

Maebas Veterinary College

Medical Association

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Nov. 1945

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THE
MADRAS VETERINARY COLLEGE
MEDICAL ASSOCIATION

Vol. IV

NOVEMBER 1945



ANNUAL NUMBER



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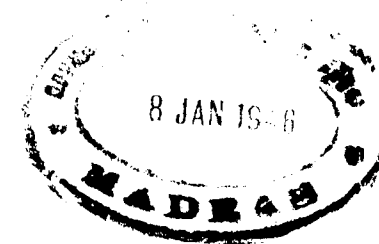
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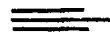
ANNUAL NUMBER

NOVEMBER
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Editorial Note

Contributions of articles for the next issue of the Annual Number of the Madras Veterinary College Medical Association should reach the Editor before 15th January, 1946.

The articles should be typed or written clearly on one side of the paper, with proper references to the number and issue of the Journals or Books referred to.

—EDITOR.

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RETIREMENT

Mr. M. A. Rangaswami Ayer, B.A., G.M.V.C., P.G. (Edin.), Lecturer in Physiology was born in the village Mangalam in Malabar. He was educated at Victoria College, Palghat and at St. Joseph's, Trichy, where he took his B.A. degree in 1912. Became one of the pupils of our renowned Alma-mater and took his G.M.V.C. diploma in 1915. He joined the C.V.D. on the 7th Feb. 1916 and underwent the P.G. course at the Madras Veterinary College in 1925. He obtained 1st rank in the P.G. examination. He proceeded overseas in 1931 and did his P.G. course at Edinburgh. On his return he was appointed lecturer in Physiology on 2nd July 1932.

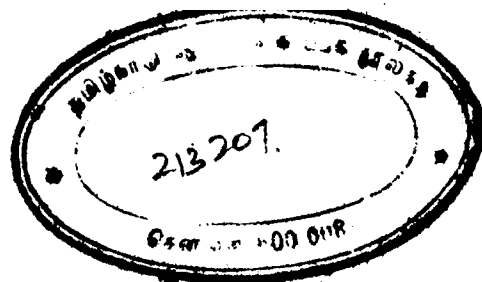
None of us could forget his simple examples of reflex action etc. to make the subject easily understandable. He retired on 15th of July 1944 and was reappointed till the end of March 1946.

As the warden of our hostel he came in intimate contact with us. He was good and kind and above all sympathetic to one and all of us.

This is our modest and sincere expression of our deep regards for our dear lecturer. May God grant him health and long life. We wish him the best of life in his retirement.

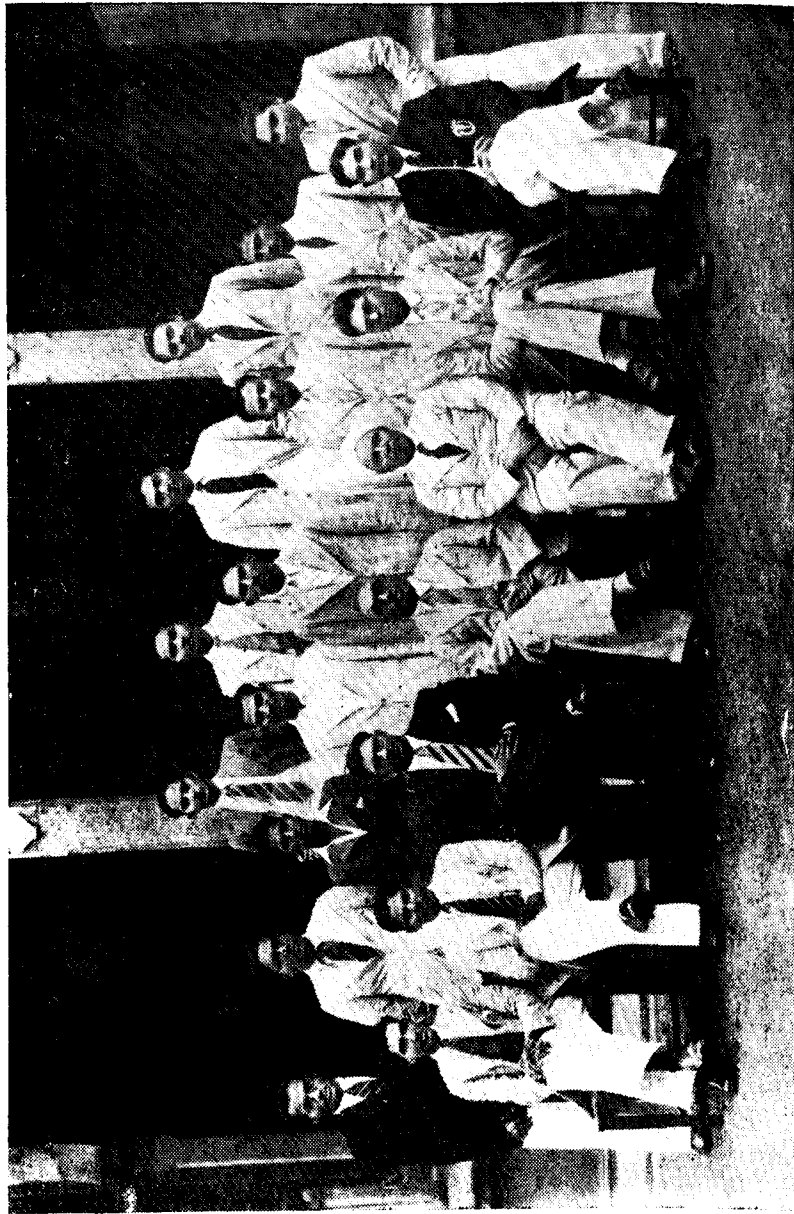


Mr. M. A. Rangaswami Ayer, B.A., G.M.V.C., P.G. (Edin.)
Retiring Lecturer in Physiology.



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THE MADRAS VETERINARY COLLEGE MEDICAL ASSOCIATION OFFICE BEARERS 1944-45



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Editorial

Ever since its inception, this Annual Number of ours has been struggling hard against finance and paper shortage.

No sooner was this war-time child strongly immunised against financial breakdown last year, than it was found to be in the death grip of "Paper Control Order", which would have cut its life short, but thanks to the authorities, the specific vaccine supplied by them, after a series of correspondence, marvellously revived it though reduced its bulk.

Like the victory of the Allied Nations in Europe, this publication of our Annual Number is a victory in the true sense over manifold odds, met with during war-time.

This magazine which is unique of its kind in India, has been considered a source of knowledge on matters of veterinary importance. We are very much indebted to the Paper Controller for having kept our Annual Number on the run.

We are much grieved at the sad demise of Sri N. S. Vadivelu, a student of the final year of this College. He was well known for his simple amiable nature.

Our association of which this is the official organ has had a very successful season this year. The success as compared to past years is unique and shows the progress of the association and in short of our Alma-mater. The activities are of varied nature, which embrace not only reading of essays but also debates, excursions, cinema shows of veterinary interest etc., a detailed account of which appears elsewhere in this issue.

The association had the proud privilege of inviting important personalities. The inaugural address was delivered by Sir K. Venkataraman, who dealt in general on "Research" and "Genetical Research" in particular. Major Graham Williamson, the Animal Husbandry Commissioner with the Government of India, visited the Madras Veterinary

College during the year and delivered a short address to the members of the association. Dr. B. V. Nath, Director of Agriculture, Madras also addressed the students at one of the meetings of the association. The valedictory address of the association was delivered by Mr. Vinayak Mudaliar, G. M. V. C., Livestock Development Officer, Madras.

We heartily congratulate Mr. T. J. Hurley, Director of Veterinary Services, Madras on his greatly deserved New Year's Honour of O.B.E.

Mr. Rangaswami Ayer, B.A., G.M.V.C., Lecturer in Physiology retired from service last October. He served the College for the last 12 years and was the warden of the hostel for more than a year. During his wardenship, the hostel had a lot of improvements. He has a very lovable personality. We are glad that he has been reappointed for one more year. We wish him sound health and many more years of useful activity.

We congratulate Mr. K. S. Nair, G.B.V.C., M.R.C.V.S., D.T.V.M., Principal, Madras Veterinary College on his appointment as Director of Veterinary Services, Madras, vice Mr. T. J. Hurley on leave and Mr. R. Swaminathan, B.A., G.M.V.C., Lecturer in Surgery for the coveted post of Principalship of the College.

The athletic activity, the complement part of Education was of a higher standard, than the last years, being evidenced by its contribution of a player to the University team.

We are extremely glad to know that three members of our staff, *i.e.*, Mr. Md. Azizuddin, B.A., G.M.V.C., B.V.Sc., Mr. V. Mahadevan, M.A., Mr. M. Dharmarajan, M.A., M.Sc. and two from the department, *i.e.*, Mr. C. Krishna Rao, G.M.V.C., B.V.Sc. and Mr. Vancheswaran are proceeding for higher studies in U. K. and U. S. A. as Government Scholars. We wish them a bonvoyage and a successful career in their training and earnestly pray for a safe return to the mother country.

Secretary's Report

General:—It gives us great pleasure to present the 9th annual report of the Madras Veterinary College Medical Association. Never before in the annals of the association was so much useful work turned out and so much activity evident as this year. In spite of the fact that M.V.C.M.A. is a professional association, it has set up a proud record which even the associations of arts colleges, which have more leisure and time would envy. The association has made important strides in many directions and we are confident that this year will always be remembered as the memorable one when the past records of the activities of the association have been excelled and bettered. This year we have set up a new record of 27 meetings as contrasted with 11 of last year. Almost there has been no week without a meeting or debate held under the auspices of the association. The association during this year, has achieved financial stability which is essential for any organisation to sail smoothly without getting itself drifted by storms of financial stress.

Our long cherished desire of organising reception to new graduates, in a way befitting the occasion took shape only this year and we are in a position to say that the reception to New graduates was arranged as best as could be, considering the times in which we are living. By adopting a resolution to the effect that reception to new graduates should be an annual feature in view of the stable financial position, we are assured of a function whose importance cannot be over-stressed. If the number of papers read and meetings convened was to be considered as index of interest and enthusiasm of members to read and speak on professional subjects has been more than, considering the fact that as many as 11 papers were read as against 5 of last year, 4 of year before last and this is a record for this association so far.

We are very fortunate to get a galaxy of eminent men to address the association like Sir T. S. Venkataraman, Major Graham Williamson and Dr. B. V. Nath. Altogether eight meetings were addressed by non-members out of which one was addressed by a lecturer of the College.

During the year under report, apart from the normal activities like reading professional papers and inviting distinguished personages to address the association, we arranged debates one of which was a mock parliamentary debate. In spite of our best efforts, we could not arrange excursions except the one to Ennore for want of transport facilities. Due to the paucity of good professional films, we could not screen more than two films as a monthly feature. In view of the fact that visual education is a very effective method of instruction we ardently wish and hope that in future when the conditions improve, a set of good professional films would be purchased for the association. The Presidency College Union made a friendly gesture in inviting a team from M. V. C. M. A. for an inter-association debate and we had to abandon the idea, though a team was actually selected for the purpose, for reasons beyond our control.

This year, an additional feature was provided by way of the extempore speaking contests which were intended to encourage members in the art of free speaking on a variety of subjects at a short notice.

Membership:—The membership of the association has increased from 107 of last year to 153 this year. We are sorry that 5 members left us during the year.

Financial Position:—During the year, as we have already pointed out the annual subscription has been enhanced from Re. 1 to Rs. 5. When we started work, at the beginning of this year, we had a balance of Rs. 55 left over by our predecessors and this year we have collected so far Rs. 596-8-3. We anticipate a further collection of Rs. 180. The expenditure till to date amounts to Rs. 309-11-6. We are not in a position to present the final statement as some more expenditure is expected in way of printing the magazine. The final statement would be submitted after it has been audited before the end of the academic year by the treasurer of the association. But we do hope to save a sum not less than Rs. 350 and this we presume would give our successors a better financial start to forge ahead the association

activities. If the association continues to save we are sure that in about 5 to 10 years, the association will have to its credit enough money to institute a scholarship or prizes. This is our dream and hope this will materialise before long.

