in a goat. The word hermaphrodite has an interesting origin. It is compounded of two original Greek names Hermes and Aphrodite which are found in Greek Mythology. The child of these parents partook of the characters of the father and mother to such an astonishing degree that they named this child as "Hermaphrodita", which term has since then been used in medical literature to mean an individual with both male and female characteristics.

The goat in question was slaughtered at the Military Slaughter house, Jabalpur, on 10th January, 55. It was about one and a half years old. On post mortem examination it was found to show some

anatomical peculiarities of the genital tract. The case was brought to our notice and the specimen sent to the College for closer study.

Enquiries revealed that at the ante-mortem examination the goat was passed for slaughter as a male without any critical examination of the sex organs. This can be overlooked as of little or no significance in view of the fact that a large number of animals are being slaughtered daily and in the absence of any clinical history of the sexual behaviour of the animal, the passing officer is not likely to deviate from his work and make a study of superficial or deep-seated developmental abnormalities while passing the animal for slaughter.

On superficial examination of the material which had plenty of fascia and fat about it, a ballooned clearly marked out uterus, vagina, bladder, urethra, an ill-developed penis (Vide Plate) and two testes one on either side adhering to the uterus, were clearly seen. Kidneys with ureters and adrenals were also present.

After clearing and dissecting out the specimen from the adhering tissue, the presence of two ovaries, one on each side in the usual normal position was also detected (Vide Plate). Each ovary was small, about the size of a pea, the right one being a little larger than the left. The Fallopian tubes were rudimentary and could be seen only by holding that portion of the uterus against light. The testes which were lying by the side of the ovaries were found attached to the uterus by its lateral ligaments. The right testis was about three times larger than the left; each was continued posteriorly by the spermatic cord about $4\frac{1}{2}$ inches in length, which proceeded backward in the direction of the urethra. The uterus was thinwalled and its ballooned appearance gave a feeling as if it was gravid, but on manipulation it was found to contain only air. The vagina which was rudimentary and measured 2 inches in length continued the uterus posteriorly and opened into the urethra. The urethra measured about 3 inches in length in its pelvic portion. The pelvic urethra was continuous with the penile urethra, without hypospadias in this case. The prostate was, however, imperceptible.

The occurrence of ovaries and testicles together in the same individual with ill-developed or mal-formed portions of both male and female genital tracts, is characteristic of a true hermaphrodite.

While manoeicous condition seems to be the usual occurrence lower down in the animal kingdom, true hermaphroditism is a very rare phenomenon in higher vertebrates and more particularly in human subjects. Not many such cases appear to have been recorded in domesticated animals.

Most of the cases of hermaphrodites that are occasionally cited amongst the higher animals are cases of false or pseudo-hermaphroditism

which, in technical parlance, and also called "intersexes". In pseudo-hermaphrodite the germ gland or gonad is of one sex and the accessory genital organs belong either to the opposite sex or to both. The pseudo-hermaphrodites are often spoken as male or female according to the sex of gonad present. In the male pseudo-hermaphrodite, there will be testes which seldom, if ever, fully descend into the scrotum; there is underdeveloped penis and scrotum; prostate, seminal vesicles and vas deferens are associated with uterus, vagina and fallopian tubes. In the female pseudo-hermaphrodite, e.g. in the free-martin, the distinguishing character is the presence of ovaries which are in their normal position while the uterus and vagina are underdeveloped, and the presence of a prostate and hypertrophied clitoris are often the only perceptible male accessories.

Having known the characteristics of a true hermaphrodite as against false hermaphrodite, it will be evident that the case of the goat referred to above satisfied the conditions of true hermaphrodite, in that:—

- (1) Both ovaries and testicles (Vide Plate) were present.
- (2) Both the testicles were seen to be retained in the abdominal cavity.
- (3) Uterus was present.
- (4) Vagina which was rudimentary opened into the urethra.
- (5) Fine tortuous Fallopian tubes could be seen, as already mentioned, when held against light.
- (6) Penis was in a relatively underdeveloped condition.
- (7) The pelvic urethra was continuous with the penile urethra without hypospadias.

