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THE INDIAN VETERINARY JOURNAL

[THE JOURNAL OF THE ALL-INDIA VETERINARY ASSOCIATION]

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★

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★

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The Indian Veterinary Journal

(The Journal of the All-India Veterinary Association)

Vol. 35 JUNE, 1958 No. 6

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THE

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Editorial

THE PUBLIC HEALTH VETERINARIAN

Recently we have had occasion to notice in the daily Press that the Government of India have furnished each State with a model Public Health Bill for adoption or revision of the existing Acts, wherever necessary. We have no knowledge of the details of this model bill. Whatever they are, it is a line of reformation which has been long overdue. The lacunae in the existing Acts are far too many and the control measures are naturally not quite effective.

For obvious reasons, we confine ourselves to the role that a Veterinarian could play in Public Health Service. First and foremost we assert that no Public Health Board could be said to be complete without a Veterinarian on it. He could then be a watch-dog, day-in, day-out, over all aspects of communicable diseases from animals to man and the several diseases conveyed through animal products. The list of such diseases is ever on the increase, with newer knowledge gained through advancement of science.

In a previous article we laid stress on the *need to train up select Veterinarians for Public Health Service.* The matter is becoming so urgent and compelling that there is no excuse for complacency on the part of the Veterinary profession. The specialisation should begin here and now and we even suggested a separate cadre being formed as a unit of either the Animal Husbandry Department or the Public Health Department. Let those in authority bestow enough thought in good time and put up proposals both for their thorough training and their due share in guarding the health of the nation at large. The public are not quite alive to the several dangers that lurk in the livestock and their products, which they handle and consume in their day-to-day life. A

list of such dangers and how best to avoid them, can certainly be prepared effectively by a Public Health Veterinarian to be of much educative value. A check on the quality of livestock feeds in the market, milk and milk products, meat and meat products, fish, skin, wool, sanitation of cattle byres, horse stables, sheep pens, abattoirs, ante and post-mortem examination of animals slaughtered, diagnosis and control in time, of diseases communicable from animals to man, will all come within his purview.

The animal reservoirs of several zoonoses should be spotted out and measures taken to eliminate them. Glanders, Anthrax, Rabies, Tuberculosis, Brucellosis, Ring-worm, Trichinosis, Taeniasis, etc., are some of the diseases that come crowding to our mind. A Public Health Veterinarian can tackle all these with greater vigour with his own specialised staff, pin-point spots of infection and eradicate them. He can utilise the Press, Radio, Television, Posters, Bulletins, Leaflets, Motion Pictures, talks and other media to enlist the sympathy and co-operation of the public.

India cannot be said to command the confidence of other countries in the matter of exports of her animals and animal products. With the expansion of livestock industries in the offing in this land, a high degree of effective and efficient control will be called for, before any sizable trade could be built up with the outside world. Is it not time then to plan for a cadre of Public Health Veterinarians? We searched in vain in the existing Central Act for the Prevention of Food Adulteration (1954) if any Veterinary qualification is included for the post of a 'Food-Inspector'. We submit this is a serious omission and now when the Acts are likely to be revised or amended, we insist, the place of a Veterinarian with regard to Public Health should receive the consideration it deserves.

Hallo!

Have you sent in your Contribution to the *I. V. J.* Reserve Fund? The Call has come after thirty-five years of its existence. It is to serve you better and for ever! It is given twice, if given quick!

General Articles

THE ANATOMY OF THE FOETAL INDIAN ELEPHANT

Part VII: The Thorax, Abdomen and Pelvis

By

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Introduction

Eales (1928-29), Miall and Greenwood (1878), Windle and Parsons (1903) and Rajagopal (1956) have described the structures of the visceral cavities. In the previous paper-Part VI, viscera have been dealt with and in the present paper, other structures—muscles, blood vessels, lymphatics and nerves, are described, leaving the skeletal elements to be taken in a separate paper on the axial skeleton.

The Muscles

The muscles are described under the following groups: abdominal muscles; muscles of the thorax; muscles of the back and loins; sublumbar muscles; muscles of the pelvis; muscles of the anus and muscles of the genitalia.

Abdominal muscles

Cutaneous muscle of the trunk has been described in a previous paper-part II of this study. The muscle is very thick and extensive, extending backward to the femoral region. The anterior abdominal artery passes back partly in the substance of the muscle in the prefemoral region.

Tunica abdominalis is very thick with abundance of elastic tissue. It extends below the pelvic symphysis to form two large laminae forming the *suspensory ligament* of the urino-genital canal.

Obliquus abdominis externus.—The fleshy part of the muscle is very extensive. The muscle fibres arise from the external faces of sternal ends of ribs from the 3rd to the 19th, intercostal fascia and lumbodorsal fascia. At its costal origin, it interdigitates with the origin of serratus magnus. The muscular origin forms a curved line joining the middle of the 3rd and 19th ribs. In the lower part, the fibres are oblique-downward and backward, but in its upper part towards the spine, the fibres tend to be longitudinal. The origin of its aponeurotic tendon is nearly in a straight line parallel to the lateral border of rectus abdominis anteriorly and behind, it forms a curved line joining the external angle of ilium to the middle of the lateral border of rectus abdominis. The muscle fibres of the upper part are inserted to the iliac

crest and the aponeurotic tendon unites with the aponeurosis of other muscles for insertion to the lateral border of the common tendon of recti abdominis inserted to the pelvic symphysis extending to the ischial arch. The aponeurotic tendon sends a reflexion to the medial face of ilium-*iliac lamina* corresponding to the inguinal ligament of other animals.

Obliquus abdominis internus.—It is fan shaped and more extensive than in ox and horse. The muscle fibres arise from the upper part of iliac crest and lumbodorsal fascia. Its anterior border corresponds nearly to a straight line extending deep to the origin of externus and covering the sternal ends of ribs to a width of 5 to 8 cms. Its posterior border corresponds to a vertical line about 2 cms behind the external angle of ilium to the lateral border of rectus abdominis. Its ventral border corresponds nearly to the lateral border of rectus abdominis. Its aponeurotic tendon blends with externus to form the outer wall of fascial sheath for rectus abdominis. Behind, it unites with aponeurosis of other muscles for insertion to the lateral border of the common tendon of recti abdominis inserted to the pelvic symphysis.

Rectus abdominis.—It is situated in the abdominal floor. It is narrow and thin in the anterior part and becomes wider and thicker near the umbilicus and beyond. The muscle fibres arise from the 3rd and 4th costal cartilages and adjacent part of sternum. The lateral border is nearly straight and medial border is curved, separated from its fellow by a wide interval in front of umbilicus and a narrow interval behind it. The medial borders of the two recti abdominis below the external angle of ilium form a large oval aperture for the umbilical cord. Each muscle forms a fibrous tendon in front of the pubis which unite to form a common tendon for insertion to the pelvic symphysis upto the ischial arch. The anterior abdominal artery pierces the muscle close to its medial border. It does not show the linea transversae as in other animals.

Transverse abdominis.—The muscle fibres arise from the medial faces of costal cartilages from the 4th to the 19th, lumbodorsal fascia and upper two thirds of the iliac crest. The origin of the aponeurotic part nearly parallels the costal cartilages and it nearly becomes vertical in front of external angle of ilium. Behind this, it blends with aponeurosis of other muscles. The muscular part is 5 cms. wide to start with and becomes wider behind. The medial borders of the muscles are separated by a wide interval of aponeurosis deeper to rectus, which forms the internal wall of the sheath for the rectus abdominis.

Nerve supply:—Intercostal nerves from the 6th to 19th.

Blood supply:—Anterior and posterior abdominal arteries.

Muscles of the Back and Loins

Serratus anticus.—The muscle is placed deeper to serratus magnus. It is entirely muscular. The muscle fibres arise from the spines of thoracic vertebrae and the supraspinous ligament and run obliquely downward and backward. The muscle extends over the upper third of the ribs and is inserted by eight digitations to ribs from the 7th to the 14th.

Nerve Supply:—Dorsal branches of intercostal nerves.

Blood Supply:—Dorsal brances of intercostal arteries.

Levator anguli scapuli:—Described in the next paper.

Transversalis costarum.—Extends from the sacral angle of ilium to I rib, covering the vertebral ends of ribs, placed lateral to longissimus dorsi. The muscle is made up of a number of bundles arising from the sacral angle and adjacent part of iliac crest and external faces of ribs. The anterior series of bundles are inserted by tendons from I to XI ribs and posterior series of bundles by fleshy slips from XII to XVIII ribs. Each bundle passes over two ribs and is inserted to the posterior border of the rib in front. The muscle is separated from longissimus dorsi by a thick fascial septum.

Blood and Nerve supply:—Dorsal branches of intercostal arteries and nerves.

Longissimus dorsi.—This is the longest muscle extending from the sacrum to the neck, placed lateral to the spines. The muscle fibres arise from the sacral spines, sacral angle of ilium, adjacent part of iliac crest, lumbar and thoracic spines and supraspinous ligament. It is inserted to the external faces of ribs, transverse processes of lumbar and thoracic vertebrae. The muscle divides into dorsal and ventral parts at XI rib. The ventral part passes deeper to serratus anticus and levator anguli scapuli and divides into slips for insertion to I rib and transverse processes of last four cervical vertebrae. The dorsal part passes deeper to complexus and is inserted to the ligamentum nuchae and spines of first five or six thoracic vertebrae.

Nerve and blood supply:—Dorsal branches of spinal nerves and intercostal arteries.

Muscles of Thorax

Levatores costarum.—Consists of small oblique bundles in the upper parts of intercostal spaces except the first. Fibres of each bundle arise from the transverse process of a thoracic vertebra, run downward and backward to be inserted to the anterior border of the rib behind. The bundles are long in the middle series and smaller in front and behind.

Nerve and blood supply :—Intercostal nerves and arteries.

External intercostals } are similar to the muscles of other animals.
Internal intercostals }

Transversus thoracis.—It covers II, III & IV costal cartilages and sternum. The muscle is made up of three bundles arising from the suprasternal ligament and inserted to II, III & IV costal cartilages below their articulations with ribs.

Longus colli.—Arises from the ventral aspects of bodies of first four thoracic vertebrae and inserted to the ventral aspects of the bases of transverse processes of last four cervical vertebrae by thin tendons.

Nerve and blood supply :—Intercostal nerves and arteries.

Diaphragm.—The costal part of its muscular rim is attached to the internal faces of ribs from the lower end of V rib to XI rib in an oblique line and then in a curved line from XII rib to the vertebral ends of last four ribs by varying extents. The sternal part of the muscular rim is attached across the Xiphoid cartilage. The lumbar part consists of two crura. Left crus is very wide, short, quadrilateral and is attached by a narrow tendon to the bodies of II & III lumbar vertebrae. The right crus is elongated and divides below into two parts which unite to circumscribe *hiatus oesophagi* at the level of XII thoracic vertebra, to the left of the median line. It is attached by a thick tendon to the bodies of I & II lumbar vertebrae. The *hiatus aorticus* is between the two crura below the body of XVI thoracic vertebra. The tendinous centre is small. It is pierced below hiatus oesophagi, 3 cms. to the right, by *foramen dextrum.*

Nerve supply :—Phrenic and intercostal nerves.

Blood supply :—Musculo-phrenic and intercostal arteries.

Sublumbar muscles

Psoas parvus.—The muscle fibres arise from ventral faces of the vertebral ends of last five ribs and the bodies of last five thoracic vertebrae, I & II lumbar vertebrae. The muscle has a long tendon which runs lateral to the internal iliac vein and is inserted to the psoas tubercle.

Psoas magnus.—Arises from the ventral faces of the vertebral ends of last two ribs, transverse processes of lumbar vertebrae and the anterior face of ilium. The lower part of the muscle blends with iliacus to form the *iliopsoas* for insertion to the medial trochanter of femur.

Iliacus.—Arises from the anterior face of ilium lateral to proceeding and blends lower down with it.

Quadratus lumborum.—It is narrow and elongated and occupies the space between the last rib and the iliac crest. It arises from the upper part of the last rib and transverse processes of lumbar vertebrae and inserted to the medial aspect of the iliac crest.

Nerve and blood supply:—Lumbar spinal nerves and lumbar arteries.

Muscles of the Pelvis

Obturator internus.—Arises from the pelvic face of shaft of ilium, pubis and ischium. The muscle fibres converge to form a large flat fleshy tendon laterally, which leaves by the lesser sciatic foramen and is inserted into the trochanteric fossa of femur.

Nerve supply :—Sciatic nerve.

Blood supply :—Obturator artery.

Obturator tertius.—It lies deeper to preceeding. It arises from the pubis and ischium along the median line and forms a fleshy tendon laterally, which leaves by the obturator foramen and blends with the tendon of obturator externus.

Nerve and blood supply :—Obturator nerve and artery.

Muscles of the anus

Sphincter ani externus.—It is a thick ring round the anal orifice, but the bundles are not bright red as in other animals.

Sphincter ani internus.—It is deeper to externus and is not distinct from it.

Suspensory ligament.—It consists of two minute bundles of plain muscle fibres descending from the vertebral body above and blending with the external sphincter.

Retractor ani.—It is a broad flat muscle arising from the pelvic face of ischium. It runs upward and backward to attach itself to the anus and then is inserted above to III, IV & V caudal vertebrae.

Recto coccygeus.—It consists of two large flat bundles of plain muscle arising from the dorsal wall of rectum, 5 cms. in front of anus. They pass up covering the middle and lateral coccygeal arteries and are inserted to the bodies of VII & VIII caudal vertebrae.

Coccygeus.—This was not described under the caudal muscles in Part IV as it was not examined then.

It is broad, thin and triangular arising from the lateral aspects of first three caudal vertebrae. The posterior part of the muscle is thick

like a bundle. It is attached to the pelvic face of ischium. Its fibres run into the wall of rectum.

Muscles of clitoris

Ischio-cavernosus.—Covers the crus clitoris all round but most of it is placed laterally. It is 5 cms. long and 1 cm. wide.

Erector clitoris.—It is a round bundle placed with its fellow on the median line of the anterior face of corpus clitoris. Below, it terminates in the glans clitoris. About midway up, the bundle expands into a semilunar lamina which is attached to the side of the ischial arch.

Retractor clitoris.—It is the continuation of the suspensory ligament of the anus, spreading on the lateral walls and the posterior wall of the urinogenital canal below the ischial arch for a very short distance.

The blood vessels, lymphatics and nerves are described under the respective visceral cavities.

Thorax

ARTERIES

Pulmonary artery has a diameter of 3·75 cms. at its origin from the right ventricle. It passes upward and backward inclined to the left over the base of the heart. About 6 cms. from its origin, it detaches the *ductus arteriosus* and passes over the left auricle for about 3·5 cms. and divides into right and left pulmonary arteries to supply the lungs. Ductus arteriosus is 2·5 cms. long and 2 cms. wide and it joins the left side of the aortic arch.

Aorta has a diameter of 3·75 cms. at its origin from the left ventricle. It passes upward and forward inclined to the right, then it turns to the left over the pulmonary artery, above which, it forms the aortic arch and reaches the body of V thoracic vertebra and passes backward below the vertebral bodies as the thoracic aorta, passes through the hiatus aorticus and enters the abdomen to continue under the bodies of lumbar vertebrae as the abdominal aorta.

About 8 cms. after its origin, it detaches the brachio-cephalic artery from the anterior face of the arch and immediately above and behind it the left axillary artery. About 3 cms. behind this it is joined by the ductus arteriosus on the left side.

Coronary artery.—In this specimen there is only one-right coronary artery, arising from the right anterior sinus of valsalva. It immediately divides in front into right and left rami which behave like the right and left coronary arteries of other animals. The left ramus is larger, winds round the base of pulmonary artery and divides into an

anterior descending branch and a left circumflex branch. The anterior descending branch passes down the anterior longitudinal groove of the heart and reaches the incisura cordis and anastamoses with the posterior descending branch. The left circumflex branch passes to the left in the transverse groove and anastamoses with the right ramus to form the posterior descending branch which passes down the posterior longitudinal groove to reach the incisura cordis and anastamoses with the anterior descending branch. The right ramus is small, turns to the right in the transverse groove and anastamoses with the left circumflex branch above the posterior longitudinal groove.

