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THE INDIAN VETERINARY JOURNAL

(The Journal of the All-India Veterinary Association)

*A Monthly Record of
Veterinary Science*



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THE INDIAN VETERINARY JOURNAL

[THE JOURNAL OF THE ALL-INDIA VETERINARY ASSOCIATION]

PUBLISHED MONTHLY

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A Monthly Record of Veterinary Science
Devoted to the cause of the
Veterinary Profession

★

EDITOR

Rao Sahib T. VINAYAKA MUDALIAR, G.M.V.C.,

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✱

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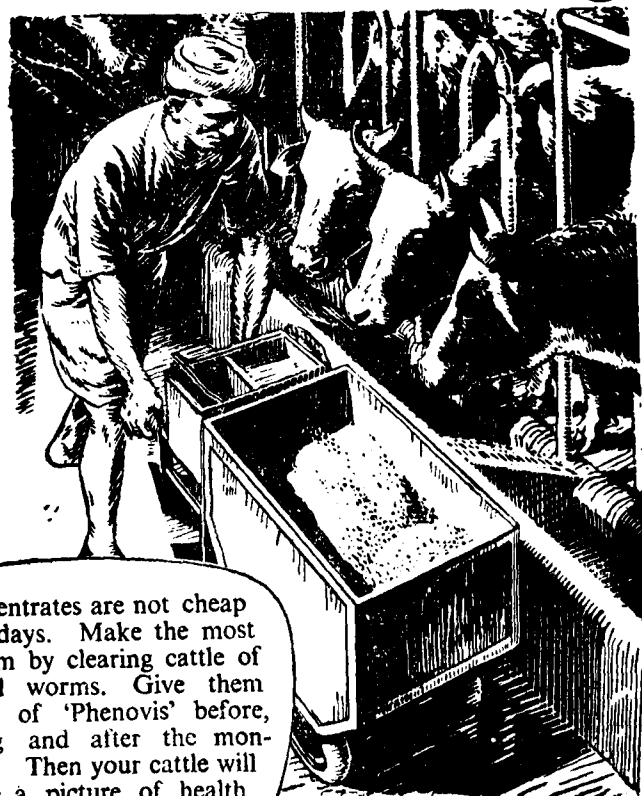
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Editorial

HIGHER VETERINARY EDUCATION

With the institution of Post-Graduate Course of Studies in four of the Veterinary Colleges in India, it may be claimed, with a certain amount of pardonable pride, that a new era has been born in the matter of Veterinary Education in this land.

Ever since the inception of the All-India Veterinary Association some 36 years ago, an incessant cry for higher and better education being made available in our own land, was kept up and we bow to the memory of those early workers who placed *service* before *self* to develop Veterinary Science in all its branches in our country and to-day we reap the fruits of their labours. It is barely seven decades since the Veterinary Education had its birth in this land and the rapid strides taken in the field, have made it possible so soon to take the next step of instituting advanced course of studies in this country. It is a 'dream come true' as was so aptly expressed by the Hon'ble Minister for Agriculture at Madras. At this moment of elation, we should not forget the heavy responsibilities that naturally devolve on the profession with the addition of such advanced course of studies. Standards should always be maintained and we should be guided by the experience of such countries which have always cared for standards and not by those who have not been very particular in this direction. The main reason for the latter has been the lack of co-ordination between theory and practice, between fundamental science and applied science. This element of lurking danger should be guarded against at all stages. The Universities concerned should not merely take an academic interest in

such courses of studies, but should see that they are of practical benefit to the country at large. It is this divorce of theory from practice that has been responsible for a lot of confusion and criticism in Arts education and we only hope that such pitfalls will be studiously avoided where science is concerned.

We fully well realise the prevailing dearth of suitable men to fill up the posts of Professors, Readers, etc., for this advanced course of studies. This is to be expected in a transitional stage and we should not lose heart over the matter. Things will straighten soon. But we only hope that both the teachers and the taught will work hard to maintain standards and bring a good name to our country. No one should be content with the cheap satisfaction of awarding a post-graduate degree but try to turn out really first class men imbued with the spirit of dedicated service in the cause of science. No mercenary view-point should cloud the vision of these scientific men, whom we expect to be the cream of our profession. Science before self should be their motto and they should leave the science better than they found it.

THE 13th ALL-INDIA VETERINARY CONFERENCE

We draw the attention of our readers to an announcement that appears elsewhere in this issue with regard to the above Conference and the Silver Jubilee celebrations of the Mysore Serum Institute.

It was about 28 years ago that Mysore played the host for an All-India Veterinary Conference at Bangalore, the memory of its grandeur is still lingering in the minds of those who attended it then. Mysore has a name for doing things thoroughly. It is not going to be otherwise this time with its expanded sphere of activities.

Mysore is full of places of interest, both historic and religious and Nature's marvel in some of the areas can hardly be excelled. Here is an opportunity to the members of our profession to visit the State of Mysore and enjoy.

There is a possibility, we learn, of the Interim Indian Veterinary Council meeting then at Bangalore. So we will probably have the elders of our profession attending this year's session. It is going to be a happy family gathering.

The popularity of the Royal family of Mysore is too well known to need any repetition here. The present head of that family in his role as Governor of that State has agreed to grace the occasion with his august presence and inaugurate the Conference. We appeal to one and all of our professional colleagues to rally round Mysore and make the session a great success.

THE PAPER FAMINE

India of to-day seems to specialise in creating scarcities. One has to look round and see how article after article is becoming more and more scarce every day. The Black-marketeer is thriving in a manner unknown to the traditions of this land. This is an art which this country had learnt as a result of the last two world wars. But to-day the Black-marketeer of India has nothing to learn from other countries. He has so perfected his art that he feels he stands at the top of the world in this nefarious business. He successfully camouflages his evil act under cover of his external religiosity. But India is a famished country and cannot stand this strain for long. The end must come sooner or later-either way.

We are moved into such pessimistic thoughts when we are driven from post to pillar to get our requirements of printing paper every month. The cost of paper which was about eleven annas a pound some three years ago, has now gone up to Re. 1—3—0 per pound! Even then the Black-marketeer must have his pound of flesh! It is disgusting to deal with such dregs of society.

Unless the Government take upon themselves regular supply of paper to all such scientific publications, the day may not be far off when all such publications, will have to close. That day will be the saddest day for India.

The Government admit from time to time that such scarcity is not warranted. But yet they are afraid to strike. The Black-marketeer fully conscious of the power of adult franchise which he wields in his hand, adds insult to injury by saying 'It is all due to wrong Import and Export policy, wrong Foreign-exchange policy, wrong Tariff policy etc., etc.,' We hear the same story whether it be with regard to cereals, milk, oil seeds, iron, motor machinery and all the rest of it. The whole scheme of things seems to be out of all human control. There can be no remedy under the existing state of affairs. We only look up to the words of Lord Krishna "When irreligion prevails and religion decays, the Power that upholds the cause of righteousness will manifest itself in the form of a human being". Yes it is time for an *Avatar!* It is time for a *Messiah!* It is time for a *Prophet!*

The Thirteenth All-India Veterinary Conference

The affiliated branches of the All-India Veterinary Association in the several states will please note the dates of the next Conference at Bangalore and the bulletin appearing elsewhere in that connection. They are requested to arrange for a good contingent of delegates from their respective State, as railway concession of a single fare for double journey, is expected to be granted soon. The orders of the Railway Board are awaited. They can apply to the undersigned early in October 1958. In the meanwhile, professional papers and resolutions may be sent direct to the Conference Secretary, The Mysore Serum Institute, Hebbal, Bangalore-6.

Visits to various places of interest and several social functions are on the card. Please apply in time to the Conference Secretary and reserve your accommodation.

Cheer you! We shall meet in that charming city of Bangalore.

All-India Veterinary Association
23, First Street,
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25-9-58

T. VINAYAKA MUDALIAR,
General Secretary.

General Articles

THE ANATOMY OF THE FOETAL INDIAN ELEPHANT *Part X: The Axial Skeleton and the Central Nervous System*

By

D. MARIAPPA, G.M.V.O.,

Professor of Anatomy, Madras Veterinary College.

Introduction

References on the skeleton of the elephant are numerous from very early times. Ayer and Mariappa (1952) and Hill (1939) have made a radiographic study of the ossification of the skeleton. Blair (1710), Osborn (1942) and Owen (1868) have made a detailed study of the skeleton. Boas and Panlli (1925) have made a comparative study of the skull of elephant and other animals. Coarse (1799) has reported on the dentition. Eales (1926, 1929 & 1931) has dealt with the skeleton and development of the mandible. Garrod (1875) has described the hyoid of the Indian elephant. Weatherford (1940) has studied the tusk of the Indian elephant.

Bindewald (1913) has described the rhinencephalon. Blair (1718) has studied the organ of hearing and Home (1823) has reported on the tympanic membrane. Elliot Smith (1902) has given an account of the brain and spinal cord. Dexler (1907) and Bregman (1915) (cited by Eales, 1926) have dealt with the central nervous system.

The Vertebral Column

The vertebral formula for this specimen is $C_7, T_{10}, L_4, S_1, Cy_{20}$.

Cervical Vertebrae

The total length of the cervical vertebrae is relatively less due to the shortening of the neck. The body of the axis is the smallest and is transversely elongated. In others it is round, increasing in size from the third to the sixth and smaller in the seventh. The ventral faces of bodies except the first one are covered by cartilage. The vertebral foramen is elongated vertically in the atlas and axis but transversely in others, increasing in size from the first to the seventh. The transverse process consists of a "true transverse" portion and a small ventral costal part, former arising from the arch and the latter from the body, connected laterally by cartilage and enclosing the foramen transversarium for the vertebral artery and nervous transversarius. The transverse part is completely ossified but the costal element is ossified only at its root. The anterior articular processes

are directed dorsally and medially and the posterior articular processes ventrally and laterally. The neural spine is vestigial in the third and fourth and is represented by a small tubercle in the fifth; it is longer in the sixth and longest in the seventh, being half the size of the first thoracic vertebra. The lower part of the transverse process of the sixth is elongated forming a caudal projection and is the most ventral in level extending below the body as compared to others. The transverse process of the seventh is mostly cartilagenous and similarly forms a caudal projection, but is smaller and in level with the ventral border of its body and is not pierced by the foramen transversarium, the costal element being very rudimentary. On the posteroventral aspects of the body are two large costal facets for the first ribs. The neuro-central junctions are cartilagenous and all of them are in two pieces-body and the arch. The first and second being atypical, merit detailed consideration.

Atlas (Fig. 1) is in two pieces united by cartilage—a ventral arch and a dorsal arch, the lateral masses being cartilagenous. The tubercle (ventral spine) is not well marked. The dorsal face of the ventral arch posteriorly is articular for the dens. The lateral masses present large vertical concave facets for the occipital condyles, separated below by a small notch and above by a wider interval. The transverse process is long and drawn anteriorly as a pointed projection and consists of two elements united laterally by cartilage and enclosing foramen transversarium. The cranial face of the dorsal arch is grooved for the first cervical spinal nerve. The dorsal arch has above two tubercles. The posterior articular facet lies below the intervertebral notch and articulates with the anterior facet of the axis.

Axis (Fig. 2) is in two pieces united by cartilage—body carrying the dens and the neural arch. The dens is large and conical. Dorsally it is grooved for the transverse ligament and ventrally, it is smooth and articular. The anterior articular facet is large, being formed by the body and the arch—dorsal fourth by the arch and the rest by the dens. The transverse processes resemble those of other typical cervical vertebrae. The posterior articular facets are dorsal to the intervertebral foramen as in others. The neural spine is massive and bifid, presenting two large tubercles behind and is slightly bent in front.

Thoracic Vertebrae

Each vertebra is in two pieces—body and the neural arch, neurocentral junctions being cartilagenous. The bodies are smaller than those of the cervical vertebrae and are covered by cartilage on their ventral aspects. The anterior costal facets are smaller and the posterior ones are larger, being present on the ventrolateral aspects of the bodies from the first to the fourth and on the arches thereafter. From the