We have detailed below the activities of the association during the year.

(1) 11th July '44—A General Body meeting was held to elect office-bearers with Sri K. S. Nair in the chair.

(2) 17th July '44—Inaugural function was held when Sir T. S. Venkataraman spoke on "The utility of genetical research" Sri K. S. Nair presided.

(3) 19th July '44—Dr. Cheah Phee Phay read a paper on "The Veterinary practitioner and his clients," Sri R. Swaminathan presided.

(4) 24th July '44—Sri M. Venkatachalam of Final B.V.Sc. class read a paper on "Lead poisoning in animals," Sri M. R. Subramaniya Sastri presided.

(5) 27th July '44—Major Graham Williamson spoke on "Veterinary education," Sri K. S. Nair presided.

(6) 9th August '44—Extempore speaking contest was held. Sri R. Swaminathan, Sri Vydyanatha Mudaliar and Mr. Md. Azizuddin acted as judges.

(7) 15th August '44—The two films "Clean milk production" and "Dipping" were screened.

(8) 18th August '44—Sir J. Krishna Murty Vasanth of Final B.V.Sc. class read a paper on "Chromosomes and Sex," Sri M. Dharmarajan presided.

(9) 25th August '44—Reception to New graduates was organised in the hostel premises. President Sri K. S. Nair congratulated the new graduates.

(10) 29th August '44—Sri Vaidyanatha Mudaliar delivered a lecture on "The Practicability of parasitology that is met in the field," Mr. Md. Azizuddin presided.

(11) 10th Sept. '44—Excursion to Ennore—Sri M. Dharmarajan led the party.

(12) 11th Sept. '44—Sri C. Sambasiva Rao of Final year read a paper on "Heredity and disease," Sri K. S. Nair presided.

(13) 12th Sept. '44—A mock parliament was held and the "Indian Dress Regulation Act of 1944" was debated. Sri M. Y. Mangrulkar acted as Premier, Sri C. G. Sivadas led the opposition.

(14) 18th Sept. '44—A meeting was called to pass a condolence resolution touching the death of Sri N. S. Vadivelu, a student of the final year class. Sri R. Swaminathan was in the chair.

(15) 11th Oct. '44—Sri G. R. Viswanathan spoke on "Anaerobes of Animals," Sri Raghavachari, Veterinary Investigation officer, Hyderabad State addressed the gathering on the diseases prevalent in Hyderabad State. Mr. Md. Azizuddin presided.

(16) 23rd Oct. '44—Rao Sahib M. Ananta Narayana Rao addressed the association. Sri K. Kylasam Iyer presided.

(17) 25th Oct. '44—Sri V. Ratnasabapathy of Final year B.V.Sc. class read a paper on "Some Essentials of a National dairy programme," Sri R. Swaminathan presided.

(18) 20th Nov. '44—Sri M. M. Doshi read a paper on "Sulphanilamide—the wonder drug of the world," Sri M. R. Subramaniya Sastri presided.

(19) 22nd Nov. '44—Dr. B. Viswanath spoke on "Cattle problem of India," Sri K. S. Nair presided.

(20) 27th Nov. '44—Sri Tulasilingam of I year class read a paper on "Modern Ideas about classification of the Biological kingdom," Sri M. Dharmarajan presided.

(21) 30th Nov. '44—Sri M. Venkatachalam of Final B.V.Sc. class read a paper on "Sterility in animals," Sri R. Swaminathan presided.

(22) 4th Dec. '44—An extempore speaking contest was held. Sri M. Y. Mangrulkar, Sri Govindan Nair and Sri Ramakrishnananda Rao officiated as judges.

(23) 11th Dec. '44—Sri J. Krishnamurty Vasanth of Final B.V.Sc. class read a paper on "Livestock improvement and Genetics," Sri R. Swaminathan presided.

(24) 4th Jan. '45—A contest was held to select the best two speakers to represent the association in an inter-association debate with the team of Presidency College union.

"Pakistan is a freedom demand" was the subject chosen for discussion. Sri M. R. Subramanya Sastri and Mr. Md. Azizuddin acted as judges.

(25) 15th Jan. '45—Mr. M. K. Patra of final year class read a paper on "Antiseptics and their application in Veterinary practice," Sri M. Y. Mangrulkar presided.

(26) 29th Jan. '45—Sri Krishnamurthy Rao of I year class read a paper on "Some interesting aspects of Biology," Sri M. Dharma-
rajan presided.

(27) 9th Feb. '45—Sri T. Narayanan of final year class read a paper on "Bovine mastitis with special reference to diagnosis and treatment," Sri R. Swaminathan presided.

This year in view of the many papers read the competition has been very keen and the standard we are informed by the judges who performed, the arduous and critical task of adjudging merit, is very high. But we are forced to comment that this year there has been a tendency to read lengthy papers. We take this opportunity to make a general appeal that in the coming year brevity in writing should be given its proper importance.

The association has really served the purpose of being the main artery along which the extra curricular activities of the college were served. Rising as it did from small beginnings the association today is an integral part of the college and this year, the association activities have reached acme of perfection. The association meetings from what has been detailed have both variety and number.

Knowing as we do intimately the association in virtue of an experience during the year, we suggest the following improvements for consideration. We suggest that

(1) a separate room be provided exclusively for the association, possibly as a post war measure,

(2) a picture gallery should be provided, to accommodate photos of college associations and members of staff

(3) scholarships or prizes should be instituted as and when the association accumulates sufficient funds

(4) professional films should be purchased as and when possible

(5) a register of all the old members of the association should be maintained.

These suggestions being very practical ones, we hope they take shape in a short time.

Before we conclude, we wish to express our sincere thanks to the president Sri K. S. Nair who has evinced a lively interest and but for whose enthusiasm coupled with force of example which was always infective could not have shouldered the responsibility.

We are profoundly grateful to Mr. Azizuddin, the vice-president, who quite characteristic of himself spared no pains to make the association a live organisation. We feel that he almost gave a fresh lease of active life to the association from the time he took office a year ago and the association as it is constituted owes a great deal to him for the improvements effected. "We are deeply thankful to the members of the staff who were eager to help the office-bearers in discharging their duties. We take this opportunity to express our great sense of appreciation of the splendid work turned out by C. Sambasiva Rao, the treasurer. The Editors of the Annual number, are exploiting every avenue in their hunt after permits and paper. We wish them success and good speed in their attempts.

Our thanks are specially due to the members of the committee who have helped us by their counsels and who were always ready to make the work easier for us.

We thank all the members of the association for their cooperation and support.

We conclude our report with the hope that the association which we served and had come to love will much improve in the hands of our successors and wish them all luck. We wish the association bright future.

P. L. NARAYANA RAO,
Secretary, M.V.C.M.A.

"Sulphonamides—The Wonder Drugs of the World"*

BY

MAHENDRAKUMAR DOSHI, B.Sc., G.M.V.C.

Introduction:—The dream of physician has always been to discover substances which will kill germs in the body without hurting the body itself. The trouble is that many antiseptics do more harm to living tissues than they do to germs so that their use for treating a disease after the germs have got a hold is obviously limited. There is a very small safety margin.

Uptil 1935, it was an article of faith that you could not kill the smaller kind of germs with drugs without killing the patient. In that year a German scientist, Domagk, announced the discovery of a remedy against the Bacteria which cause septic infection. This was the first of what we call the "sulphonamide" drugs. The discovery of sulphonamides marked a two-fold revolution. In the first place it enabled us to go right in and smash the kingdom of bacteria, secondly, Wound infection, blood poisoning, septic throat, puerperal fever, pneumonia, meningitis, venereal diseases, dysentery, Carbuncles, all can now be cured and still the list is not complete. These are mighty conquests which history will count as greater than all the battles of world war I and II.

In this paper an attempt is made to trace the history and therapy of the more important of the "Sulfa" drugs.

Historical aspects:—The story of the development of the 'Sulfa' drugs begins with the introduction of 'prontosil' by Dr. Foerster in 1933. And the story of the development of 'Prontosil' itself is absorbing. In 1908, Gelmo (a Viennese chemist) synthesized Para-amino-benzene sulphonamide but its therapeutic value was at that time neither suspected nor investigated. In the following year, Horlein, Dressel and Kothe

prepared azo-dyes with sulphonamide and substituted sulphonamide groups. Their aim was to develop dyes for textile purposes and they found that the azo sulphonamide compounds "were distinguished by greater fastness for washing and milling than those of sulphonamide free products." These qualities were attributed to the intimate union of the protein cells of the wool and the dye. As far as is known, no attempt was made to apply these compounds to the control of bacterial infections.

Five years later Eisenberg noted that the dye, chrysoidine (2:4 diamino azo-benzene) was bactericidal in vitro. Subsequently many other workers prepared related dyes and found some of them bactericidal in vitro. The precise date of the synthesis of prontosil is uncertain but the first clinical report upon its use appeared in 1933. Subsequently, Grutz, Veil and others reported the beneficial effects of prontosil in the treatment of septic and toxic erythemas erysipelas and streptococcal empyema.

Upto February 1935, no experimental data relating to prontosil had been reported. However in the 15th February 1935 issue of a German Medical magazine appeared the epoch-making communication of Domagk. In this paper Domagk stated that prontosil, a relatively non-toxic red dye, when given by mouth in small doses prevented the evolution of otherwise fatal haemolytic streptococcal infections in mice, controlled and cured chronic streptococcal infections in rabbits and favourably influenced the course of staphylococcal infections in rabbits but that the drug was without effect in the treatment of certain pneumococcal and other experimental infections. In the same magazine

*Awarded the first prize for the best essay read during the year.

there appeared three clinical reports attesting the efficacy of prontosil in streptococcal infections. Klee and Romer from their experience of two years with this drug stated that prontosil was highly effective in septic haemolytic angina with lymphadenitis and thrombophlebitis, in erysipelas, in infected abortions, in acute infectious arthritis, in septic complications of scarlet fever and in urinary tract infections due to the colon bacillus. From the historical point of view it is very interesting to note the simultaneous clinical confirmation of Domagk's experimental findings. In July 1935 a new soluble azo-dye compound was announced. It was called "Prontosil S" and it was said to be as effective as prontosil.

Later in the year 1935 Nitti and Bovet suggested that the effective azo-dyes underwent certain modifications in the tissues of the treated host which resulted in their breaking down at the azo linkage to para amino benzene sulphonamide, a compound first synthesised by Gelmo, 32 years ago. Following this lead para-amino-benzene sulphonamide was prepared and found to be as efficient as Prontosil in the treatment of the animals. This observation was of great importance because it not only demonstrated that the azo linkage was unnecessary for therapeutic effects but also that a relatively simple organic compound was active as a chemotherapeutic agent in the control of experimental streptococcal infections.

Nomenclature:—During the past few years hundreds of compounds based on the sulphonamide groupings have been subjected to extensive experimental and clinical tests. The ones that are commonly used at present, according to Buttle, may be divided into two groups:—(1) Those with the substitutes in the amino group and (2) Those with the substitutes in the amido group. To the first group belong prontosil rubrum prontosil soluble, Rubiazol, Proseptasine, soluseptasine. The activity of these compounds is probably due to their break down in the body into sulphanilamide and an inactive substance.

In the second group are substances like Uleron, Albucid, sulphapyridine (M & B 693), Compounds which probably do not break down into sulphanilamide but are themselves active agents against bacteria.