Brachiocephalic artery is 2.5 cms. long, passes forwards over the dorsal border of thymus and below the trachea in the anterior mediastinum and divides at the thoracic inlet into three terminal arteries right axillary, left and right common carotid arteries.

Left Axillary artery arises from the aortic arch behind I rib and it immediately detaches three branches at the same level-costo-cervical artery above, internal thoracic artery laterally and vertebral artery in front. It then detaches in front the inferior cervical artery and winds round the anterior border of I rib and enters the axilla.

Costo-cervical artery passes up, detaches I, II & III intercostal arteries and continues as the cervical artery into the levator anguli scapuli and other cervical muscles.

Vertebral artery passes forwards, enters the foramen transversarium of VI cervical vertebra with the nervus transversarius, passes through the canalis transversarius, enters the cranium through the foramen magnum and meets the other vertebral artery to form the basilar artery.

Internal thoracic artery passes down over the left precaval vein and left phrenic nerve, runs down on the first intercostal space with a satellite vein on either side and divides below into musculophrenic and anterior abdominal arteries. The *musculophrenic artery* passes back along the lower border of thymus and left lung and enters the costal attachment of the diaphragm. The *anterior abdominal artery* detaches perforating branches which supply the pectoral mammary gland and passes under transversus thoracis and leaves the thorax by VI interchondral space, runs on the deep face of rectus abdominis and pierces the muscle at its medial border, then passes through the cutaneous muscle to the pre-femoral region and anastomoses with the posterior abdominal artery.

Inferior cervical artery passes forward out of the thoracic inlet, detaches the *suprascapular artery* (Vide Part II) and continues on the deep face of omotransversarius supplying the lateral cervical muscles upto the wing of atlas.

Right axillary artery arises from the brachio-cephalic artery at I rib and detaches similar branches as the left one.

Broncho-oesophageal arteries. The left artery arises from the concavity of the aortic arch at the level of II rib, detaches the *left bronchial artery* and continues as the *left oesophageal artery* on the oesophagus. The right artery arises from the right face of the left III aortic intercostal artery, detaches the *right bronchial artery* and continues as the *right oesophageal artery.*

Aortic intercostal arteries arise from the dorsal face of the thoracic aorta, the left ones being slightly behind the right ones at their origin. They form III to XIX intercostal arteries and resemble the arteries of other animals. There is transverse anastamoses between the arteries about the middle and lower parts of intercostal spaces.

Caeliac artery arises from the ventral face of the thoracic aorta about the level of XII thoracic vertebra. It passes obliquely downward and backward through the diaphragm, lateral to the left crus and enters the abdomen.

Anterior mesenteric artery arises immediately behind the preceeding and enters the abdomen similarly.

Phrenic arteries are right and left arising behind the preceeding and supply the respective halves of the diaphragm.

Veins

Coronary veins are three-left or great coronary vein, middle and right coronary veins which open into the left precaval vein. The latter two open by a large common opening at the termination of the precaval. Besides there are Vena cardis minimae.

Pulmonary veins are two pairs-one pair from each lung. The anterior pulmonary vein of left lung is formed by tributaries from the apical and cardiac lobes and the posterior pulmonary vein from the diaphragmatic lobe in both the lungs. The anterior pulmonary vein of right lung is formed by tributaries from the apical, cardiac and mediastinal lobes.

Vena hemiazygos is situated on the left side, dorso-lateral to the thoracic aorta. It receives the left intercostal veins from III to the XIX. It arises in the abdomen from small veins from the lumbar region and passes through hiatus aorticus into the thorax. It turns to the right at the level of III thoracic vertebra and joins the azygos vein.

Vena azygos is situated on the right side, dorso-lateral to the thoracic aorta and receives the right intercostal veins from III

to XIX. Like the preceding it arises in the abdomen. It joins the right precaval vein behind the costocervical.

Postcaval vein.— In the foramen dextrum, it receives the right and left phrenic veins and passes forward related to right phrenic nerve above, in the groove between the diaphragmatic and mediastinal lobes of the right lung and opens into the right auricle.

Precaval veins are two-right and left opening into the right auricle. Each is formed by the union of common jugular and axillary veins at the thoracic inlet. Each receives the costocervical and internal thoracic veins. The right precaval receives the azygos vein and is larger than the left.

Axillary vein drains the forelimb and receives the vertebral, inferior cervical and cephalic veins at the thoracic inlet and joins the common jugular vein.

Lymphatics and lymph glands

Thoracic duct. The lumbar and gastrointestinal trunks pass through hiatus aorticus and join on the left face of thoracic aorta at XV thoracic vertebra. They meet at an acute angle to form a pyramidal dilatation—*cisterna chyli* which gives origin in front to the thoracic duct that passes dorsal to the large haemolymph gland and continues its course forward on the dorsolateral aspect of the thoracic aorta on the left side having the vena hemiazygos below it. It bends down at the thoracic inlet and opens into the left precaval vein behind the costocervical vein. The left vagus passes deeper to the duct at its termination. The duct is 3-4 mm wide and thin walled.

Haemolymph glands. A large lamina shaped gland, 4 cms long and 2 cms wide is located on the left face of the aorta at XIV thoracic vertebra over which the thoracic duct passes. Another oval gland is found below the right precaval vein and one over the right lobe of thymus. There is one large gland on the pericardium and another elongated gland 4 cms long and I cm wide on the right face of aorta at its termination.

Nerves

Vagus. The *left vagus* enters the thoracic inlet, passes under the root of the axillary artery with the *ansa subclavia,* continues on the base of the heart between the left precaval vein and the aortic arch, detaches the left recurrent laryngeal nerve behind the arch, supplies the the cardiac and pulmonary branches and reaches the left lateral face of oesophagus above the root of the lung and divides into dorsal and ventral branches about 3 cms. in front of hiatus oesophagi.

The *right vagus* enters the thoracic inlet, passes under the root of the axillary artery with the *ansa subclavia*, detaches the right recurrent laryngeal nerve behind the costocervical arfery, passes deeper to the right precaval vein and vena azygos over the base of the heart, detaches cardiac and pulmonary branches at the root of the lung and reaches the right lateral face of oesophagus and divides into dorsal and ventral branches. The corresponding branches of the vagi unite to form the dorsal and ventral oesophageal trunks which run on the respective faces of oesophagus, pass through the hiatus oesophagi and enter the abdomen. The *dorsal oesophageal trunk* is larger deriving greater number of fibres from the right vagus. It passes over the cardiac end of stomach, reaches the saccus caecus and divides into gastric and caeliac branches. The gastric branch ramifies on the visceral face of the stomach to form the *posterior gastric plexus*. The caeliac branch passes over the caeliac artery and joins the left caeliac ganglion and continues as the interganglionic cord and joins the left anterior mesenteric ganglion. It also detaches a branch that passes to the right side and joins the right caeliac and anterior mesenteric ganglia. The *ventral oesophageal trunk* divides into caeliac and gastric branches. The gastric branch ramifies on the parietal face of stomach to form the *anterior gastric plexus*. The caeliac branch joins the right caeliac and anterior mesenteric ganglia.

The *left recurrent laryngeal* nerve winds round the aortic arch and the *right nerve*, round the costocervical artery. Both pass forward to the thoracic inlet with similar relations as in other animals.

Phrenic nerves are formed at the first intercostal space by the union of two roots-large and small, the former from the Ventral primary branch of VI spinal nerve and the latter deriving fibres from the ventral primary rami of IV and V cevical spinal nerves, both being deeper to scalenus.

On the left side, the large root passes lateral to inferior cervical artery and axillary vein. The small root passes deeper to the inferior cervical artery, axillary and cephalic veins and joins the large root behind the axillary vein to form the left *phrenic nerve*. The nerve passes over the internal thoracic veins and deeper to the internal thoracic artery, continues over the base of heart below the left precaval vein and reaches the tendinous centre of diaphragm.

On the right side, the large root passes over the root of axillary vein and deeper to the internal thoracic artery. The small root passes below the axillary vein and deeper to the internal thoracic vessels and joins the large root below the right precaval vein to form the *right phrenic nerve*. The nerve passes over the base of the heart below the right precaval vein, runs dorsal to the postcaval vein in the groove

between the diphragmatic and mediastinal lobes of the right lung and reaches the tendinous centre of the diaphragm.

Thoracic Spinal nerves are nineteen and resemble the nerves of other animals in their course, distribution and connection with the sympathetic ganglia. The ventral rami of I & II contribute most of their fibres to the *brachial plexus*. The ventral rami continue as intercostal nerves in company with the artery and vein along the posterior borders of ribs. Greater part of their course is subpleural, the order from before backwards being vein, artery and nerve. At the lower parts of ribs, they obliquely cross from behind forwards reversing this order of structures - nerve, artery and vein from before backwards. The ventral primary branch of XIX thoracic nerve after giving XIX intercostal nerve, passes backward and detaches the *iliohypogastric nerve* and joins I lumbar nerve to form the lumbar part of the lumbosacral plexus. At the point of its union with the lumbar, it detaches the *ilioinguinal nerve*. The iliohypogastric and ilioinguinal nerves resemble the nerves of other animals and man.

Abdomen

ARTERIES

Caeliac artery passes behind the saccus caecus of stomach and divides into two trunks—anterior and posterior. The anterior trunk reaches the visceral face of stomach, detaches *oesophageal artery* and divides into gastric and splenic branches. The *gastric branch* divides into anterior and posterior branches which ramify on the respective faces of saccus caecus. The splenic branch supplies *splenic artery* and continues as the *left gastroepiploic artery* along the greater curvature of the stomach. The posterior trunk is the *hepatic artery* which detaches on the visceral face of liver, *left gastric artery* to the lesser curvature of the stomach, and descends on the left side of portal vein and below it, furnishes two branches to the lobes of liver and continues as the *gastroduodenal artery* to supply pancreas, bend of duodenum and passes to the left of the hepatic receptacle as the *right gastroepiploic artery* to anastamose with the left artery on the greater curvature of stomach.

Anterior mesenteric artery passes to the right face of terminal colon, descends through the concavity of the duodenal loop and enters the mesentery. Its branches are (1) a branch to supply pancreas and right limb of the duodenal loop and continue as the *right gastric artery* to the lesser curvature of stomach to anastamose with the left gastric artery, (2) A left mesenteric branch to the coils of jejunum on the left side of abdomen. (3) A large mesenteric branch which divides into two trunks-left and right. The left trunk gives the *caecal artery* and descends into the mesentery to supply coils of jejunum and ileum. The right trunk descends into mesentery as *colic artery* to supply coils of

colon. The transverse communicating branches of the two trunks anastamose to form the arterial arches which are close to the colon in the mesentery, whereas similar arches are away from jejunum.

The caeliac and anterior mesenteric arteries are the branches of thoracic aorta.

The following are the collateral branches of the abdominal aorta in order.

(1) Right adrenal artery; (2) Left adrenal artery; (3) Right ovarian artery; (4) Right renal artery; (5) Left renal artery which detaches the left ovarian artery; (6) Posterior mesenteric artery descends between the common iliac veins and enters the mesocolon and divides into anterior and posterior branches. The anterior branch ramifies on the terminal colon and the posterior branch is the *haemorrhoidal artery* which divides into right and left branches ramifying on the respective faces of the rectum; (7) Lumbar arteries are four pairs, arising from the dorsolateral face of the aorta. The first three arise from the aorta and the last from the internal iliac artery. They resemble the arteries of other animals in their course and distribution.

The abdominal aorta terminates in *iliac quadrification* under IV lumbar vertebra.

External iliac artery is half the size of the internal iliac in calibre. It passes backward and outward below the common iliac and external iliac veins under the tendon of psoas parvus, runs deeper to psoas magnus and is continued as the *femoral artery* below the pubis. (Vide Part IV). Its collateral branches are:

(1) Circumflex iliac artery (superior) detached below the tendon of psoas parvus, runs outward and supplies the abdominal wall at the iliac crest.

(2) Circumflex iliac artery (inferior) detached deeper to psoas magnus, runs outward under the iliopsoas supplying them and capsularis, reaches the external angle of ilium and continues on the deep face of tensor vaginae femoris. These two arteries correspond to the superior and inferior branches of the circumflex iliac artery of the ox.

(3) Posterior abdominal artery arises in front at the level of hip joint. It supplies two branches to the joint and the abdominal floor and accompanies the ilioinguinal nerve with a number of satellite veins and anastamoses with the anterior abdominal artery.

VEINS

Portal vein is formed by the union of anterior mesenteric, gastro-splenic and gastro-epiploic veins. It enters the portal fissure and divides into right and left branches. The right branch supplies the

right central and right lateral lobes of liver. The left branch joins the umbilical vein, gives off the *ductus venosus* and supplies the left lobe of liver.

Umbilical vein from the umbilical cord continues in the free margin of the falciform ligament, and enters the umbilical fissure. About a dozen veins take the blood directly from it to the left lobe of liver. It then joins the left branch of portal vein.

Ductus venosus is 8 cms. long and 4 mm. wide connecting the anastamosis of umbilical and left branch of portal vein to the left hepatic vein at its opening into the postcaval vein. It passes through the substance of left lobe of liver.

Postcaval vein is formed by the union of two common iliac veins below the anterior pole of left kidney. Each common iliac vein receives the renal, ovarian and lumbar veins. The postcaval vein passes on the right side of abdominal aorta, descends on the anterior face of the liver, receives the veins from the right lobe of liver, right and left hepatic (with ductus venosus) veins, passes through foramen dextrum into thorax and opens into the right auricle.

Lymphatics and lymph glands

There are lymphatics in the mesentery. There are numerous haemolymph glands along the mesenteric blood vessels and a few lymph glands along the lymphatics. A large haemolymph gland is situated in the portal fissure and another in relation to the external iliac artery.

NERVES (Fig. 1)

Lumbar spinal nerves are four, resembling the nerves of other animals in their course, distribution and their connection with the sympathetic ganglia. The ventral primary branches of I & II lumbar nerves receive XIX thoracic nerve in front and a branch from the III lumbar nerve behind to form the *lumbar plexus* between the psoas parvus and psoas magnus. The ventral primary branches of III and IV lumbar nerves enter the pelvis to join the sacral nerves to form the *sacral plexus*.

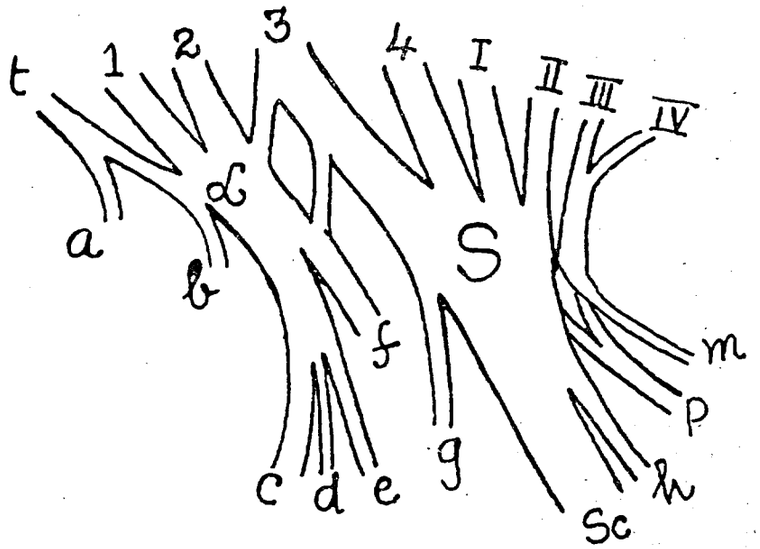
The *lumbar plexus* furnishes the following nerves: ilioinguinale, great crural, lateral cutaneous nerve of thigh and obturator.

Ilioinguinal nerve derives its fibres from XIX thoracic and I lumbar nerves.

Great crural nerve passes between the two parts of psoas magnus and then between magnus and iliacus, detaches the *internal saphena nerve* (vide Part IV) and terminates in the Quadriceps.

Lateral cutaneous nerve of thigh passes through iliopsoas about the middle of the iliac crest and reaches the external angle of ilium

and continues on the deep face of tensor vaginae femoris to supply skin on the lateral aspect of the thigh.