The Anatomy of the Foetal Indian Elephant

Part X: The Axial Skeleton and Central Nervous System

By

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

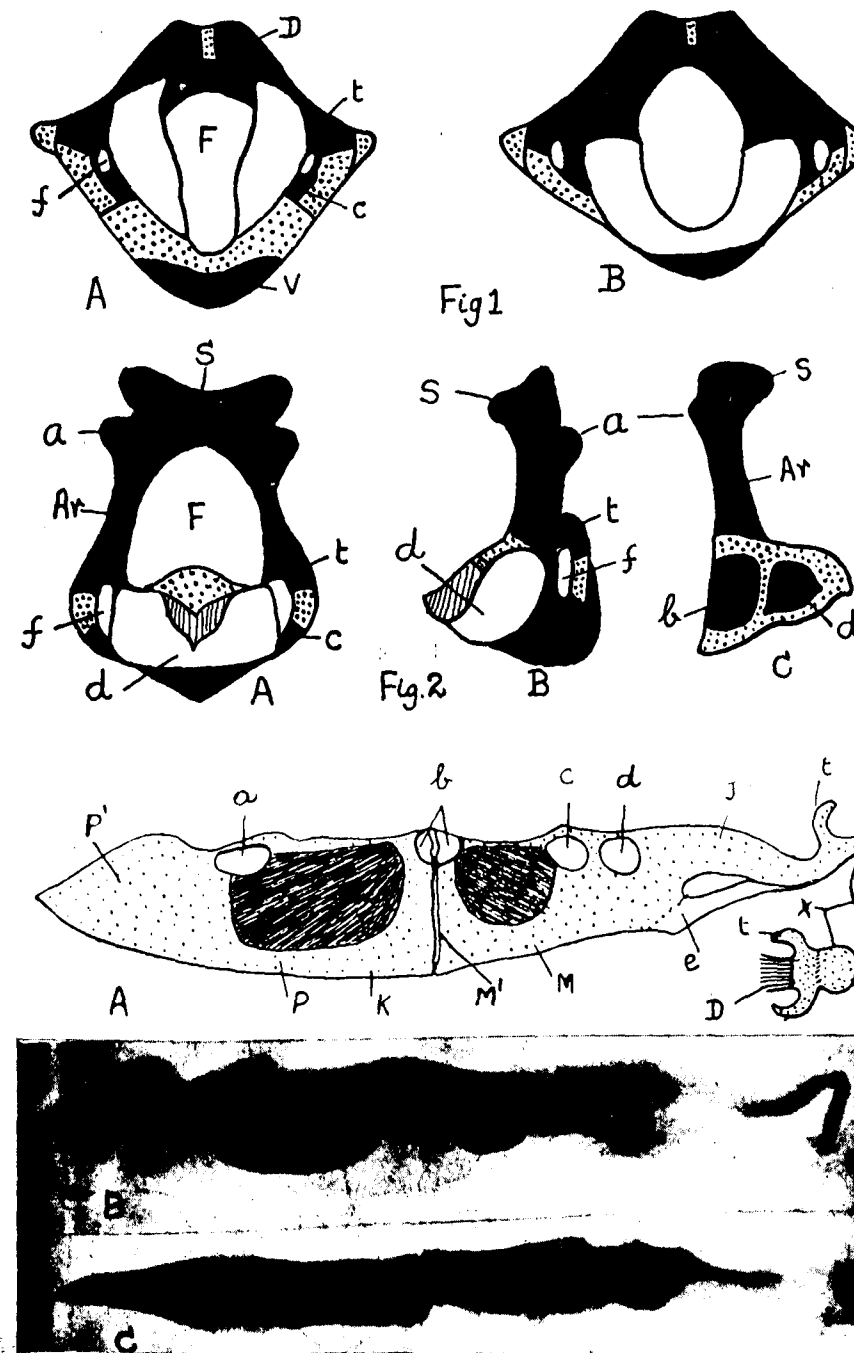


Fig. 3

The Anatomy of the Foetal Indian Elephant

Part X: The Axial Skeleton and Central Nervous System

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

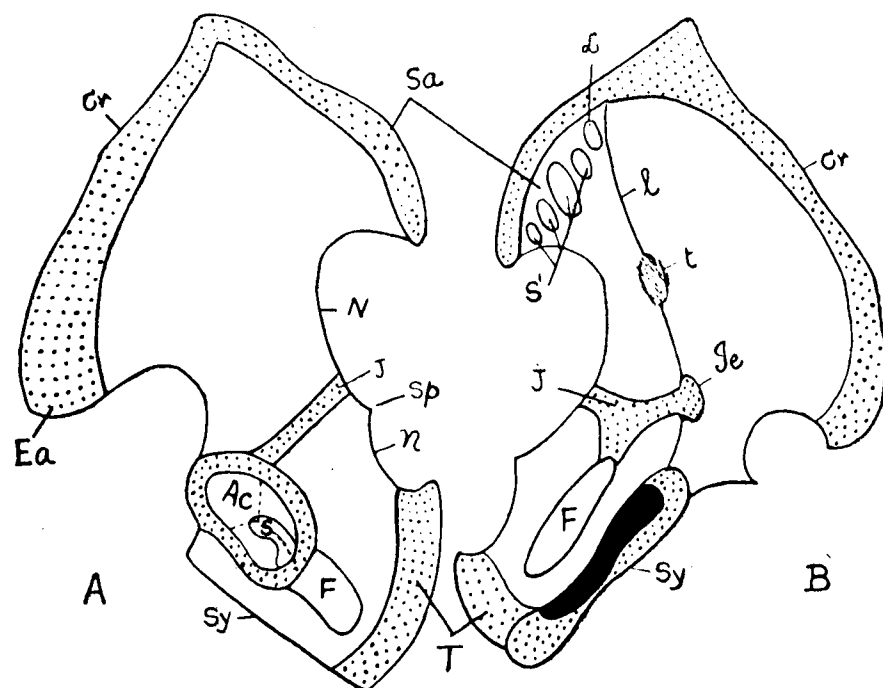


Fig. 4

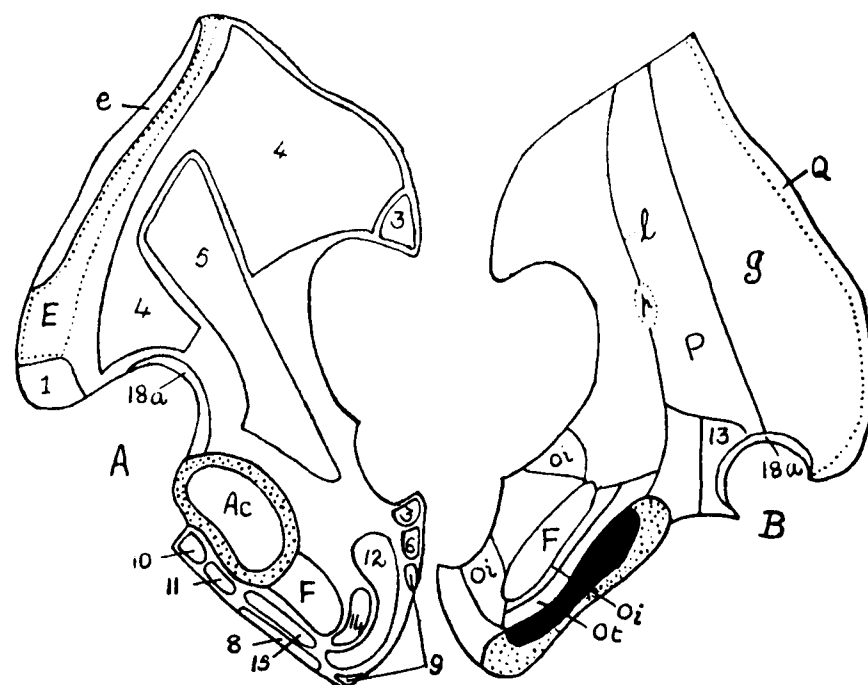


Fig. 5

fifteenth to the nineteenth, each vertebra has a single complete costal facet on the lateral aspect of the arch. The articular facets are as in the cervical vertebrae. The transverse processes gradually become smaller posteriorly and have cartilagenous ends. The tubercular facets on the transverse processes of the first and second vertebrae are large and distinct; from the third onwards they are confluent with the costal facets upto the seventh; from the eighth to the thirteenth they are separate; and they are absent in the last five. The mammillary process and accessory process are present in the last five. The vertebral foramen is triangular and gradually becomes narrow posteriorly. The neural spines are large, increasing in height from the first to the fifth and gradually diminish behind. The spine of the third is the thickest and that of the fifth the longest. All the spines are directed very obliquely backwards, overlapping those behind upto the fourteenth. From the fifteenth to the last there are clear interspinous spaces. Tips of the spines are entirely cartilagenous. There is no anticlinal vertebra in the elephant.

Lumbar Vertebrae

Each vertebra is in two pieces like the preceding. The bodies are thicker and covered by cartilage on their ventral aspect. The posterior articular process of the last two are directed ventrally. The mammillary processes are well developed and the accessory processes are absent. The transverse processes are flat, longer than those of preceding, gradually diminish in size from before backward and their tips are cartilagenous. The neural spines are short, broad and oblique like those of the posterior thoracic series with very narrow interspaces and their tips are cartilagenous. The vertebral foramen is larger than that of the last thoracic but smaller than that of the cervicals and is wider behind. The lateral face of the transverse process of the fourth presents a vertical elongated facet for the ilium.

Sacral Vertebrae

Each vertebra is in two pieces like the preceding. They progressively become smaller from the first to the last. The transverse processes are united by cartilage forming a large area showing four elongated facets for the ilium. The anterior articular processes face dorsally and the posterior ones ventrally. The neural spines are short with cartilagenous tips. The arches are completely ossified and there is no sacral hiatus.

Coccygeal Vertebrae

They become progressively smaller behind—small rods and finally nodules at the tip of the tail. Arches are present in the first eight. From the ninth to the sixteenth, the neural spine is represented by two

The Anatomy of the Foetal Indian Elephant Part X: The Axial Skeleton and Central Nervous System

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



Fig. 8

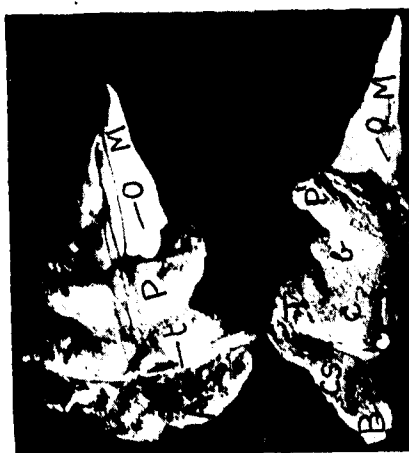


Fig. 9

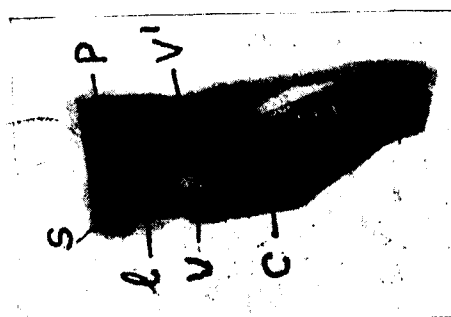


Fig. 10

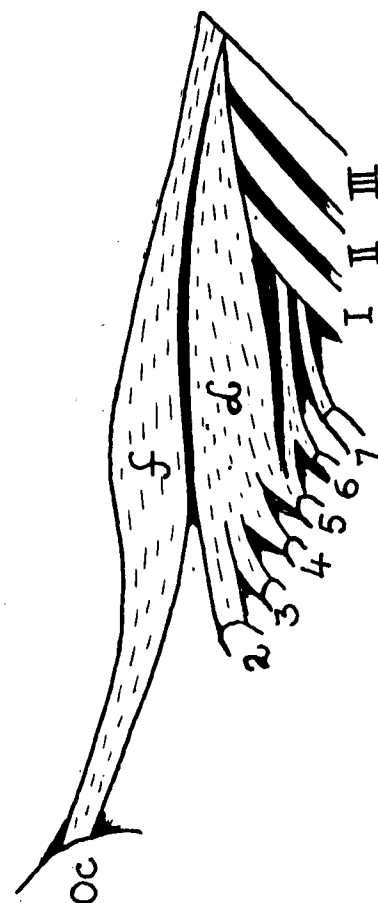


Fig. 11

Ribs

There are 19 ribs, 6 sternal, 9 asternal and the last 4 being floating ribs. They progressively increase in length from the first to the 7th; 7th, 8th and 9th are the longest; and then decrease to the last, 19th being the shortest.

The first rib is the widest and oblique in direction, with the vertebral end more cranially placed than the sternal end. Its sternal end is the widest with a short and thick costal cartilage. The head has two unequal facets—anterior one is larger, articulating with the 7th cervical vertebra and the posterior one is smaller, articulating with the first thoracic vertebra. The conjugate ligament is attached between the facets.

The heads of succeeding ribs upto the 14th have two similar unequal facets with the conjugate ligament attached between facets and each head articulating with two adjacent thoracic vertebrae. The heads of last five ribs—15th, to 19th have only one facet without the attachment of conjugate ligament and each head articulates with a single corresponding thoracic vertebra.

7th, 8th and 9th ribs are typical, broad at sternal ends and narrow towards the vertebral ends. The angle is below the vertebral third of the rib and is not distinct. The head is globular. Between the head and the angle is a tubercle with a round facet for articulation with a like facet on the transverse process of the thoracic vertebra behind. Anterior borders are thin and posterior borders are thick in the upper half and thin in the lower half.

The tubercular facets on the first and second ribs are distinct; from the 3rd rib to the 7th they are confluent with the capitular facets; from the 8th to the 13th they are distinct and separate; and from the 14th to the 19th they are absent.

The vascular groove on the medial face is distinct in the upper half of the 5th rib and less distinct in others. The anterior series of ribs upto the 10th are nearly straight and the others are curved, the curvature increasing to the last. The costal cartilages of the floating ribs are very small and their ends are separated by an interval filled up with muscle and connective tissue.

THE SKULL

(A) THE CRANIAL BONES

The Occipital Bone (Figs. 6 & 8)

The occipital bone consists of four parts - basioccipital, supraoccipital and two exoccipitals.

The *basioccipital* is quadrilateral, thick and narrow in front and wide and thin behind. In front it is united by cartilage to the body of postsphenoid and behind it forms a small part of the ventral margin of the foramen magnum and the ventral fourth of the occipital condyles. It is united above to exoccipitals and laterally to the temporals by cartilage. The lateral border forms the medial margins of foramen lacerum posterius above and carotid foramen below. Hypoglossal foramen is absent. The ventral face is concave and has a pair of faint depressions on either side for muscular attachment.

The *supraoccipital* is the largest component and is nearly pentagonal. In front, it is medially dented to receive the interparietal and behind, it forms a projection which is received in a notch between the exoccipitals. Laterally, it is related to the parietal in front and the temporal behind. The *lambdoid crest* is distinct. The area in front of the crest is convex and smooth, whereas the area behind is larger, rough and depressed and shows a long median crest that separates the insertions of the right and left funicular parts of ligamentum nuchae in depressions on either side. Lateral to this is another small depression for the complexus. The cranial face is grooved for the transverse sinuses that lead to the foramina lacerum posterius and presents a large triangular internal occipital protuberance.

The two *exoccipitals* meet above forming the dorsal margin and present medially the dorsal three fourths of the condyles forming the lateral margins of the foramen magnum. The condyles are oblique, separated by a large interval above and a narrow interval below. The lateral border is related to the squamous temporal and the posterior border to the petrous temporal where it is pneumatic. The cranial face is grooved by the transverse sinus. The cartilagenous gap is greater between the exoccipitals, supraoccipital and the squamous temporals.

The Interparietal Bone (Fig. 6)

It is a small quadrilateral bone wedged in between the parietals in front and the supraoccipital behind. Its fusion with the left parietal is complete, but on the right side it is incomplete.

The Parietal Bones (Figs. 6 & 8)

This is the largest bone forming greater part of the roof of the cranium with its fellow. The external face is convex above, and concave below and laterally forming part of the temporal fossa. This concavity divides the anterior border into two processes - medial and lateral, the former articulating with frontal close to the supraorbital process and the latter with the frontal and squamous temporal. The medial border is thicker in the anterior half to form the *median parietal boss* with its fellow, which is small in the foetus. Its union with the surrounding bones is clearly indicated by sutures.

The Frontal Bone (Figs. 6 & 8)

The bone is irregularly quadrilateral, consisting of nasofrontal, orbital and temporal parts.

The nasofrontal part forms the lower of the forehead with its fellow. The external face is gently convex, smooth and subcutaneous. The lateral border is concave forming the medial margin of the orbit and ends above in a small blunt supraorbital process, behind which the temporal part is inflected to form the medial wall of the temporal fossa. The ventral border of the temporal part is a prominent ridge separating the orbital part which is deeply concave, forming the medial wall of the orbit, and is continuous with the nasofrontal part at its orbital rim. At its articulation with the cribriform plate of the ethmoid in the cranium, it has the ethmoidal foramen which opens in the orbit in front of the optic foramen. Its articulation with the surrounding bones and its fellow are marked by sutures. The nasofrontal part is separated into two tables by the frontal sinus. The ratio of the width of the interparietal suture to the width of the forehead is 1:4 which decreases with development.

The Sphenoid Bone (Figs. 6 & 8)

The bone consists of a postsphenoid and a presphenoid.

Postsphenoid

It has a body, two wings and two pterygoid processes.