Absorption, distribution and excretion:—It is obvious that until an adequate method for the quantitative determination of sulphanilamide and its derivatives is at hand, knowledge regarding their absorption, distribution and excretion would be lacking and a rational system for their administration cannot be developed. Thanks to the energies of Marshall, Fuller and others, methods are now available for quantitative determination of sulphanilamide. From these reports dates accurate knowledge concerning the absorption and excretion of Sulphanilamide and certain of its derivatives. Marshall's most recent method for the determination of Sulphanilamide in the blood and body-fluids depends on the diazotization of Sulphanilamide and coupling of the resulting diazo compound with N(1-naphthyl) ethylenediamine dihydrochloride to form a purplish red dye which can be estimated colorimetrically. Sulphanilamide is rapidly absorbed from the alimentary canal, absorption being complete in about 4 hours. It is now known that Sulphanilamide is not any more rapidly absorbed if given subcutaneously. Studies of absorption curves show that a maximum concentration in the blood is reached in about 3 hours and if only one dose is given the concentration curve falls in a straight line almost to zero in the course of 24 hours. It appears that before results can be obtained in the treatment of disease a concentration in blood 1 in 10,000 (i.e. 10 m. gm. per 100 cc. of blood) is necessary, therefore the therapeutic action of a single dose, provided that it is sufficient to produce the desired concentration in the blood, can persist for only about 6 hours. It is therefore necessary if the action of the drug is to be maintained, that administration should be repeated in from 4 to 6 hours.

After administration, Sulphanilamide is

uniformly distributed thro'out most tissues of the body. The concentration in the cerebrospinal fluid, however, is only about 75 per cent of that in the blood. Diffusion of Sulphanilamide in the body is so readily accomplished that its concentration in various body tissues and fluids is approximately equal. According to Marshall it is present in saliva, pancreatic juice, bile, exudates and transudates in a concentration slightly lower than in the blood. It passes from maternal to foetal circulation in pregnant animals and women and is present in the same concentration in the maternal and foetal blood. It has produced abortion in rabbits and should be given with care during pregnancy.

In the dog it does not appear to be changed or destroyed to any appreciable extent whereas in mouse, rat, rabbit, cat, monkey and man it is acetylated to varying degrees. The acetylated compound is therapeutically inactive. This acetylation is supposed to occur in Liver.

Abnormal intestinal activity or impaired renal function was noted by Marshall and his co-workers to disturb the normal pattern of the absorption and excretion of Sulphanilamide. These observers, found that the drug was excreted almost entirely by the kidneys and that 70.80 per cent of the drug in the glomerular filtrate is reabsorbed. The clearance of the drug was independent of its plasma level, and was increased by an increased rate of urine flow. There was no indication to suppose that Sulphanilamide exerted a deleterious effect upon the kidney function.

According to the studies of Molitor and Robinson, proseptasine is, pharmacologically, a fairly inert substance in experimental animals. Little is however, known about the absorption, distribution and excretion of this compound.

There is little available information regarding the behaviour of Sulphanilamide or its dimethyl derivative (Uleron) in experimental animals. Domagk stated that these compounds were pharma-

cologically inert. Long and Bliss (1938) have demonstrated that they are not well absorbed by mice. Studies by Marshall, Alyea and others have shown that sulphanilamide was poorly absorbed in mice, rabbits, dogs and human beings. The excretion was also not rapid.

Little is known concerning the absorption and excretion of sulfones by the animal body.

The absorption, excretion and distribution of Sulphapyridine (M & B 693) has been studied by Long and Bliss. From their observations it is evident that sulphyridine differs markedly from sulphanilamide in that sulphyridine is less readily absorbed than sulphanilamide but the concentration of the drug in the blood of animals is better maintained. The absorption of Sulphapyridine as measured by the concentrations in the blood, or its excretion in the urine, varies greatly in human beings. The drug exists in the blood and urine of human beings in both the unaltered and conjugated forms. Sulphapyridine is not excreted in the urine with the same completeness as is sulphanilamide.

Sulphapyridine passes into the cerebrospinal fluid somewhat more slowly and less readily than does sulphanilamide. Its concentration in the spinal fluid varies from one-half to three-quarters of that observed in the blood.

While much more work requires to be done before we have a thorough understanding of the principles governing the absorption, distribution and excretion of Sulphapyridine enough evidence is at hand to show that in comparison with Sulphanilamide, the absorption, conjugation, distribution and excretion of this compound is definitely more irregular and capricious.

The absorption of thiazole compounds when given by mouth is variable more so than that of Sulphanilamide or Sulphapyridine. Experimental work on animals indicates that a large amount of the drug is often recovered from the faeces when the blood concentration

is low, indicating most probably that the drug remains unabsorbed in some instances.

Sulphadiazine: Plummer and Ensworth have reported that Sulphadiazine is rapidly absorbed into the blood, that the proportion of acetyl Sulphadiazine in the blood is small, that the concentration of the drug in the blood falls rather slowly after the drug has been discontinued and that most of the ingested Sulphadiazine is excreted in the urine. Long however states that Sulphadiazine is less rapidly absorbed from the gastro-intestinal tract than Sulphathiazole, Sulphapyridine or Sulphanilamide.

Mode of action:—In view of the extraordinary therapeutic value of Sulphanilamide, medical scientists are naturally curious to know just how it goes about making spectacular cures of erstwhile lethal infections. The mode of action of Sulphanilamide is still uncertain. However, a number of different theories have been put forth by different workers. We will review these theories in brief here.

(1) Sulphanilamide inhibits the production of bacterial toxins. According to Gay this inhibition permits certain defence cells especially Macrophages to accumulate from the circulation and from local sources, and destroy the inhibited bacteria more readily.

(2) It causes bacterial 'starvation'. According to Garrod bacteria actually multiply for a while after Sulphanilamide is given; the bacteriolysis only starts later. From this he concluded that the drug somehow interferes with assimilation of food by bacteria.

(3) It operates by an electro-physical action where Sulphanilamide carrying a negative charge neutralises the bacteria carrying a positive charge.

(4) It hinders the capsule formation.

(5) It activates the reticulo-endothelial system.

(6) It stimulates phagocytosis.

(7) It activates opsonins. Finklester and Brickland believe that the presence of Serum is essential for the drug to be effective in causing phagocytosis in vitro.

(8) Some regard Sulphanilamide as bactericidal *in vivo* tho' not *in vitro*. This theory was suggested by some earlier workers and is still upheld by many. Farrel and others have found that when sufficient quantity of Sulphanilamide was given, the urine and prostatic secretions were bactericidal to *B. Coli* and *Staphylococcus aureus*. They believe that against these infections at least, the drug acts directly in the urinary tract. This theory was not confirmed by other workers.

Arguments have been advanced from time to time for and against the above-mentioned theories. The fact remains that the actual mode of action is not perfectly understood.

At present it is believed that Sulphonamides alter the body tissues and fluids in such a manner as to render the environment biochemically unfavourable for the multiplication of bacteria. But, admittedly, the chemistry of the unfavourable state remains unknown. At the present time one must be contented with this so called bacteriostatic action as the explanation. In losing their ability to multiply the bacteria are depressed to a degree that enables the natural defence to dispose of them. This, of course, is a theoretical generality, a logical guess based upon previously acquired knowledge of pathogenic bacteriology. Factors influencing the action are: (1) The number of bacteria in the infected zone and (2) the concentration of the chemical in the blood. The first is in an old observation. Dosage of bacteria is well known for its effect upon the seriousness of an infection but concentration in the blood of the curative agent required to master an infection was never before as precisely defined as in the studies of Sulphanilamide therapy. For optimum results definite concentrations are the guide not only to curative effects but also to the tolerance of the patient.

Lockwood points out the activity of the defences in the infected area and the amount of proteolysis of tissue accompanying the inflammatory process as influences modifying the action of Sulphanilamide.

Toxicity:—Experimental toxicity in laboratory animals is not discussed in this paper, only the clinical toxic manifestations of sulphanilamide and its derivatives are briefly reviewed. It is true that the fear of toxic reactions attendant upon the administration of sulphonamides has had a great deal to do with the hesitant attitude of many practitioners towards the use of these drugs. With proper precautions and intelligent use of these drugs many of these toxic reactions can be avoided. It must be remembered that a patient who has suffered a toxic reaction from sulphanilamide or its derivatives may develop another more severe reaction if the drug is administered a second time.

Sulphonamide preparations used in the treatment of various diseases have been responsible for many cases of acute yellow atrophy of liver, hydronephrosis, urinary calculi, gastritis, anuria, polyneuritis, peripheral neuritis, haematuria, intestinal haemorrhage, cyanosis, methaemoglobinaemia, sulphaemoglobinaemia, acute haemolytic anaemia, urticaria, agranulocytosis, conjunctivitis, acidosis, various forms of rashes resulting in severe photosensitization of those parts of the body exposed to direct sunlight. Peripheral neuritis has been caused by sulphanilyl sulphanilamide and dimethyldi-sulphanilamide. Splenomegaly and severe anaemia may be caused by sulphonamide therapy. Splenomegaly is not uncommonly associated with sulphathiazole therapy and under these conditions the splenic enlargement is usually one of the manifestations of drug hypersensitivity.

The hydrochloride of sulphanilamide is considered to be four times as toxic as the base and diethylene glycol and sulphanilamide appear to have synergistic effects. Neoprontosil administered orally is less toxic than sulphanilamide.

In patients treated with sulphanilamide and its derivatives the uses of drugs (purgatives), which render the contents of colon liquid, facilitate the development of sulphae-

moglobinaemia. Liquid paraffin is the only safe laxative and should be combined with enemata in severe constipation. Liquid colon contents facilitate bacterial growth and purgatives cause less food to be absorbed. Hence more protein material, capable of being decomposed into hydrogen sulphide, finds its way into the colon.

A high protein diet protects against sulphanilamide poisoning. This is probably due to increased excretion of the drug as the urinary output is increased on such diets.

Care must be taken when prescribing sulphonamides during pregnancy as these drugs pass thro' the placenta into the foetus. Sulphathiazole, administered *per os*, is less poisonous than sulphapyridine for monkeys. Sulphaguanidine is less harmful than other sulphonamides. It is suggested that it causes goitre in rats. Sulphadiazine is a new sulphonamide which is much better tolerated than sulphathiazole or sulphapyridine by man. It is also reported to be less harmful than sulphathiazole. Renal complications have been noted more frequently in the use of M & B 693 than in sulphathiazole.

In Man uleron has been responsible for fatal "softening" of the spinal cord, paralysis of peripheral nerves, collapse, polyneuritis, nephritis and various types of skin eruptions.

Not much is known about the toxicity of sulphonamides in the veterinary practice. From the available literature it can be concluded that animals are fairly resistant to the toxic effects of sulphonamides. Drowsiness, anorexia, a state of nephritis, incoordination of movement, paresis, paralysis, diarrhoea and haemolytic anaemia are some of the toxic symptoms described in animals.

Alkalies in Sulphonamide therapy:—The drugs are highly sensitive to the medium in which they are called upon to act. Any substance which contains or resembles p-aminobenzoic acid is antagonistic to Sulphonamides. The most important inhibitory substance is pus; others which intrude from time to time are the procain derivatives and eusol.

The antibacterial activity of sulphonamides has been shown to depend on their degree of ionisation. It has been shown that raising the pH. of sulphonamide solution to neutral or alkaline levels by increasing their degree of ionisation will increase their activity in proportion. Furthermore, the greater potency of sulphadiazine and sulphathiazole as compared to sulphapyridine and sulphanilamide is explicable by their greater degree of ionisation at pH. 7.4. These observations have now been applied to the local use of sulphonamides in wounds and burns and the influence of alkalis on the solubility of these drugs has been studied with a view to preventing the precipitations in the urinary tract.