Explanation to Fig. 1

t, XIX thoracic nerve; 1, 2, 3 & 4, lumbar nerves;
I, II, III & IV, Sacral nerves; L, lumbar plexus;
S, Sacral plexus; a, iliohypogastric nerve;
b, ilioinguinal nerve; c, great crural nerve;
d, internal saphena nerve; e, lateral cutaneous nerve of the thigh; f, obturator nerve; g, anterior gluteal nerve;
Sc, sciatic nerve; h, posterior gluteal nerve,
P, pudendal nerve; m, muscular branch.

Obturator nerve passes behind the crural nerve and receives a branch from III lumbar, passes deeper to the medial part of psoas magnus, then crosses under the tendon of psoas parvus and external iliac artery, reaches the anterior border of pubis, passes under obturator internus, leaves by the obturator foramen and terminates in the muscles of the medial aspect of thigh (vide Part IV).

The Pelvis

ARTERIES

Right internal iliac artery passes back below the sacral ganglia and then bends downward and backward to terminate by dividing into *posterior glutcal* and *internal pudic arteries*. Its collateral branches in order are:

1. *Umbilical artery* is very large. It crosses medially the external iliac artery and passes down along the pelvic inlet in the margin of the

lateral ligament of bladder and accompanies the urachus to the umbilicus and ramifies in the placenta. The left artery is twice as wide as the right one.

2. *Lumbar artery* is the fourth one resembling other lumbar arteries.

3. *Right lateral sacral artery* arises medial to III sacral ganglion, passes deeper to sacrococcygeus lateralis and continues in the tail as the *right lateral* coccygeal artery (vide Part IV).

4. *Anterior gluteal arteries* are three; two arising from the posterior border and one from the anterior border at different levels. They leave the greater sciatic foramen and terminate in the muscles of the gluteal region.

5. *Vesicogenital artery* passes downward and forward and divides into vesical and genital branches. The vesical branch is small, descends vertically down and terminates in the bladder. The genital branch is the *uterine artery* which spreads along the visceral border of the broad ligament of uterus.

6. *Obturator artery* accompanies the obturator nerve under obturator internus, leaves by the posterior part of the obturator foramen and terminates in the muscles arising below the ischial symphysis.

Posterior gluteal artery leaves by the lesser sciatic foramen, accompanies the sciatic nerve along its posterior border and terminates in biceps femoris, semitendinosus, gamellus and quadratus femoris.

Internal pudic artery accompanies the internal pudic or pudendal nerve. Both leave by the greater sciatic foramen and re-enter by the lesser sciatic foramen. It passes over obturator internus and reaches the lateral wall of vagina, detaches branches to vagina, bladder and urinogenital canal; bends over the ischial arch and reaches the anterior wall of the urinogenital canal (extra pelvic part). It detaches a large branch which passes forward between the laminar parts of erector clitoris and terminates in the abdominal floor. The artery then continues on the anterior face of corpus clitoris as the *dorsal artery of clitoris* with the nerve up to the glans clitoris.

Middle sacral artery is large arising from the dorsal face of abdominal aorta at the level of origin of internal iliac arteries. It is deflected to the left in close relation to the left sacral ganglia which it covers. Beyond the last sacral body, it detaches the *left lateral coccygeal artery* and turns to the median line at the level of III coccygeal body and continues in the tail as the *middle coccygeal* artery (vide Part IV).

Left lateral coccygeal artery passes back in the tail deeper to sacrococcygeus lateralis (vide Part IV).

VEINS

Internal iliac vein is formed from tributaries which are the satellites of the branches of internal iliac artery. It joins the external iliac vein at the pelvic inlet to form the common iliac vein.

HAEMOLYMPH GLANDS

A chain of twenty small haemolymph glands are found along the arteries on the lateral walls of rectum.

NERVES (Fig. 1)

Sacral spinal nerves are four resembling the nerves of other animals in their course, distribution and connection with the sympathetic ganglia. IV sacral nerve is the smallest. The ventral primary branches of the four unite with III & IV lumbars in front to form the *sacral plexus* on the medial pelvic wall. The plexus furnishes anterior gluteal, sciatic, posterior gluteal, internal pudic and a large muscular ramus. The first three were dealt in Part IV.

Internal pudic or *pudendal nerve* derives the fibres (parasympathetic) from II, III & IV sacrals. It accompanies the artery over the vagina and urinogenital canal supplying branches to them, bends over the ischial arch and continues on the anterior face of corpus clitoris as the dorsal nerve of clitoris with the artery upto the glans clitoris.

Pelvic splanchic nerves (parasympathetic) are derived from the deep face of II, III & IV sacrals (vide Part V).

Coccygeal spinal nerves are five. Their dorsal branches pass up to supply sacrococcygeus dorsalis and skin of tail. Their ventral branches unite to form the *lateral coccygeal nerve* which passes over the transverse process of the vertebrae between the sacrococcygeus lateralis and intertransversalis coccygeus (Vide Part IV).

Discussion and Summary

1. Tunica abdominalis detaching two laminae to form the suspensory ligament of the urinogenital canal though remarkable has not received attention by previous workers.

2. Miall & Greenwood (1878) and Rajagopal (1956) refer to the 'Poupart's or Inguinal' ligament while describing the abdominal muscles. In the elephant-a 'testiconda', such terms are inappropriate and the corresponding structure in named iliac lamina in this study.

3. The previous workers have not taken note of the existence of transversus thoracis muscle covering the thoracic face of sternum. It consists of three transverse bundles under which the anterior abdominal artery runs.

4. Erector clitoris though described by others, its laminar part arising from the ischial arch is not emphasised.

5. The number of coronary arteries vary in the elephant and other animals. In this specimen there is only one-right coronary artery the branches of which subserve the function of two coronary arteries.

6. The internal thoracic artery detaches a large musculophrenic artery as in the ox, which is not taken note of by others.

7. The left umbilical artery is twice as large (wide) as the right one in this specimen. Such great disparity in the size is not noted by others either in the elephant or other animals. Whether this is related to the uterine posture of the foetus (lying on the right side) or what other factor underlies this needs a rational explanation.

8. The lateral coccygeal arteries are larger than middle coccygeal artery. They do not arise from the posterior gluteal artery as reported by Rajagopal (1956). The left one arises from the middle sacral and the right one from the right internal iliac.

9. Origin of caeliac and anterior mesenteric arteries from the thoracic aorta as in this study has not been observed by previous workers either in the elephant or in other animals.

10. The course of the thoracic duct noted by Rajagopal (1956) exactly corresponds to the condition that obtains in man. But in this specimen, it totally differs from what he describes and exactly corresponds to the condition seem in ox.

11. Rajagopal (1956) has noted the phrenic nerve deriving its fibres from IV and V cervical nerves. But in this study, they derive fibres from IV, V and VI cervical nerves-the right and left nerves and their roots having different relations.

12. In this study the formation of lumbar plexus is by XIX thoracic nerve with the I, II & III lumbar nerves. XIX thoracic, detaches the iliohypogastric nerve and with some fibres from I lumbar forms the ilioinguinal nerve. This condition has no paralled in any other animals except man. The sacral plexus is formed by III and IV lumbar, I, II, III and IV sacral nerves. These details in the formation of lumbar and sacral plexus greatly differ from the observations of all previous workers and Rajagopal (1956).

REFERENCES

Same as for Part VI. which appeared in No. 5, Vol. 35 of *I. V. J.* (1958).

STUDIES ON THE MORPHOLOGY AND DEVELOPMENT OF THE SPERMATOZOA OF FARM ANIMALS

By

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The rapid growth of artificial insemination in farm animals has thrown a heavy responsibility on a comparatively small number of males. Many criteria are employed for the evaluation of semen quality. A knowledge of the morphology and development of sperm is essential for the proper evaluation of semen on the basis of sperm morphology.

A. *Significance of sperm morphology in male fertility.*—Williams (1920 a, b) and Williams & Savage (1925) considered the morphology of sperm heads of great value in assessing fertility of bulls. Moench (1927, 1929), Mason (1929), and Moench and Holt (1931) attached great importance to sperm morphology in their studies on human semen. Moench (1930, 1933, 1936) published persistently on the subject and has done much to accentuate the emphasis placed on semen evaluation in the diagnosis of human sterility. Mckenzie & Phillips (1934) found that sperm morphology gave an index of fertility in rams. Mckenzie & Berliner (1937) found that the percentage of abnormal sperm was influenced by the breeding season.

B. *The cytoplasmic drop of spermatozoa.*—Redenz (1924) observed protoplasmic drops on epididymal sperm and later, on ejaculated sperm and found that its position varies with the region from which sperm are collected. He correlated this translocation of the drop with the process of sperm maturation. Roemmele (1927), Kusnezva *et al* (1932) and Rodolfo (1934) were in general agreement with Redenz. Selivanova (1937) described six types of spermatozoa depending on the position of the kinoplasmic droplet. Merton (1939) was of the view that the kinoplasmic droplet was of special importance in the maturation of mouse sperm. Other workers also reported the occurrence of these drops in spermatozoa of various species of animals. Rao & Berry (1950) proposed the term cytoplasmic drop in place of the protoplasmic drop.

C. *The cytoplasmic cap of spermatozoa.*—Mckenzie, Miller & Bauguess (1938) found that frequent ejaculation in the boar induced the appearance of sperm with an enlarged cap about the head, which they termed as the cytoplosmic cap. Green (1940) observed a small, hyaline vesicle at the anterior end of the head of the ram sperm. Seymour & Benmosche (1941) reported a crater-like depression at the vertex of the human sperm head. Comstock *et al* (1943) found a structure comparable to the vesicle of ram sperm on the bull and boar sperm. Baylor

Nalbandov & Clark (1943) reported the presence of a cap-like structure at the anterior end of the head of the bull sperm under the electron microscope. Blom (1945) reported the occurrence of galea capitis in bull and stallion sperm. Reed & Reed (1948) made a comparative study of human and bull sperm and found that the former lacked the galea capitis which is possessed by bull sperm. Rao & Hart (1948) demonstrated the cap on bull sperm using opal blue-eosin stain.

The objects of the present study are,

1. to study the relationship of the cytoplasmic drop to sperm maturation with reference to a wide variety of farm animals ; and
2. to determine the presence of the cytoplasmic cap on the spermatozoa of farm animals.

Materials and Methods

Several species of farm animals were involved in this study. The farm mammals studied were—the buffalo, stallion, jack, ram, buck and boar. The rooster, turkey tom, drake and male pigeon were the avians used in this study.

The male reproductive tract was obtained by castration by the open method in case of the stallion, jack, and some of the rams, bucks, and boars. The entire male reproductive tract of the buffalo-bulls and from some of the rams, bucks and boars was collected from the slaughter house. In every case, the organs were removed within half an hour after the death of the animal and examined within another half to one hour. In the case of the birds they were decapitated, defeathered and the entire male reproductive tract carefully dissected out and examined within one half hour after their death.

To make preparations from the testes and parts of the epdididymis, the cut portions of these organs of suitable size were slightly moistened with normal saline and impression smears made. Another technique was to subject these portions to multiple incisions with a sharp scalpel and apply the incised portions to a couple of drops of normal saline on a clean glass slide and smears drawn from this fluid. It was comparatively easier to collect material from the tail of the epididymis, where the epididymal duct is well-developed. Material from the ampulla and vas deferens was obtained by gently milking them.

Two techniques of staining were adopted in this study. In one case, a drop of the material was mixed with a couple of drops of 5 per cent indulin or aniline blue in M/8 Phosphate buffer and smears made from this mixture. When smears were to be stained, the following procedure was adopted.

1. Staining with Weigert's iron haematoxylin for 3 to 5 minutes followed by counterstaining with 1 per cent aqueous erythrosin B for ¼ to ½ minute.

2. Staining with aceto-carmine for 5 minutes followed by counterstaining with 1 per cent aqueous aniline blue for ¼ to ½ minute.

All stained preparations were examined under the oil immersion objective at a magnification of 800. For the classification of sperm into various groups, 100 sperm distributed in several fields of the smear were counted. Cytoplasmic drops located on the anterior half of the connecting piece, were designated as anterior drops, while those located on the posterior half were termed posterior drops for the sake of convenience in the classification of sperm.

Results

(a) *Morphology of the sperm head* :—The head of the stallion sperm when viewed in the on-flat position was broadest in the middle gradually tapering towards the extremities with the ends being rounded off. The head of jack sperm resembles the stallion sperm closely, but it is more rounded anteriorly and the base is broader. The point of greatest width also lies slightly behind the middle line. The head of the ram sperm in the on-flat view is oval in shape with the greatest width about the middle of the head. The anterior end is broader and more rounded than the base of the sperm head. The head of the buck sperm is of about the same length as that of the ram but differs markedly in shape. The greatest width lies about the anterior third of the head and even here it is only slightly broader than at either extremity. The head of the spermatozoa of the buffalo-bull bears no resemblance to the bull sperm but is more after the ram sperm in outline though shorter and narrower. The head is narrowest at the base, the greatest width lying slightly behind the anterior end. The head of the boar sperm is larger than that of other species mentioned, being longer and broader. The greatest width is about the middle from where it narrows down to the base while anteriorly the width is only slightly less than at the centre. In the on-edge view all the mammalian sperm are flattened from side to side and are of about the same thickness as the connecting piece. The base of the sperm head in all these species has a shallow depression for the attachment of the neck. The head of the sperm is capable of limited movement about the flexible neck, but not of rotation.

The head of the spermatozoa of the birds studied is narrow, elongated and cylindrical with an inconspicuous, apparently inflexible head. The anterior end of the head is drawn into a short, needle-like process, while the rest of the head is of uniform thickness.

(b) *Cytoplasmic drop.*—The cytoplasmic drop was found on the sperm of all the mammalian species studied. According to the location of this drop the following six types of sperm could be recognised.

1. Sperm with the drop surrounding the posterior half of the head.

2. Sperm with the drop surrounding the neck region,

3. Sperm with the drop at the anterior end of the connecting piece,

4. Sperm with the drop at various levels down the connecting piece between the two extremities,

5. Sperm with the drop at the posterior end of the connecting piece ; and

6. Sperm without the drop.

The drop in the first two types of sperm was of the nature of a large irregular mass and such sperm usually also had a filiform connecting piece. The drop when located on the connecting piece was in the form of a compact, globular mass and the connecting piece of such sperm was normal in thickness. However, in some sperm with anterior drops, particularly those collected from the testes and the epididymal head, the connecting piece presented a tortuous appearance. In the testes the first three types of sperm were most predominant, the first two types being restricted to the testes only. Sperm with posterior drops were rare in the testes and dropless sperm unusual. In the epididymis sperm of types III to VI were present, type III being most numerous in the head region with lesser numbers of IV, V and VI types. The proportion of type III decreases as we go down the epididymis and the other 3 types increase in number proportionately. In the epididymal tail of the stallion, jack, ram, buck and buffalo most of the sperm did not have any drop at all, while in the boar the majority had posterior drops. Generally speaking the anterior drops were larger and more compact than the posterior drops. In the vas deferens and ampulla, practically all the sperm were dropless in the case of stallion, jack, ram and buck and most of the sperm dropless in the buffalo and boar.

In the case of avian sperm no structure similar in appearance to the cytoplasmic drop of mammals was evident. However, the majority of testicular sperm in these species had large irregular masses of cytoplasm surrounding varying lengths of the head. A large number of testicular sperm in these species showed a tortuous connecting piece of normal thickness, while sperm from the vas had a normal connecting piece. With differential staining, the drops of the mammalian sperm as well as the cytoplasmic masses in the avian sperm took the acid stain

while the head proper took the basic stain. The neck and tail of the sperm also took the cytoplasmic stain.

The distribution of different types of sperm in the several regions of the male reproductive tract is presented in Table I.