The *body* or *basipostsphenoid* is united above to the basioccipital by a small cartilage and to the body of the presphenoid below by a large cartilage. The cranial face has a shallow pituitary fossa, margined laterally by a pair of prominent ridges which terminate behind in the posterior clinoid processes. A small blind foramen is found in the middle of the fossa. Lateral to the ridges are the carotid grooves that diverge behind and contain the openings of the pterygoid canals in their lateral walls. In front of the fossa, the body is raised to form the tuberculum sellae. The external face of the body is narrow and it is excavated to form the sphenoidal sinus which is divided into two halves by a median perfect septum.

The wings or *alisphenoids* extend laterally from the body and form part of the cranial floor. The anterior border of the wing has the foramen rotundum and the posterior border has the foramen ovale.

The *pterygoid processes* are large and massive triangular projections, excavated by the extension of the sphenoidal sinus. Each is formed by a lateral and a medial lamina which are united behind and below and diverge in front to enclose the *processes molares* of the maxilla containing the developing posterior molar.

The medial lamina presents the hamuli below, indicating the fusion of pterygoid bone with it and posterosuperiorly it is grooved for the ventral end of the petrous temporal. The lateral lamina posterosuperiorly has the alisphenoidal foramen.

Presphenoid

It has a body, two orbital wings and an ethmoidal spine.

The body or *basipresphenoid* is small and excavated to form the sphenoidal sinus.

The orbital wings or *orbitosphenoids* are large, presenting on their cranial face, the optic foramina in front and sphenoidal foramina foramen lacerum anterior behind. Behind the optic foramina are the prominent anterior clinoid processes. The wings are excavated by the extension of the sphenoidal sinus.

The *ethmoidal spine* springs from the front of the body and is fused with the mesethmoid.

The Ethmoid Bone (Fig. 8)

The bone consists of five parts—a perpendicular plate, two cribriform plates and two lateral masses.

The perpendicular plate or *mesethmoid* is a small triangular plate, fused behind the body of the presphenoid and projecting above as crista galli between the cribriform plates. In front it has the septal cartilage of the nose.

The cribriform plate is a large sieve-like semipyriform depression for the olfactory bulb.

The lateral mass or *labyrinth* is situated in the olfactory recess and consists of a large number of delicate scroll like plates of bone *ethmoturbinates* which consist of large *endoturbinates* and small *ectoturbinates*. There are seven endoturbinates, the anterior one being the largest called the *nasoturbinate*. The ectoturbinates are about 28-30. They are attached to the cribriform plate behind, and to the *lamina lateralis* externally. A small *lamina transversalis* is projected from the *lamina lateralis* under the posterior ethmoturbinates. From the *lamina transversalis*, a small vertical lamina is projected above partly separating the endo and ectoturbinates.

The Temporal Bones (Figs. 6 & 8)

The temporal bone forms the greater part of the lateral wall of the cranium and consists of five elements—squamosal, petrotic, tympanic, endotympanic and the tympanohyal, the latter four have already fused to form the petrous temporal.

Squamous Temporal Bone

The squamosal or squamous temporal is a shell-like plate, larger than the petrous temporal bone. The cranial face is concave and the temporal face is convex forming the medial wall of the temporal fossa. The zygomatic process springs from the ventral part forming the lateral boundary of the temporal fossa. The process is directed forwards, articulating with the jugal to form the zygomatic arch. Ventral to and medial to the root of the process is the transversely elongated condyle, behind which is the glenoid cavity and the postglenoid process, the foramen being absent. Above and behind the root of the process is the false external auditory meatus, the floor of which is formed by two plates separated from each other along the floor. The meatus is funnel shaped. The bone is not pneumatized.

Petrous Temporal Bone

It is placed between the occipital, sphenoid and squamosal. It is a four sided pyramid with the base ventral.

The lateral face is concealed by its articulation with the squamosal. A short tube of bone, the external auditory process is projected from its lower part into the false meatus of the squamosal. The medial face forms the lateral wall of the cerebellar fossa and is convex and smooth. In its lower part is the internal auditory meatus. Along the posterior margin of this face, behind and above the meatus is aqueductus vestibuli and below it is aqueductus cochleae. The anterior face looks upward and forward and forms the posterior wall of the cerebral fossa. The petrosal crest separating these two surfaces is convex and smooth above and sharp below. The posterior face is covered by the articulation with the exoccipital.

The base forms the lateral margin of foramen lacerum posterius and presents important features. The hyoid process (tympanohyal) is a cartilagenous rod in a fossa at the lateral end of the base, attached to the short stem of the great cornu of hyoid. The vaginal process is absent. The stylomastoid foramen is lateral to the process. The bulla tympanica or auditory bulla is a large convex eminence centrally situated; it is thin walled, enclosing a cavity, which is part of the tympanum. Its medial border has a notch and a groove to form the carotid foramen and carotid canal. The muscular process (styloid process) is very short and blunt. Lateral to the process is the small glasserian fissure. The osseous Eustachian tube is anteromedial to the process, leading into the tympanum. Medial to the process is the minute opening of the petrosal canal which communicates with the facial canal.

The apex projects upwards and backward in the cranium between the squamosal and exoccipital.

(B) THE FACIAL BONES

The Maxillae (Figs. 6 & 8)

Due to the fore shortening of the skull, the maxillae are not extensive. The body of the maxilla is prolonged in front as a conical shaft to support the premaxilla. The shaft is grooved medially and it stops a little behind the anterior end of premaxilla. On the nasal face of the body, ventral to the posterior end of the premaxilla, is the attachment of the maxilloturbinal. Above and lateral to this is the large oval opening of the maxillary sinus and behind on the floor is a large opening of the maxillary sinus closed by the mucous membrane. The alveolar part of the body is very large containing three developing molars, the posterior one being the smallest. The posterior end containing the germ of the posterior molar is the *processus molaris*, enclosed by the two laminae of the pterygoid process of the sphenoid. The posterior wall of the process is thin and membranous.

The palatine process articulates medially with its fellow and with the palatine behind forms the greater part of the bony palate and the floor of the nasal cavity. The medial border of the process at the anterior end is concave to form a median cleft with its fellow, which is covered above by the premaxillae.

The zygomatic process springs from the external face of the body and extends backward horizontally to articulate with the jugal. The root of the process is pierced by a large infraorbital canal (or foramen) which has on its medial wall, the superior dental foramen by which the nerves and blood vessels to the molars and tusk pass. Its superior face forms part of the floor of the orbit and is deeply cut posteriorly by the lacrymal fissure. The body and the processes are pneumatized.

The Premaxillae (Figs. 6 & 8)

The premaxilla has a body, a palatine process and a nasal process.

The body or *pars dentalis* is greatly developed for the implantation of the tusk. The anterior face is concave to support the proboscis and the posterior face is mostly covered by the maxilla except at the anterior end which forms the roof of the mouth cavity. The superior face forms part of the floor of the nasal cavity and here, the septal cartilage of the nose is received in the groove formed by the two bones.

The palatine process is not developed and the anterior end of the body laterally is uncovered by the palatine process of the maxilla to form the anterior border of the bony palate.

The nasal process or *pars ascendens* is enormous and meets the nasal dorsomedially and frontal and maxilla laterally and forms the lateral wall and margin of the bony nasal opening. The body and the nasal process are pneumatized.

The Palatine Bones (Fig. 6)

The palatine bone is small and consists of two parts—horizontal and vertical.

The horizontal parts of both sides form the posterior third of the bony palate. The nasal face forms part of the floor of the nasal cavity and its posterior border forms the ventral margin of the posterior naris. There are two posterior palatine foramina along the lateral border.

The perpendicular plate is small, thin and triangular and is in contact with the maxilla and its medial face forms the lateral wall of the nasal cavity. The wing of Vomer articulates with it medially. The junction of the two parts posteriorly is in the form of a blunt process in contact with the anterior end of the hamular process of pterygoid.

The Nasal Bones (Figs. 6 & 8)

The nasal bone is pyramidal with its base related behind to the frontal and the blunt apex directed forwards and the bone is completely hollow. The cavity does not communicate with that of its fellow. The anterior margin is free to form the dorsal margin of the bony nasal aperture. The lateral wall of the base has a large opening communicating with the sinus of the premaxilla.

The Lacrymal Bones (Fig. 6)

The lacrymal bone is small and pyramidal, being wedged in between the premaxilla and the frontal at the medial angle of the orbit. The base forms the facial part showing laterally the lacrymal tubercle. The lateral face forms a small part of the medial wall of the orbit and the lateral border of the facial part and forms part of the medial margin of the rim of the orbit. The nasal face at its ventral part is free forming a small part of the lateral wall of the nasal cavity and is dented below to form the dorsal margin of the large nasomaxillary opening. In the specimen it is not pneumatized but in the skull of a calf available, it is hollow.

The Jugal Bones (Fig. 6)

The jugal or malar bone is a thin rod of bone flattened on the sides and forms the posterior three fourths of the zygomatic arch. The anterior end articulates in front with the zygomatic process of the maxilla and had immediately above, a small, blunt orbital process. The posterior half of the dorsal border is bivelled for the zygomatic process of the squamosal.

The Vomer (Figs. 6 & 8)

It is a median bone forming the ventral part of the septum nasi. It is a thin lamina bent so as to form a groove to receive the ventral

part of the septal cartilage of the nose. The lateral surfaces are highest below the mesethmoid and diminish gradually at the anterior end. The ventral border is thin and free in its posterior two thirds, the gap being closed by the mucous membrane. The anterior end and the rest of the ventral border are received between the premaxillae and maxillae. The posterior extremity consists of the wings that extend below the cartilage connecting the presphenoid and mesethmoid and is related laterally to the vertical part of palatine and the pterygoid process of sphenoid. It is 6 cms. long and 1.5 cms. high at its widest part.

The Turbinate Bones

They are two in each nasal cavity - nasoturbinal and maxilloturbinal, the former is larger and the latter is very small.

Nasoturbinal

This is the anterior most endoturbinal of the ethmoid, placed ventral to the inner table of the frontal which underlies and supports the nasal. It is long and rhomboid with the base towards the cranium and the apex towards the nasal aperture. It is hollow containing an air sinus and is made up of a thin bony lamina covered by mucous membrane. The apex is prolonged outside the nasal aperture as an 'S' shaped ridge in the medial wall of the nasal tube for a distance of about 7 cms. The core of the ridge consists of a bar of cartilage.

Maxilloturbinal

In the specimen it is very small as a thin ridge, but in the skull of a calf available, it is a small triangular plate on the nasal face of the maxilla, ventral to its articulation with the premaxilla.

Hyoid (Fig. 7)

The body consists of a bar of cartilage ossified in its core only. The *thyroid cornua* are the largest pieces, completely ossified and united in front to the body by cartilage which forms above a small pointed projection representing *small cornu* having attachment of the stylohyoid ligament. The tip of the thyroid cornu behind is cartilagenous to form a synovial joint with the anterior facet of the thyroid cartilage. The *styloid cornu* is smaller and more slender forming an inverted Y shaped bone. The tail of the Y is the short stem attached by cartilage in a fossa of the petrous temporal in the foetus. The posterior process is short and curved and the anterior process is longer in the form of a slender rod, with the stylohyoid ligament attached to its tip. The middle and small cornu are absent.

Mandible (Fig. 7)

The mandible consists of two halves that join at their anterior ends forming a symphysis. Each half has a horizontal part or body

and a vertical part or the ramus. Lateral surface of the body is smooth, convex and has three mental foramina—openings of the inferior dental canal. The alveolar border has molar teeth covered by the mucous membrane. The lateral face of the ramus has a fossa for masseter and the posterior border has a rounded angle. Its medial face has a very large mandibular foramen below the condyle. The ramus is thick, smooth and convex below and is flat and thin above, presenting the massetric fossa laterally. Superiorly it has a triangular coronoid process in front, separated by a wide notch from the condyle behind, which is slightly higher in level than the process. Articular face of the condyle is pyriform with the narrow end medial. The ramus is shorter in height when compared with the length of the body, whereas in the adult they nearly equal each other. The anterior end of the symphyseal part forms a median blunt projection—rostrum.

Dentition

The dental formula in the foetus is :

$$\begin{array}{cccc} \text{I} & \frac{1-1}{0-0} & \text{DP}^2 & \frac{1-1}{1-1} & \text{DP}^3 & \frac{1-1}{1-1} & \text{DP}^4 & \frac{1-1}{1-1} \end{array}$$

Thus the upper jaw has two incisors or milk tusks, one in each premaxilla and the deciduous premolars, 2, 3 and 4 in each half of upper and lower jaw, the first premolar having disappeared.

The ridge plate formula or number of ridges of teeth is :

$$\begin{array}{ccc} \text{DP}^2 & \frac{4-4}{4-4} & \text{DP}^3 & \frac{8-8}{8-8} & \text{DP}^4 & \frac{7-7}{7-7} \end{array}$$

None of them have erupted and are covered by the gum.

Milk tusks: They are two, deeply implanted, one in each premaxilla. Each is 5 cms. long. The crown is compressed dorsoventrally and is spatula shaped, being 1 cm. long and 1 cm. wide at the base. The root is conical, curved like a gently bent 'S' with a pointed tip showing the opening of the root canal.

Premolars: Each consists of a number of transverse plates with cusps on their free borders, the central ones being the longest and others sloping at the medial and lateral ends. The plates are cemented together only in the 2nd and are free in others.

The dental formula of the adult elephant is :

$$\begin{array}{cccc} \text{I} & \frac{1-1}{0-0} & \text{C} & \frac{0-0}{0-0} & \text{P. M.} & \frac{3-3}{3-3} & \text{M} & \frac{3-3}{3-3} \end{array}$$

At no time there are more than two molars in each half of the jaw, others appearing successively in a caudocranial sequence. Unlike in other mammals where they are vertically replaced, in the elephant

they are pushed out from behind. Each molar consists of a large block formed by the cementing of numerous plates. The table shows as many enamel loops or infundibula as the plates. In *Elephas indicus*, the loops are straight crimped or sinuous, where as they are "Lozenge" shaped in *Loxodon africana*.

The Orbit (Fig. 6)

The orbit is open laterally being confluent with the temporal fossa. It lies over the molars and the orbital opening is behind the anterior margin of teeth which is reversed in the old elephant. The medial wall is formed by the frontal, lacrymal, maxilla, orbitosphenoid and alisphenoid. The orbital rim is deficient posteriorly, which is made up by the orbital ligament extending from the orbital process of the jugal to the suborbital process of the frontal. The orbital hiatus is a deep trench medial to the pterygoid crest (sphenofrontal crest). The orbital group of foramina is arranged in an oblique line. Anteriormost in the medial wall is the ethmoidal foramen; a little below and behind is the optic foramen separated laterally by a plate of bone from the sphenoidal foramen (foramen orbitale) which is behind, and further back is the foramen rotundum.

The Cranial Cavity (Fig. 8.)