The solubility of sulphapyridine and sulphaguanidine is not much altered by making the urine alkaline within the physiological range but Jenson and Fox have found that sulphathiazole and sulphadiazine, like other weak acids, are made much more soluble by the addition of alkali. Their solubility in urine is minimal from pH. 5.5 to 6.6, doubled or trebled at pH. 7.5 and increased ten fold at pH. 8.0. In a patient receiving a sulphonamide the glomerular filtrate contains a concentration of sulphonamide approximating to that of blood and sharing a similar pH. As the filtrate proceeds thro' the tubules many constituents especially water are reabsorbed so that the concentration of sulphonamide increases and this leads to a fall in pH. of urine to acidic level. As a result crystals may be deposited in the renal tract.

The observations of Jenson & Fox seem to provide a clear indication for the use of alkali as an adjuvant to sulphathiazole and sulphadiazine therapy not only to eliminate the risk of crystalluria but to increase their therapeutic effect in the urinary tract. Large doses of alkali are required to neutralise the acidity of urine and also that of sulphonamides. The alkalis recommended for use are sodium bicarbonate, sodium citrate and sodium lactate.

Treatment of sulphonamide poisoning:—The following methods of treatment are advocated

by Steyn in the cases of sulphonamide poisoning:—

- (a) Administration of Nicotonic acid.
- (b) Intravenous injection of isotonic glucose solution and methylene blue to relieve cyanosis due to methaenoglobinaemia.
- (c) Treatment in renal complications should consist of alkalinization, diuresis and arthral catheterisation and irrigations with warm (107°F) distilled water. The bactericidal effect of sulphanilamide is greater in alkaline than in acid urine.
- (d) Clonic and tonic convulsions should be treated with small doses of hypnotics like nembutal. It is reported that subhypnotic doses of nembutal can eliminaterestlessness, nausea and vomiting, which follow the use of large doses of sodium sulphapyridine. The following points will help to prevent complications arising in sulphonamide therapy:—

(1) Commence with small doses especially in aged patients and increase these if the patient tolerates them well. It is not advisable to continue the administration of these drugs for a long time uninterruptedly otherwise hypersensitivity may develop.

(2) In diseases of blood, liver and kidney, these drugs should be cautiously used. In order to protect the kidneys the daily output of urine should be increased by giving lot of fluids.

(3) Sodium bicarbonate protects the system, especially the kidneys, against the sulphonamide poisoning by combating the acidosis.

(4) During the administration of sulphathiazole, the urine should be regularly examined as crystals of this drug, haematuria and oliguria are danger signals. Chill followed by fever is another landmark during sulphathiazole administration and in such cases it should be stopped.

(5) Frank land warns against the subcutaneous use of "sulphapyridine soluble" as it results in the ulceration of the skin with a persistent sinus. Intravenous injection is recommended only in cases of emergency

Intramuscular route is also not at all satisfactory for the administration of this drug.

(6) Nodular rash is the most serious lesion of all cutaneous manifestations in sulphonamide medication. Conjunctivitis is also frequently seen.

(7) High protein diet protects against sulphanilamide poisoning. But high fat and high carbohydrate diets increase the susceptibility of the experimental animals to the harmful effects of these drugs. Sulphur containing substances which on decomposing liberate sulphuretted hydrogen facilitate the production of sulphaemoglobinaemia. Such substances are egg, sulphur, sulphites, thio-sulphates etc. and they should be avoided during sulphonamide treatment.

(8) As already pointed out, purgatives should not be used during sulphonamide administration; evacuation of bowels can be brought about by the use of liquid paraffin and enemata.

(9) Drugs such as phenacetin, nitrites, amidopyrine and members of sulphonol group which predispose to methaemoglobinacemia, should not be administered at the same time as sulphonamides.

(10) Sulphapyridine appears to inhibit the curative action of nicotinic acid in dogs.

(11) Calcium rapidly clears up the eruptions of the skin caused by uleron.

(12) Quinine and sulphonamides should not be administered simultaneously as the former facilitates the absorption of the sulphonamides and also their excretion by the kidneys and consequently aggravates the kidney complications. These effects were not noticed when atebirin was used instead of Quinine.

(13) Novocaine and related products are chemically incompatible with sulpha compounds. In a test-tube these anaesthetics block the germ-inhibiting action of sulphapyridine, sulphathiazole and sulphanilamide.

Clinical application of sulphonamides:—It is hardly necessary to mention that sulphanilamide and related drugs have been found most conspicuously successful in the treatment of

streptococcal infections. But it must be clearly recognised that susceptible infections are only those due to streptococcus pyogenes. Other varieties such as Str. viridans and Str. faecalis are not much influenced by these drugs. Reports are still conflicting as regards the efficacy of sulphonamides over the streptococcus faecalis and viridans infections; some workers have found these drugs to be successful while others have not been able to confirm this.

From the comparative point of view it is interesting to note that sulphanilamide, Prontosil and related compounds have been found successful in the treatment of puerperal fever and erysipelas in man. Less favourable results have apparently been obtained in tonsillitis, scarlet fever, otitis media and meningitis. The treatment has been used successfully in various other conditions including streptococcal pneumonia empyema, burns, and cellulitis.

In regard to infections other than those due to Streptococci, information on clinical result is rather scanty. Among infections of veterinary importance it would appear that Staphylococcus aureus is at least moderately susceptible and according to Domagk, Uleron gives better results in this case than the other compounds. Sulphanilamide has given promising results in gas-gangrene due to Cl. Welchii and amply justifies further trial.

From the work of R.M. Montgomerie (1938), there is good evidence that the treatment with Sulphanilamide cleared the udder of Br. abortus infection and this goat thereafter resisted the attempt to reinfect by udder injections.

According to Dalrymple-champneys, reports are available of 27 cases due to Br. abortus infection treated in England or Wales with Prontosil or Sulphanilamide. In 14 of these the effect was judged to be beneficial and in 4 doubtful, in 9 no beneficial effect was observed.

From available reports it is clear that results obtained from Sulphanilamide therapy in bovine Mastitis are contradictory.

The reports upon the use of Sulphanilamide in the treatment of spontaneous distemper in dogs are also conflicting. Those workers who reported favourable results with Sulphonamides in the treatment of Distemper in dogs believe that the secondary bacterial infections were more responsible for fatalities than the original virus.

Information about the effect of Sulphonamides on virus diseases is scanty. These drugs, however, are valuable in the treatment of Secondary bacterial infections in virus diseases. Favourable results with Sulphonamides have been claimed in the following virus diseases; the common cold, lymphocytic choriomeningitis, influenza and lymphogranuloma inguinale.

Sokhey and Dikshit (1940) of the Haffkins Institute, Bombay conducted experiments on mice infected with cultures of plague bacilli to find out the effect of Sulphonamides in this disease. Both Sulphapyridine and Sulphathiazole were found to be equally effective when treatment was commenced before Septicaemia set in. After Septicaemia set in, with Sulphapyridine only 10% and with Sulphathiazole 90% of the animals were cured. Kraneveld and Mansjoer (1940) reported that Sulphanilamide given per os or subcutaneously was found to increase the resistance of rabbits to a fatal doses of *Pasteurella bubaliseptica*. Soluseptasine also had good prophylactic and curative effects when injected intravenously or subcutaneously.

Helmholtz (1941) reported on the bactericidal effect of Sulphathiazole on many strains of the various bacteria frequently found in urinary infections. These organisms are: *Staphylococcus aureus*, *Proteus ammoniae*, *Streptococcus faecalis*, *Pseudomonas aeruginosa* and *E. Coli*.

Sulphonamide drugs have been found useful in trachoma, gonorrheal ophthalmia and Panophthalmitis.

May and Baker laboratories report the following with regard to their products M and B 693 and soluseptasine.

"M & B 693 is a valuable chemotherapeutic agent indicated in all animals in cases of pneumonia, Septicaemia, cellulitis, peritonitis, metritis, endometritis, nasal catarrh, laryngitis, bronchitis, puerperal septicaemia and to prevent septicaemia following parturition, operations and wounds. It is of remarkable value in the treatment of strangles, acute mastitis, joint ill, contagious pneumonia of calves, calf Diphtheria, necrophorus infections, white scour, equine-influenza, equine pneumonia, pneumonia in adult cattle due to *Pasteurella* infections and canine distemper associated with pneumonia. It is useful in fowl cholera.

Besides the above indications, M & B 693 possesses a powerful bacteriostatic action and is useful for dressing of wounds both of traumatic and surgical origin. In treating wounds it is necessary to provide effective drainage to keep the wound dry and free from pus or necrotic tissue as far as possible to ensure rapid healing.

Soluseptasine is especially indicated in strangles, acute mastitis, joint ill, distemper, diseases of the respiratory tract, septic pneumonia and for the prevention of sepsis following parturition, operations, wounds, bites and stings. It is effective in canker, otorrhoea, interdigital abscesses and purulent dermatitis in dogs".

5% Sulphanilamide pastes and ointment, prepared with equal parts of Zinc Oxide or Iodoform and liquid paraffin; or 12g of Sulphanilamide powder in 120 cc. of Cod liver oil and made upto 8 ozs. with lime-water are recommended in the treatment of wounds. Steyn (1943) had most excellent results in the treatment of fresh and infected wounds and cases of blood-poisoning by dusting Sulphanilamide powder on the wounds or applying pastes or liniments with Sulphanilamide powder and cod liver oil.

Dr. F. W. Gehrman (1942) reports success in treating moist eczema in dogs with topical applications of Sulphanilamide powder. He clips round the affected area, washes it with soap and water, followed by alcohol and

applies the Sulphanilamide powder by means of a shaker top can. The animal should be prevented from licking the wound in order to avoid its ingesting toxic amounts of the drug.

Sulphadiazine is said to be highly effective in pneumococcic, staphylococcic and streptococcic pneumonia, meningococcic infections, influenzal meningitis, acute infections of the respiratory tract including tonsillitis, sinusitis, erysipelas, acute infections of the urinary tract particularly those associated with *B coli* and acute gonorrhoeal arthritis. Toxic effects from its use are mild and is well tolerated by man.

Consequently its use is indicated in the treatment of Chronic bacterial infections where prolonged administration of the drug is required.

It is not yet possible to decide on the relative value of the various Sulphonamides in the treatment of intestinal infection and Paulley has suggested that Sulphapyridine has advantage over the more widely used Sulphaguanidine. It is clear however that Sulphaguanidine is a readily absorbed drug and one capable of giving rise to toxic symptoms and that urinary output should be maintained to prevent the drug crystallising out. This is of particular importance since the conditions for which the drug is usually given—dysentery and dysentery like illnesses—tend to a small output of concentrated urine unless energetic measures are taken.

Conclusion:—In these few pages an attempt has been made to introduce the reader into the realm of Sulphonamides, the wonder drugs of the present century.

The encouraging preliminary reports that the Sulphonamides were a potent series of drugs capable of curing most of the bacterial diseases led to their indiscriminate use. It must be remembered that the discovery of these drugs is so recent that very little has been achieved by way of experimental investigation. The clinical data is very vast and conflicting and it far outweighs the experimental data. In such circumstances it was quite natural that some untoward results

followed the early use of these drugs in ignorant hands. Even at present we are in no better position. Our knowledge of Sulphonamides is still imperfect. The paucity of experimental data makes it impossible to assess the correct value of these drugs.

Great strides have been made in the application of these drugs in human diseases. But on the veterinary side even the clinical data is very much lacking. It is rather disappointing to note that though animals are being used for the experimental determination of the usefulness of these drugs, little care has been taken to apply these experimental results in the veterinary practice. It is hoped that as researches advance more and more attention will be paid to the veterinary side of the question also.

At present indiscriminate use of Sulphonamides is being made, our knowledge being based on a few imperfectly known principles. The present war may, however, prove an impetus for further and more intimate researches into the mystery of Sulphonamides and may we hope, ere long, the minutest details of the therapy of these drugs is laid bare to the students of medicine.

Advance is likely in two directions. One is the better employment of the existing remedies—several types of infections have apparently not yet been made the subject of adequate therapeutic trial. The other line of advance lies in the introduction of new compounds now only in the stage of laboratory trial.