TABLE I

Species	Head of epididymis			Tail of epididymis			Vas deferens or ampulla		
	Mean % ant. drops.	Mean % post. drops.	Mean % drop-less	Mean % ant. drops.	Mean % post. drops.	Mean % drop-less.	Mean % ant. drops.	Mean % post. drops.	Mean % drop-less.
Stallion	38·6	20·2	41·2	2·7	7·4	89·9	0·3	1·9	97·8
Jack	35·0	29·5	35·5	3·5	14·0	82·5	0	4·0	96·0
Ram	56·7	7·6	35·7	0·2	15·7	84·1	0	1·0	99·0
Buck	63·5	13·0	23·5	3·3	20·7	76·0	0	3·28	96·71
Buffalo	38·1	26·0	35·9	4·3	39·9	55·8	1·7	8·4	89·9
Boar	56·5	30·8	12·7	10·1	59·4	30·5	5·33	12·83	81·83
Bull	45·8	30·0	24·2	1·2	37·7	61·1	—	—	—
(Rao & Hart 1948)									

When the contents of the epididymal tail of all the farm mammals were diluted in the ratio of 1: 10 with normal saline and incubated for one half hour at 100°F. the proportion of sperm with posterior drops declined considerably while the number of dropless sperm increased proportionately. There was a slight decline in the number of sperm with anterior drops which was not so marked as in the case of sperm with posterior drops. The decline in the number of sperm with posterior drops was due to the active motility of sperm in incubated samples, the drops being knocked off by the powerful lashing movements of the tail. The effect of dilution and incubation of epididymal tail contents can be seen in Table II.

TABLE II

Species.	Before incubation			After ½ hour incubation at 100°F.		
	Mean % ant. drops.	Mean % post. drops.	Mean % dropless.	Mean % ant. drops.	Mean % post. drops.	Mean % dropless.
Stallion	2·25	5·5	92·25	1·25	1·0	97·75
Ram	1·0	18·8	80·2	0·6	3·4	96·0
Buck	1·2	19·4	79·4	0·6	3·0	96·4
Buffalo	4·4	42·6	53·0	2·2	5·2	92·6
Boar	13·4	53·8	32·8	9·6	4·4	97·0
Bull	7·0	56·33	46·67	5·33	17·67	77·0
(Rao & Hart, 1948)						

(c) *Cytoplasmic cap* :—The cytoplasmic cap was evident in the spermatozoa of all the farm mammals studied. It was best developed in boar sperm followed by the buck, buffalo, ram, stallion and jack. The cap was found to be a thin membraneous structure going all round

the anterior end of the sperm head and extending laterally and stopping abruptly at the junction between the acrosome and the post-nuclear cap. The cap was better developed on epididymal sperm than on ejaculated sperm. Irrespective of the degree of development the cap could always be clearly demonstrated by differential staining techniqnes, the cap taking a cytoplasmic stain while the head proper took the nuclear stain. In the avain sperm, a short needle-like process was found at the anterior end of the head, which took the cytoplasmic stain by differential staining, while the rest of the head took the nuclear stain. In making smears of avian semen diluted with normal saline it was found that the sperm heads in such preparations were swollen and distorted and even in such preparations the needle-like process preserved its shape giving an impression that it was made of some hard material. The best method of staining avian sperm appears to be by negative staining (Rao, 1957 a) which preserves the natural shape of the avian sperm.

Discussion

Many workers reported about the appearance of sperm with cytoplasmic drops in ejaculated semen of various species of animals and others studied the proportion of sperm with the drops at the different levels of the connecting piece of sperm in the ex-current ducts of the male reproductive tract. At the moment, there is some controversy as to the position of sperm with drops in the morphological evaluation of sperm. Some workers classify these as abnormals (Mckenzie & Phillips, 1934; Mckenzie, Miller & Bauguess, 1937; Rollinson, 1951). Other workers regard such sperm as immature (Donham Simms, 1931; Lagerlof, 1934; Branton and Salisbury, 1947). Selivanova (1937) was of the view that the disappearance of the drop was brought about by a change in the composition of the secretions and that change in position of the drop is no criterion of maturity.

During the studies on the morphology of sperm from the different regions of the male reproductive tract of several species of farm animals, six different types of sperm were noted as already mentioned earlier. All the six types were found in the genital tract of all the species examined. Many features regarding distribution of various types or sperm in different regions were found to be common to all the species studied. Thus, sperm of types I and II were restricted to the testes only. Type I perhaps corresponds to the sperm with protoplasmic cuff reported by Selivanova (1937). These two types also have a filiform connecting piece in all species. Type III were found in small numbers in the testes and at this region, they often presented a tortuous connecting piece of normal thickness. This type is, however, predominant in the head of the epididymis, where the tortuous nature of the connecting piece is generally not evident. The proportion of these decreased progressively

and the number of Type VI sperm increased as we go towards the vas. Regarding the distribution of sperm of Type V there was some variation among the different species of animals studied. In the boar and buffalo their number increased as the sperm travelled towards the tail of the epididymis and from that point onwards their number suddenly declined. In the case of the other species, however, the maximum number of sperm with posterior drops was in the body of the epididymis and their proportion showed a sudden fall in the tail of the epididymis. Their number declined still further in the ampulla.

The explanation for the variation among species in the distribution of the different types of sperm in the different regions appears to lie in the fact, that, whereas sperm collected from the epididymal tail of the buffalo and the boar exhibit no motility, sperm collected from the same regions in the other species exhibit very active motility even when the epididymal contents were examined in the undiluted state (Rao, 1958). It also appears that sperm of the latter groups of animals exhibit some degree of motility even *in vivo* in the epididymal tail and that this sperm motility aids in the detachment of the posterior drops from the sperm. That sperm motility helps in the detachment of posterior drops has been experimentally proved in the course of the investigations reported earlier. The decline in the number of sperm with posterior drops in the vas and ampulla is also believed to be the result of sperm motility induced by more favourable conditions in this region, like higher environmental temperature, lower viscosity of secretions and lower sperm concentration. The proportion of sperm with anterior drops is not much affected by incubation partly perhaps due to their stronger attachment to the connecting piece as well as the fact that the lashing movements of the tail do not produce sufficient concussion in the region of the anterior half of the connecting piece, as in the posterior half, or that sperm with anterior drops may not be capable of such active motility as those with posterior drops. The third possibility can be ruled out as it was found that in incubated samples of sperm from the epididymal tail sperm with anterior drops evinced as active motility as those with posterior drops or the dropless sperm. It was also noticed that the anterior drops were more compact, larger and surround the connecting piece more completely than the posterior drops which tend to be thinner to one side or the other very often.

Selivanova (1937) reported the occurrence of sperm with two drops, one at the neck and the other on the tail in the epididymis, but such sperm were not observed by the author in any of the species studied. The same worker reported that normally spermatozoa of the bull, boar, ram and dog had drops at the neck in the head of the

epididymis and on the tail in the epididymal tail, while those from the body did not have any drop at all, the same disappearing from these and reappearing on those in the tail of the epididymis. The investigations of the author revealed that the majority of sperm in the body of the epididymis of all the species studied had the cytoplasmic drop. Selivanova (1937) also reported that the drop stretched along the entire length of the connecting piece in the body of epididymis and assumed its globular shape in the tail of the epididymis. The results of the present study did not offer any support to this theory and the author is of the opinion that the descent of the drop is a gradual process starting from the posterior half of the sperm head and proceeding upto the posterior end of the connecting piece. Selivanova also found that the addition of the accessory secretions to sperm with posterior drops activated them and the drops slided off the sperm. If the liberated drop came in contact with a sperm it was repelled, except when the contact was in the area of the distal or proximal ring, when it was retained on the surface for some time. In the present study accessory secretions were not used, but when the contents of the epididymal tail were diluted with normal saline and observed under the microscope, the sperm evinced active motility and the posterior drops got detached from a large number of sperm. The detached drops, however, did not adhere to the tail subsequently irrespective of where the contact was made. The author also believes that the movement of the drop is the result of the ageing of sperm and that it is not controlled by the epididymal secretions.

Regarding the function of the cytoplasmic drop nothing is known so far. Merton (1939) believed that the drop was essential for the process of maturation in the mouse sperm. Rao & Hart (1948) hypothesized that the drop might be associated with sperm maturation and perhaps had a nutritive function, particularly in the building up of the connecting piece. This is supported by the following findings :

1. The filiform or tortuous condition of the connecting piece was seen only on sperm which had the drop located at the anterior end of the connecting piece or higher up.
2. The drop was comparatively larger, more compact and more firmly adherent to the connecting piece, when situated at the anterior end of this region than lower down. The connecting piece in sperm with posterior drops was also normal in appearance.

The function of the drop appeared to be completed when it reached the posterior end of the connecting piece and the loss of the drop after that stage did not appear to affect sperm viability during storage.

Lasley & Bogard (1944) reported that when boar sperm from the epididymal tail were stored at 45° F. a large number with posterior drops developed bent tail, the bend occurring just behind the drop and expressed the view that such sperm were immature. The author does not share this view in as much as the bending of tail after cold storage was noticed even in dropless sperm either from the epididymal tail or ampulla or the ejaculate in all the mammalian species studied. The greater frequency of the bent-tailed condition in sperm with posterior drops could perhaps be explained more satisfactorily on physical criteria than on a physiological basis. It might be, that the drop acted as an insulation against sudden cooling of the portion covered by it with the result that the rate of cooling of the tail above and below the drop were greater, leading to the bending of the tail. When precautions were taken to avoid cold shock to the sperm the proportion of bent-tailed sperm was considerably reduced.

In the case of smears of epididymal sperm of all species stained by any of the differential staining techniques (Rao, 1957 b) the sperm heads took the nuclear stain while the rest of the sperm along with the drop and cap took the cytoplasmic stain. It would appear, therefore, that the drop was of cytoplasmic origin and represented the cytoplasmic components of the spermatid differentiated for some special function, and, therefore, the term cytoplasmic drop appeared to be more appropriate than other terms employed.

Regarding the significance of sperm with cytoplasmic drops in the morphological evaluation of semen, it is felt that the position of the drop on the sperm can generally be taken to indicate the degree of sperm maturity. The author is of the opinion that sperm with anterior drops are immature and while their presence in ejaculated semen is rare, their appearance even in small numbers in the ejaculate may be taken as indicative of excessive strain on the reproductive system. Sperm with anterior drops are not generally capable of maximal motility and for this reason, perhaps they may also be considered as abnormal. Sperm with posterior drops can be considered mature in view of their ability for maximal motility given the optimal conditions and also their ability to cast off the drop. Normally, in the process of ejaculation sperm from the ampulla get mixed with accessory secretions and the semen is then expelled with great force by the powerful, rhythmic contractions of the urethral walls down the long and narrow urethral canal at the height of orgasm. This factor perhaps is largely responsible for freeing even the small number of sperm with posterior drops in the vas and ampulla from the drops.

No structure comparable to the cytoplasmic drop could be detected on the spermatozoa of the birds examined. However, large masses

of cytoplasmic material were found to be surrounding varying lengths of the head and connecting piece in testicular preparations on a large number of sperm, and these perhaps may be taken as corresponding to the cytoplasmic drop of mammalian sperm.

The cytoplasmic cap is another structure reported for the spermatozoa of several species of animals. This structure has been variously termed as the cytoplasmic cap, protoplasmic cap and galea capitis. The hyaline vesicle described on ram sperm by Green (1940) and Comstock *et al* (1943) presumably corresponded to this cytoplasmic cap. With all the species of farm mammals studied, sperm from all levels of the male reproductive tract carried a cytoplasmic cap at the anterior end of the acrosome, which also extended laterally to a variable extent upto but not beyond the junction between the acrosome and the post-nuclear cap. The cap was present on all sperm, both normal and abnormal. The cap was best developed on boar sperm, followed by the bull, buck, buffalo, ram, stallion and jack. Sperm from the deeper regions of the reproductive tract i.e., epididymis and testis had more pronounced cap than the ejaculated sperm. Even in the species in which the cap was not pronounced it could be very clearly demonstrated by differential staining techniques (Rao, 1957 b). Hancock (1952) reported that the cytoplasmic cap of bull sperm adhered more closely to the live sperm than to the dead sperm. In differentially stained smears, the development of the cap was found to be fairly uniform. In preparations stained by live and dead differential sperm staining, the dead sperm demonstrated the caps more prominently than the live ones presumably due to the staining effect in dead sperm.

In smears stained by differential staining techniques the cap was found to take the cytoplasmic stain while the entire head took the nuclear stain and the rest of the sperm took the cytoplasmic stain. It, therefore, follows that the cap is of cytoplasmic origin and probably represents the remnants of the cytoplasmic components of the spermatid and the most appropriate term for this structure will be the cytoplasmic cap. The view that sperm having the cap are immature (Mckenzie, Miller and Bauguess, 1938) is erroneous since the cap is a normal component of the sperm.

In the avian sperm, a short, needle-like process was found at the anterior end of the sperm head and in smears stained by differential staining this structure was found to take the cytoplasmic stain while the rest of the sperm head took the nuclear stain. By virtue of its location and by reason of its staining reaction this structure is believed to correspond to the cytoplasmic cap of mammalian sperm. This process was found on sperm from all levels of the reproductive tract and showed the same degree of development on all sperm. This structure

appears to be made up of some hard material and maintains its shape constant, even in preparations in which the sperm head was swollen and distorted. This process was called acrosome by Parker and Co-workers (1942), Wakely and Kosin (1951) and Van Drimmelin (1951). It appears to the author, in the light of the staining reaction and location of this process on the avian sperm, to be most appropriate to designate this structure as the cytoplasmic cap.

Nothing definite is yet known about the functions of the cytoplasmic cap. The cap appears to be the cytoplasmic remnant of the spermatid and its persistence throughout the sperm development and even after sperm maturation suggests that it might be differentiated for some specific function. By virture of its location at the tip of the sperm head this cap is likely to play a dynamic role in the process of fertilisation of the ovum. Karras (1950) discussed the various theories concerning the biological role of the cap. He disfavours the view that the function of the cap is that of mere perforation or protection, but considers it to represent an antenna system of the spermatozoa. Since the discovery by Maclean and Rowlands (1940) that the enzyme hyaluronidase is required for the dispersal of the cumulus cells surrounding the ovum before fertilisation could be effected, much work has been done on this enzyme and its role in fertility. Johnstone and Mixner (1948) found that bull sperm secreted this enzyme and bull testis was one of the richest sources of hyaluronidase. Perhaps this enzyme is secreted by the cytoplasmic cap as suggested by Rao and Hart (1948). On the other hand, it is reported that the rooster testis does not contain this enzyme and rooster semen lacks this enzyme. The avian ovum has a thicker cell wall than the mammalian ovum and it is believed by the author that the cytoplasmic cap of the avian sperm has a perforatory function in the process of fertilisation of the ovum. For this reason presumably, the cap of the avian sperm is built of some strong material and is also pointed in shape. This cap persists on the sperm head inside the hen's oviduct even after the tail breaks of and this is further evidence that the cap has some definite function in the process of fertilisation.

Summary

Studies were undertaken to follow the morphological changes undergone by sperm of the following species during their sojourn from the testis to the ampulla—stallion, jack, ram, buck, buffalo, boar, rooster, turkey tom, drake and the male pigeon. The spermatozoa of all mammals studied could be easily distinguished from those of others by the shape of their heads which had distinctive features. The head of the mammlian sperm was broad in the on-flat view and flattened from side to side in the on-edge view. The spermatozoa of the birds studied were very similar in appearance and only differed in size. The avian sperm had a cylindrical head of uniform thickness tapering to a hard, needle-like process anteriorly. The head is attached by a very narrow, inconspicuous and apparently inflexible neck with the short connecting piece. The chief piece of the avian sperm was much longer than that of the mammalian sperm.

The cytoplasmic drop was found to be associated with the development of the sperm of the mammals studied. No structure analogous to the cytoplasmic drop could be detected on the avian sperm. The descent of the drop appeared to be controlled by internal factors like the ageing of sperm rather than by the epididymal secretions. Spermatozoa with posterior drops can be considered as physiologically mature and morphologicaly normal. Sperm with anterior drops should be considered as immature and abnormal.

The cytoplasmic cap was found on the spermatozoa of all the mammals studied being best developed in the boar. It can be very clearly demonstrated by differential staining. The anterior pointed process on the head of avian sperm can be taken to correspond to the cytoplasmic cap of mammalian sperm.

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NOCARDIOSIS *(ACTINOMYCOSIS)* IN A DOG

A PATHOLOGICAL AND BACTERIOLOGICAL STUDY

By

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Introduction

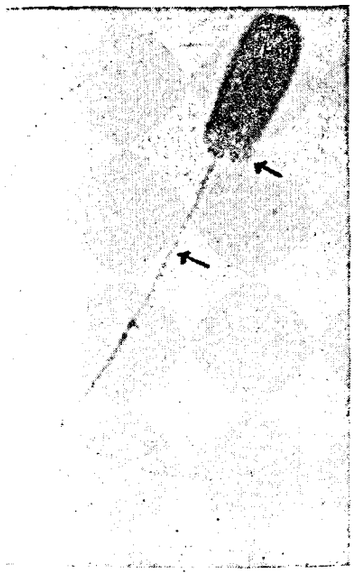
Actinomycosis in dogs has been reported by various workers. In most of them unfortunately diagnosis was based on incomplete examination.