The cavity is relatively small and ovoid with the narrow end in front. It consists of three fossae - the anterior one the largest and the posterior one being the smallest. The bones forming the boundaries of the fossae and their contents are the same as those of the ox and horse.

The Nasal Cavity (Fig. 8)

The nasal cavity is relatively short and the greater part of it is occupied by the ethmoturbinates, so that the olfactory part is larger and respiratory part is smaller which condition is reversed in other mammals. The nasal meati are only two - dorsal and ventral. The bones participating in forming the boundaries and the openings of the air sinuses of the skull into the cavity nearly correspond to those of the ox and horse.

The Paranasal Sinuses (Fig. 8)

1. The *maxillary sinus* is the largest, excavated in the maxilla and extending into the premaxilla, nasal and lacrymal bones and opening into the nasal cavity by a large nasomaxillary opening.

2. The *ethmoidal sinus* is next in size to the preceding, consisting of the cavity of the nasoturbinates and other ethmoturbinates and opening into the nasal cavity by minute openings in the ethmoidal meati.

3. The *sphenoidal sinus* is smaller than the preceding, excavated in the bodies of the post and presphenoid, orbitosphenoid and the pterygoid processes of sphenoid and opening into nasal cavity by minute openings in the ethmoidal meati.

4. The *frontal sinus* is the smallest excavated in the frontal and opening into the nasal cavity by minute openings in the ethmoidal meati.

The Central Nervous System

The meninges of the brain and spinal cord are similar to those of the ox and horse.

The Brain (Fig. 9)

In size, it is slightly smaller than that of the adult man. The cortex was soft and unfit for study. Only the base of the brain was hardened showing these important features:

The olfactory bulbs are very large the brain being strongly macrosmatic. The optic nerves are very small, whereas V and VII cranial nerves are very large for innervating the proboscis. The Pons is very large and quadrilateral on the ventral aspect. The olivary bodies are very large, prominent oval eminences, medially related to pyramids on the ventral face of the medulla. In front and lateral to the olivary body, covered by the pons is a small oval eminence - tuberculum faciale. The optic thalamus is small and so also the optic tract. The medial geniculate body is prominent and well defined, but the lateral geniculate body is merged with the posterolateral angle of the thalamus. The corpus striatum is large. Dimensions of the brain are as follows:

Dimension	Cerebrum	Cerebellum	Pons	Medulla
Length	12 cms.	5 cms.	8 cm.	5 cms.
Breadth	15 "	12 "	8 "	4 "
Height	8 "	7 "	1 "	2 "

The Spinal Cord

The spinal cord is 58.5 cms. long, occupying the whole length of the spinal canal. The cervical enlargement is small extending from the sixth cervical to the first thoracic segment, after which it rapidly diminishes in size. The lumbar enlargement is large, extending from the first lumbar to the fourth lumbar segment, beyond which it is narrow and conical—conus medullaris occupying the sacral canal. From tip of the conus medullaris, filum terminale extends into the coccygeal

canal. There are 39 pairs of spinal nerves — 7 cervical, 19 thoracic, lumbar, 4 sacral and 5 coccygeal, (Cauda equina shows 2 or more five coccygeal nerves.)

The Middle Ear

It is an air cavity in the tympanic and petrous parts of the temporal bone. The lateral wall is formed by the tympanic membrane which is oval measuring 2.5 cms X 2 cms. The handle of malleus is attached to its centre. Above and anterolateral to it is the epitympanic recess containing the incus and head of malleus. Posteromedially the osseous Eustachian tube opens by a small slit. The labyrinthine wall has a large oval fenestra vestibuli measuring 6 x 4 mm in which the stapes is fixed. The auditory ossicles are the malleus, incus and stapes, as lenticular having fused with the end of the long process of sinus. They are large and resemble those of the horse in all their details and their articulations.

The tympani is a very fine muscle arising from the groove in continuation of the Eustachian opening. It passes laterally and is inserted to the muscular process of malleus.

Stapedius is large having a conical belly and a fine tendon. The belly arises from a recess in the medial part of the roof and descends downward and forward and is inserted to the neck of the stapes.

The Internal Ear (Fig. 10)

The internal ear is situated in the petrous part of the temporal bone. It consists of an osseous labyrinth contained within it the membranous labyrinth.

The osseous labyrinth has the middle part — vestibule, anterior part — cochlea and the posterior part — 3 semicircular canals. They are identical with those of the horse and other mammals. The cochlea forms $2\frac{1}{2}$ turns. The nonampullated ends of the lateral and posterior semicircular canals unite. The illustration shows the natural size of the internal ear.

ARTICULATIONS OF THE VERTEBRAL COLUMN

Intercentral Articulations

These are *amphiarthroses*, formed between the ends of the bodies of adjacent vertebrae. The articular surfaces in the cervical region consist of a gentle cavity on the posterior end of the body and a convexity on the anterior end. In the thoracic and lumbar regions the concavity on the posterior ends of bodies is distinct and well marked. In the sacral and coccygeal regions the ends of bodies are flattened.

The ligaments are:

1. The *intervertebral fibrocartilages*. Each of these is a disc connecting the bodies of adjacent vertebrae. They are thicker in the posterior thoracic and lumbar regions.

2. The *ventral longitudinal ligament*. This lies on the ventral faces of the bodies and the intervertebral discs. It is a well developed band in the posterior thoracic and lumbar regions. In the sacral and anterior part of the coccygeal regions it is a fine thin narrow band.

3. The *dorsal longitudinal ligament*. It lies on the floor of the vertebral canal from the axis to the sacrum. It is narrow over the bodies and widens over the intervertebral discs.

Interneural Articulations

These are *diarthroses* formed by the articular process of the adjacent vertebrae.

The ligaments are:

1. The *Joint capsule* is strong and ample in the cervical region and small in other regions.

2. The *ligamenta flava* connect the arches of the adjacent vertebrae.

3. The *supraspinous ligament* extends medially from the occipital bone to the sacrum. It consists of a strong band of elastic tissue attached to the summits of the neural spines. In the neck, it is remarkably developed to form the *ligamentum nuchae*.

The *ligamentum nuchae* (Fig. 11.) is a very powerful elastic structure to assist the extensors of the head and neck. It extends from the occipital bone over the cervical spines and is continuous behind with the thoracolumbar part which is not well developed. It consists of two parts - funicular and lamellar.

From the lateral aspects of the 1st, 2nd and 3rd thoracic spines, the fibres arise and divide into a dorsal funicular part and a ventral lamellar part which are separated by a mass of fat in front. The right and left ligaments are also separated by a mass of yellow fat and connective tissue.

The *funicular part* passes forwards and expands over the cervical spines and is oval in section and then as it reaches the occipital, it becomes narrow and rounded and is inserted to the lower depression on the supraoccipital, below the tendon of the complexus. The insertions of the right and left funicular parts are separated by a median vertical bony ridge.

The *lamellar part* expands over the cervical spines and divides into slips which are inserted to the spines of the 2nd, 3rd, 4th and 5th cervical vertebrae. This corresponds to the anterior division of the lamellar part of the ox. From the anterolateral aspect of the first thoracic spine, 2 cms. below its summit, two bundles arise, of which the lower smaller bundle is inserted to the spine of the 7th cervical vertebra and the upper larger bundle divides into two slips that are inserted to the spines of the 5th and 6th cervical vertebrae. This corresponds to the posterior division of the lamellar part of the ox. Of the slips, the largest is attached to the axis and the smallest to the 7th cervical vertebra.

Sacral and coccygeal articulations

The sacral vertebrae are separated by intervertebral discs which ossify later to form the sacrum. The spines and the articular process are free but the transverse processes are united by cartilage.

In the coccygeal region the intervertebral discs are thicker. The articular processes of sacral and coccygeal vertebrae form *diarthroses* as in other regions.

Sacro-iliac articulation (Fig. 4)

This is a *diarthrosis* between the transverse processes of the 4th lumbar and the four sacral vertebrae and the five facets and the pelvic face of the sacral angle of ilium. The *joint capsule* is a very close fitting attached round the margins of the articular areas.

The following ligaments are accessory to the joint:

1. The *dorsal sacro-iliac ligament* is similar to that of the horse.
2. The *ilio-lumbar ligament* attaches the tips of transverse processes of second and third lumbar vertebrae to the sacral angle of ilium.
3. The *sacro-sciatic ligament* is a strong thick fibrous sheet completing the lateral pelvic wall, with similar attachments as in the horse and forming the greater and lesser sciatic foramina.

Symphysis Pelvis (Figs. 4 & 5)

This is formed by the meeting of the pubis and ischium of both sides at the ventral median line. The pubic bones are separated by a thick bar of cartilage, which is broad and rounded in front and tapering behind. Behind this the two ischia are connected by fibrous tissue only. Behind the cartilagenous epiphyses of the two ischia are united by fibrous tissue. The symphysis is reinforced dorsally and ventrally by fibrous bands.

Obturator membrane

This is a thin membrane of connective tissue attached to the margin of the foramen and leaving a gap in front for obturator nerve and vessels.

Atlanto-occipital articulation

This is a *ginglymus* consisting of two joints between the occipital condyles and the corresponding facets of atlas.

The ligaments are:

1. Two *joint capsules*—one for each joint.
2. The *dorsal atlanto-occipital membrane*.
3. The *ventral atlanto-occipital membrane*.
4. The *lateral atlantal ligaments*.

They are similar to those of the horse.

Atlanto-axial articulation

This is a *trochoid* or *pivot* joint between the anterior articular area of the axis and the corresponding facet of the atlas.

The ligaments are:

1. The *joint capsule* is loose and ample.
2. The *transverse ligament of dens* is a strong flat band stretching over the dens and connecting it to the internal faces of the lateral masses of atlas.
3. The *odontoid ligament* is a short thick strong band connecting the dorsal face of dens and its apex to the ventral arch of atlas and the basi-occipital.
4. The *dorsal atlanto-axial ligament*.
5. The *ventral atlanto-axial ligament*.
6. The *interspinous ligament*.

They are similar to those of the horse.

ARTICULATIONS OF THE THORAX

Costo-vertebral articulations

Each typical rib forms two joints - costo-central and costo-transverse.

Costo-central articulation is a *trochoid* joint formed by the head of a rib with capitular facets of two adjacent vertebrae.

The ligaments are:

1. The *joint capsule*.
2. The *radiate ligament*.

3. The conjugal ligament.
4. The ligament of the neck of the rib.

They are similar to those of the horse.

Costo-transverse articulation is a *gliding joint* between the facet on the tubercle of a rib and the corresponding facet on the transverse process of the thoracic vertebra. The *joint capsule* is tight and is reinforced by the dorsal *costo-transverse ligament* as in the horse.

Costo-chondral articulations are *gomphoses*.

Chondro-sternal articulations are *diarthroses* between the facets on the sternum and the costal cartilages of sternal ribs. The *joint capsule* is strong and tight. The joint of the first rib does not communicate with that of the opposite side, as the facets on the sternum are separated by an interval. The second joint communicates with the opposite joint through the intersternal articulation.

Sternal articulation

This is a *diarthrosis* between presternum and mesosternum. The *joint capsule* is common to it and the second chondro-sternal articulation of that side. Besides there is *suprasternal ligament* as in other animals.

ARTICULATIONS OF THE SKULL

Mandibular articulation

This is a *ginglymus* between the condyle of the mandible and the squamous temporal.

The ligaments are :

1. The *inter-articular disc* placed between the joint surfaces, which it renders congruent and its circumference is attached to the capsule, dividing the cavity into a larger upper part and a slit like lower part.

2. The *joint capsule* is strong and thick. Both in front and behind it is reinforced by the *lateral ligament* and the *posterior ligament*, as in the horse.

3. *Medial ligament* is a strong fibrous band connecting the margin of the glenoid fossa to the lower margin of the mandibular foramen.

Articulations of the Hyoid

Temporo-hyoid articulation is an *amphi-artrosis*, in which the stem of the great cornu of the hyoid is attached by a bar of cartilage in a fossa of the petrous temporal.

Basi-cornual articulation is also an *amphiarthrosis* between the thyrod cornu and the body of hyoid connected by a bar of cartilage.

Discussion and Summary

1. Variation in the number of vertebrae in different regions except the cervical has been observed by previous workers. There are 19 thoracic vertebrae in the specimen, being one less than in the *Loxodon*. The lumbar and sacral vertebrae are 4 in each, but may show variation by one as noted by others and the coccygeal vertebrae are 30, and may range from 26 to 30. The ossification is more advanced than that seen by Rajagopal (1956) in his specimens, as the arches are completely ossified in the atlas and axis and also the neurocentral joints of coccygeal vertebrae from the first onwards, indicating their progressive ossification cranialward.

2. Ilium has five facets for the 4th lumbar and four sacral vertebrae. The post pubic bone described by Eales (1929) as the fourth bone (element) in the os coxae is the symphyseal ramus of ischium.

3. The sternum is in two pieces - presternum and mesosternum, the xiphisternum having united with the latter. Two centres of ossification are present, one in each segment close to the joint and ossification is extending in opposite directions - cranial ward in presternum and caudalward in mesosternum. Rajagopal (1956) has noted in his specimens, three segments and more centres of ossification. In the sternum of a calf available, there are four bony segments.

Ribs vary in number, one more in the *Loxodon* and one less in the *Elephas*. In the specimen there are 19 - 6 sternal, 9 asternal and 4 floating ribs.

4. Detailed consideration of the skull and the developmental changes exhibited in the ontogeny of the elephant are beyond the scope of this paper and will be taken up later. The reader can benefit by a reference to Osborn (1942) on the subject. The most significant features are the presence of a large mesethmoid and fusion of tympanic, periotic and endotympanic to form the petrous temporal bone in the specimen. The false external auditory meatus of the squamosal corresponds to the notch of the squamosal of other domestic animals.

5. Absence of small and middle cornua with the presence of stylohyoid ligament, allows not only greater movement of the tongue, but permits the insertion of the tip of the trunk into the mouth cavity to withdraw slight amounts of mucus to be blown out as a spray over the head or body.

6. Brain is strongly macrosmatic and the olivary bodies are very prominent. The spinal cord occupies the whole length of the spinal canal.

7. The middle ear and the internal ear resemble those of the horse and other mammals.

(This article completes the series on the subject).

EXPLANATION TO FIGURES

Note: In figs. 1 to 7.

Solid black used for bone.

Stippled area used for cartilage.

Striped area in fig. 2 used for ligamentous attachment.

White area used for facet.