There remain both in human and in veterinary medicine many problems in the solution of which chemotherapy may well be expected to play an important part. No chemotherapeutic agent as far as is known, has yet shown to be effective against a true virus infection; yet it is not too much to expect that in due time researches now being directed to that end may prove successful.

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STERILITY IN ANIMALS

BY

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Introduction :—Inspite of the hazardous enterprises of the past in order to probe into the problem of sterility and animal breeding, inspite of many an opinion and contribution directed towards the subject of sterility. Inspite of many brains rocking together towards the dissolution of the mighty problem of the day, the question of sterility still remains a hard nut to crack. A colossal economic loss is attributed not only in our country, but also in other countries where breeding and dairying are the prime concerns, and the subject of sterility must, henceforth, receive due and proper attention of both the breeders, as well as the Veterinarians, who are naturally "Sterility—prohibiting—minded." Especially in India every possible means must be directed towards the stamping out of this menace.

Sterility, the antithesis of fertility, is an effect behind which lie many causes. It can be defined as the Catastrophic failure of the animal to behave as a healthy, normal breeding individual.

Sterility is a common factor affecting both male and female, especially latter, due to the complexity of their generative organs. A normal bull may discharge defective semen, which fails to impregnate the cow. Also, an impotent animal may discharge normal semen, which, when collected and artificially inseminated, effectively produces a young one. The same can be applied to females also. A normal oestrous does not indicate signs of fertility.

Ordinarily conception requires a healthy, open, genital canal, for the healthy active spermatozoa, to fuse with the healthy ovum

and multiply. And deviation from the normal, therefore, may lead on to sterility. Hence it is worth while to remember a few points about the physiology of reproduction before we deal with the subject in question.

Physiology of Reproduction

The mature ovum formed within the graafian follicle under the influence of the Anterior pituitary Hormone 'Prolan' is liberated into one of the fallopian tubes and travels towards the uterus. Due to the endocrine secretion of the ovary "Oestrin," the female exhibits symptoms of Oestrous. It is at this period, when the bull should be allowed to the cow, whose active spermatozoa migrate towards the ovum and fuse with it, on its way to uterus. The fertilised ovum is at first unattached to the uterine wall, but later gets attached to it. The placental membranes begin to form, increase in vascularity, develop cotyledons which are firmly fixed by a dove-tail arrangement to the maternal cotyledons. It is through the cotyledons, that the foetus gets its nourishments, and discharges its waste materials. The gestation period varies in different species of animals and terminates with the propulsion of the young one into this broad world.

Etiology of Sterility

The condition called sterility may be permanent, temporary or lowered fertility. The latter two cause greater loss than permanent sterility, as such animals may be discarded even at the first instance. The others have to be kept for years and treated, and ultimately discarded if found useless as breeders.

Etiology of sterility may be briefly classified as follows :—

I. Developmental abnormalities.

- (a) Congenital.
- (b) Genital.

II. Physiological.

- (a) Functional.
- (b) Dietetic.

III. Deficiencies.

- (a) Mineral.
- (b) Vitamins.
- (c) Endocrines.

IV. Pathological :—

- (a) Structural alterations.
- (b) Bacteriological (1) Nonspecific.
(2) Specific.

V. Causes unknown.

I. Developmental Abnormalities.

(a) Congenital

(1) *Free-martins*: Sterility in a free-martin is explained by the fact that during foetal development, the harmonic secretions of the male, exerts a nulling effect to the development of the genital system of the freemartin, whose generative system is poorly developed.

(2) *Hermaphrodites*:—Here they do not produce any functional gametes and are not useful as breeders.

The above two cases represent permanent sterility and are incurable.

(3) *Cryptorchism*:—When both testicles are retained in the abdominal cavity, the testes undergo atrophy with the disintegration of germinal epithelium. But the harmonic function of the organ is not interfered with. This condition is said to be due to deficiency of 'Prolan', and when 'prolan' treatment was administered to such an animal, the testicles descend into the scrotum. Failure of testicular descent into the scrotum, after the harmonic treatment is attributed to mechanical impediments. If one of the testicles retained in the abdominal cavity, the descended testicle undergo compensatory hypertrophy and takes the function of the

other testicle also, and discharges normal semen.

(4) *Persistent hymen*:—This condition interferes with normal copulation. It also blocks the outlet for the oestral and other normal secretions of the uterus and Vagina, which may lead on to further complications.

(5) *Imperforate Os*:—Here also the opening of the os uterus is closed by an imperforate membrane, which interferes with the normal fusion of the sperm with the ovum.

The above two conditions (4 and 5) can be remedied by surgical means.

Uterus unicornis, and cervix duplex are also mentioned by one author, but these are very rare, and even if present not at all serious. In cervix duplex, one of the os dilates during parturition. The partition can be removed by surgical means, converting the two openings into one.

(b) Genetical

(1) *Inbreeding*:—Inbreeding does not necessarily induce sterility. However, it does segregate those animals homozygous for these factors, and so if no selection is made for fertility then these animals and their progeny will be shy breeders.

It is possible to develop a progeny of high fertile animals by method of inbreeding as it is to perpetuate sterility.

(2) *Hybrids*:—In certain animals, the parents belonging to different species who are individually normal give rise to an offspring which is incapable of breeding. This is explained by the alteration in the chromosomal structure by which further breeding is not possible. In such cases the two sets of chromosomes derived from the respective parents, work in harmony through out the somatic life of the hybrid, but are unable to pass successfully through the more intricate process of germ-cell formation.

Good examples of this class are mule (cross between jack-ass and mare) and Hinny (cross between Stallion and she-ass). The hybrid between Stallion and a female Zebra also is sterile.

The above two factors are permanently sterile and should be dispensed with even at the very beginning.

II. Physiological Sterility

Even normally it has been found that 33% of ova shed, are not fertilized. Experiments conducted in gravid uterus of rabbits go to show that 8% of fertilised ova have been found atrophied in each litter, though the remaining 92% of the embryos, and uterus itself were normal.

(a) *Functional*: (1) *Age*:—Very young animals have low fertilising power due to want of full development. Yet age is seldom an obstacle for conception. The following are the different periods at which the animal comes to heat.

Mare—1 to 2 years; cow—18-24 months.

Bitch—8 to 12 months; cat—8-12 months.

Sheep—8 to 12 months;

Animals normally continue to breed regularly to a good old age. Cows ordinarily breed up to 10 to 12 years. Mares breed up to 15 years. As age advances there is a senile decay of the essential organs of reproduction.

(2) *Period of copulation*:—Unless the cow is mated during oestrous, there is little chance of putting the cow-in-calf.

(3) *Number of copulations*: The second ejaculation of a bull contains more of sperms, and less of the secretions of prostate etc. than the first ejaculation. That is the reason, why breeders insist on second copulation.

(4) *Excessive sexual use*:—This pertains only to sires. This is due to overwork during one season, also too frequent matings without sufficient intervals between two consecutive copulations. Here the semen is watery, contains less number of spermatozoa, most of them being immature and sluggish. If neglected at early stages, the bull becomes sterile.

(5) *Exercise*:—Excessive feeding and absence of exercise make the animals more obese & indifferent as a breeder. Restriction of exercise and sunlight, with due feeding

has been found to play an important part in sterility. Such animals are found to require greater number of services to effect pregnancy.

(6) *Physical inability to copulate*:—Present in either sex, but seen more in males due to adhesions, tumours, inability to erect and introduce the penis into vagina. Disparity of size between male & female may also constitute a cause. Sometimes the male is able to introduce his penis into the vagina, but powerless to complete the act (impotent). A condition known as "excessive erection of the penis" is frequently met with in stallions. The animal introduces his erected penis into the vagina, but no semen is discharged, and the penis is withdrawn still erect. These defects can be overcome by adequate measures to be mentioned later.

(7) *Climatic and nervous influences*:—Extremes of temperature, change in environments, excitability of the animal etc. are factors, which influence the fertility of animals. Mares are prone to suffer from undue excitement, and strains violently after service and eject the semen. Such mares should be worked hard to settle them down, and then allowed to the stallion. The ejaculation of semen may be prevented by diverting the attention of the animal by means of a twitch, or by other means, as washing cold water over the loins, walking ortrotting after service etc.

(8) *Reaction of Vagina & semen*:—The vaginal reaction of the cow is slightly alkaline and of the bulls semen slightly acid. The PH of semen and vagina if altered to a great extent, is lethal to the sperms. The motility of sperms is greatly interfered with, and thus fecundation not possible. In such cases an alkaline douche (i to ii drachms of soda bicarb in a pint of warm water) acts like a charm to overcome such difficulty.

(b) Dietetic

Dietetic errors evoke specific reactions interfering with the metabolism, activity and functions of various systems of the body, of which the genital system especially of the female is the first to be affected reflexly to

dietetic excess or deficiency. Decreased fertility or temporary sterility ensues.

Feeding the animals with proper ration is one of the important items to be noted. Overfeeding with little or no exercise inclines to fatten the animals and makes them indifferent as breeders. This can be seen by the fact, that show animals are notoriously infertile. Any feed, which is deficient in one or more ingredients is less palatable and so the feed intake is less than normal. In almost every case, the animal refuses to eat a normal amount of deficient food. Dry feeding reduces fertility. This in rats fail to implant the fertilised ovum due to placental necrosis. Histologically the placental disturbances are due to an abnormality in the endometrium, detected even before implantation."

Carbohydrates: There is no evidence that carbohydrates have any influence on reproduction. However the excessive portion of carbohydrate which is converted into fat has some relation towards sterility.

Proteins: Experiments show that nitrogenous food increases fertility of animals. In males it has been found that a liberal ration of proteins increased the number of mature sperms, and has an important bearing on fertility. This ration depends on age, amount of work, and number of services in the male. Thus, a stallion serving 80 mares, or a bull serving 100 cows require a generous diet rich in proteins. It has been seen in certain cases, that failure in ovulation has been traced to protein deficiency.

Fats: Complete fat for a diet do harm to oestrus and ovulation. "The decomposition products of fats appear to affect the developing embryo, and the genital system of the maternal animal. The active ketones obtained from the decomposition products of fat prevents implantation of the embryo, or causes destruction shortly after implantation."

"The derangement in oestrous cycle is caused by a disturbance of the ovarian metabolism due to considerable deposition of

pigmented fat, in the interstitial tissue, and is accompanied by an unusually extensive degenerative process of the follicles, which may lead to a prolonged sterility. However since degeneration does not usually occur to a great extent in less mature follicles, it can be remedied by reduction in ration and increase in exercise." Wentworth is of opinion that deposition of fat in ovary is due to endocrine deficiency of the organ, and that the deposition of fat in ovary may indicate, rather than initiate sterility. (Does this happen in males also?)

III. Deficiencies

(a) *Mineral*: The chief minerals that are concerned with the subject in question are calcium, phosphorus, iodine, manganese, iron, cobalt and copper.

Ca & P:—Actual counts of spermatozoa, has been found to vary with Ca and P content of the ration. It appears that when the Ca contents of the ration is reduced, the vit. A content is also likely to be reduced, and that the failure in reproduction which have occurred in deficient ration are to be attributed to vit.-A. deficiency, rather than Ca deficiency. The physiological effects of ration which are deficient in Ca, though adequate in vit.-A. are in need of further investigation", Hopkink states, that in a condition known as 'Wail's disease, the cow will not show oestrous. This, he says, is a deficient condition (perhaps of Ca and P) and has been cured by giving plenty of bone-meal.

Iodine:—Interference with reproductive process and birth of a deformed off-spring is often attributed to Iodine deficiency, which affects the thyroid function. Iodine deficiency in domestic animals results usually from a deficiency of this Mineral in the soil, and hence, in food and water. When iodine in the form of Pot.-Iodide is given for a long time in the treatment of Actinomycosis, it is said to cause atrophy of the gonads. Diets having high calcium or fat is said to be antagonistic to iodine absorption.