There has been a great deal of confusion regarding classification and nomenclature of the actinomycetes. The various strains isolated from dogs have been designated in a variety of ways—*A. baudeti* (Brion, 1942); *A. bicolar* (Trollendier 1903); *A. canis* (Levy 1899); *Cladothrix canis* (Rabe 1888); *Nocardia canis* (Chalmers and Christopherson 1916); *Streptothrix canis* (Musgrave and Clegg, 1908); *Cladothrix asteroides* (Eppinger 1891). The organism isolated by Ginsberg and Little (1948) was considered identical with Eppinger's *Cladothrix asteroides*.

Studies on the Morphology and Development of the Spermatozoa of Farm Animals

By

Dr. C. Krishna Rao



Buck sperm from testis. Note filiform C.P. and drop surrounding neck.

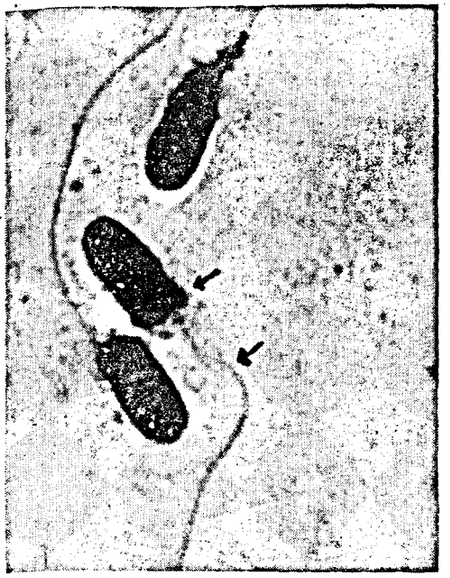
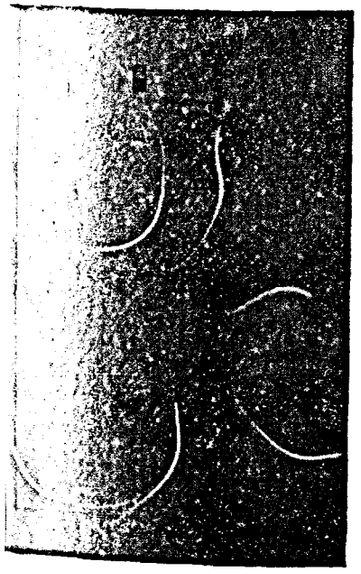


Fig. 2. Bore sperm from testis. Note filiform C.P. and drop surrounding neck.



Turkey sperm — negatively stained.

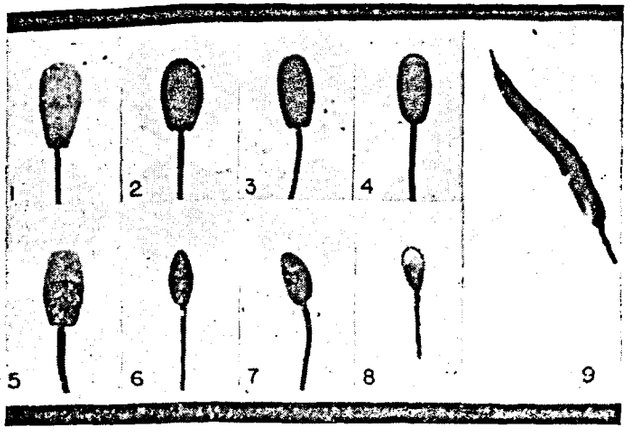


Fig. 4. Heads of spermatozoa of some farm animals and man. 1. Bull, 2. Ram, 3. Buck, 4. Barbary sheep, 5. Boar, 6 Stallion, 7. Jack, 8. Man, 9. Rooster.

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Nocardiosis (*Actinomycosis*) in a Dog — A Pathological and Bacteriological Study

By

B. Narasinga Rai and K. P. Chandrasekharan.

Fig. 2. Pus smear stained by Gram's method to show the organisms (Nocardia) in tangled filaments.

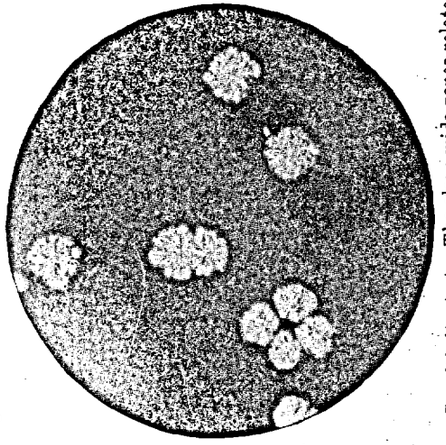

Fig. 4. Sensitivity test—The clear wide zones relate to Aureomycin and Terramycin.

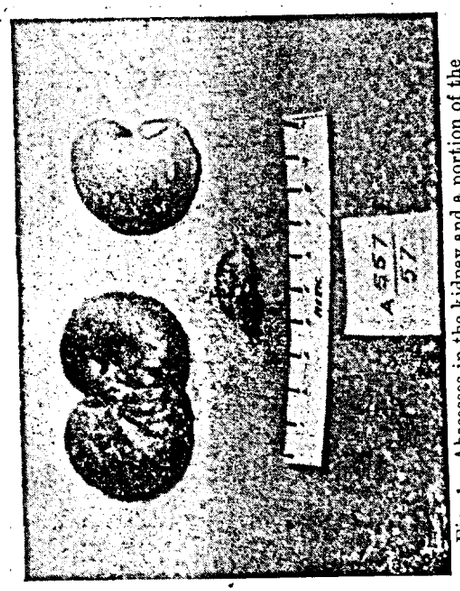

Fig. 1. Abscesses in the kidney and a portion of the suppurating bronchial lymph node

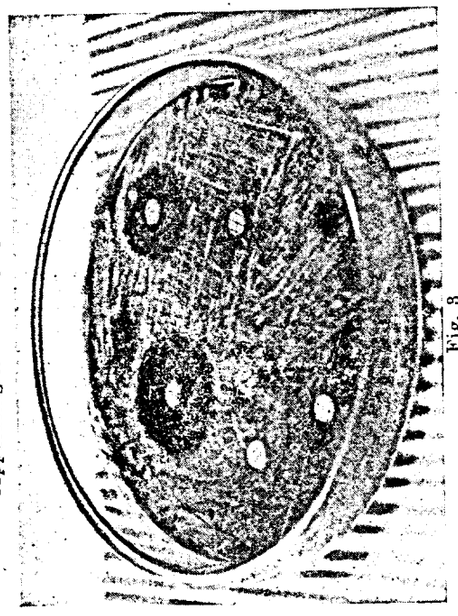

Fig. 3 Colonies of the organisms on nutrient agar.

The micro-organisms listed above would probably in the light of the present knowledge, belong to the family Actinomycetaceae, Buchnan (Waksman and Henrici 1943).

Cutaneous, subcutaneous and systemic actinomycosis in dogs have been reported occasionally. In the cutaneous form tumour-like growths have been described. Subcutaneous actinomycosis is in the form of a granulomatous condition eventually resulting in the formation of pus filled cavities (Baudet 1934); (Hartil 1901).

Thoracic actinomycosis has been recorded in dogs by many workers (Madsen 1942); (Martin 1942); (Schnelle 1929); (Torrance 1900); (White 1945). The important lesions encountered were broncho-pneumonia, pulmonary abscess and pleuritis. Abdominal actinomycosis has been seen involving the peritoneum and the abdominal viscera and has been described by some workers (Bader 1949); (Fieldman and Mann 1932); (Forsyth 1949); (Ginsberg and Little 1948); (Morant 1951).

Actinomycosis affecting the nervous system of dogs has also been described (Trolldenier 1903).

The present paper deals with a case of Actinomycosis in a dog. From the lesions an aerobic gram positive branching filamentous organism was isolated. It was thought appropriate to classify this organism under the genus Nocardia and the disease as Nocardiosis. The organism isolated resembled *N. asteroides* in many respects.

Case History:—Sheep dog—cross, male, aged 2 years, was admitted to the college canine clinic on 20-11-57 with the history that the animal was having hairless patches over the body, especially the abdominal region and that it had been suffering from pruritis for nearly six months. Physical examination showed mucopurulent discharge from eyes, congested visible mucous membranes and tenderness over the abdominal region. The appetite was poor and the temperature on 20-11-57—104·6°F. A clinical diagnosis of nephritis was made. The next day, the temperature rose to 105°F. though the condition remained unchanged. Haematological examination yielded the following data: R.B.Cs. 4·94 millions/cmm., W.B.Cs. 38,400/cmm., Differential count of white cells, Neutrophils 88% and lymphocytes 12%. The animal died on 22-11-57 and almost immediately the post-mortem was conducted.

Autopsy findings:—The carcase was emaciated and superficial lymph nodes, especially parotid and prescapular on either side appeared enlarged. Extensive hairless patches could be noticed on the under aspect of the abdomen, thigh, scrotum and inter-digital space. The enlarged lymph nodes did not reveal any abscess formation on incision. No mange mites could be detected on microscopical examination of scrapings from hairless patches on the skin.

In the lungs dark greyish consolidated areas, about 2—3 cms. in depth in each of the diaphragmatic lobe and a much larger area of consolidation involving the right apical lobe, were seen. Thin layer of fibrin covered these consolidated portions of lungs. Cut surface of affected lung was greyish red and a sanguino-purulent exudate obtained from the edge. In other portions of the lung multiple small haemorrhages were seen. The trachea at its bifurcation showed a fluctuating swelling about 4–5 cms. in diameter. On incision this was found to include the enlarged, indurated and suppurating bronchial lymph nodes. The purulent exudate was whitish yellow fairly thick and odourless. Both kidneys presented a number of yellowish white, of either pin head or slightly large sized abscesses. These were located in the cortex and none grossly detected in the medulla. (Fig. 1).

Smears of the exudate from the lesions were stained by Leishman's, Gram's, Ziehl-Neelsen's and modified Ziehl-Neelsen's methods to study the morphology of the organisms in tissues. Thin slices of affected tissues were fixed in 10% formalin for histopathological examinations. Sections were stained by Erhlich's acid haematoxylin and eosin, Gram-Weigert and Ziehl-Neelsen's methods.

Microscopical examination of gram stained smears from lesions in bronchial lymph nodes showed pus cells, reticulo-endothelial cells, lymphocytes, red blood cells, much cellular debris and numerous gram positive filamentous organisms (Nocardia—actinomyces) showing true dichotomous branching and short rods (Fig. 2). The organisms were extra cellular and there was marked beading evidently due to the darkly stained gram positive granules in the filamentous mass. Z. N. method showed the organism non-acid fast. Similar morphology of the organism was seen in the smears from kidney and lung lesions, the organisms being not so numerous in respect of the latter.

Histopathological examination :

Bronchial lymph nodes :—Sections revealed purulent centres, necrosis, hyperaemia and externally fibrosis. Patches of scarring and granulamatous area were also distributed in an irregular manner, the former occasionally seen joined by thick septa with the fibrous tissue on the outside. The fibrous septa formed at places an imperfect capsule for the suppurating areas. The nature of the change clearly indicated the chronicity of the lesion. Gram stained sections revealed branching filaments and occasional rods which appeared relatively small in size in the suppurating and necrotic portions of the node.

Kidney :—Unencapsulated recent abscesses some large through coalescence of smaller ones and located mostly in the cortical area and stray ones in the medullary portion were seen in sections. The inflammatory cells present in the lesion were mostly polymorphs and mononuclears ; many cells undergoing karyorrhexis were also seen in the area, where practically all the glomeruli and tubules have been destroyed. In the neighbourhood the tubules showed degenerative changes in the epithelium and infiltration with mononuclear cells in the interestitial tissue. Gram-Weigert stained section revealed dark violet stained masses of filaments which were branched at places and short and long or curved rods. The changes are indicative of recent haematogenous invasion of the organ.

Lungs :—Sections from consolidated areas revealed heavy infiltration with polymorphs, mononuclears and occasional lymphocytes and plasma cells. At many places dissolution of the alveolar wall has occurred, but in some other areas it was prominent with engorgment of the vessels and presented a beaded appearance. There was neither frank suppuration nor extensive necrosis. The bronchi, both large and small, were filled with exudates consisting of polymorphs, large mononuclears, erythrocytes, and desquamated epithelial cells. The wall of the bronchi showed acute inflammatory reaction, most of the vessels engorged and occasional ones showing extravasation. Heavy infiltration with polymorphs, mononuclear cells and occasional lymphocytes were seen. Most of the vessels, both large and small showed engorgment and the microscopic picture suggested a recent involvement of the lungs evidently from bronchial lymph nodes.

Bacteriological examination:—Materials were taken aseptically from the affected lymph nodes and from the kidney abscesses for detailed bacteriological examination.

Inoculations were made on Nutrient agar, blood agar and broth, incubated aerobically and anaerobically in a thermostat at 37°C. Minute visible colonies were found after 24 hours incubation in plates incubated aerobically. The colonies increased in size after 48 hours. They were flat 1–2 mm. in diameter, umbonate, surface granular, chalky white in colour, wrinkled. No growth occured under anaerobic conditions.

Smears made from the colonies revealed gram positive branching filaments and rods identical with those seen at the microscopic examination of the lesion smears. Smears from the colonies stained by Ziehl-Neelsen's method revealed acid fast filaments, rods and coccoid elements. Acid fastness was not uniform. There were non-acid fast filaments but majority of the rods and coccoid bodies were solidly acid fast. Smears from pus in the lesions revealed no acid fast filaments. The presence of the acid fast rods and branching filaments in the smears from cultures supported the supposition that infection was actinomycosis.

A detailed systematic study of the strain isolated was found necessary for a proper identification and accordingly studies were undertaken.

Morphology, staining characters and reproduction :—The pus in the lymph nodes and kidney abscesses did not reveal any 'sulphur granules' which is a constant feature of the specis *A. bovis*, Harz. Smears from the pus revealed gram positive long intertwining branching filaments, short rods and coccoid elements.

Pus smears from the lesion stained by Z.N. method did not reveal any acid fast filaments.

Smears from the culture on staining by Gram method revealed gram positive long filaments, some branching, some in short segments in the form of rods. Filaments showed intense staining and bulging at intervals. Smears from the culture stained by Ziehl-Neelsen method revealed acid fast and non-acid fast filaments. Acid fastness was not uniform. Acid fastness was maintained even in subcultures. The filaments showed granular bodies in them.

Reproduction was studied by the hanging drop preparation. An old culture containing numerous segments and coccoid bodies was inoculated into glucose broth, and incubated at 37°C. The culture was examined every 24 hours for 5 days. It was observed that the coccoid elements began to grow by developing short filaments, which on further incubation increased in length. True branching was noticed. The growth continued for about 5 days. Later the filaments began to break down giving off short segments in the form of rods and coccoid elements. The organism was non-motile.

Cultural characters:

Agar plate at 37°C. after 5 days. Fig. (3)	Good growth, colonies round, about 1-2 mm. in diameter, umbonate, granular surface, chalky white in colour, radially striated centre and a feathery edge. Consistency friable and emulsifiability difficult.
Nutrient broth at 37°C. after 5 days.	Good growth. Moderate granular sediment and thick white surface pellicle depressed at the centre. No turbidity. On shaking the sediment rises up and the pellicle does not easily disintegrate.
Blood agar at 37°C. after 5 days.	Colonies as on agar plates. No haemolysis. Colonies are compact and sink into the medium.

Dorset's egg. (Glycerinated and non-glycerinated).	Visible growth after 24 hours at 37°C. After 72 hours incubation at 37°C. there was a distinctive appreciable difference of growth in the two media, growth being abundant and profuse in the glycerinated medium.

Metabolism and growth requirements.—Grows aerobically and micro-aerobically. No growth anaerobically. Glucose and glycerine favourable for the growth of organism.