- Fig. 1. A, anterior view; B, posterior view of atlas; V, ventral arch; D, dorsal arch; f, foramen transversarium; C, costal element; t, transverse process; and F, vertebral foramen.
- Fig. 2. A, anterior view; B, lateral view; C, sagittal section of axis; a, articular process; b, body of axis; Ar, neural arch; s, neural spine; d, dens; c, t & F as in preceding.
- Fig. 3. A, lateral view; B & C, lateral and dorsal view of positive prints of skiagrams of sternum. a, facet for I; b, facets for II; c, facet for III; d, facet for stern of costal cartilages of IV, V & VI ribs; K, keel; P, presternum; P₁, presterneal cartilage; M, mesosternum; M₁, joint; J, xiphisternum; e, fibrous band connecting meso and xiphisternum; t, cornua; X, xiphoid cartilage; D, sternal part of diaphragm attached to xiphoid cartilage shown in dorsal view. Note the two ossified masses in the segments in B & C. In A the direction of bony plates is shown.
- Fig. 4. A, lateral view; B, medial view of os coxae. Ea, external angle; Sa, sacral angle of ilium; Cr, iliac crest; Sy, symphysis; T, tuber ischii; N, greater sciatic notch; n, lesser sciatic notch; Sp, superior ischiatic spine; J, Y-shaped cartilagenous junction of bony elements; F, obturator foramen; Ae, acetabulum with Y-shaped cartilagenous junction marked by interrupted line; S, synovial fossa; St, facets for sacral vertebrae; L, facet for IV lumbar vertebra; l, iliopectineal line; le, iliopectineal eminence; t, psoas tubercle.
- Fig. 5. A, lateral view; B, medial view of os coxae showing areas of muscular attachment. The numbers marked correspond to the numbers of muscles in the text of previous paper Part IV. Origin is marked by continuous line and insertion by interrupted or dotted line. E, external oblique; e, internal oblique muscles of abdomen; Q, quadratus lumborum; I, iliacus; P, psoas magnus; p, psoas parvus; l, iliopectineal line; Ot, obturator tertius; Oi, obturator internus; F, obturator foramen; Ac, acetabulum.
- Fig. 6. A lateral view; B, ventral view; C, dorsal view of the skull. a, alveolus for milk tusk; Bo, basioccipital; bs, basipostsphenoid; F, foramen magnum; J, jugal; Fr, frontal; Oc, exoccipital; t, tympanohyal; St, stylomastoid foramen; L, foramen lacerum posterius; l, lacrymal; C, carotid foramen; Sp, alisphenoidal foramen; Ab, auditory bulla; S, squamosal; To, temporal condyle; R, orbit; Pt, pterygoid process of sphenoid; h, hamular process of pterygoid; M, maxilla; P, parietal; p, interparietal; P₁, premaxilla; p₁, palatine; V, vomer; Of, infraorbital foramen; N, nasal; O, bony nasal opening; m, external auditory meatus; So, supraoccipital; 2, 3, respective deciduous premolars.
- Fig. 7. A, Hyoid; B, lateral view; C, medial view of mandible. b, body of hyoid; t, thyroid cornu; S, styloid cornu; c, small cornu; l, stylohyoid ligament; C, condyle; P, coronoid process; m, mental foramina; Sy, symphysis; M, mandibular foramen; DP₁ & DP₂, respective deciduous premolars.
- Fig. 8. Sagittal section of the skull showing the basicranial axis. B, basioccipital; b, basipostsphenoid; B₁, basipresphenoid; h, hamulus of pterygoid; V, vomer; M, maxilla; P, premaxilla; e, endoturbinates; N, nasal; E, mesethmoid; f, frontal; P₁, parietal; S, supraoccipital; t, petrous temporal showing internal auditory meatus. Air sinuses in nasal, frontal, maxilla, prebasiophenoid and post-basiophenoid are evident. White area between the presphenoid, postsphenoid and mesethmoid is cartilage uniting them and continuous with septal cartilage of the nose which is partly cut in front of ethmoid exposing the endoturbinates.
- Fig. 9. A, ventral view; B, lateral view of the brain stem. P, pons; M, medulla; C, cerebral peduncle; Cs, corpus striatum; T, optic thalamus; t, optic tract; O, olivary body; P₁, brachium pontis; b, brachium conjunctivum.
- Fig. 10. Positive print of skiagram of petrous temporal showing the lateral view of the internal ear in natural size. C, cochlea; V₁, vestibule; V, fenestra

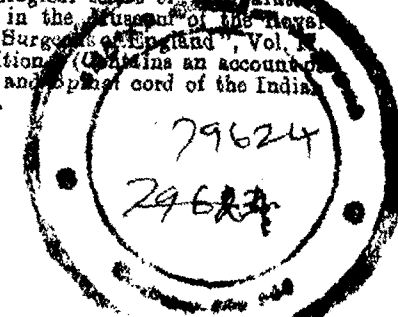
vestibuli (oval white area), p, s, l, posterior, superior and lateral semicircular canals, the union of the former two is evident. Ampullas are large, but not brought out in the illustration.

- Fig. 11. I, II, III neural spines of respective thoracic vertebrae; 2 to 7, neural spines of respective cervical vertebrae; f, funicular part; L, lamellar part of ligamentum nuchae; oc, occipital.

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SOME FACTORS ASSOCIATED WITH SEASONAL SEX RHYTHM IN THE FEMALE WHITE CATTLE

By

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Variations in climatic conditions greatly influence the breeding efficiency and productivity of farm animals, especially under range and poor management conditions. The incidence of depression of oestrous cycle in the females, ranging from suboestrus to anoestrus, is higher in the colder and northerly areas of United Kingdom possibly because of lack of sunshine and of vitamin D (Miller and Ras, 1952). A decline in summer milk production, both in the tropics and in temperate zones, is due to the rising environmental temperature and nonavailability of good fodder both in quality and quantity. Variations in female sex activity during different calendar months with a peak in March and December in the nondescript and Kangayam cattle respectively were observed by Rathnasabapathy (1958), while analysing the records of the Artificial Insemination centre at the Coimbatore Agricultural College. Similar seasonal sex rhythm, however, could not be noticed in the English crosses and Sindhis.

A knowledge of the factors, genetic and environmental, associated with sex periodicity would be of great avail not only in understanding the problems of fertility and sterility in greater detail, but also in the use of the factors for exploitation of the reproductive potential and thus the life time productivity of the farm animals. The object of the present study is to determine the extent of control of the various factors over the sex activity of the female white cattle in this part of the country.

Materials and Methods

The work was done at the Artificial Insemination centre, College of Agriculture, Coimbatore, located in the tropics of India at a latitude 11°00" North, longitude 76°58" East and altitude 1305 feet above mean sea level. The records of the centre over a period of two years from April, 1955 to March, 1957 supplied figures for the oestrous activity of the females monthwar in respect of the nondescript and Kangayam cattle totalling 1506 of the former and 309 of the latter. The 'B' class meteorological observatory located at the college of Agriculture furnished data on climatic factors for the corresponding period.

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TABLE I
Number of oestrous females of the Non-descript and Kangayam cattle, and climatic data monthwar for the period April 1955 to March 1957.

Variables.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Number of oestrous females of Non-descript cattle	145	167	223	129	128	80	115	70	83	105	109	152
Number of oestrous females of Kangayams	38	32	22	13	20	25	27	23	23	34	24	36
Average daily maximum temperature (°F)	84.5	89.3	94.0	95.8	91.0	87.6	84.4	87.2	88.6	86.9	84.0	82.0
Average daily mean temperature (°F)	74.2	77.0	81.3	84.4	82.0	80.0	77.5	79.3	80.0	78.6	76.4	73.2
Average daily humidity (%)	88.0	88.5	78.4	83.0	78.8	80.5	83.5	84.0	84.2	89.0	91.5	88.0
Hours of bright sunshine per day	8.80	9.45	9.19	8.46	7.54	5.48	5.28	4.86	6.56	6.27	6.88	7.86
Monthly rainfall (inches)	.05	.51	.02	2.32	2.44	3.00	1.14	.84	1.20	3.41	6.24	.72

The following factors were studied in relation to the seasonal sex behaviour of the females :

1. Average daily maximum temperature.
2. Average daily mean temperature.
3. Average daily humidity per cent.
4. Hours of bright sunshine per day.
5. Total monthly rainfall.
6. Seasonal food supply rhythm.

Correlation coefficients, partial correlations and other statistical analysis were done by methods described by Snedecor (1946).

Results

Table I gives figures for oestrous activity of the females of non-descript cattle, and Kangayams monthwar for two years and also meteorological data for the corresponding period. A perusal of the Table will indicate, at a glance, that the high sex activity of the nondescript cattle during March, numbering 223 oestrous females, is associated with longer hours of bright sunshine, 9.19, and the low sex activity during August numbering 70 oestrous females with shorter hours of bright sunshine, namely 4.86, beyond which little could be made out. Statistical analysis of data brought out the exact degree of association of the different climatic factors with the female sex activity and the values appear in Table II.

TABLE II

Correlation coefficients (r) between seasonal factors and sex activity in the female white cattle.

Independent Variable (X)	No. of observations	Dependent variable (Y) Oestrous activity of the females	
		Nondescript (r)	Kangayam (r)
Average daily maximum temperature (°F)	24	+0.256	—0.300
Average daily mean temperature (°F)	24	—0.010	—0.352
Average daily humidity (%)	24	—0.504*	+0.010
Hours of bright sunshine per day	24	+0.670**	+0.135
Total monthly rainfall (inches)	24	—0.303	—0.294

* Significant; $P < .05$.

** Highly significant; $P < .01$.

In the nondescript cattle the correlation coefficient between sunshine and sex activity was positive and highly significant ($r = +0.670$; $P < .01$) and the correlation between humidity and sex activity was negative and significant ($r = -0.504$; $p < .05$). Temperature and rainfall seemed to

have little influence over sex activity as indicated by the very low and insignificant values. Partial correlation between sunshine and sex activity, keeping the humidity constant, continued to be positive and highly significant ($r = +0.626$; $p < .01$) and that between humidity and oestrous activity with sunshine constant was still negative and significant ($r = -0.422$; $p < .05$), which showed that the stimulating effect of sunshine and the depressant effect of humidity on sex activity are quite independent of each other, Figure 1 clearly illustrates the two significant associations of climatic factors with sex behaviour; the parallelism between sunshine and sex rhythm is quite obvious; the curves for seasonal sex and humidity rhythms seem to follow opposite trends.

The harvest season in this area is late December and January. Consequently the fodder position in the field conditions is better during the months January to March. It is probable that this is an additional factor besides solar radiation which contributes to the high sex activity during this season.

In the Kangayams none of the seasonal factors were significantly associated with the sex rhythm (Table II). The peak of sex activity in December with 36 oestrous females corresponds to the lowest values of maximum and mean temperatures for the year, namely 82°F and 73.2°F respectively (Table I). The correlation coefficients of maximum and mean temperatures with sex activity -0.300 and -0.352 respectively were not statistically significant. The peak occurring during December has no correlation with the harvest season either. It is, however, surmised that the heavy rainfall during October and November 3.41 and 6.24 inches respectively, the highest values for the year, and consequent availability of good green pasture could be one of the major factors which stimulate female sex activity in the Kangayams.

Discussion

"The sun some 93 million miles away, is the celestial limiting factor in life process in furnishing not only energy but also catalysts which directly or indirectly condition many activities, one of the most dramatic of which is seasonal sex activity" (Brody, 1945). The most important of the known climatic factors which have been recognized to influence greatly the sex activity are sunlight and temperature. Some species the deer, sheep and goats are stimulated to sex activity by decreasing day light (Marshall, 1937). Ferret, fox, carnivores and practically all birds investigated are stimulated to sex activity by increasing day light. Domestication tends to free animals from the seasonal influence; the wild cat, for instance, breeds once a year but domestic cat breeds several times; the wild cattle is seasonal in breeding, whereas the domestic cattle breed throughout the year.

The physiologic mechanism whereby the sex activities are set into motion at different calendar months has been applied for increasing the reproductive efficiency and profit. Ogale and Lamoreux (1942), for example, showed that the use of morning lights during fall, to increase day length, stimulated fall and winter egg production.

The role of climatic factors in the sex activity of the bovines is incompletely known and it is more so under the Indian farm conditions that the knowledge available can be of little use in dealing with the gigantic problems of low fertility, sterility and low milk production. Preliminary studies with four classes of white cattle, the nondescript, Kangayam, English Cross and Sindhi in the Coimbatore region by Rathnasabapathy (1958) indicated the existence of a seasonal sex rhythm in the first two classes. The pattern of seasonal sex behaviour was also different in nondescript females and Kangayams, the peak of the curve occurring in March in the former and in December in the latter. Inter-class variations in the pattern of sex behaviour during the different months can only be attributed to the differences in the genetic constitution of the individuals belonging to the four different classes.

The climatic factors studied in relation to the seasonal sex rhythm showed that the nondescript females were significantly photoperiodic (Figure 1; Table II). The mechanism of action of sunlight is most probably by the initiation of nervous impulses which travel through the eye and other neural pathways to the hypophysis to increase the secretion of gonadotropins (Bissonette, 1936). Brody (1945) observes that photoperiodicity is dependent on many other factors, food and warmth being the most obvious. In the present study temperature had little relation with sex activity. Photoperiodicity was independent of the humidity as shown by the partial correlation keeping the humidity constant. Harvest season is the only factor which synchronized with the increasing hours of sunshine and intense sex activity. It remains, therefore, to be worked if the photoperiodism is dependent or independent of the food supply rhythm. A uniform management condition wherein the food supply is constant throughout the year might probably explain this phenomenon.

Indian cattle are noted for their heat tolerance and they withstand heat better than the European cattle (Rhoad, 1938) probably because they have more sweat glands which make their homeothermic mechanism efficient. It is, therefore, no surprise that a rising environmental temperature had little effect on the body temperature and in turn on the physiologic sex mechanism.

Humidity adversely affects the sex activity of the females as seen from the curves of seasonal sex and humidity rhythms which

take opposite trends (Figure 1) and by the significant negative correlation between both (Table II). It seems logical that a high humidity can more easily interfere with the homeothermic mechanism of Indian cattle than a high environmental temperature by its interference with sweat mechanism and evaporation of moisture from skin area; the body temperature, therefore rises quickly upsetting the whole physiologic mechanism of the animal of which the sex is the most sensitive part. The present studies also indicate that the adverse influence of humidity is independent of other factors as sunlight.