Manganese :—Rations deficient in Mn. has been noticed to produce testicular atrophy in males, and in females failure to suckle their young ones.

Iron, Copper and Cobalt :—Deficiency of this type is said to be more prevalent in young cattle over 6 months, and in heifers calving for the first time. Cattle of all ages, and both sexes may be affected if restricted to deficient areas. Affected animals gradually lose their appetite, become weak and emaciated. Young cattle fail to grow normally, sexual maturity is delayed, and reproduction and lactation are far from satisfactory. Cobalt when deficient produces retarded sexual development. Copper deficiency also causes slow growth and lowered fertility.

(b) Vitamins and Sterility

Practically all vitamins have a role in reproduction, the deficiencies of which affect the various systems of the body of which the genital system is the most susceptible.

The important vitamins that will be considered here are Vitamins A, B. complex, C, D and E.

Vitamin A :—A minor deficiency of Vit. A. affects the soft m.m. of the genital tract of female rats. But oestrus and formation of ova and the early development of the foetus are not interfered with. Difficulty occurs midway in pregnancy resulting in haemorrhage and abortion. Retention of placenta is said to be common. Severe deficiency affects testes. This condition can be cured by Vit. A in both male and female. Carotene or Vitamin A for normal reproduction are much more higher in value than for prevention of night blindness.

Vitamin B. Complex :—Ruminants are able to synthesise B. complex. It is difficult to say that Vit. B affects reproduction beyond its effect on food intake. Further it is difficult to be brought about since it is present in commonstock feeds. Yet deficiency of B complex causes severe decrease in energy intake and later results in severe disturbances in sex organs. It has been found that Vitamin

B. deficiency causes atrophy of male and female gonads.

Vitamin C :—It was originally believed that in farm animals it was synthesised to their requirements. But recent studies indicate it is not true. By the experiments conducted by Phillips and co-workers, it has been found that Carotene deficient ration impairs with the normal Vitamin C content of blood plasma, and that the breeding deficiency of some bulls may be markedly improved by s/c injection of Ascorbic acid. Some cows, that have failed to conceive were put in calf by s/c injection of Ascorbic acid. The motility of the sperms is markedly hindered by ascorbic acid deficiency. When the deficiency is made up, the sperms assumed their normal motility.

Vitamin D :—Essential for normal Ca and P metabolism in young and adult animals. Vit. D deficiency leads to important changes in body fluids and tissues, chiefly of the reproductive organs.

Vitamin E :—This vitamin is so widely distributed in nature, that its deficiency has been recorded as "laboratory curiosity". This is the vitamin that is directly concerned with sterility. Rats fed on deficient ration failed to reproduce. But in Goats, it has been found that they reproduce normally through several generations. In rats the foetus is resorbed in the middle of pregnancy. In males the spermatogenic cells are affected which condition is incurable. In the immature rat, the association between the production of Anterior pituitary hormone and Vitamin E has been demonstrated. There is reason to suppose, that with a deficiency of Vitamin E, synthesis of Anterior pituitary hormone is interfered with, or the action of anti Pituitary hormone, and Vit. E. resemble each other.

(c) Role of Hormones in Sterility.

Pituitary :—The gland is unquestionably the master gland of the body. Its secretions have important functions to do in the body. We shall restrict ourselves to Gonadotropic hormones, of which anti Pituitary is chiefly concerned.

The two important hormones secreted by anti pituitary are Prolan A and Prolan B.

Prolan A :—(Follicular stimulating hormone). Lack of this hormone causes the degeneration of the follicles. In hyper secretion, it leads to excessive follicular growth and cyst formation leading to Nymphomania.

In males, Prolan A stimulates spermatogenesis in young, and maintains the activity in mature animals. It is used in some cases of sterility in both man and animals, due to deficiency of Prolan A.

Prolan B :—(Lutinisng Principle). The deficient secretion of Prolan B fails to rupture the mature follicles. Hyper function, stimulates the immature follicles also and forms corpus luteum before rupture occurs and prevents subsequent release of the egg. In males it stimulates the production of Testosterone.

Ovarian Hormones :—(a) **Oestrogen Hormone** :—Ripening of the follicles, and the height of Oestrogen production is characterised by the onset of heat in the female. A deficiency in Oestrin is manifested by passing through Oestrous cycle without showing signs of heat although ovulation occurs at the normal time. This can be overcome by artificial insemination. The presence of this hormone during pregnancy inhibits pituitary from secreting follicular stimulating principle. Hypersecretion causes nymphomania without ovarian cysts.

(b) **Progestin** :—This inhibits Oestrus and is connected with corpus luteum. Abortions and resorptions, occurring during pregnancy may be due to a deficiency of progestin. The corpus luteum may be slow to develop and thus may fail to prepare the uterus for the implantation of the fertilised ovum.

Testicular Hormone :—Testicles begin to secrete Testosterone actively from the time of puberty or sexual maturity and is essential for the development of the body, including genital activity. When deficient, the animal shy females and shows no indication of sexual activity.

Thymus :—There seems to be an intimate relationship between thymus, and genital glands, and it exercises a retarding influence on the development of the genital system.

Thyroid :—Derangement in thyroid function, leads to obesity which is a helping factor to sterility. Deficiency of iodine in thyroidal secretion and its effects have been already dealt with.

Adrenals :—Extracts of cortex 'cortin' is similar to testosterone in its chemical formula, and is antagonistic to Oestrogen. When there is hyper activity of the adrenals by the presence of tumours etc., in young females, causes excessive secretion of cortin which produces antagonistic effect against Oestrine, by causing cessation of menstruation.

Placental tufts :—Secrete a hormone, "Emmenin." Its function resembles corpus luteum, and is antagonistic to Graafian follicle, and Anti pituitary. In diseased condition of the tufts, these functions are impaired with.

IV. Pathology and Sterility

(a) **Structural alterations** :—(1) **Stenosis of Vagina** :—May be due to injuries during parturition, which, later causes cicatrization, and Occlusion of the vaginal passage.

(2) **Filnosis of Os uterus** :—Due to cicatrization of Os, as a result of injury during parturition.

(3) **Curvature of the Cervix** :—The same condition as above with displacement of Os to a side. It has been seen as a congenital factor also.

(4) **Ballooned Vagina** :—Seen in old cows, due to relaxation of the genital tract.

(5) **Dilation of Os uterus** :—Due to lack of muscular tone of the organ.

In the above two conditions the animal is unable to hold the semen. This condition can be overcome by artificial insemination.

(6) **Tumours** :—May be in or around the genital tract obstructing the lumen, acting as a mechanical impediment to copulation.

Cystic ovaries, Tumours in ovary and testes upset their normal functions. This has been dealt under various classes.

(b) Bacterial :—(i) Non-specific

A variety of organisms are responsible for this condition especially Strepto and staphylococci, *B. pyogenes*, *B. coli* etc. These gain entrance into the genital tract at the time of parturition due to bad hygiene.

The extent and nature of lesions depend on the infection, and state of the genital organs. Infection, once started may extend to other parts also. Thus Vaginitis, may lead to cervicitis, metritis, and even salpingitis. Metritis, may even lead to cystic degeneration of graafian follicle or corpus luteum, by extension through fallopian tubes.

The way in which micro-organisms bring about sterility may be summarised as follows :—

(1) The spermatozoa and ovum may be prevented from coming in contact with each other, as in cervicitis, or salpingitis, which occludes the passage.

(2) Bacteria produce acid reaction of the vagina, which nullify the sperms. They also produce toxins—spermatolysin and spermatoxin—which kills the sperms out right.

(3) In metritis the ovum is not able to attach itself to the uterine mucosa, with the result the ovum die of malnutrition. The ovum may also be killed by the bacterial toxins.

(4) The foetus may develop normally for sometime, when bacterial infection takes place and cause necrosis of cotyledons and the foetus dies. Abortion may follow. If abortion is in the early stages of pregnancy, it may not be noticed, except for a discharge from the vulva. If abortion occurs at later period of gestation, then retention of placenta is a common feature, with the usual consequences.

In some bulls which were sterile, streptococci have been found in the epididymus, leading to faulty spermatogenesis.

Some of the common infections of the

genital system of animals especially females are Dourine, genital horse pox, vesicular exanthema in horses and in cows vesicular exanthema of cattle and granular vaginitis and in dogs infectious venereal granuloma. The above conditions directly or indirectly influence on the fertility of the animals,

(ii) Specific

Brucellosis in cattle :—The damage done to the head by *Brucella abortus* and the fact that this affection causes so often sterility in animals, makes this disease very important. Abortion, sterility, loss in milk production are some among the train of evils that follow infection by Bang's bacillus.

Brucella germs may be present in uterus, or udder of cows and in the testes or vesiculae seminalis of male. This condition is transmissible through copulation. Abortion is probably most widely known, and most rapidly observed symptom. Sterility is usually a serious trouble in herds infected with *B. Abortus*. The chief cause of which is retention of placenta, with subsequent invasion of secondary bacteria, which are responsible for the condition.

Trichomonas foetus :—Only within recent years were the Trichomonads discovered to be the cause of abortion, sterility and breeding difficulties in cattle. As a result of infection, one of the following may happen.

1. The animal may fail to conceive.
2. Conception may take place and may be followed by abortion.
3. The foetus may die and instead of abortion may become macerated, while uterus is filled with greyish white fluid.
4. A normal gestation and birth may occur inspite of infection.

Animals that fail to conceive may develop a uterine infection manifested by a vaginal discharge, which may be continuous or intermittent, occurring chiefly during oestrous periods which may become irregular.

In recent infection of a bull, inflammation of prepuce, with pus formation and

discharge is seen. The penis is inflamed. This condition usually becomes chronic and can be transmitted by copulation.

Vibrio foetus :—Certain cases of abortion are known to be caused in the cow, by *vibrio foetus*. This organism is however responsible for the contagious abortion in sheep.

Other specific infections, which cause abortion and sterility are, *Salmonella abortus equi*, *Salmonella abortus ovis*, Dourine etc.

v. Causes unknown

A review of the above-mentioned causes will, I hope, give an impetus to our members in order to find the depth of the ocean of sterility, and I believe that in near future, still more factors unknown to-day may be discovered, so that a better treatment may be meted out than to-day.

Symptoms :—In a typical case, the history goes, that the cow is repeatedly going to the bull without conceiving. Perhaps, that is all the history given by the owner. But still closer observation is required for diagnosis. The most prominent symptom in the domestic animals is the occurrence of abnormal oestrus. The abnormality may be in frequency, degree, or duration of oestrus.

Frequency of oestrus :—Here the animals come to heat too frequently, or at too long intervals. The normal cow shows oestrus every 3 weeks. Many cows take the bull, 6 to 8 weeks after calving. But in deep yielders the signs are generally delayed for several months.

Degree of heat :—Varies. If too excessive is called nymphomania, due to cystic ovary and sometimes also in chronic inflammation of uterus, cervicitis, etc. It is seen mostly in mares past middle age, and in cow between 4th and 7th calving and in bitches that has been bred for several times. This condition is uncommon in sheep, goats, pigs; and heifers are rarely affected.

Duration of oestrus :—May be short or prolonged. If short and weak may be un-

observed especially at night. Sometimes the duration may be abnormally prolonged to 6 or 7 days. The average duration of oestrus in a cow is 16—24 hours. In confined animals, the oestrus may be too weak although the period and duration may be normal.

Oestrus may be absent in some cases when the animal is known as a "dumb-buller." This is due to oestrogen deficiency, ovarian tumours etc.

Symptoms in Nymphomania :—To start with such cows exhibit considerable excitement in the company of female animals in oestrus, becomes irritable, restless and has a tendency to mount other animals and allows to be mounted by other animals. The animal assumes the characters of male, the head becomes more or less that of a male, hair become, coarse, neck becomes very thick, voice more and more harsh and gruffy like that of a male and constantly bellows. Such animals are termed as "Bullers".