I am much thankful to Capt. Anand, Veterinary Officer, Military Dairy Farm, Jabalpur for supplying me the material for investigation and also to Shri M. Y. Mangrulkar M.Sc., M.R.O.V.S., D.T.V.M., Principal, M. P. Veterinary College, Jabalpur for help and encouragement in writing this article.

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OCCURRENCE OF *SETARIA CERVI* IN THE LIVER OF CATTLE

By

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Of the numerous Helminth parasites infesting ungulates the members of the family filariidae are by far the most important. The worms of the genus *Setaria* are commonly found in the peritoneal cavity of the ungulates. They are slender and males measure 40 to 60 m. m. and females from 60 to 120 m. m. These worms are milky white in colour and taper towards the hind end, which is spirally coiled. The mouth is surrounded by a cuticular ring which bears dorsal and ventral and frequently also lateral prominences. The tail of the male bears four pairs of precloacal and four pairs of post cloacal papillae. The tail of the female may bear spines or conical projection.

The microfilaria of this parasite are found in the circulating blood of infected cattle. They are transmitted by some blood sucking insect (*Stomoxys Calcitrans*). The life cycle is not completely known.

In certain cases, usually in unsuitable host, the worms are carried to distant foci as "erratic parasites". They have been recorded in testes, eyes and also reported to have been found in the udder of a cow. It is a belief that the worms enter the portal system and from there they gain access to the other organs of the body.

During the course of helminth collection work in the months of April and May 1955 at the various slaughter houses of Secunderabad Hyderabad (Dn), I collected a specimen from Amberpet (Hyd) slaughter house in which the entire worm *S. cervi* (Syn. *S. Labiato-papillosa*) is located in the liver of a Ox. This appears to be the first record of the occurrence of *S. cervi* in an atypical foci in cattle in the State.

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I. C. A. R.

Farm News Release

Growing Mesquite—Good For Arid And Barren Lands:—Farmers can profitably utilise any arid barren ground, where no other crops can be grown, for growing Mesquite (*Vilayati Khyri*, *Vilayati babul* or *Vilayati Kikar*). The tree resists droughty conditions well.

The tree yields sugary pods rich in protein that are good cattle feed. The tree yields trannin. The wood is good for fence posts. Apart from these uses, when planted closely, it can be trained to form a good live hedge.

Plantations of mesquite can be raised on waste lands for fuel and for cattle feed. Before sowing, the pods should be broken into pieces and soaked in water for 24 to 48 hours. Then the seed should be rubbed to separate it from the pulp. It is best to sow the seed in a nursery first and then transplant the seedlings when ready.—No. 98.

Poultry Diseases. Early Protection Advised:—Though most poultry-keepers know the usefulness of vaccinating their birds against Ranikhet disease and fowl pox, it is common for them to wait till the birds are old.

It is better that vaccinations are done early. Vaccination against Ranikhet disease can be done when the birds are eight weeks old. Poultry-keepers are advised to get their birds vaccinated when they are between two and three months of age.

When buying, it is safer to buy birds which are guaranteed to have been protected against Ranikhet disease and fowl pox.—No. 100.

Velvet Beans. A New Green Fodder:—Mucuna or velvet beans, a new legume plant from Australia, does well as green fodder under irrigated conditions.

The crop is a *Kharif* legume. It can be cultivated like cowpea. The seed is drilled in lines two or three feet apart. Eighty to 100 lb. of seed will be required for sowing an acre. It can be grown alone or mixed with maize or *jowar*. Mucuna is highly nutritious and is relished by the cattle.

A maize-mucuna mixture at the Indian Agricultural Research Institute, New Delhi, yielded 45 to 50 percent more fodder, on an average, than the maize-cowpea mixture.—No. 103.

Farm Fillers:—For best results, hatch your eggs during the winter months of October to March.

India claims more than 95 per cent of the international trade in cashew kernels. In 1948, kernels valued at 15 million dollars and shell oil worth half a million dollars were exported.

The cashew kernel is a very nutritive food. It is rich in protein, fats, phosphorus, iron and vitamins A and B.

On an average, about one lakh cattle worth more than two crores of rupees die in the Indian Union due to rinderpest disease alone.—No. 106.