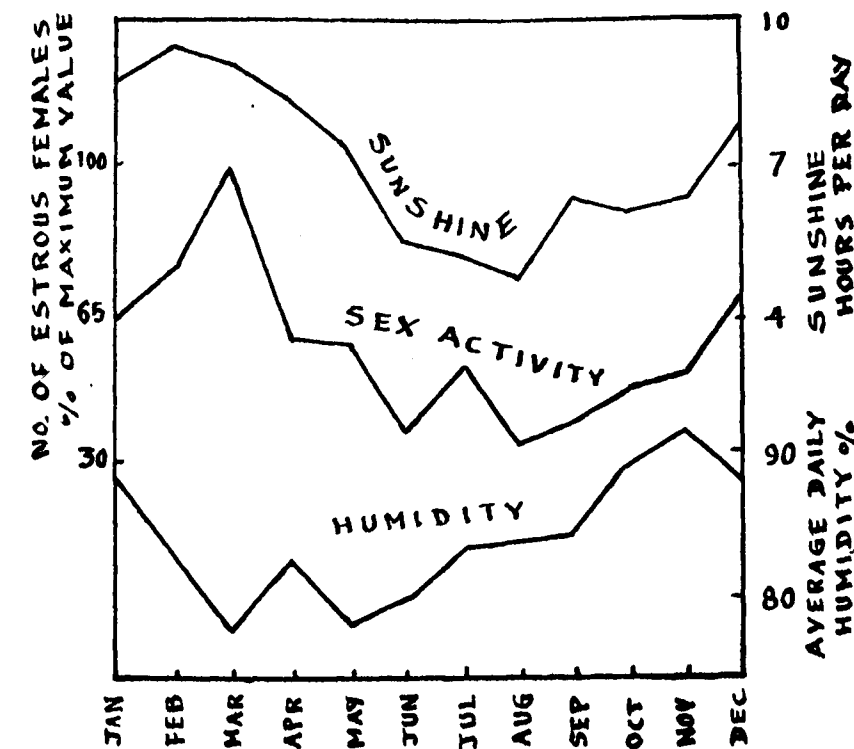


FIG. 1. SEASONAL RHYTHM IN SEX ACTIVITY (NON DESCRIPT CATTLE), SUNSHINE AND HUMIDITY

The Kangayam females, in view of the peculiar genetic constitution of the breed, different from those of others, were least affected in their sex activity by the various climatic conditions. The heavy rain fall during October and November (Table I) and availability of good green grass in the fields seem to be a prelude to high sex activity

in December. Whether it is the quantity and nutritional quality of the grass or the presence in it of some gonadotropic substances that were responsible for the intense oestrous activity need to be investigated.

The following inferences may be drawn from the present study.

Bright sunshine coupled with low humidity is the most conducive for high oestrous activity in the nondescript cattle under the ordinary farm conditions.

Animal habitations which are poorly lighted and ill-ventilated and which tend to raise the humidity of the atmosphere surrounding the animals may depress the oestrous cycle which may range from sub-oestrous, through silent heat to anoestrous.

Breeds vary significantly in their seasonal sex behaviour and in their reaction to environmental conditions.

Whether the low oestrous activity in certain months is due to inanition, or poor sunshine and lack of vitamin D resulting in disturbed calcium-phosphorus metabolism needs to be experimented upon.

As a result of seasonal and day to day changes in plants, temperature, light, humidity and even cosmic rays the farm animals find themselves subject to an incomprehensible number of variables. The precise function and dependence of each variable and the exact way the different breeds react to these variables need to be worked out by elaborating such studies to different regions and classes of livestock. Where field studies are inadequate this may have to be extended to laboratories. This will add greatly to the knowledge of the problem of sterility due to poor adaptability and also assist in recommending breeds to particular locations. In breeding for adaptability it will aid selection for resistance to adverse conditions.

Summary

Genetic and environmental factors that are responsible for seasonal sex rhythm in the females of nondescript and Kangayam cattle were investigated.

The nondescript cattle were found to be significantly photoperiodic, the correlation co-efficient between sunshine and sex activity being highly significant. The photoperiodism was independent of variations in humidity.

The harvest season synchronized with the season of intense sex activity in this class of animals.

Kangayams differed from the nondescript cattle in that none of the climatic factors studied had any significant association with

the female sex rhythm. Heavy rains in October and November, indirectly through the growth of green pasture, seemed to stimulate oestrous activity.

Suggestions for further study on the basis of the present findings have been made.

Acknowledgments

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STUDIES ON DUCK VIRUS HEPATITIS*

BY

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Levine and Fabricant (1950) recorded a highly fatal disease in young ducklings in 1949, in duck raising section of Long Islands, New York. The disease occurred in 2 to 3 week old ducklings and later in less than a week old were affected. Mortality was 85 to 90%. The cause of the disease was a filterable virus, and was isolated in chick and duck embryos. As the livers were primarily affected, the condition was termed Duck Virus Hepatitis (D.V.H.). In July 1953, Asplin and Mc Lanchlan (1954) recognised the disease in Norfolk in England as causing a 60% mortality. Most losses occurred in two and three week old birds, mortality varying from batch to batch despite disinfection and depopulation of the brooder houses, and premises, but proof is lacking to suggest the egg-borne nature of the virus. Hanson and Albert (1956) similarly isolated the virus of D. V. H. in Illinois in 1953. Fabricant *et al* (1955) made an exhaustive study of the histopathology of duck livers in both natural and experimentally produced disease. Information about its epizootiology and incidence throughout the world is lacking. In India the incidence of various duck diseases are not yet fully known for lack of survey.

Experimental

Two hundred Khaki Campbell ducklings were imported by air to Delhi from U.K. at the end of December, 1955, and transported by train to Izatnagar. They had been despatched when day-old from London.

Mortality started when they were 5 days old and continued up to 5 weeks, and restarted after a gap of 15 days and persisted for another 4 weeks. The death losses were highest between 6 and 11 days, 38 dying in 6 days at an average of 7 per day, which later it was nearly one per day and ceased at 5 weeks. Subsequent resumption of mortality after a gap of fortnight also averaged at 1 per day and continued up to 12 weeks. The total mortality was 47%.

The general symptoms in the early deaths were incoordination of movements, tumbling over, sprawling on the side, convulsions, and death. Dead ducklings on autopsy showed either no lesions except pallor of the internal organs, or the lesions were confined to the liver, which was enlarged to twice the normal size, pale in colour or in severe cases

yellow, with mottling of the entire surface with a variable number of petechial and ecchymotic haemorrhages. An yellowish exudate was sometimes present in the air sac resembling C.R.D.

Cultural tests were either sterile or not significant for any pathogenic bacteria.

Virus isolation in chick-embryo.—One per cent spleen tissue suspension from the dead ducklings, preserved in glycerine/saline under refrigeration, was treated with antibiotics to obtain bacteria-free inoculum, and 0.1 ml. was passaged into 12 of 10 day-old chick embryos by the (I) c.a.m. (II) c.a.s. (III) and y.s. routes. After 72 hours, 2 deaths, other than due to traumatic causes were noticed in the group II and III. On examination, haemorrhages on head, chest and legs, and some parts of skeletal muscles were seen. Internally the livers were highly congested. On candling, the embryos were found to be sluggish at 72 hours after infection, and continued to be so till death which occurred by 6 or 7 days. The allantoic blood vessels were markedly distended and dark. After 96 hours a greenish discolouration was noticed which was progressive. On opening the 14 day-old embryo (four days after infection) the much enlarged greenish liver, and gizzard were visible through the semi-developed translucent oedematous tissue of the abdomen. Very little pressure was required to enucleate the two organs out of the body. The liver was green in colour, much hypertrophied, with round borders and with white necrotic areas scattered all over its surface. Stunting of the embryo was very marked. Bile pigment stained the course of the intestines, by a dark green colour. More or less similar lesions were seen in group III, but their development took 48 to 72 hours more to reach the same level of syndromes. Embryos infected after 13 days of development did not show the characteristic green colour, but were cream in colour with whitish necrotic areas. They failed to hatch even though alive up to 24 days. Marked stunting was not noticed. (See table D.V.H.I.). The virus did not agglutinate the chicken or horse red cells.

Transmission.—Six of 4 to 5 day-old ducklings from local indigenous stock were infected intraperitoneally with 0.5 c.c. of the allantoic fluid virus from the third passage. All the ducklings were visibly sick showing incoordination of movements 3 to 5 days after, and died in 6 to 8 days. The lesions were confined to the liver, which was yellow in colour with large areas of necrosis and punctuate haemorrhages scattered over the surface. Virus was reisolated from the livers, and on inoculation produced pathognomonic changes in 10 day-old embryos.

Serum virus neutralization tests.—Pooled samples of sera from recovered ducklings were used in a serum-neutralization test, with equal quantities of decimal dilutions of the allantoic fluid virus in 10 day chick

* Proc. Indian Science Congress. Jan., 1958.

TABLE D.V.H. I

Death Pattern of D.V.H. Virus Infection in 10-day-old chick embryos.
D.V.H. Virus in 10th Passage. 0.1 m.l. was injected into C.A.S.

Embryos	24 hrs.	48 hrs.	72 hrs.	96 hrs.	120 hrs.	144 hrs.
1	T	DN	DE	DLD	DLD	DLD
2					DL	
3					DL	
4					DL	
5					DL	
6	T	DN	DE	DL	DLD	DL
7						
8						
9						
10						
11	1 c					A
12						
	2 c					A
	8 c					A

T = Death due to trauma, no lesions. DL = Dead, but liver lesions present.
AL = Alive, but liver lesions present. DLD = Dead, liver lesions and dwarfism.
A = Alive and no lesions. DN = Dead but no lesions in liver.
DE = Dead, embryo oedematous. C = Controls injected with healthy allantoic fluid 0.1 ml. into C.A.S.

embryos. The embryos were opened after 6 days and lesions were checked to detect the presence of the virus as compared with the healthy controls. The S. N. titre was about 10^4 , LD₅₀, (See table D.V.H. II). A sample of this serum was flown by air to the Veterinary Laboratory, Ministry of Agriculture and fisheries, U.K. and is reported by Dr. Asplin, to have neutralized approximately 100,000 LD₅₀ of the virus per m.l. of the T.N. strain of D.V.H., which is quite significant of the anti-viral protection in the serum.

TABLE D.V.H. II

Serum Neutralisation test in Chicken Embryos.

Inocula	Virus dilutions							
	Undiluted	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}
Virus isolated from Khaki Campbell ducks at Izatnagar Saline	0.1 4/4 ml. 0.1 ml.	4/4	4/4	8/8	3/4	2/4	0/8	0/4
Virus D.V.H. (Izatnagar)	0.1 ml.	4/4	3/3	4/4	4/4	1/4	0/4	0/4
Normal serum from indigenous ducks	4/4 0.1 ml.							
Virus D.V.H. (Izatnagar)	0.1 ml.	1/4	0/4	0/4	0/4	0/8	0/4	0/4
Serum from recovered Khaki Campbell ducks from Izatnagar flock	0/4 0.1 ml.							

* Numerators indicate the number of embryos dead after 6 days infection, while denominators indicate the number of eggs inoculated.

Histopathology :—Examination of series of sections of all organs revealed no significant lesions except in the liver. Grossly, the liver becomes much enlarged, pale or cream coloured and soft, studded with ecchymotic haemorrhages. Microscopically, the changes consists primarily of extensive necrosis of the parenchymal cells and proliferation of the bile duct epithelium and some undamaged liver cells. These changes are often accompanied by varying degrees of inflammatory response and haemorrhage. No inclusion bodies were seen. In some of the less severely affected ducklings, successful regeneration of the parenchyma occurs with fast fading evidence of the destruction of cells and cirrhosis. In others the regeneration is unable to keep pace with the functional demand of the organ and results in death as a sequel to the advanced disease process. This presumably accounts for the deaths which continued to occur 15 days after the disease had subsided. Of course no virus could be isolated in such cases in spite of several attempts, probably the recovered ducklings soon cease to be a source of infection.

Histopathological examination of the infected chick embryo livers.

Liver collected 48 hours after infection :—The sinusoids showed mononuclear infiltration and some of the cells were lymphoblasts. The latter could also be detected in some of the blood vessels. The liver also showed congestion and evidence of degenerative changes in some of the parenchymatous cells.

72 hour liver :—The sections showed distinct lymphoblastic infiltration around the blood vessels and young lymphoid cells could also be detected in the sinusoids. A few foci of lymphoid cell infiltrations were present in the interstitial tissue. Apart from these histopathological changes, the parenchymatous cells in some areas, were showing evidence of necrobiotic changes characterised by distinctly eosinophilic staining of the cytoplasm and ill-defined cellular outline.

96 hour liver :—The parenchymatous cells showed fatty metamorphosis and in some areas there was coagulation necrosis of the hepatic cells, the latter showed karyorrhexis and karyolysis. Focal leucocytic infiltration showed lymphoid cells but the infiltration was predominantly neutrophilic in nature.

120 hour liver : Liver, collected 120 hours after inoculation of the chick embryo, showed fatty infiltration and prominent necrotic foci together with neutrophilic infiltration.

Sections of the livers stained with Stovall and Black's method showed no inclusion bodies in the hepatic cells.

The liver from the 18 day embryos showed fatty infiltration and focal necrosis.

Regarding the changes in the Duck Virus Hepatitis livers it is clear that hepatic cells have shown progressive degenerative changes ending up in their necrosis and the death of the embryos. The pattern of leucocytic infiltration is interesting in so far as it is lymphoblastic to start with and gradually changes to neutrophilic as the parenchymatous necrotic tissue, for phagocytosis, increases in the infected liver. Lymphoblastic response indicates reaction to the defensive mechanism to start with but the subsequent changes in the parenchymatous cells and the leucocytic reaction show failure of the mechanism to cope with the infection. Initial lymphoid reaction would also fit in with the cellular reaction generally met with in viral diseases.

Discussion:—Information is lacking in the available literature about the sequel to the disease as to how long the survivors may keep on living when the destruction of liver parenchyma is extensive, and the regeneration is unable to keep pace with the functional demand of the organ. Further how the virus persists in a flock (if not egg-borne) causing repeated outbreaks despite sanitary measures and depopulation of the premises for a time, before restocking with newly hatched ducklings is not clear. This phenomenon was observed both by Levine and Fabricant (*loc. cit.*) and Asplin and his coworker (*loc. cit.*). Next, as the disease has been noticed in the imported flock in India for the first time it is possible that it might have come with it. Exposure to the infection may have occurred outside India, presumably during the journey, when ducklings were most susceptible, as no ducklings were raised on the Indian Veterinary Research Institute Farm, through wild aquatic birds like cormorants and different species of cranes roost in large trees in the premises. Nevertheless the origin, as in other parts of the world where the disease first occurred, is a matter for surmise as definite information is lacking.

Summary

An outbreak of Duck Virus Hepatitis was recorded for the first time in the Indian Union among 200 Khaki Campbell ducklings imported by Air. The disease started when the ducklings were 5 days of age, lasted up to 5 weeks causing a 47% mortality, and was characterised by incoordination of movements, convulsions preceding death, petechial and ecchymotic haemorrhages on the liver.

The virus was isolated in chick embryo, and its histopathology was studied at various levels till the death of the embryos. The embryo death pattern, and the serum neutralization titres were also studied. The antisera sent by Air to U. K. from recovered duck-

lings was confirmed as having a high level of antiviral protection of approximately 10^4 LD₅₀ per m.l. against the T. N. strain of Duck Hepatitis Virus.

These findings are of immediate practical value to the duck raisers.