Locally there may be discharge from vulva. There is relaxation of pelvic ligaments and sinking, especially at either side of tail where a hollow is formed, Vagina is found to be relaxed, and cervix, wide open. The tail is raised. Some animals have a tendency to get fattened, while others go down in condition.

In males this condition (sterility) is easily diagnosed. History saying that all the cows that are served by a particular bull do not conceive, is more than enough to come to a conclusion that the bull is sterile.

Diagnosis :—Successful treatment lies in the efficacy of diagnosis. A methodical and systematic way of examination is required for an efficient veterinarian to pitch on the right cause of this condition.

vi. Complete History of Breeding Records

This should include :—

(1) **Previous calvings :—**Whether calving was normal in each case, or associated with

dystokia, whether all calves are alive and healthy etc.

(2) *Abortions*:—To make sure that the animal has been injected by B. Abortus.

(3) *Retention of placenta*:—Is the chief cause for secondary bacterial invasion into genital tract and cause sterility.

vii. General Examination

(a) *General character of oestrus*:—Excessive as in nymphomania, short or weak, duration of oestrus or its absence etc.

(b) *Presence or absence of any Vaginal discharge*:—Suggestive of Vaginitis, cervicitis etc.

(c) *Tension of pelvic ligaments*:—Sinking of the ligaments is present in cases of nymphomania.

(d) *Appearance of Extl. genitals*:—Vulva and Vagina, for any inflamed condition or fluting of vulval lips (often seen in mares).

(e) *Reaction of Vaginal mucosa*:—Tested with litmus paper. If too acid is lethal to spermatozoa.

viii. Special Examination

(a) *Examination per rectum*:—This proceeds examination per vaginum. While examining uterus per rectum, it is important to distinguish pregnancy from any morbid condition of the uterus, as pyometritis etc. to avoid necessary mistakes, and to allow the treatment to be begun without delay. Things that are noted per rectum, are cystic ovary, salphingitis, metritis etc.

(b) *Examination per Vaginum*:—Necessary to detect developmental abnormalities, and also to note the condition of Vagina, as ballooned vagina, etc. and to find out the condition of os, open or closed and any inflamed condition of the genital passage.

Special attention should be paid to the state of os, which should be open and soft during oestrus and firm and closed to a greater extent at other times.

In Males also a systematic examination is necessary as examination of drawn out penis, also scrotum, testicle and other parts if

necessary. Internal examination per rectum is necessary to detect inflammation of prostate, vesiculae seminalis etc. If the animal is able to copulate, observe the act and note whether semen is ejaculated, collect the semen from vagina immediately after copulation and examine under microscope for motility etc.

It will not be out of place to remember a few points regarding healthy, normal conditions, of the genital organs:

The mucous membrane of vulva and vagina should be moist and be of rosy tinge uniformly. The cervix is of rosy tinge and is closed at all times except during Oestrus when it is slightly open, to allow the sperms to enter the uterus. Ordinarily, the uterus is more or less pelvic, and when manipulated, a spasmodic contraction of the uterus indicates health. The fallopian tubes cannot be detected normally, as they are very slender, and only in inflammatory condition as in salphingitis, it is thick and detectable by rectal exploration. The size of ovaries varies in different animals, and normal ovary should not show any marked undulations or cysts on its surface.

Prognosis:—This depends upon the etiological factors that are involved in this malady and the diagnosis of the right cause. Usually a variety of causes take part in sterility rendering prognosis to be guarded.

Treatment:—Treatment must depend upon the detection of the cause and the breeder can render great assistance to the veterinary surgeon by giving full particulars of his animals.

When a heifer is suspected to be sterile, it has to be borne in mind, that the animal is breeding for the first time and so sterility if present might be due to congenital abnormalities and a careful search may disclose the condition, such as imperforate Os, or persistent hymen etc. Surgical means can be adopted according to the circumstances.

The chief cause of sterility according to one author is the inflammatory condition of

genital tract, as vaginitis, cervicitis etc. Out of five herds he has examined and treated with various drugs, he gives the following data.

Herd No.	Vaginal lesions		Percentage conceived to one service	
	Before Treatment	After Treatment	Before Treatment	After Treatment
I	78%	97%	56%	88%
II	65%	29%	66%	83%
III	65%	47%	55%	82%
IV	80%	60%	32%	60%
V	61%	35%	50%	63%

The same cause has been confirmed by another experienced author who has done extensive work on this subject in Hissar cattle farm and gives a review of his findings below.

Endo metritis	32%
Ovarian diseases	20%
Cervicitis	24%
No appreciable pathological lesion but not coming to heat (functional)	10%
Suspected salphingitis	3 %
Hermaphroditism	1 case
Constriction of vagina	1 case
Recto vaginal rupture	1 case
Pregnant	5 %

From the foregoing it will be found that vaginitis, cervicitis, etc. are chiefly held responsible in most of the cases of sterility.

Various treatments have been tried and good results claimed for.

For *vaginitis* an antiseptic douche as Normal Saline Solution or Soda bicarb drachms i to ii in a pint of water, followed by 5% Argyrol gives good results.

For *cervicitis* also the same treatment may be adopted with benefit. Pessaries containing Iodoform one part, Boric acid four parts, having cocoa butter as vehicle can be used.

For *metritis*, the uterus is flushed out with

warm antiseptic lotion (Pot. Permanganate lotion is best suited) by means of a double channel catheter. Douching should be continued till the return flow is clear. Then inject 5 to 10% sol. of argyrol, or 1 to 5% soln. of mercurio-chrome. In cases of chronic Metritis the following is claimed to give good results:

Lugols iodine 10 ounces.

Iodoform $\frac{1}{2}$ —1 ounce.

Liquid paraffin or glycerin 10 ounces. This is mixed and injected. This treatment is repeated every 4 weeks.

Rivanol (Bayer) 1 in 1000 gives good results as claimed by some, especially, when there is purulent discharge.

In addition to the treatment above intramuscular injections of "contramfine in 2 c.c. doses at 6 to 7 days interval works up well in many cases.

Salphingitis, is not worth treating if bilateral. It is best to fatten the animal for the butcher. Mild infections may spontaneously improve with treatment for metritis. If the condition is unilateral, Ovario-Salpingectomy may be performed without any ill effect.

Ovarian cysts must be ruptured per rectum and corpus luteum enucleated if detected.

As a rule a combined treatment may be necessary. Crushing the ovarian cysts, or enucleation of corpus luteum, massaging the ovaries, and uterus had to be resorted to in certain cases.

In males, a course of aphrodisiacs to induce sexual excitement may be adopted in impotent animals. But they do not assist in the formation of healthy sperm. Vitamin E, as in cod-liver-oil, or wheat germ oil can be given in some cases of sterility.

Recommendation of strict exercise, work, and feeding has a lot to do to eradicate sterility. Well balanced ration with plenty of green grass etc. particularly with regards to proteins, minerals as Ca, P, Iodine, and vita-

mins A and E which are of paramount importance have to be considered. Fat and sluggish animals should be put to hard work. Pedigree bulls and cows which are too fat and so indifferent as breeders however tend to become vigorous and fertile when put to hard work as at plough. Such work is however restricted to bulls. In some obscure cases, a change of environment seem to produce good results.

In *nymphomania*, a combined treatment mentioned above is said to give good results in early stages. In such cases, if one ovary alone is diseased and the other healthy, the diseased ovary may be removed with benefit by ovariectomy. This partial operation is worth a trial in valuable breeding stock, large and small.

Artificial insemination: In certain cases, as in animals failing to show oestrus but where normal ovulation occurs it is said to be of great use. Animals having unusually contracted os, or curved and displaced os, or ballooned vagina have been successfully impregnated by artificial insemination. It can be successfully used in impotent animal discharging normal semen. It will not be out of place to mention here, that artificial insemination plays an important part in controlling diseases spread through sexual act, the important of which are Brucellosis, trichomoniasis, vibrio foetus, coital exanthema, granular vaginitis etc. which are responsible for sterility in some cases.

Hormonic treatment especially in sterility of bulls have been undertaken with promising results, the chief source of which is pregnant mare's urine.

Of late *transplantation of gonads* have been found to be a helping hand in solving the problem of sterility. The experiments have been however restricted to males only till now and is said to be of real value. Further experiments have to be conducted before any definite conclusions can be formed about the utility of this method.

Prevention.—"An ounce of prevention is worth a pound of cure is a sound advice regarding sterility. Thorough understanding and avoidance of all the causes mentioned above is of supreme importance.

Remembering that sterility is often due to infection during copulation or at the time of parturition, the following points need a stress.

Sex Hygiene:—It is of utmost importance in order to keep the incidence of genital diseases at its minimum. Suspicious animals having vaginal discharge, abortion, etc., should be isolated at once and treated.

In parturition strictest hygienic measures should be maintained especially regarding instruments used, and in Retention of placenta to avoid any bacterial invasion.

It is always a better plan to give an antiseptic douche, followed by an alkaline douche in cows, before serving and in bulls washing the penis and sheath with an antiseptic lotion to reduce any infection to the minimum.

Diet and exercise etc. have been already stressed under treatment.

Control of Bang's Disease:—This consists in segregating the positive cases by means of agglutination tests at least twice a year, and adopting hygienic measures at the time of parturition and abortion, and disinfection of the cows genitals and premises. If the percentage of the reacting animal is low, it would be advisable to dispose of them by selling to the butcher.

Recently a method of vaccination has been tried in our country. This consists of a s/c injection of 5 c.c. of a saline suspension of a low virulent strain of Br. Abortus, the suitable subject being a calf or a heifer. It is claimed to be promising.

Conclusion:—In such a small paper as this every attempt has been put forward towards the confronting question of sterility; and yet many an etiological factor remains unexplored, as we have already pointed out in this essay; consequently, a positive hit at

the etiological agent of sterility and an adequate means to combat such happening are essential. Hence it is left to the members of this parliament as well as the profession to go deeper still into the fathom of the ocean.—"Sterility".

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Several dogs in the U. S. Army Air Corps have been awarded silver wings for making five parachute jumps from a plane. The best known of these dogs is Max, which has jumped eight times by parachute.

'New Automatic Stitchers' provide the surgeon with a continuous flow of surgical thread, the tension of which he can regulate by pressing a button. Needles of various types may be set at different angles, so that they can be applied to tissues on the body's surface or deep in its interior.

A recent development in electronics has been the 'Electron Microscope', which magnifies objects up to 100,000 times normal size. Viruses, difficult to observe because they are so minute, now can be studied in detail, thus enlarging our knowledge of disease and ways to combat it.

Other uses for electronics in medicine have been the X-ray and fluoroscope, permitting physicians to locate and cure hidden injuries; improved techniques in asepsis; measuring the vitamin content of foods; and the generation of artificial fever in the body by electronic reaction, destroying bacilli, difficult to reach by other means.

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 - (a) "Sterility in dairy cows"—"W. L. Hindmash"—page 90.
 - (b) "Sterility in the cow in India and its control"—R. L. Koura—page 301.
7. Nutritional Abstracts and Reviews—Vol. VII, 1937—Pages: (a) 239, (b) 318, (c) 1145, (d) 1151.
8. Veterinary Record, Vols. 13, 14 and 15.
9. "Sterility in Bulls"—M. G. Fincher, Peter Olafson, and Joan Ferguson—Cornwell Veterinarian—Oct. 1942—page 407.
10. Year Book of Agriculture, 1942—Pages (a) 155, (b) 323, (c) 501, (d) 605 and (e) 645.

The World's chief source of helium is the United States. Helium is used medically to prevent Caisson disease in divers, to treat Asthma and Heart Disease, and to make anaesthetics non-explosives.

Ultrasonic Waves—sound waves too high-pitched to be heard by the human ear—may become useful tools. U. S. scientists have already used them to make permanent emulsions of such "unmixables" as oil and water, and even mercury and water.