Biochemical reactions :—The strain isolated failed to attack any of the usual sugars. It did not produce Indole. It proved negative to M. R. and V. P. tests. In Koser's citrate medium there was growth. Nitrites were produced from nitrates. Slight H_2S was produced. Catalase positive ; L. M. no change except slight alkalinity after 4 days. In gelatin stab there was good surface growth but no liquefaction.

Resistance to heat and disinfectants :—Broth cultures on exposure to 60°C for 30 minutes destroyed the microorganisms. No growth occurred when the organism was cultivated in 0·5% phenol broth incubated at 37°C.

Susceptibility of the strain to antibiotics :—With a view to determine the sensitivity of the strain to the various antibiotics, a simple test was performed on blood agar plates using Bacto-sensitivity disks issued by the 'Difco' Laboratories. Highest concentration disks were used in the test. The test revealed that the strain was highly sensitive to *Aureomycin* and *Terramycin*, slightly to Chloromycetin but not susceptible to Dihydrostreptomycin, Polymyxin and Bacitracin (Fig. 4).

Discussion

Smears from the pus in the lesions of lymph glands and kidney abscesses did not reveal any acid fast organisms. The nature of the lesions and the presence of gram positive, branching, acid fast pleomorphic organisms in cultures indicated that the infection was Actinomycosis. Waksman and Henrici (1948) suggested a classification and nomenclature for members of the family Actinomycetaceae. They consider that strains growing under anaerobic conditions only should be classified under the genus Actinomyces and those growing under aerobic conditions to be classified in the genus Nocardia. Wilson & Miles (1955) are of the opinion that until an international agreement is reached regarding the classification and nomenclature of the members of the family Actinomycetaceae it would be wise to classify both aerobic and anaerobic species in the genus Actinomyces. They however feel that at a future date organisms growing under different environmental conditions will necessarily have to be classified in separate genera.

We observe that the classification suggested by Waksman and Henrici is convincing and appropriate in the light of our present knowledge of the members of the family Actinomycetaceae.

The strain isolated grew aerobically but not under anaerobic conditions. It is therefore considered to belong to the genus *Nocardia.*

Bergey (1848) lists a number of species of the genus Nocardia. These species differ from one another in certain characters like pigment formation, haemolytic activity, proteolytic activity, pathogenicity and in morphological, staining and physiological characters.

McGaughey (1952) in his review of actinomycosis in dogs since 1882 refers to the enormous difficulties encountered by workers in the isolation and proper identification of the organisms causing this condition. He also points out to the very little agreement among the workers as to the species involved in the causation of this condition.

Very few cases of Nocardiosis in dogs caused by *N. asteroides* have been recorded. Balozet and Pernot in 1936 claimed to have been the first to record the isolation and identification of *A.asteroides.* In 1946 Ginsberg and Little isolated an organism from a dog which they identified as *A.asteroides.* This they considered as the second recorded case of an *A.asteroides* infection in a dog. Christensen and Clifford in 1953 isolated an organism from a dog which they described as one identical with *A. asteroides* of Ginsberg and Little. Bohl *et al* in 1953 isolated an organism from a case of Nocardiosis in a dog and identified it as *N.asteroides.*

The strain isolated by the authors seems to be related to *N.asteroides* or *A.asteroides* (Wilson and Miles 1955) in its cultural and biochemical reactions but differs from the organism isolated by Bohl *et al* (1953) in its sensitivity to antibiotics.

Pathogenicity :—The strain isolated proved to be of low virulence to laboratory animals as it produced stray nodules in liver. The organisms could however be isolated in pure cultures from the lesions.

Summary

1. Literature on Actinomycosis in dogs has been reviewed.

2. Details of the bacteriological and pathological studies of a case of Nocardiosis (Actinomycosis) have been described.

3. Sensitivity of the micro-organism to various antibiotics has been studied and has been found to be susceptible to aureomycin and terramycin and slightly to chrloromycetin but not to Bacitracin and Polymyxin.

4. The taxonomic position of the organism isolated in the light of our present knowledge has been discussed and it is suggested that the disease may be treated as Nocardiosis and not as Actinomycosis.

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STUDIES ON THE AGE RESISTANCE AND RESISTANCE TO SUPERINFECTION OF POULTRY AGAINST *RALLIETINA CESTICILLUS* (MOLIN), WITH SOME OBSERVATIONS ON THE HOST SPECIFICITY OF THE PARASITE

By

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It has long been known that the presence of a single tapeworm of the species *Taenia saginata* or *T.solium* protects against additional infection (Chandler, 1932). Joyeux and Baer (1928) found that the presence of even one or two specimens of *Hymenolepis nana* in rats was sufficient to prevent further infection. Miller (1931) found that the presence of a large single *Cysticercus fasciolaris* in the liver of a rat prevented the development of additional cysts after artificial infection. He, however, showed that the presence of mature worms of the species *Taenia taeniaeformis* in the intestine of cats does not protect the host from subsequent infection.

Regarding *Raillietina cesticillus* Ackert and Reid (1937) demonstrated that the chickens 2½ to 5 months of age may be markedly more resistant to the viability and growth of the tapeworm than are younger fowls 1 to 2 months of age from the same flock. Luttermoser (1938) found that 6 to 12 weeks after receiving a relatively heavy infection of *R. cesticillus*, the young chickens apparently had acquired little or no resistance to reinfection. In the present paper the fate of superinfection of *R. cesticillus* of poultry has been dealt with. The age resistance of poultry to the infection of *R. cesticillus* and the host specificity of the parasite were also studied, the results of which are included in this paper. The abstract of this paper was published much earlier (Sinha and Srivastava, 1954).

Materials and methods.—Chicks were kept in controlled conditions in the laboratory. The cages were covered with muslin curtains and placed on trays containing water. The infective cysticercoids required for the experiment were raised in the laboratory. Dung beetles of species *Opatroides vicinus* were collected from areas away from the poultry farm and reared in the laboratory. These beetles were infected in the laboratory by feeding fresh gravid segments of *R. cesticillus*. The cysticercoids recovered from the dissected beetles were pooled in normal saline before giving infection to several birds at a time. The cysticercoids were given to the birds in gelatine capsules. The gravid segments passed by the infected birds were collected twice in 24 hours from the

tray below the cages and counted. The number of segments passed by a bird in 24 hours was the criterion of the amount of infection present in a bird.

Experiments and observations :—Two experiments were performed to see the fate of a superinfection. In one experiment with five 2 week old birds, three were experimental and two were control. A primary infection was given to the three birds with 8 cysticercoids each. After one month when the birds were passing segments more or less uniformly, a super infection of 200 cysticercoids each was given to all the three experimental birds and the two control birds. After ten days from the date of superinfection all the birds were sacrificed and the worms counted. The worms developed from the primary infection was easily distinguishable from those developed from the superinfection, by their size and state of development. It was found that while the number of worms developed from the primary infection were 4, 6 and 4 in the three experimental birds, that developed from the superinfection was 36, 89 and 50 respectively. Only 30 and 40 worms developed in the control birds.

In another experiment five 2 week old birds were taken, out of which three were experimental and two control. The experimental birds were given 4 cysticercoids to one and 2 each to the other two birds to produce a primary infection. After about a month when the birds were passing segments more or less uniformly a superinfection of 100 cysticercoids each was given to all the three experimental birds and the control birds. The passage of segments after three weeks from the date of superinfection to the experimental birds was compared with the passage of segments of the control birds. The results are given in the annexed table.

Three experiments were performed to find out the age resistance of poultry against *R. cesticillus*. A batch of five birds 4 to 6 months old developed no infection even after feeding with 68 cysticercoids each. In another experiment a batch of four birds 10 to 12 week old (No. 1. 10 weeks, No. 2. 11 weeks, No. 3. 11 weeks and No. 4. 12 weeks) were given 30 cysticercoids each. Only one worm developed in the 10 week old bird. Eleven and 12 weeks old birds were not susceptible to infection. Cysticercoids from all the lots developed in control chickens.

Two birds each from five species of common birds *e.g.*, sparrow, " Gulguchia " or " Salikh " (*Acridotheris tristis*), dove, pigeon and duck were infected with more than hundred cysticercoids each to study the host specificity of the cestode. No worm developed in any of them. White rats were also negative to experimental infection. Cysticercoids from the same lots developed in control chickens.

Table showing daily segment production before and after the superinfection.

No. of chicks	4786	2189	1716	2966	3694
No. of cysticercoids given as primary infection	4	2	2	nil	nil
No. of days from the day of primary infection	Number of segments passed in twentyfour hours.				
10	nil	nil	nil	nil	nil
11	,,	,,	,,	,,	,,
12	,,	1	,,	,,	,,
13	2	3	1	,,	,,
14	6	4	2	,,	,,
15	11	6	5	,,	,,
16	20	10	8	,,	,,
17	28	18	12	,,	,,
18	30	15	12	,,	,,
19	31	19	14	,,	,,
20	32	16	11	,,	,,
21	36	18	13	,,	,,
22	34	13	10	,,	,,
23	29	17	9	,,	,,
24	31	19	12	,,	,,
25	26	15	11	,,	,,
26	28	14	13	,,	,,
27	19	17	13	,,	,,
28	25	18	12	,,	,,
29	28	16	11	,,	,,
One hundred cysticercoids given to each of the five birds as superinfection.					
30	31	16	18	,,	,,
31	30	17	13	,,	,,
32	34	15	10	,,	,,
33	29	15	11	,,	,,
34	18*	17	10	,,	,,
35	7	14	9	,,	,,
36	10	16	12	,,	,,
37	9	17	11	,,	,,
38	10	19	9	,,	,,
39	9	13	9	,,	,,
40	9	10	7	4	,,
41	11	13	10	20	,,
42	14	18	19	40	1
43	30	25	27	46	16
44	41	33	40	59	30
45	50	46	53	70	56
46	65	49	89	77	63
47	70	70	112	69	60
48	78	68	100	72	83
49	70	76	106	57	95
50	85	73	110	49	100
51	82	65	93	65	105
52	80	61	73	74	79
53	75	70	80	60	56
54	61	76*	75	68	82
55	56	30	68	63	67
56	68	25	74	53	75
57	61	20	65*	57	58
58	50	23	25	67	60
59	45	27	27	54	63
60	40	31	34	49	58

* Pieces of strobilae were shed.

Discussion

It is observed that the number of worms developed in the experimental birds out of the superinfection were more or less same as the number of worms developed in the control birds having no primary infection. Again it is found in the second experiment that the increase in the number of segments in the experimental birds due to superinfection were more or less similar to the number of segments passed by the control birds which had no primary infection. Thus it appears that small primary infection does not produce any immunity against large superinfection. Similar results were obtained by Luttermoser (1938), who determined this only by the presence of original terminal segment.

The experiments on the age resistance show that fowls develop age resistance against *R. cesticillus* at the age of 11 to 12 weeks. Age resistance was also recorded by Acker and Reid (1937) in the birds of 2½ to 5 months.

Although *R. cesticillus* develop in a number of species of beetles as their intermediate host, it is strictly host specific regarding its definitive host. Other birds therefore do not act as carriers of infection of *R. cesticillus*.

Summary

It has been confirmed that primary infection does not produce any immunity against superinfection of *R. cesticillus*

2. The fowls developed age resistance against *R. cesticillus* at the age of 11 to 12 weeks.

3. Some common birds like sparrow, dove, pigeon and duck did not take any experimental infection of *R. cesticillus*, which shows that the tapeworm is strictly host specific.

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PARASITES OF DOMESTIC CATS (*FELIS CATUS*) IN MADRAS*

By

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Though details about the parasites of cats in Calcutta is available as a result of the helminthological observations made by Chandler (1925), not much information is available on the nature and extent of parasitic infection in this domestic animal in Madras beyond that found in the check-list of parasites in Madras Veterinary College laboratory (Mudaliar and Alwar, 1947); even that was not the result of a systematic survey either. A regular investigation was therefore taken up in order to obtain precise information on the frequency of incidence, intensity of infection and the pathogenesis of the parasitic fauna in cats.

Fifty cats of both sexes and of different ages either brought to the Madras Veterinary College hospital for euthanasia or secured from markets for experimental physiology demonstration classes formed the material for the study.

Results of examination

The results of the survey are tabulated hereunder. The intensity of infection is classified as light, moderate and heavy. These terms indicate parasitisation by the number of parasites ranging from 1 to 10, 11 to 30 and 30 and more respectively.

Name of the parasite	Location	Number infected	Intensity of infection		
			Light	Moderate	Heavy
Heterophyes heterophyes	Small intestine	1	—	1	—
Dipylidium caninum	do.	4	2	1	1
D. catus	do.	1	—	1	—
Diplopylidium nolleri	do.	13	4	6	3
Joyeuxiella pasqualei	do.	10	8	2	—
Taenia taeniaeformis	do.	14	14	—	—
Toxocara mystax	do.	9	8	—	1
Capillaria sp.	Bladder	1	1	—	—
Strongyloides stercoralis	Small intestine	1	1	—	—
Ancylostoma braziliense	do. & lungs	22	15	3	4
A. caninum	Small intestine	7	6	1	—
Vogeloides ramanujacharii	Lungs	12	10	2	—
Cylicospirura subaequalis	Stomach	3	3	—	—
Rictularia cahirensis	Small intestine	3	1	2	—
Physaleptera praeputialis	Stomach	18	10	4	4
Gnathostoma spinigerum	do.	1	1	—	—
Ctenocephalides felis	Skin	24	17	3	4
Felicola subrostratus	do.	3	3	—	—
Haemophysalis bispinosa	do.	3	3	—	—
Boophilus australis	do.	1	1	—	—
Otodectes cynotis	Ear	3	3	—	—
Isospora felis	Small intestine	7	7	—	—
I. rivolta	do.	2	2	—	—

* Read at the Medical and Veterinary Section of the 45th session of Indian Science Congress, 1958.

Discussion

Out of the 50 cats, 18% were found free from parasites and all of them were kittens. All the adults except one were found parasitised. The number of species of helminths, arthropods and protozoan parasites encountered during the investigation were 16, 5 and 2 respectively. 14% of the cats harboured only one species of parasites, 18% revealed two species and the rest were found infected with 3 to 9 species.

Among the helminths *Ancylostoma braziliense* was found to be the most common infecting 44% of cats and 18% of them harboured *A.caninum* also. The post-mortem examination especially in heavy infections revealed the typical picture of ancylostomiasis—poor condition, anaemic changes and haemorrhagic enteritis. In all the affected cats the intestinal mucosa round about the attachment of the worms showed haemorrhagic inflammation. Mature *A. braziliense* were recovered from the lungs also of 4 cats. This find was puzzling since all precautions were taken to avoid contamination. It was interesting to note that Chandler (1925) recorded *A.braziliense* in 70% of Calcutta cats and the complete absence of *A.caninum.* in them.

Vogeloides ramanujacharii, a new species of lung worm, was found in 24% of the cats. This happened to be the first record of a lung-worm in cats in India. It was surprising to note that *Anafilaroides rostratus*, the most common lung worm of adult cats in Ceylon (Seneviratna, 1955) was not met with even in a single instance.

Cylicospirura subaequalis and *Rictularia cahirensis* were recovered for the first time from cats in Madras even though the former was recorded earlier from a tiger and *Rictularia mjobergi* was collected from a dog, a cat and a cat-bear (Mudaliar 1943; Mudaliar and Alwar, 1947). While no appreciable damage to the gastric mucosa caused by *C.subaequalis* was observed, intestinal catarrh was evident in the infection by *R.cahirensis*. Only six per cent of the cats were found infected with *R.cahirensis* in Madras, while Srivastava (1940) found 75% of the cats infected in U.P. The incidence of *C.subaequalis* in cats in Madras did not vary much from that found in Calcutta.

Only one out of 50 cats was found to harbour *Gnathostoma spinigerum* in this survey. This is in contrast to the observation of Chandler (1925) in Calcutta, who recorded this highly pathogenic helminth in 11 out of 35 cats.

Though 36% of cats harboured *Physaloptera praeputialis* and 18% had *Toxocara mystax*, only in heavy infections erosions and mild catarrh of mucosa were noticed. These infection rates varied from respectively those of 3% and 63% recorded in Calcutta (Chandler 1925).

Only 2% of cats were found to harbour *Strongyloides stercoralis* in our studies while 20% of cats in Calcutta revealed this infection (Chandler, 1925).