Acknowledgments

The advice and help given by Dr. N. Dobson, B.Sc., M.R.C.V.S., F.R.S.E., Ministry of Agriculture and Fisheries and Food, Central Veterinary Laboratory, Weybridge, in confirming the disease as Duck Virus Hepatitis by Serological tests is gratefully acknowledged.

It is also a pleasure to acknowledge the histopathological interpretations of the infected embryo livers by Dr. Sharma, L. V. P., M. S., Ph. D. (Mich.), Research Officer, (Tissue) Pathology, Path. & Bact. Division, Indian Veterinary Research Institute, Mukteswar.

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A SURVEY OF HELMINTHIASIS IN EAST PAKISTAN

By

M. H. RAHMAN

(Disease Investigation Officer, Helminthology, East Pakistan, Comilla).

A systematic and taxonomic survey of the incidence of helminthiasis in domestic animals indicates that it accounts for a serious and gradual loss of livestock wealth in East Pakistan. The loss is mainly due to helminths like Liverflukes, Ascarids, *Moniezia expansa* and *Oesophagostomum* which induce severe pathogenesis either by sucking blood or by liberating destructive toxins into the animal system.

Investigation in this direction has led us to the belief that the degeneration of livestock, which should have set in some centuries back, has been due to the load of worms parasitic in their bowels and livers. Although there may be several other factors responsible for the stunted appearance and small size of our animals, helminthic infections should be a major one among them. Helminthic diseases in animals usually go unobserved by our farmers as they are chronic, lingering and slowly destructive, seldom spectacular, acute or fatal. The geographical and climatic condition in our land are extremely favourable to the round-

worms, tapeworms and flukes. It is therefore clear that any scheme intended to promote animal welfare would be frustrated without strict measures being undertaken for the cure and control of parasitic diseases.

Survey of Losses of Liver from Liverflukes Infection

(*Fasciola gigantica* and *Paramphistomum explanatum*)

An up-to-date survey of the extent of damage in cattle and goat livers caused by liverflukes indicated that 75% of cattle livers and 25% of goat livers are infected with liverflukes. It is difficult to purchase even a piece of livermeat without some flukes embedded in it. The annual loss of livermeat due to the damage caused by flukes, as estimated, amounts to nearly one hundred thousand rupees. In addition to this direct loss, indirect losses due to debility and weakness and consequent poor resistance to diseases, and milk and working capacity also occur.

Damages cause by Tapeworm Cysts

Besides other parasites, 66% of goats are found to lodge cysts of Tapeworms. These cysts mostly remain attached to peritoneal cavity, hanging from the intestines, liver, and lungs and even from the heart and brain. The presence of cysts under the skin and inside the muscles in goat and sheep is very common.

The percentage of infection in cattle with the cysts of *Taenia saginata* and other cysts is about 45. These cysts are found lodged in the liver, lungs, spleen, kidney and heart. Many calcified cysts are found on post-mortem examination, in old cattle which escaped early death. These cysticerci are the infective stages of many tapeworms which cause heavy damage in our livestock and their vital organs. In the early stages of infection, the animals work without showing any symptoms but with the increase in the volume and number of cysts, the movement of the animals become remarkably slow; and, if such animals are chased they get easily exhausted, and sometimes fall down. Cysts in the liver produce periodical pain when they move inside the organs.

The applied side of the subject of Animal Parasitology has long been neglected, in the field as well as in the Veterinary Institution and has led to our animals being eaten up by parasites, without the knowledge of the farmers and the animal husbandry workers in the field.

Observations on Poultry

A new observation was also carried out on the effect of helminths on egg-laying capacity in poultry, with two sets of R.I.R. birds. 20 R.I.R. chickens, 10 in each lot were taken for study from the seventh day of their hatching. The control batch was dosed at regular intervals

A Survey of Helminthiasis in East Pakistan

BY
M. H. RAHMAN



A country-bred calf which suffered a heavy infection with *Mecistocirrus digitatus*.



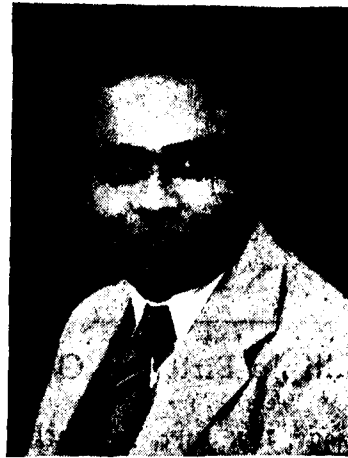
A Black Bengal Goat which suffered heavy infection with *Moniezia expansa*. 30 *Moniezia* were collected from the intestine. Average length was 7'-9" longest one 10' -11"

Multiple Births in Cattle

BY
S. M. ISHAQUE, J. K. SINGH, AND M. M. PRASAD



The Cow with four living calves out of the five she delivered on 1-3-58.



Sri D. MARIAPPA, G.M.V.C.,
Professor of Anatomy, Madras Veterinary College,
who has left for U.S.A., for Post-graduate studies.

with anthelmintics and kept separate from the other ten which were let loose and allowed to graze with other chickens in the locality. The latter were given the same kind and quantity of food except the green fodder. They acquired infection with *Ascaridia galli* and *Raillietina tetragona* at the age of 35 days, as detected by regular examination of droppings; but the droppings of the control group were free of worm eggs.

The first egg was laid by a hen from the control group on 195th day and the first egg was laid by a hen of the experimental group on 215th day. On counting the eggs of both the control and the experimental group for 365 days, it was found that the experimental group laid 25% less number of eggs than the control set of birds.

Diseases caused by helminthic parasites in domestic animals in East Pakistan is one of the major hazards to animal health and which is causing the degeneration and stunted growth of cattle, goat and poultry. Eradication of the helminthic parasites, specially of Liver-flukes, and the disease caused by them is the *sine quanon* of any major step to improve the livestock wealth of this territory.

Fortunately enough, the Animal Husbandry Department of East Pakistan has taken up the matter of eradication of animal parasites in earnest. It is also expected that the Schemes for dealing with parasitic diseases in livestock would draw the immediate attention of the authorities and have a place in our *Five Year Development Plans*.

Percentage of infection of livestock with different species of Helminths. This has been worked out on the examination of the gut and other internal organs of 400 goats, 350 cattle and 230 poultry in various slaughter houses and on the Microscopical Examination of faeces in the field.

	Cattle	Goat	Poultry
<i>Ascaris vitulorum</i>	25%	x	x
<i>Ascaridia galli</i>	x	x	60%
<i>Heterakis</i>	x	x	30% (in chicken)
<i>Haemonchus</i>	in a few cases only		
<i>Oesophagostomum venulosum</i>	x	85%	x
<i>Mecistocyrus digitatus</i>	20%	x	x (Majority in calves)
<i>Trichuris</i>	10%	20%	x
<i>Stephanofilaria assamensis</i>	25%	x	x (On the hump of cattle causing Hump sore)
<i>Oesophagostomum columbianum</i>	x	60%	x (Mixed infection with <i>Ovenulosum</i>)
<i>Moniezia expansa</i>	in a few cases 90%		x
<i>Raillietina tetragona</i>	x	x	90%
<i>Taenia hydatigena</i> (Cyst)	45%	58%	x <i>Cysticercus tenuicollis</i>
<i>Fasciola gigantica</i>	75%	25%	x
<i>Paramphistom cervi</i>	60%	25%	x
<i>Cotylophoron cotylophorum</i>	60%	30%	x

Clinical Article

MULTIPLE BIRTHS IN CATTLE (Five Calves Delivered by a Cow)

By

S. M. ISHAQUE, G.B.V.C., P.G. (Germany), F.R.V.C.S. (Sweden),
Regional Sterility Officer, Bihar, Patna,

J. K. SINGH, B.V.Sc., & A.H.,
Regional Sterility Scheme, Bihar,
and

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Regional Sterility Scheme, Bihar.

Review of literature.—According to available literature occurrence of multiple births (in cattle), of more than three calves, is rare. Engler (as quoted by Lush 1947) studying 14,111 births in Brown Swiss cattle found that there were 97·3% single births, 2·7% twins, 0·3% triplets and there was one case of quadruplets. Craig (1952) described incidence of multiple births in cattle of more than four calves as rare and in most cases the calves seldom lived. Bhattacharya (1958), in his presidential address to Zoology and Entomology section, 45th Indian Science Congress at Madras, under the heading "Sex ratio, twinning and multiple births", said that incidence of twin and triplet birth was found to be 0·22% and 0·004% respectively of the normal births. Birth of more than three calves at a time has not been recorded. Lagerlof (Personal communication, 1958) says that the investigation on multiple births in cattle was taken up in 1946 when five still born calves of one cow were sent to the Obstetrics and Gynaecology clinic, Royal Veterinary College, Sweden. He cites the work of Dr. Holcombe, on multiple births in cattle, who has described cases up to seven calves from time to time between 1850 and 1950. But most of them were still-born.

History of the case.—The present record is that of a cow which delivered five calves at Semari village in Dumraon N.E.S. Block (Arrah-District). She is of the local Shahabadi breed and is aged about six years. This is her second lactation. She was served by a bull from Sirampure near Calcutta. She delivered the five calves at full term *i.e.*, 280 days on 1st March 1958.

Out of five calves born, four are alive. The one still-born was fourth in succession of delivery and was a female calf having scanty hair on the body. The sex ratio of the living four calves is two males to two females. The calves are satisfactorily healthy but they are fed on purchased milk as the milk of mother cow is not sufficient to maintain them, but they appear to be normally developed for their age.

Summary and Discussion

Occurrence of multiple births in cattle of more than three calves has not been recorded in India (Bhattacharya 1958). It appears that this may be the first occurrence in this country. But according to Lagerlof (1958), in European cattle there were occurrences of more than three births and up to seven calves from time to time. From the breeding point of view it is really very interesting to find out the incidence of multiple births in cattle and also to find out the incidence of identical twins in this country. Photograph of the cow with the four living calves is attached. It may be one of the very rare instances of multiple births in cattle where four calves have lived and developed normally.

Acknowledgments

We are very thankful to Mr. S. K. Sen, B.Sc., M.B.C.V.S., Director, Animal Husbandry, Bihar who took special interest in providing all facilities for the investigation of the case. We are also thankful to Sri M. D. Singh, Manager, Hariana Cattle Farm, Dumraon, Sri R. D. Singh, Farm Veterinary Assistant Surgeon and to Sri B. N. Singh, Livestock Supervisor, Dumraon N.E.S. Block.

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Abstracts

Evaluation of a Combined Vaccine consisting of Modified Canine Distemper Virus and Modified Infectious Canine Hepatitis Virus for Simultaneous Immunization of Dogs.—By J. A. BURGHER, J. A. BAKER, SIDHARTHA SARKAR,* V. MARSHALL and J. H. GILLESPIE. *The Cornell Veterinarian*; April, 1958.

As simultaneous infection with infectious canine virus and canine distemper virus often occurs in dogs, the possibility of a combined vaccine was considered. Accordingly, the authors produced attenuated strains of both the viruses by the tissue culture method and prepared an inactivated type of combined vaccine consisting of both the attenuated viruses and tested in dogs for determining safety, effectiveness and the minimal immunizing dose of each virus component. The tests showed

* A graduate from Bengal Veterinary College, now on training in U.S.A. (private candidate).

that each viral component produced neutralizing antibodies and immunity if adequate amounts of each virus were given. Virulent canine distemper virus inoculated subsequently did not increase the initial antibody content produced by vaccine virus, whereas virulent infectious canine hepatitis virus produced an increase in titre. No signs of illness developed in vaccinated dogs, and unvaccinated dogs placed in contact also remained free from illness. On the basis of these findings it was concluded that a safe and effective vaccine, which would immunize dogs both against distemper and infectious canine hepatitis by a single inoculation, could be offered as an article of commerce, provided care was taken to ensure not only adequate amounts of each virus but also adequate amounts of immunizing virus.

A. MUKERJI.

Report on An Outbreak of Coli Septicaemia among Chickens.—By D. P. CHATTERJEE, Research Assistant and A. MUKERJI, Assistant Professor of Bacteriology. Bengal Veterinary College, Calcutta. *The Bengal Veterinarian*, Vol. 6, July, 1958.

A severe outbreak of an acute infectious disease among chicks, belonging to the Bengal Veterinary College Poultry Farm, resulting in heavy mortality among the affected was investigated. Newly hatched out chicks kept in the Brooder house were the main sufferers. The symptoms were mainly droopiness, inappetence and dyspnoea. There was absence of white pasty diarrhoea. Noticeable post mortem changes were found in the liver and spleen which were invariably enlarged, soft and friable. Coliform organisms, often in pure culture, were recovered culturally from heart blood, liver and spleen of fresh carcasses and also from freshly killed ailing birds. Smears from heart blood and internal organs also revealed numerous coliform organisms. Biochemical tests confirmed this strain as typical *B. Coli*. It was found to be pathogenic for fowls, guineapigs and rabbits by parenteral routes. This disease is the same as Avian Colibacillosis. Several drugs were tried and satisfactory results were obtained with Chlorostrep and Embazime.

B. B. DEB.

The Production of Dense Cultures of Pasteurella Multocida.—By R. V. S. BAIN and R. F. JONES. *Brit. Vet. J.* Vol. 114, No. 6, P. 215-220.

For cultivation of dense cultures of H. S. strains in Casein Hydrolysate medium enriched with yeast extract and pancreatic digest, the authors describe the apparatus for the two aeration systems (1) the Sparger type and (2) the Vortex type. The latter was adopted finally for mechanical simplicity.

Culture attains maximum density in 15 hrs. Capsules remain visible. Dissociation is not observed. There is leaching of surface antigens particularly polysaccharides into the medium.

Comparative study of the growth as expressed in grams of dry bacteria per litre in meat, Casein Hydrolysate and Casein Hydrolysate media enriched with pancreatic digest was 0.6 gm., 0.9 gm. and 1.9 gms respectively as against 0.15 gm, 0.3 gm and 0.5 gm in still cultures. Yield is primarily dependent upon the type of medium employed.

Formalized cultures emulsify easily in oil. Stability is increased by a small addition of mannite mono-oleate to the oil and lanoline.

M. S. J.

The Incidence of Hydatids in Victorian Cattle.—By E. M. PULLAR and W. K. MARSHALL. *Aust. Vety. Jour.* Vol. 34, July 1958, P. 193-201.