In India, hides and skins worth about Rs. 18 crores are produced annually.

Milk production in India amounts to 48 crores and 15 lakh maunds per day.

There are over 130 sugar factories in India and nearly 35,00,000 acres of sugarcane are cultivated every year.

The warble fly causes a loss in value of skins and hides to an extent of a little less than two crores of rupees in India every year.—No. 112.

Groundnut Haulms. A Good Fodder:—Groundnut haulms are good forage for cattle. Experiments in Mysore show that when haulms are partially dried in the open and then stacked and allowed to cure, a rather dark-coloured hay is produced. The hay, highly palatable to the cattle, is as good as that of berseem or cowpea.

It is better to handle the produce early in the day for curing. Frequent handling is not advised in the dry weather, as then the tips get broken and the leaves are shed.—No. 115.

Perennial Fodders. Way to get better yield:—Perennial fodder grasses yield well if they are properly cultivated.

To get best results, plough the land four times, twice with a soil-inversion plough and twice with the *deshi* plough, to give it a good

tilth. If necessary, break clods with a mallet. Apply 25 tons of well-decomposed cattle manure per acre if sullage or sewage irrigation is not available, and spread and cover the manure by working with a plough. The soil should be then thrown into ridges and furrows $2\frac{1}{2}$ ft. apart.

If a rapid growth of the grass is desired, apply 25 to 50 lb. of ammonium sulphate per acre in the irrigation water.

The best time for harvest is just before the grass flowers. No. 117.

Farm Fillers:—In India, loss in milk production due to rinderpest alone is estimated at about 17 lakh maunds, worth more than $3\frac{1}{2}$ crores of rupees.

* * * *

By inducing anaerobic fermentation of cowdung, a gas containing methane and hydrogen can be produced for use as an illuminant in mantle lamps.

India is the largest single sugar-producing country in the world, possessing 30 percent of the total world cane-acreage.

Compared with potato, sweet potato is richer in carbohydrates, calcium and vitamin A. No. 118.

Association News

MADHYA PRADESH VETERINARY ASSOCIATION

Proceedings of the meeting of the Executive Committee
held on 8-4-1955.

The first meeting of the members of the Executive Committee of the Madhya Pradesh Veterinary Association was held in the M. P. Veterinary College, Jabalpur, with Shri M. Y. Mangrulkar, the Vice-President of the Association in the chair in the absence of the President Shri R. N. Pendharkar. The following members were present:—

Shri R. S. Rangan,	} Secretary.
" K. V. Deshmukh,	
" V. N. Sarma	} Treasurer.
" C. N. Kelkar	
" G. K. Rayalkar	} Members.
" S. L. Choubey	
" S. S. Chatty	
" T. V. Salpekar	

The meeting started with a short speech by the Chairman. He said that this is the first meeting of the Executive Committee after so many years, most probably after 1936, and as such was an important one. He also informed that the President had permitted him to take up all the subjects proposed in the Agenda, and that a letter of invitation to Shri G. G. Oka to attend the meeting has also been sent by the President.

After transacting business of routine nature, the meeting considered the question of paucity of trained personnel for several important posts. The meeting felt that in order that the State need no more depend upon outside candidates for manning superior posts, the department should depute as many officers as possible for undergoing various kinds of P. G. training in India and also abroad in Veterinary and Animal Husbandry subjects. Application for such training at the expense of the officers themselves should also receive the encouragement they deserve and not turned down on the plea that they cannot be spared. The meeting appealed to the Government to rectify this state of affairs.

Most of the other items on the agenda are to be taken up at the next meeting.

R. S. RANGAN,
Secretary.

Extracts

The following article appeared in the Evening News of India dated 10th Sept. 1955.

Veterinarians are important to Agriculture in U. S.

The 12,000 Veterinarians in the United States deserve much of the credit for the progress that has been made by agriculture. The nation's farmers depend upon them to keep their livestock and poultry healthy, to prevent costly epidemics and to administer to maimed animals.

Although most veterinarians are engaged in caring for animals, on and off the farms, many carry on activities which safeguard human health. In this capacity they serve as food inspectors in private food dispensing operations and in the nation's armed services. Some are Inspectors of meats and animal carcasses being prepared for meat in the nation's packing plants.