Diplopylidium nolleri and *Joyeuxiella pasqualei* were found to be more common than *Dipylidium caninum*. 14% of the cats had the combined infection of *Diplopylidium* and *Joyexiella*. Though the frequency of incidence of *Taenia taeniaeformis* was the maximum among the cestodes, the infection was always very light. Chronic catarrhal enterities caused by the tapeworms was noticeable depending upon the severity of infection. In heavy infections, the carcases presented an unthrifty appearance. The comparative low incidence of *D. caninum* was similar to that observed by Moghe who found only 2 infections in about 40 cates in Nagpur, but differed from that of Chandler (1925) who noticed the helminths in 43% of cats in Calcutta.

Heteropyes heteropyes was recovered from only one kitten secured from the market and the number of cats got from that source was not considerable. One can expect to find a larger percentage of them infected with this trematode, since the animals have a greater access to raw fish. The only other record of this fluke in Madras was in dogs (Rao and Ayyar, 1932). As this trematode is of zoonotic importance, it is worthwhile that a detailed investigation into its exact incidence in animals as well as in human beings and into its life history is taken up. No cat was found to harbour *Opisthorchis felineus*, the commonest parasite of cats in Calcutta were the infection rate was over 60% (Chandler, 1925).

Among the arthropod infestations *Ctenocephalides felis* was seen in a maximum number of cats.

Isospora felis was found in adults and kittens as well and was more common than *I. rivolta*. While only 7 out of 50 cats revealed coccidial infection in this survey, knowles and Das Gupta (1934) found 14 out of 21 cats infected in Calcutta and Rao and Hiragauder (1952) found the infection in 50% of the cases. No apparent pathological changes were noticed in intestines as the infection was mild.

Summary

Almost all the adult cats were found parasitised, while some of the kittens were free from infection. The number of species, of helminths, arthropods and protozoan parasites encountered in the survey were 16, 5 and 2 respectively.

Heterophyes heterophyes, *Dipylidium catus*, *Strongyloides stercoralis*, *Capillaria* sp., *Cylicospirura subaequalis*, *Rictularia cahirensis* and *Felicola subrostratus* were recorded for the first time in cats in Madras.

Vogeloides ramanujacharii, a new species of lung worm was found infecting a large number of cats.

The frequency, intensity and pathogenesis of the infections were studied.

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THE POLL GLANDS IN CAMEL

By

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The Poll Glands are present only in camels and absent in other domestic animals. As there is no detailed description available, the authors, therefore, decided to conduct a complete and thorough study of these glands. Materials from ten discarded camels were collected and gross and microscopic studies were made.

Leese (1) in 1927 stated that the Poll Glands in a camel are found only in the male, in which they are situated in the skin below the apex of the head on the back of the poll.

These glands in a camel are two large cutaneous glands. Each gland is broader at the base (towards head) and narrower at the apex. The poll glands are found only in the male, in which sex they are detectable from very early age. In the adult these are situated in the skin about two inches below the apex of the head, on the back of the poll, on each side of the midline. Each gland is about 3·6" long, 3" wide and 1·6" thick, differing from the surrounding skin in being slightly elevated, black in colour and carrying comparatively a few haris (Fig. No. 1). These glands have many excretory pores. In the male during rutting season their secretion which is of brownish tinge and offensive odour is much augmented, so that it often runs down the neck. During hot weather or when the animal is put to hard work it begins to sweat visibly from these glands first of all.

The sweat glands are simple coiled tubular glands, while each poll gland is in reality an aggregation of a number of compound tubulo-alveolar glands and resembles somewhat the mammary glands in the microscopic appearance. The two lobes are separated and surrounded by a thick layer of connective tissue. From the periglandular connective tissue thin bands pass in between the lobules (inter-lobular septa) and from interlobular septa delicate strands of connective tissue extend into the lobules where they act as support for the glandular structure proper. The lobules finally terminate into alveoli. The secretion of the poll glands is poured into the lumen of the alveoli, from where it is carried to the surface through duct system. From the alveoli the excretory ducts run a straight or oblique course through dermis, and enter epidermis; where they open into minute pits, the excretory pores between the tuft or hair follicles. The secretory portion of the glands, *viz:* the alveoli are lined with a simple columnar or low cuboidal epithelium, the height varying with the activity of the cells. The nuclei are round

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Poll Glands in Camel

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Fig. 1
P. Poll glands of a camel.

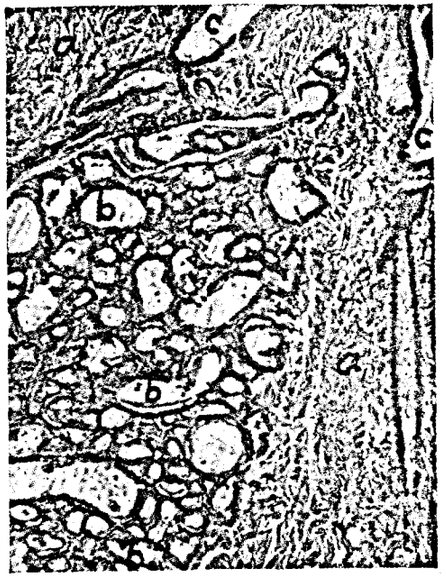

Fig. 2
Photomicrograph of the inactive pollglands.
a. Interlobular connective Tissue.
b. Inactive alveoli lined by low cuboidal epithelium.
c. Excretory ducts lined by stratified cuboidal epithelium 270 X.

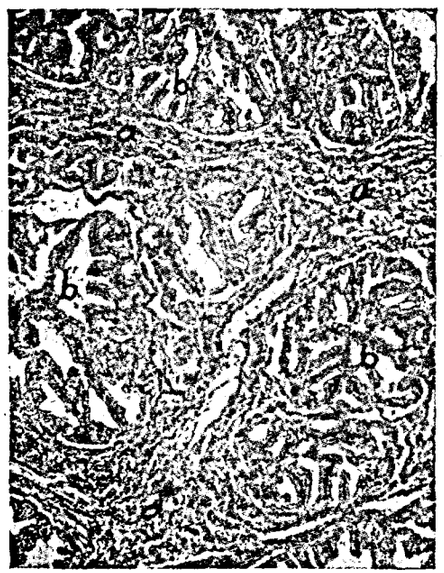

Fig 3. Photo Micrograph of active pollglands
a. Interlobular connective tissue
b. Active alveoli lined by tall simple columnar epithelium 270 X.

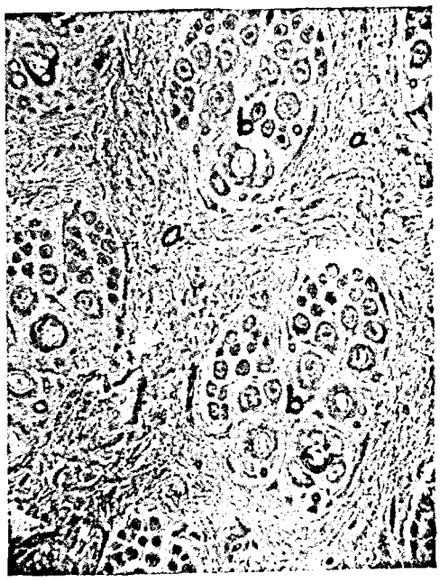

Fig. 4. Photo Micrograph of the hair follicles.
a. Connective tissue between the groups of hair follicles.
b. Hair follicles in groups 80 X.

Our Men on the March

(See News and Views)

Dr. O. SUNDARARAMA REDDI, B.V.Sc., Ph.D.

Dr. D. K. DESAI, G.B.V.C., D.V.M. (Toronto), M.R.C.V.S.

Dr. C. F. MATANEY, G.B.V.C., M.Sc., Ph.D.

Shri PREM NATH SHARMA, L.V.P.

or oval and stain deeply and are located at the base of the cells. The protoplasm of the cells contain secretory granules.

Similar to the ducts of the sweat glands, the walls of the ducts of the poll glands are also lined with stratified cuboidal epithelium, resting upon a delicate basement membrane. On reaching the epidermis the duct loses its own wall and becomes a mere channel through the epidermis.

The Inactive Poll Glands.—The poll glands upto the advent of puberty and between the period of rutting seasons are inactive and consist mainly of connective tissue and scattered groups of lobules and alveoli (Fig. No. 2).

The interlobular connective tissue, which forms the bulk of the glands during this inactive stage, consists of a rather densely arranged collagenous fibres and only few elastic ones.

The Active Polls Glands.—Throughout rutting season, *i.e.*, winter, these glands are under extensive developmental changes. The microscopic appearance now differs greatly from that of the inactive glands. The previously abundant connective tissue becomes reduced to thin septa (Fig. No. 3) which encloses large lobules. The alveoli are spherical, ovoid or irregular in shape and vary considerably in size. During this active condition they are lined by a single layer of tall columnar cells which rest on a homogenous basement membrane and are thrown into folds in the lumen. The general structure of these alveoli at this stage resembles that of active mammary glands, and not at all that of sweat gland.

This kind of proliferation during the rutting season with the increase in size of alveoli and decrease in connective tissue indicates that these glands in addition to the secretion of sweat also secrete some unknown substances of a male character for which one has to conduct a detailed study.

The Skin of the Poll Glands

The skin which covers the poll glands is rather thin. It consists of two main parts.

(1) Epidermis and Dermis

The epidermis which is composed of stratified squamous epithelium is very thin, and has the following four sublayers :—

(i) Stratum germinativum, (ii) Stratum granulosum, (iii) Stratum Lucidum (iv) Stratum Corneum.

(1) *The Stratum germinativum* is composed of a number of cell layers. The nuclei are ovoid or round.

(2) *The Stratum Granulosum* consists of one to two rows of flattened cells. The protoplasm contains deeply staining granules.

(3) *The Stratum lucidum* appears as a homogenous translucent band in which cell boundaries are difficult to make out.

(4) *The Stratum corneum* is very thick and is composed of scale-like cells, containing horny plates; appearing as homogenous pinkish mass when stained with Haemotoxylin and Eosin stains.

Dermis The dermis is composed of dense irregularly arranged connective tissue in which the collagenous fibres predominate.

As the arrangement of hair in this region is in bundles and not uniform, therefore, the hair follicles appear in groups with lot of connective tissue in between (Fig. No. 4).

The Sebaceous Glands These are branched alveolar glands, spherical or ovoid in shape. The alveoli are filled with stratified cuboidal epithelium. These sebaceous glands are closely related to hair follicles. These glands lie in derma, and their excretory ducts open into the neck of the hair sacks. The general structure of sebaceous glands is similar to other domestic animals.

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Clinical Article

CERVICAL CHOKE IN A HORSE

By

JOSE B. ARAÑEZ, D.V.M., M.S.

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History of the Case :—On March 29, 1958, a 6-year-old grey native mare about 51 inches tall for draft purposes was presented for treatment. According to the owner, the mare was choked since the animal was liberally fed with chopped green fruit of jackfruit (*Artocarpus integrifolia*) six days ago. The horse was observed to be restless with partial anorexia, and when given grass or water it was regurgitated through the nose. Salivation, coughing, and swelling at the lower left anterior one-third of the neck were likewise noticed. Numerous attempts of the owner to massage the obstruction downward or upward the oesophagus were all in vain. Water given frequently to the mare for six days failed to soften or dislodge the foreign body.

Symptoms :—Close examination of the mare on the sixth day revealed the following symptoms: respiratory rate, 30; pulse rate, 50; and temperature, 38·2°C. A hard, immovable and painful swelling at the left side of the neck approximately below the junction of the third and fourth cervical vertebra, dorso-lateral to the trachea, about the size of a hen's egg was noticed on palpation. Exploratory puncture of the foreign body by a 19-gauge hypodermic needle revealed a hard mass. Massage of the swelling induced retching, arching of the neck with the nose drawn toward the chest, and spasmodic contractions of the oesophagus. The mare was unable to eat. Polydipsia was marked, but the swallowed water was immediately returned through the nose. Vain efforts at swallowing with gulping movements, fetid and profuse salivation, occasional coughing and dyspnoea, loss of condition and pronounced weakness were noted.

Diagnosis :—From the nature of the history and all the symptoms observed, this was a serious case of cervical choke.

Treatment :—The mare was properly restrained. A rubber stomach tube was inserted through the left nose. About 50 cubic centimeters of cocoanut oil was poured through the rubber stomach tube as lubricant. Pushing of the stomach tube downward in the esophagus failed to soften or dislodge the foreign body. The above procedure was repeated three times within one hour with discouraging results. The mare was then

injected subcutaneously with 1/4 grain of arecoline hydrobromide in 5 cubic centimeters of distilled water at 6 p.m. The next morning after preparing the instruments, drugs, and other equipment for esophagotomy, the horse was led out of the stable and to my surprise she drank plenty of water and ate abundant grass. Palpation at the original site of the foreign body revealed the absence of the obstruction. Due to the possibility of an injury to the mucosa of the esophagus by the foreign body, 1,200,000 units of penicillin was injected intramuscularly. Tetanus antitoxin, 3,000 units, was prescribed to be given intramuscularly. The owner was advised to give 1 : 2000 aqueous solution of potassium permanganate for drinking for one week. Five hundred cubic centimeters of 5 per cent dextrose in physiological saline solution was also given intravenously. The recovery of the mare was rapid thereafter.

Conclusion.—The possible injury to the esophagus by the foreign body, progressive loss of condition and vigor resulting in marked emaciation and weakness would have been minimized without endangering the life of the mare had the owner called a veterinarian earlier. It is worthwhile to mention in this article that the prognosis of complete cervical choke in horses is more favourable than in cattle because of the dangerous complication of gastric tympany in the latter. In another 10-year-old chestnut native mare which died twelve days after the lodgment of the foreign body at the cervical part of the esophagus, the removed foreign body was a chopped ear of corn. It is doubtful whether cattle suffering from complete cervical choke will ever live one-half that long.

Abstracts

Pleuropneumonia-like Organisms and Respiratory Diseases of Poultry.—By H. P. Chu, *The Veterinary Record*, Vol. 70, No 3, January, 1958.

The presence of Pleuropneumonia-like organisms in Poultry and their possible association with respiratory infection was suspected as early as 1936 by Nelson when he described a type of fowl Coryza caused by a Coccoleacilliform body which has many similarities to pleuropneumonia-like organisms. Later on in 1945, other workers reported to isolation of a pleuropneumonia—like organism from embryonated eggs during the passage of a pneumonia virus. The organisms produced haemagglutination which was inhibited by sera from a high proportion of hens in the hatchery providing the eggs. Subsequently in 1952, other workers confirmed the finding of this group of organisms in chronic respiratory disease of chickens and infectious sinusitis of turkeys. The other important points stressed by the author are (1) PPLO isolated from chickens suffering from chronic respiratory disease and turkeys affected with Sinusitis, as well as those isolated from Pigeons and Pheasants, are indistinguishable by cultural, morphological, biochemical, serological and Pathological methods. (2) PPLO or Chronic respiratory disease agents have been shown to be transmissible through the eggs of infected hens. (3) PPLO isolated from chronic respiratory disease were shown to be susceptible *in vitro* to the action of a number of antibiotics, including streptomycin, oxytetracycline and chlortetracycline, but treatment of outbreaks of chronic respiratory disease with these antibiotics have been rather disappointing. (4) A haemagglutination-inhibition test and a slide agglutination test using PPLO as antigen have been developed for the detection of chronic respiratory disease in flocks of chickens. (5) PPLO have been isolated not only from chickens suffering from chronic respiratory diseases, but also from those affected by practically all kinds of respiratory infections, e.g., infectious laryngotracheitis, infectious bronchitis and even acute New castle disease, and also from some apparently normal chickens. However, this does not necessarily mean that PPLO are only innocuous commensal organisms ; it shows that the role PPLO play in respiratory disease is not as straightforward as has been currently suggested.

A. Mukerji.

The Effect of High Levels of Vitamins on the Susceptibility of Chickens to Salmonella Gallinarum Infection.—By L. G. Chubb, R. F. Gordon and J. F. Tucker. *The British Veterinary Journal.* Vol. 114. No. 2, February 1958.