Survey of Hydatidosis by the authors in 17,316 slaughtered Victorian cattle revealed the following data:—

1. 12% of animals were infected with Hydatids.
2. Age incidence was 0.2% under one year, 1.4% between 1-2 years, 6.2% between 2-4 years and 15.2% over 4 years. This points more to the opportunities of picking up infection rather than to increased susceptibility depending upon age. Since Echinococcus does not show tendency towards early death and absorption mounting incidence relative to age is anticipated.
3. 17.7% of females were affected as against 8.3% and 4.7% in bulls and steers respectively. This is probably due to greater opportunities for dairy cows to come in contact with dogs and dog's faeces.
4. Percentage of affection or organs in infected case was for liver 88.4%, lungs 72.7% and spleen 7.2%.
5. Liver: Lung ratio was 1: 0.43. It showed considerable variation.
6. 65% of Hydatid showed marked degeneration. The figures increased with age.
7. 9.7% of the cystic forms were of the typical bovine non-malignant multi locular type.
8. 22% of all Hydatid lesions were fertile. Fertility declined with age.

M. S. J.

Arecoline Hydrobromide as a Taeniafuge in Dogs, with Special Reference to its use in controlling Hydatid Disease.—By M. A. GEMMEL. *Aust. Vety. Jour.* Vol. 34, July 1958, P. 207-212.

Arecoline Hydrobromide as a taeniafuge, was administered to 875 rural dogs at the rate of 1/16—1/4 gr/ 10 lb. body weight either as a draught or in capsule. There was no significant difference in the mode of administration. 22.5% of animals did not purge; 20.9% vomited, which did not affect the efficiency of the drug if already retained for

5 minutes. Temporary collapse in one case and severe discomfort in ten cases were observed.

There is a wide margin of safety in the dose of the drug.

Six out of nine dogs found to be infested with *E. granulosus* were still found to harbour the parasite during the second treatment within a month. But the degree of infestation had considerably reduced.

Treatment in five dogs experimentally infected with *E. granulosus* also showed a high degree of efficiency of drug in cases which had purged. Dogs not purging require re-treatment.

Incidence of *E. granulosus* may remain at the same level after treatment if there are avenues for re-infection viz. access to raw sheep offal.

Administration of Arecoline Hydrobromide can only serve as an additional control measure. It also assists in the diagnosis of the incidence of cestodes in dogs.

M. S. J.

News and Views

Dr. Bertie A. D'Souza, B.V.Sc.,—Principal, Madras Veterinary College, has left for U.S.A., for Post-graduate studies. His study of the several Colleges in America will certainly add to his rich experience and is bound to benefit him and his College very much on return.

* * * *

Dr. D. Mariappa, G.M.V.C.,—Professor of Anatomy, Madras Veterinary College, has left for U.S.A., on 1st September 1958 for Post-graduate studies in Veterinary Anatomy. It will still further help him to improve the already high standard of his Department, which has attracted the appreciation of International Visitors to the Madras Veterinary College.

* * * *

We learn the Milk Colonisation Scheme in Madras is taking definite shape and is fast progressing. Let us hope it will make the great success it deserves.

* * * *

Another great Livestock Farm at Pallathur (Chettinad) in Ramanathapuram District, Madras State was opened recently. They are going to have Kangayam and Tharparkar breeds of cattle there. In point of extent (nearly 1800 acres) it is going to be the biggest farm in the State. Nothing succeeds like success. Madras seems to believe in it! We wish the Farm all success!

* * * *

"The Indian Veterinarian."—The All-India Veterinary Students Association is bringing out the first number of their proposed annual journal 'The Indian Veterinarian' sometime in November 1958. Top ranking men are contributing articles to this first issue. Copies can be reserved in advance by addressing The Literary Secretary, A.I.V.S. Association, 37, Belgachia Road, Calcutta-37.

Block Development Corner

[Articles under this section, should be more in the nature of simple 'talks' to rural folks and village level workers, on Animal Husbandry matters, and not loaded with scientific terms and theories.]

ROLE OF ANTIBIOTICS IN ANIMAL NUTRITION

By

M. B. TATKE, B.Sc. (Vet.),
Veterinary Officer, Uruli (Poona).

Antibiotics as animal feed-supplements are becoming increasingly popular. In fact it is estimated that the major part of the production of the newer broad-spectrum antibiotics like TERRAMYCIN and AUREOMYCIN, is utilised as livestock feed-supplements, while only a small part is used for therapeutic purposes.

Advantages of antibiotic feed-supplementation

- (1) Lower incidence of infectious diseases.
- (2) Lessened cost of treating the sick animals.
- (3) Increased growth-rate, early maturity and consequent savings in feed costs in early non-productive stages of life.
- (4) In poultry, increased egg-production, fertility and hatchability.
- (5) Reduced mortality in young animals.

It is not intended here to explain the way in which antibiotic feed-supplements help in the ways mentioned above. The purpose of this note is to show how the use of antibiotic feed supplement can increase the profits greatly with only a relatively small extra expenditure.

The experiment was carried out in the poultry and dairy farm belonging to the "Pandita Ramabai Mukti Mission," Kedgaon (Poona). The poultry farm maintains White-leghorn and Rhode Island Red fowls, and the dairy farm maintains Red Sindhi and nondescript buffaloes. The initial reluctance of the management was overcome by explaining

that the cost of treatment per animal was relatively small as compared to the advantages.

In the case of Poultry, records of egg production per month are given below in two groups. One group shows egg production before treatment and the second one shows the same after the treatment was commenced. The number of birds throughout this period was between 40 to 45.

Monthly Production Figures

Before Treatment		After Treatment	
Month	Egg production	Month	Egg production
Jan '57	175	June '57	203
Feb '57	200	July '57	553
March '57	200	Aug '57	617
April '57	146	Sept '57	494
May '57	218	Oct '57	590
Total	989	Total	2457

Thus it will be seen that the egg production increased by 1518 during the period of five months, when the antibiotic feed-supplement TM-5 was used.

The increase was about 160%. The average price of eggs if taken to be Rs. 1.40 per Doz (the actual price varies in this region from Rs. 1.00 to Rs. 1.90 depending on season and market demand.), and since during 5 months the egg production increased by 1518, the additional income from the extra production was Rs. 177.10. The additional expenditure incurred over supplementation with TM-5 at the rate of 3 ozs. per maund was about Rs. 23 only, giving a return of about 800% over the investment.

The other advantages noticed were reduced sickness and mortality. Hatchability was estimated to have increased from 50 to 90%, from the results of eggs actually hatched. Exact Figures are not available to prove this.

The dairy farm of the same institution had a serious problem of calf-scours. Practically every calf born at the farm suffered from scours. Much expenditure was incurred over their treatment. The recovered calves were unthrifty and matured late. TM-5 was given to calves during the most susceptible part of their life i.e., upto three

months of their age. The dosage adopted was 1 drm. during the first month, 2 drms. during the second and 3 drms. upto the end of three months. Thus a calf was given in all, 1.4 lbs of TM-5 during three months, the cost being Rs. 8.10 only, for each calf.

Since the calves were weaned from birth, it was easy to mix the required quantity of TM-5 in the milk fed. However where the calves were not weaned the required amount could be given in a little quantity of milk as long as the calves were entirely on milk and then mixed in grains as soon as they were started on grain ration.

The introduction of TM-5 supplementation as a routine measure completely suppressed calf-scours. The treated calves appeared healthier and sleeker. The management estimated that saving over the treatment cost of affected calves alone justified additional expenditure incurred over the use of TM-5. Another thing noticed was a sharp fall in the mortality rate of the young calves. This can be seen from the figures given below.

Calves Born		Deaths	Mortality %
Before treatment			
1954	18	5	27.7%
1955	40	12	30 %
1956	41	11	26.8%
After Treatment (TM-5 was introduced from the middle of 1957)			
1957	42	6	14.3%
1958	19	1	5.3% (six months upto June '58)

Thus the mortality rate shows a sharp fall during 1957, when it was halved. It should however be noted that TM-5 supplementation was started only during the latter half of the year. The figures for the present year are still more illuminating. The mortality being only 5.3%, since only one death is recorded.

The spectacular results obtained at this farm may not be the same in other farms, with healthier stock, as the original stock by themselves may be good. However for the majority of farms in the rural areas TM-5 feed supplement will definitely improve the health and production and lessen the mortality rate. In dairies where calf-scours presents a serious problem incorporation of Antibiotic-feed supplement like TM-5 may offer a good solution. It should however be remembered that sanitation is of paramount importance and medicines are only of secondary help.

My thanks are due to the management of the Mission farm who afforded me the necessary scope and co-operation.

Association News

The All India Veterinary Association

THE RESERVE FUND

An event of great importance to the Veterinary profession in India, took place in August 1924. It was the birth of the *Indian Veterinary Journal*. Circumstances were positively hostile and yet the profession took that bold step and the lion-heartedness of the early pioneers cannot be too highly praised. Ever since then, the *I.V.J.* has toiled hard under very adverse circumstances. The *I.V.J.* lives to-day so that the profession could prosper and science advance.

And now the hat is sent round so as to place this journalistic venture on a sounder and firmer basis. The *I.V.J.* is a priceless possession of our profession. It has placed the Indian Veterinary Surgeon, on the map of the scientific world. Just pause and ponder over, how much we owe to the Journal both individually and collectively. Is it too much then to expect the profession to respond to the appeal issued for a Reserve Fund? We hope not.

Some enquiries have come to us asking us to indicate the extent of help expected. We do not want to put the members of the profession to any undue financial strain in these hard days. At the sametime, a certain amount of sacrifice is needed to make this fund a great success, so as to make it worthy of our profession. So we feel that the following scale of contribution will be quite reasonable. It could even be paid in two or three instalments.

Class I Officers	...	Rs. 100/- and above.
Class II Officers	...	Rs. 50/- and above.
All others	...	Rs. 25/- and above.

It is our ambition that no Veterinary Surgeon in this land should remain without contributing to this fund. Brick by brick, this great edifice of our's should begin to rise higher and higher. On the success or otherwise of this venture, the solidarity of our profession depends. "Pay and Prosper" is the slogan we pass on to the members of our profession.

Jai Hind!

T. VINAYAKA MUDALIAR,
Editor,
The Indian Veterinary Journal,
and
General Secretary, A.I.V.A.

THE I. V. J. RESERVE FUND

LIST OF CONTRIBUTORS

	Rs. nP.
Amount acknowledged in September 1958 issue	1,803.80
Dr. C. G. Bhaskar, Vety. College, Tirupati, A. P.	25.00
„ Tejdhari Singh, Choutham, Bihar	25.00
„ C. Bharadwajan, Corporation of Madras	10.00
„ K. Vythianathan, Raub, Malaya	50.00
Total	1,913.80

Cheques, money orders and all correspondence should be addressed to the Editor, *The Indian Veterinary Journal*, Madras-17.

THE MYSORE VETERINARY MEDICAL ASSOCIATION

The Silver Jubilee Celebration of the Mysore Serum Institute and

The 13th All-India Veterinary Conference

The combined session of the above two functions will be held at the Mysore Serum Institute, Hebbal, Bangalore, on the 6th, 7th, 8th and 9th November 1958.

His Excellency the Governor of Mysore has kindly consented to inaugurate the celebrations at 4 P.M., on 6-11-58.

Shri B. D. Jatti, Chief Minister of Mysore has been requested to preside over the Inaugural function.

Dr. Lakshmi Sahai, M.Sc., M.R.C.V.S., Animal Husbandry Commissioner with the Government of India, has kindly consented to preside over the Conference.

Dr. K. S. Shetty, G.M.V.C., Ph.D., Director of Animal Husbandry and Veterinary Services, Mysore, Bangalore, is the Chairman of the Reception Committee.

The Reception Committee fee has been fixed at Rs. 10/- and the Delegation fee at Rs. 10/- each. It is proposed to provide free lodging and boarding to a limited number of delegates with available facilities at the Mysore Serum Institute premises itself. Delegates desirous of availing this are requested to intimate early. Arrangements on a limited scale will also be made to accommodate delegates attending the Conference with their families. Intending Delegates will please write to the undersigned to the address given below sufficiently early the accommodation required by them, the time of their arrival etc. If separate hotel accommodation is desired, it will also be arranged as far as possible, on previous intimation and payment.

Volunteers will meet the Delegates arriving by all important trains from the evening of 5th November 1958. They could be recognized by the badge they wear.

Bangalore is generally very cold in the month of November. Delegates are advised to bring their warm clothing and other necessary kit.

Visits to a few places of interest, such as the Garsoppa Falls, Kunigal Stud Farm, Livestock Farm at Hesserghatta, Dairy Research Institute, Sir C. V. Raman's Institute, Hindustan Air Craft Factory, Indian Institute of Science, Chamundi Hills and Brindavan (Kannambadi Dam) at Mysore, Temples and Tombs at Srirangapatam &c will be arranged on request and will be separately charged for.

Professional papers to be read at the Conference and resolutions, if any, may please be sent before the 20th October 1958.

The General Secretary, All-India Veterinary Association, has addressed the Railway Board for Railway concession. He may be addressed in time for the necessary forms, etc.

T. VINAYAKA MUDALIAR,
General Secretary,
All-India Veterinary Association,
23, First Street, Vidyodaya East
T Nagar, Madras-17.

R. D. NANJIAH,
Hon. Secretary,
The Mysore Serum Institute,
Hebbal, Bangalore-6.

Review

The Kangayam Breed of Cattle—A Monograph:—By Dr. D. Pattabhiraman, G.M.V.C., A.I.D.I. Popular Education Publishers, Madras-31 Price Rs. 12.50.

This is a compendium of all available data both at Pattagar's Farm and at the Livestock Research Station, Hosur, on this famous breed of cattle of Southern India. The author had the unique opportunity of working at both the farms over a period of years and being directly in charge of these herds of cattle, in his early years of service. Opportunities come in the way of many, but only a few have the necessary vision and aptitude to make use of them. The amount of trouble taken and the patience shown in collecting all the data do great credit to the author. Coming as it does from a person of his status and with such intimate knowledge of the Kangayam breed of cattle, this book may be taken as a standard work on the subject. The management practices on the Pattagar's farm described in this book should provide valuable guidance to all Animal Husbandry workers. This Monograph is a well deserved tribute to Pattagar's family and more particularly to Sri Rai Bahadur N. Nallathambi Sarkarai Manradiar to whose memory this book has so rightly been dedicated. Cattle breeders are born and not made. This is a universal truth which we notice all over the world. The late Pattagar has put the name of South India on the map of the livestock wealth of the world. He stands "immortalised" as has been so rightly put by the Hon'ble Sri M. Bhaktavatsalam in his foreword. The photographs are excellent and the get up on fine art paper makes the work extremely attractive. The publishers are to be congratulated on this fine piece of production, in which they have shown much skill and good taste.

T.V.M.

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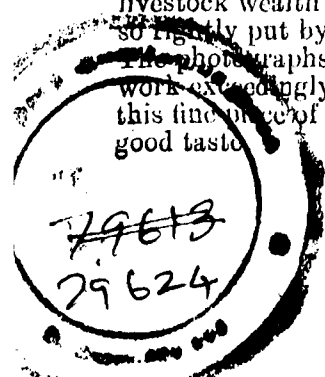
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