Others are milk and dairy inspectors and sanitary officers for states and municipalities and for private milk and dairy plants and

processing organisations. Still others are manufacturers of vaccines, and other medicines for animals.

Must Receive Degree

Before he is permitted to practice, the veterinarian must receive the degree of Doctor of Veterinary Medicine from one of the 17 Veterinary Colleges of recognised standing in the United States. This means he must complete two years of pre-veterinary study and four years of full professional work beyond the secondary school level.

For the most part, the Veterinary Colleges are units of land-grant agricultural institutions. The 17 recognised institutions received their professional ratings only after a review of their work by the American Veterinary Medical Association, the Bureau of Animal Industry, the veterinary examining board of the State in which the College is located.

The farmer depends on his local veterinarian for emergency service to his animals as much as he depends on his family doctor when a member of his family becomes ill or is injured. Often he also calls upon the veterinarian for advice in the control of insects or communicable diseases.

This local service is supplemented by the work of other veterinarians employed by the state or by the U.S. Bureau of Animal Industry. These men, serving as inspectors and advisers, may be highly accomplished specialists in the diagnosis, treatment and control of various serious diseases.

Special Worker

Their work has been responsible for bringing under general control such former serious ailments as tuberculosis, Bangs disease, mange, tick fever and foot-and-mouth disease.

Although these special workers are achieving great things for U.S. agriculture, the general veterinary practitioner is the man who works most closely with the American farmer. He is available at all hours, day or night, when the farmer has vexing problems with his animals.

And he has probably been the most persistent advocate of sanitation in his community. He knows that disease breeds best where there is a lack of cleanliness—and the immaculate conditions of the average U.S. farm result, in large measure, from his preachments.

Today scores of American Veterinarians are also serving with technical missions to other countries. They are members of teams working for the betterment of world agriculture.

Correspondence

[The views and opinions expressed in correspondence are those of the writers themselves and are not always endorsed by the Editor. Ed. I.V.J.]

The place of sterilisation in mass vaccinations.

It is unscientific and dangerous on some occasions not to strictly follow the sterilisation of the site of inoculation, the syringe and the needle, in between two inoculations, in the vast mass vaccination programme of 'Eradication of Rinderpest' from India, which covers about one-fourth of the world cattle population.

Various standard veterinary text books prescribe strict asepsis for subcutaneous injections. But our present day field practice is greatly divorced from the theory.

It is to be hoped that the Central Rinderpest Control Committee will give its serious consideration to this situation and prescribe some standards for field practice regarding asepsis of the syringe, needles and the site of inoculation in mass vaccinations.

The Interim Indian Veterinary Council

Ref:—Paragraph No. 4 of the editorial, page no. 218 of the November 1954 issue of I.V.J.

It is stated in the above referred to paragraph of the editorial "It is well to remember that the claims of only men with experience, capacity, moderation, tact and patience should be considered and the best among them chosen".

Only fully democratic constitutions for the different state Veterinary Associations with provision for elections of all the office bearers through postal ballot can achieve this aim at its best.

Parbhani, }
1st July, 1955.