The effect of feeding high levels of all the required Vitamins on the susceptibility of three breeds of chickens to experimental *Salm gallinarum* infection has been investigated. Apart from one experiment, neither the administration of high levels of all the required vitamins in the diet for four weeks prior to infection or at infection had any effect on the average survival time or total mortality in 8-week-old Rhode Island Red or Brown Leghorn Chickens. The separation of the vitamins into the fat-soluble or water-soluble groups and their administration in the diet at high levels for four weeks prior to infection had no effect on the average survival time or total mortality in Rhode Island Red or Brown Leghorn chickens. With white Leghorn chickens infected with *Salm gallinarum* a great variation in response to the high level feeding of Vitamins was encountered. Some results would suggest that the feeding of high levels of Vitamins for four weeks prior to infection may increase the susceptibility of this breed to *Salm gallinarum* and this may possibly be associated with the fat-soluble group (A, D, E & K). The problems associated with investigations into the inter-relationship of nutrition and disease and some of the variables encountered in experiments with Poultry are discussed.

A. Mukerji.

Chlortetracycline as a Preventative of Vibrionic Abortion of Sheep.—By F. W. Frank, L. H. Scrivner, J. W. Bailey, W. A. Meinershagen. *Journal of the American Veterinary Medical Association.* Vol. 132, No. 1. January, 1958.

Vibrionic abortion of sheep is an acute infectious disease characterized by abortion during the last half of the gestation period. It has been demonstrated that ewes which abort as a result of the infection are immune for at least one year. This immunity may, in part, account for the absence of recurrence of the disease on the same premises in successive years. The knowledge that immunity results from natural infection suggests that a vaccine might be the cheapest and most effective method of prevention. However, no vaccine is available. Field trials have been described in which single injections of various antibiotics failed to alter the course of abortion outbreaks, even though normal sheep given comparable amounts of the antibiotics developed serum levels which would inhibit the organism. As a preliminary step toward finding measures to control established field infections, this study was undertaken to determine whether the continuous feeding of Chlortetracycline to ewes in late pregnancy would prevent Vibrionic abortion. Accordingly, 60 ewes were allotted to three groups of 20 each and inoculated with *Vibrio foetus* — infective tissues. Twelve days earlier, ewes in two of the lots had been placed continuously on feed containing different levels of the antibiotic, computated as a daily average of 0·71 mg. per pound in lot 3. The actual levels which each ewe received daily, as revealed by assays of the treated feeds, was 0·45 mg. per pound of body weight in lot 2 and 2·9 mg. per pound in lot 3. Eleven abortions occurred among 18 untreated pregnant ewes in lot 1 (61%), three abortions occurred among 17 pregnant ewes in lot 2 (18%), and two abortions occurred among 20 pregnant ewes in lot 3 (10%). Statistically, both levels of Chlortetracycline, when fed continuously, resulted in a highly significant reduction in the abortion rate due to vibrionic infection.

A. Mukerji.

News and Views

Dr. O. Sundarama Reddi, B.V.Sc., Ph.D.—A product of the Madras Veterinary College, he took his Ph.D., degree in Animal Genetics at the University of Madras. His thesis dealt with the problem of Colour determination and inheritance in South Indian Cattle, especially the Kangayams. He worked under Dr. M. Dharmarajan, Professor of Animal Genetics, Madras Veterinary College. Dr. Reddi is now a Lecturer in Animal Husbandry at the Agricultural College of the Osmania University.

Dr. D. K. Desai, G.B.V.C., D.V.M. (Toronto), M.R.C.V.S.—A product of the Bombay Veterinary College, he went to the United Kingdom and Ireland under the auspices of the Veterinary Education Trust, and after having worked at several Laboratories and Institutions, he got himself qualified for the D.V.M. of Toronto (Canada) and is now a Registered Member of the Royal College of Veterinary Surgeons. He has had varied experience having worked at Baroda, New Delhi, Manjri Stud Farm, and British East Africa. He has been seconded to the Government of the Republic of Sudan by the Government of India to work as a Livestock Officer, Department of Animal Production, for 3 years from 1956 and is expected back in India soon.

* * * *

Dr. C. F. Mataney, G.B.V.C., M.Sc., Ph.D.—Again a product of the Bombay Veterinary College, he went to the U.S.A., in 1951 and got an Assistantship from the University of Minnesota for higher studies in Bacteriology. He got his degrees of M.Sc., and Ph.D., from the University of Minnesota. He returns to India shortly to take up the post of Research Officer (Disease Investigation) at the I.V.R.I., Mukteswar.

* * * *

Shri Prem Nath Sharma, L.V.P.—Assistant Animal Husbandry Officer, Himachal Pradesh, proceeded to Canada in September 1957 under the Colombo Plan. He is now studying at the Poultry Division, Ontario Agricultural College, Guleph, under the guidance of Prof. J. R. Cavres. He is expected back in India soon.

* * * *

Have it always in view.—Addressing a mammoth gathering at Tiruchur in Kerala on the 26th April 1958, Mr. Nehru emphasised the importance of sticking to India's traditional ideals of moral, ethical and spiritual aims of life while working for material prosperity. Pointing out that those ideals had made for the strength and vitality of India, which it represented for centuries, Mr. Nehru asked whether if they were to give up those ideals for the sake of material prosperity, it would not be too great a price to pay.

* * * *

No Retirement.—"But there is no retirement for me" declared Mr. Nehru at Tiruchur." I believe, even at present, I have some strength and energy left in me. I have still fire in me. I want to share that energy, strength, vitality and fire with the youth of the land. I want you to take that living flame and keep it alive even after my generation passes away. Before we go we want to do as much as we can." What an ideal for others to follow, in whatever humble walk of life they find themselves!

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.]

THE UTILISATION OF BAGGASE IN GOSADANS

By

S. K. Ranjhan and C. P. Singh,

U.P. College of Veterinary Science and Animal Husbandry, Mathura.

In the progressive parts of the world, where dairying is considerably advanced, low yielding or otherwise unprofitable cows are usually removed by slaughter. So only the high producing cows are maintained for dairy Industry—a procedure which not only effects considerable economy in the production of milk but also saves fodders and other feeding stuffs for useful stocks. In India, due to religious sentiments it has not been possible to eliminate the unprofitable stock by similar method. The matter has further been complicated by recent legislation prohibiting the slaughter of cows in most of the States. As a result of this legislation there has been a considerable strain on the fodder resources of the country which is already short by about 50 percent in Roughages and 75 percent in concentrates.

Having considered the various circumstances and opinions prevailing in the country regarding the disposal of useless cattle, the Indian Council of Agricultural Research, of late, has financed and organised the well known scheme, known as GOSADANS, where useless cattle are preserved till they die a natural death, a method which does not go against the sentiment of the people of our land. Although the scheme has been conceived in a superb manner, even then, it is undoubtedly a taxation on the lean fodder resources of the country. Because even in these *GOSADANS* the animals cannot be maintained without food, the cheapest of which is straw. But even the price of straw in recent years, has also gone very high as compared to their nutritive value. This appears to be a tremendous burden on the financial resources of the various State Governments. The problem, therefore, is was to maintain these unprofitable animals at a nominal cost.

With a view to utilizing stuffs, that are usually not fed to cattle but otherwise available in great abundance and are a sort of waste materials in sugar factories, a procedure may be followed for the manufacture of a feed by mixing one part of baggase, screenings with two parts of molasses (Baggomolasses). Such a method has already been adopted on a commercial scale in one of the sugar factories in Northern India and is

sold under the trade name ' Meetha chara '. The authors had the opportunity to test the food value of this stuff at the U.P. College of Veterinary Science and Animal Husbandry.

Meetha Chara as a feed for cattle

In order to determine the palatability of Meetha chara to cattle of various description, a number of experiments was conducted. The details of which are given below.

Consumption of Meetha chara.—Experiments were conducted on four groups of animals with ' Meetha chara ' for a period of about 1½ months. Four categories of animals were included in the experiment.

(*a*) Under fed adult animals.

(*b*) Pregnant adult animals (early pregnancy).

(*c*) Growing Animals (Late growth).

(*d*) Actively growing animals.

In each group two identical animals were taken for experiment They were fed concentrate mixture according to their requirement. The data on the consumption of ' Meetha chara ' are shown below in the following table.

TABLE I

*Consumption of Meetha Chara in Kilograms.**

Particulars	Under fed animals		Pregnant animals (early pregnancy)		Growing animals (late Growth)		Growing animals (Active Growth)	
	Animal No. 1	No. 2	Animal No. 1	No. 2	Animal No. 1	No. 2	Animal No. 1	No. 2
First Thirteen days average	4·8	4·4 (4·6)	4·4	4·0 (4·2)	4·0	5·3 (5·1)	4·0	3·0 (3·5)
Second ten days average	5·1	3·8 (4·5)	4·8	3·9 (4·4)	5·0	5·3 (5·2)	4·5	4·0 (4·3)
Third ten days average	6·1	5·7 (5·9)	5·7	5·3 (5·5)	5·6	5·7 (5·7)	5·4	5·8 (5·6)

* 1 Kilogram = 2·2 lb. or roughly about one seer. Figures in parenthesis indicate the average consumption during the period.

From the perusal of the data found in the above table it appears that the consumption of Meetha chara increased during the last ten days of the experiment. The under-fed animals consumed on an average about six kilograms of the stuff, while the pregnant animals and calves consumed about 5 to 6 kilograms. The consumption may, therefore, be considered satisfactory.

Chemical composition and digestibility Co-efficient of 'Meetha chara.' —The chemical composition and digestibility coefficient as determined in an earlier work are shown in the following table.

TABLE II

Feeding stuff	Chemical Composition of Meetha chara (Percentage on Dry Basis)								Digestibility co-efficient of Meetha chara				
	Dry matter	Organic matter	Crude Protein	Ether Extract	Crude fiber	Nitrogen free extract	Ash	Calcium	Phosphorus	Organic Matter	Crude Protein	Ether Extract	Total carbohydrates
Meetha-Chara	80·7	83·91	2·71	0·37	16·83	64·50	16·09	1·02	0·096	69	Nil	Nil	72

From table II it is clear that meetha chara does not contain any digestible protein and ether extract, whereas digestibility coefficients of organic matter and total carbohydrates are 69 and 72 respectively.

Nutritive value of Meetha chara.—The nutritive value of Meetha chara can be shown by the following table.

TABLE III

Feeds	Digestible nutrients per 100 lbs. of dry material			Digestible nutrients per 100 lbs. of Raw material		
	Digestible crude protein	Total digestion nutrients	Starch equivalent	Digestible crude protein	Total digestible nutrients	Starch equivalent
Meetha chara	0·00	58·2	45·7	0·00	47·0	36·9
Wheat Bhusa	0·00	47·56	24·52	0·00	42·8	22·1
Rice Straw	0·00	41·0	21·8	0·00	34·9	18·6

Compared to other inferior quality roughages Meetha chara is about 1½ times richer in net energy as expressed in Starch equivalent and like other inferior quality roughages it does not contain any digestible protein. This indispensible nutrient must have, therefore, to be supplied by protein rich concentrates. It is a well known fact that high energy concentrates cost nearly two to three times more than protein rich oil cakes in our country. From this consideration any roughage which will contribute more energy than other roughages should have to be encouraged. It is evident from the data presented in the above table that even the feeding straws to the animals in the Gosadans involves additional expenditure as compared to 'Meetha chara'.

From the data presented in table, it is evident that the adult animals, must have consumed 4·81 lbs. of Starch Equivalent while the pregnant and growing animals 4·44 lbs. of Starch Equivalent. This means that to get the same amounts of Starch Equivalent from wheat Bhusa or any other inferior quality dry roughages at least 20 to 22 lbs. will be required. The cost of 20 to 22 lbs. of wheat Bhusa at Rs. 2-8-0 per maund should roughly work out to As. 0-10-0. Even assuming that the cost of 'Meetha chara' as Rs. 2 per maund, the cost of 12 to 13 lbs. of the same is only about As. 0-5-0. 'Meetha chara' is, therefore, definitely cheaper than any other inferior quality roughages.

It has been noted that if the animals are not properly watered, the consumption of 'Meetha chara' decreases to a considerable extent. In this connection it may be mentioned that abundant water supply is always to be recommended when 'Meetha chara' is fed.

Finally, it may, however, clearly be emphasized that 'Meetha chara' is a sort of scarcity feed and should only be included in the dietry of cattle in a restricted sense. The stuff could be utilized more profitably in various GOSADANS of the State and other famine stricken areas where scientific ration is not of great importance, so that the present high cost of feeding the useless animals could be reduced nearly to half.

MEMOIR

Sri R. RANGAMANNAR, G.M.V.C., B.V.Sc.
(Contributed)

We deeply regret to record the premature and sudden demise of Sri R. Rangamannar, G.M.V.C., B.V.Sc., Assistant Lecturer in Pharmacology, Madras Veterinary College, on 1-4-58 due to cerebral apoplexy. Born on 20-8-1923 in a family of agriculturists at Meenakshipuram village of Ramanathapuram District, he graduated from the Madras Veterinary College in 1947. He served in several districts as a Veterinary Assistant Surgeon for about five years before he was drafted on to his *alma mater* as a member of the staff, in 1952. We learn that besides teaching, he was engaged in research for the Post-graduate degree of M.Sc. in Pharmacology and was more than half way through his work. None of his colleagues who were with him at the college till late in the evening on 31-3-58 attending a pleasant party, could ever suspect that the cruel hand of death was lurking so close as to snatch him away within eighteen hours. He was a very genial and lovable colleague and his sad demise at the early age of 34 has cast a gloom on the entire staff of the College. We offer our heartfelt condolences to the members of the bereaved family.

Announcement

Post Graduate Examination Results

The following candidates have passed the final Post-graduate Diploma Examination in Veterinary Parasitology held at the Madras Veterinary College in March—April 1958.

1. Baidyanath Sinh (Bihar).
2. Basudev Patnaik (Orissa).
3. P. V. Krishnamurti (Andhra).
4. M. S. Sivasubramaniam (Kerala).

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 this 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.

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THE I. V. J. RESERVE FUND

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Reviews

Salmonellosis in Animals—A Review.—By A. Buxton, PH. D., M.R.C.V.S., Department of Veterinary Pathology, University of Liverpool. Review Series No. 5 of the Commonwealth Bureau of Animal Health. Price 25 sh. Commonwealth Agricultural Bureau, Farnham Royal, Bucks, England.

Not only the size of the Salmonella group has increased to such an extent that to-day, it has more than 300 Sero types, but the techniques employed for typing them have also become more exacting. The above book is a comprehensive and masterly review of the vast literature on Salmonellosis recorded in so many languages from all parts of the world. The reviewer has not only taken great pains in sorting out and presenting the available information into eight well arranged chapters but has also given his own opinions and posed new problems for further study. This makes the book interesting and useful and will no doubt stimulate the Veterinary Bacteriologists to explore into the still fertile and complex field of Salmonellosis in animals.

In the first chapter, the general characters of Salmonella including the exhaustive tables of Biochemical reactions and the Antigenic structures are discussed and in the second chapter, Serological typing including a complete Scheme of Antigenic structure of Salmonella Serotypes and Bacteriophage Typing are dealt with. In the subsequent chapters Salmonella Serotypes, Symptoms, lesions and epidemiology, immunology including Serological diagnosis, genetic immunity and chemotherapy of Salmonella infections in animals are discussed. Public Health aspects of Salemonella infection in animals have also been reviewed. A very exhaustive list of references is given.

V. R. R.

Wright's Veterinary Anaesthesia.—Fourth Edition by Professor J. G. Wright, Professor of Veterinary Surgery in the University of Liverpool. Price 30 sh. Publishers:—Messrs. Bailliere, Tindall & Cox, London, W.C. 2.

The fourth edition of Wright's Veterinary Anaesthesia includes practical observations on many newer methods of inducing anaesthesia in ordinary veterinary practice besides details regarding the newer products available for use as narcotics and anaesthetics.

The book continues to maintain its original high character and the publishers have as usual succeeded in doing a good job of work. It may perhaps be advisable to render the script in smaller types in the future editions, that are bound to follow.

M. N. M.

Veterinary Ophthalmology.—By R. H. Smythe, M.R.C.V.S., Second Edition, Price 42s net. Bailliere, Tindall and Cox, London, W.C. 2.

That a book should have gone into a second imprint within less than two years from its first appearance, is in itself an evidence of its great merit.

Much of the matter has been "radically revised and re-arranged and new illustrations added." This has enhanced the value of the book very much. It is a unique contribution to the subject of Veterinary Ophthalmology and is bound to be of enduring interest to the profession.