K. B. RAO, G.B.V.C.,
District Veterinary Officer.

Obituary

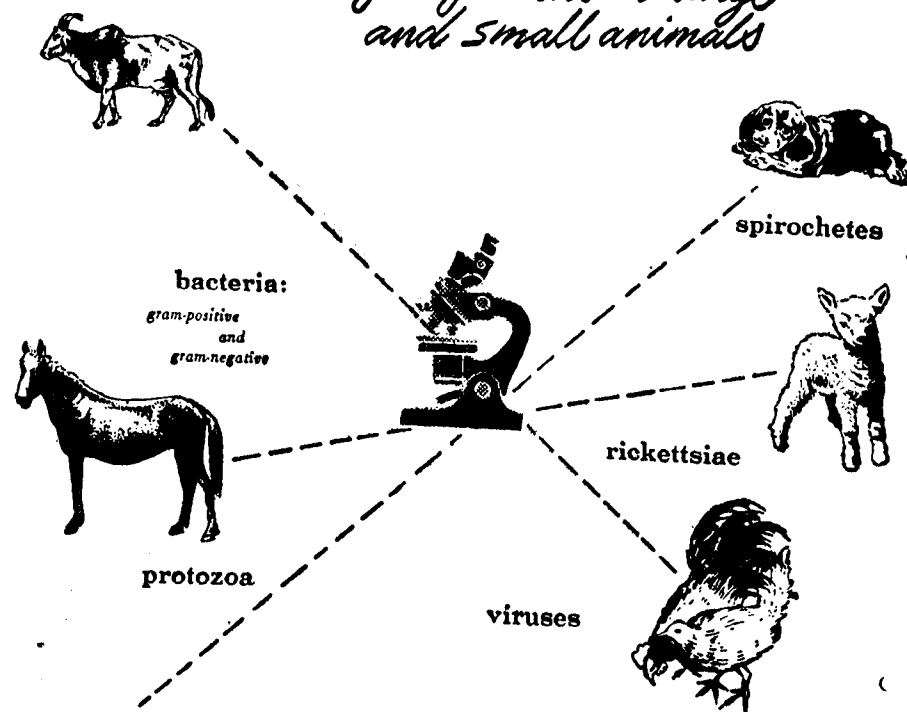
We regret to note in the *Veterinary Record* dated 15th October 1955, the sad demise of Professor D. H. Udell, B.S. D.V.M., D.Sc. (Hons.). He was a well known figure in the Veterinary world and had many a position of distinction during his life time.

He was Editor of the *Cornell Veterinarian* from 1918 to 1939 and was the author of that great work "The Practice of Veterinary Medicine", the sixth edition of which was published only last year and we had the honour of reviewing it in our *journal*. He was Professor of Veterinary Medicine at the New York State Veterinary College, Cornell University and was for some time Associate Professor of Veterinary Surgery at Ohio University. Since 1942, he has been Professor Emeritus at the Cornell University. He was 81 years of age. He died full of years and full of honours and the profession is poorer to-day by his death. May his soul rest in peace!

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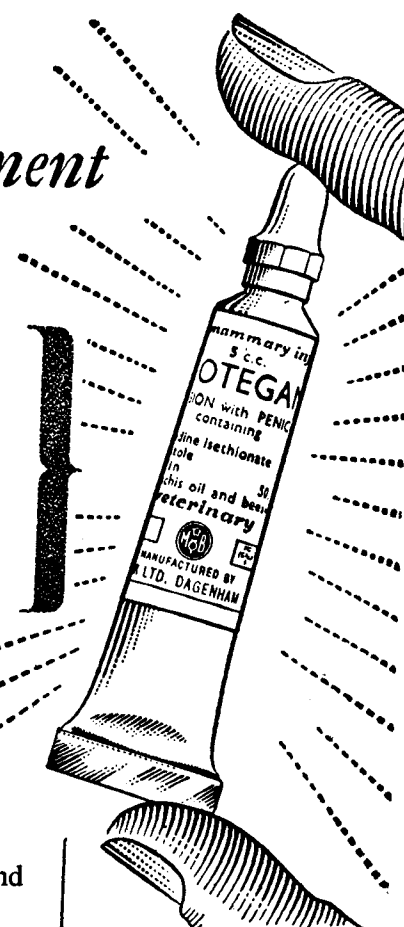
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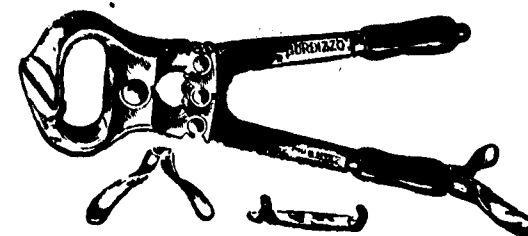
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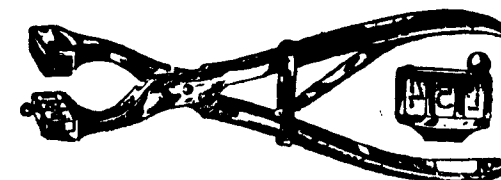
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