TANTALUM is the answer to the long quest for a perfect surgical metal, one of the greatest orthopedic developments in modern medicine. The strong, pliable, non-poisonous, non-irritating and non-corrosive tantalum does not have electrolytic action in the presence of body fluids. It is soft enough to be shaped by a rubber mallet while an operation is in progress. Almost every part of the body can be repaired with tantalum wire, plates or foil—used to relieve facial paralysis, to correct cleft palates and to repair damaged joints. The new metal has played a remarkable role in delicate, hyperprecise neurosurgery.

A Check-List of Parasites, In the Department of Parasitology, Madras Veterinary College Laboratory.

BY

S. V. MUDALIAR, G.M.V.C.

(Lecturer in Parasitology, Madras Veterinary College)

The idea of making a collection of the endo-parasites found in this part of India originated about the year 1920 when the present laboratory was fitted up. The pioneer work in this direction was done by the late Mr. V. Krishnamurthi and he was followed by other workers, no less enthusiastic, among whom, may be mentioned the names of the late Mr. M. R. V. Panikkar, Rao Sahib M. Anant Narayan Rao, L. S. Parameswara Ayyar and the present author.

Specimens were collected from animals in the College during post-mortem examinations, from the local slaughter house, obtained from the staff of the Civil Veterinary Department, Madras, from Muktesar, Lahore and Hyderabad in India and also from places outside India, while certain specimens have been sent from here to England, Africa and America. Still, there are gaps in some of the genera if not in the families that require filling up.

The following check-list of helminths with hosts, location and locality, with the year of collection and a short note regarding the intensity and prevalence wherever deemed necessary, has been prepared with the idea of making a record of collections in this Department of Parasitology, and also, to indicate the regional prevalence of the various helminths. Since the collection is an assemblage of specimens that were received from the staff of the Civil Veterinary Department, Madras, for diagnostic purposes and not obtained as a result of a regularly constituted survey, it does not pretend to be of a representative character. For instance, a large number of specimens have been received from

certain places while none at all from others. This does not denote an absence of parasitism at the latter places. Any how, the list will show the places in this province from where the specimens were obtained and their kind.

A truly representative collection is a necessary pre-requisite for constituting control measures in the eradication of helminths.

Synonyms of valid specimens have been omitted in the list as it will not serve any purpose. A brief account of the intensity of different species of helminths is included, wherever deemed necessary.

The present paper deals with the members of the Class Trematoda available in this department and the Classes Cestoda and Nematoda will follow this in due course.

Due acknowledgments have been given to workers from whom specimens were received. The author's thanks are due to Mr. K. S. Nair, Principal of the College and Rao Sahib M. Anant Narayan Rao for the encouragement and to Mr. S. N. Vaidyanathan for his very willing co-operation and help in this compilation.

Class—TREMATODA Rudolphi 1808.

Order—DIGenea V. Benden 1858.

Sub-order—PROSOSTOMATA Odhner, 1905.

FAMILY: DICROCAELIIDAE Odhner, 1910.

Genus—DICROCAELIUM Dujardin, 1845.

Species. *Dicrocoelium dentriticum* (Rudolph, 1819).

Host. Goat; Location. Liver.

Locality. Kangra Valley, Punjab (1937).

This specimen was obtained through the courtesy of the Principal, Punjab Veterinary College, Lahore.

Genus—EURYTREMA Looss; 1907.

Species. *Eurytrema pancreaticum* (Janson, 1899).

Host. Cow; Location. Intestines.

Locality. Muktesar, U.P. (1923)

Hyderabad, Deccan (1936). Same host and location.

These specimens were obtained through the courtesy of the Director, Imperial Institute of Veterinary Research, Muktesar and the Veterinary Investigation Officer, Hyderabad.

FAMILY: OPISTHORCHIDAE Luhe, 1901.

Genus. OPISTHORCHIS R. Blanchard, 1895.

Species. *Opisthorchis neverca* Braun, 1902.

Host. Dog; Location. Intestines.

Locality. Muktesar, U.P. (1925) through the courtesy of the Director, Imperial Institute of Veterinary Research, Muktesar.

Gudalur, Madras (1941) obtained from the liver of a bitch, being the only collection from a natural case, so far recorded from Madras.

FAMILY: HETEROPHYIDAE Odhner, 1914.

Genus. HETEROPHYES Cobbold, 1866.

Species. *Heterophyes heterophyes* V. Siebold (1852).

Host. Experimental dog; Location. Small Intestines.

Locality. Madras. (1929).

Genus. MONORCHITREMA Nishigori, 1924.

Species. *Monorchitrema taihokui* Nishigori, 1924.

Monorchitrema taihui Nishigori, 1924.

Host. Kite; Location. Intestines.

Locality. Madras (1932).

FAMILY: TROGLOTREMATIDAE.

Genus. PARAGONIMUS Braun, 1899.

Species. *Paragonimus westermanii* Kerbert, 1878.

Host. Tiger; Location. Lung.

Locality. Coorg (1933).

Other hosts. Dog; Location. Lung.

Locality. Calicut and Coimbatore (1934).

The finding of this lung-fluke in dogs is interesting and attempts at more careful post-mortem examination may reveal the helminth in more localities and hosts, including man.

FAMILY: FASCIOLIDAE Railliet, 1895.

Genus. FASCIOLA Linnaeus, 1858.

Species. *Fasciola gigantica* Cobbold, 1855.

Hosts. Cattle, sheep and goats, Buffaloes.

Location. Bile-ducts, gall-bladder and liver.

Locality. Madras (1921).

Several specimens from all over Madras Province, from all the hosts mentioned have been recorded.

FAMILY: ECHINOSTOMATIDAE Dietz, 1910.

Genus. ECHINOSTOMA Rudolphi, 1809.

Species. *Echinostoma revolutum* Frohlich, 1802.

Hosts. Dog, pigeon and chicken.

Mounted slides obtained through the courtesy of P. Beaver, Lawrence College, Appleton, Wisconsin, U.S.A. (1940).

Genus. ECHINOPARYPHIUM Dietz, 1909.

Species. *Echinoparyphium recurvatum*.

Host. Pigeon; Location. Intestines.

Locality. Specimens in glycerin alcohol and Mounted slides obtained through the courtesy of P. Beaver.

Genus. EUPARYPHIUM Dietz, 1909.

Species. *Euparyphium malayanum* Leiper, 1911.

Host. Dog and cat; Location. Intestines.

Locality. Madras (1931).

These specimens were obtained experimentally at the Madras Veterinary College, Department of Parasitology, by feeding metacercariae from fish to dogs and cats.

Genus. ECHINOCHASMUS Dietz, 1909.
 Species. *Echinochasmus narayani* Mudaliar, S.V., 1937.
 Host. Kite; Location. Intestines.
 Locality. Madras (1937).

FAMILY: SCHISTOMATIDAE.

Genus. SCHISTOSOMA Weinland, 1858.
 Species. *Schistosoma spindalis* Montgomery, 1906.

Host. Cattle and sheep; Location. Mesenteric and portal veins.

Locality. Madras (1922).

This parasite is recorded from many places in South India.

Schistosoma nasalis Rao, 1932.

Host. Cattle and buffalo; Location. Nasal veins.

Locality. Madras (1932).

Bovine nasal schistosomiasis is caused by this parasite and fairly widespread all over the province. The life-history of the causal parasite—*Schistosoma nasalis*—was worked out at this laboratory.

Schistosoma incognitum (*Schistosoma suis*) Rao and Ayyar, 1933.

Host. Pig; Location. Portal vein.

Locality. Madras (1932).

This helminth was met with and described from portal vessels of the pig, for the first time, in Madras.

Other hosts. Dog; Location. Portal vein.

Locality. Madras (1941).

Schistosoma indicum Montgomery, 1906.

Host. Horse and cattle; Location. Portal and mesenteric veins.

Locality. Madras (1922).

Schistosoma bovis Sonsino, 1876.

Host. Cattle and sheep.

Location. Mesenteric and portal veins.

Locality. Iraq.

Preserved specimens were obtained through the courtesy of Mr. Mchattie (1935). Iraq.

Species. *Schistosoma turkestanicum* Skrjabin, 1913.

Host. Sheep and goats, cattle; Location. Portal vessels.

Locality. Iraq.

Preserved specimens were obtained through the courtesy of Mr. Mchattie (1935). Iraq.

New species. *Schistosoma nairi* N. Sp. Mudaliar, S.V., and Achary, G.R., 1945.

Host. Elephant; Location. Portal vessels; Locality. Coimbatore, (Topslip area) Madras, S. India.

FAMILY: PARAMPHISTOMIDAE.

Genus. PARAMPHISTOMUM Fischöder, 1901.

Species. *Paramphistomum cervi*, Schrank, 1790.

Host. Bullock; Location. Rumen.

Locality. Madras (1923). (The identity of this is doubtful and specimens resemble species of *Cotylophoron*.)

Other hosts. Buffaloes, sheep and goats. Location. Rumen.

Paramphistomum explanatum Creplin, 1847.

Hosts. Cattle, buffalo, sheep and goats. Location. Liver and bile duct.

Locality. Madras (1923).

Genus. COTYLOPHORON Stiles and Soldberger, 1910.

Species. *Cotylophoron cotylophorum* Fischöder, 1901.

Hosts. Cow, sheep and goats; Location. Rumen.

Locality. Madras (1926).

Genus. GASTROTHYLAX Poirier, 1883.

Species. *Gastrothylax crumenifer* Creplin, 1847.

Hosts. Cattle, buffaloes, sheep and goats; Location. Rumen.

Locality. Madras (1923).

Genus. FISCHOEDERIUS Stiles and Goldberger, 1910.

Species. *Fischoederius elongatus* Poirier, 1883.

Hosts. Cattle, buffaloes, sheep and goats; Location. Rumen.

Locality. Madras (1923).

Fischoederius cobboldi Poirier, 1883.

Hosts. Cattle, buffaloes, sheep and goats; Location. Rumen.

Locality. Madras (1923).

All the members of the Family Paramphistomidae mentioned above except *Paramphistomum explanatum* are very commonly met with in the rumen of cattle, buffaloes, sheep and goats of this province and do not appear to cause any great inconvenience. The larval forms of *Paramphistomum cervi* and possibly of others also are of consequence as causative factors in gastro-enteritis and diarrhoea in young animals. The species *Paramphistomum explanatum* has been very often met with in the livers of buffaloes particularly and may prove harmful to the organ though the extent of the harm caused has yet to be assessed.

Genus. GASTRODISCUS Leuckart, 1877.

Species. *Gastrodiscus aegyptiacus* Cobbold, 1876.

Host. Horse; Location. Large intestines.

Long distance shipping of dairy bull semen is being regularly practised in the United States. By ordinary means, shipment of semen requires 48 hours or longer and keeping the sample at a temperature between 35° and 45° F (2° and 7°C) during that period to preserve its potency.

Owing to the prospect of making continent to continent shipments of semen after the war, studies of this subject have been made at the Missouri and New York agricultural experiment stations. Studies of packaging have resulted in desirable storage temperatures being maintained for more than 80 hours in atmospheric temperature between 80° and 90°F (27° and 32°C). In 24 shipments made, the semen samples arrived at their destination in a condition comparable to storage for the same time in the refrigerator at 40°F (4°C).

Twelve cows have been inseminated and eight conceptions resulted from properly packaged semen samples, inseminated after 48 to 130 hours in transit, while of six samples in storage more than 144 hours, none were successful.

—*Journal of Animal Science.*

Locality. Madras (1923).

Other hosts. Elephant; Location. Intestines.

Locality. Madras forests (1930).

Host. Mule; Locality. Intestines.

Locality. Madras (1935).

Genus. PSEUDODISCUS Sonsino, 1895.

Species. *Pseudodiscus hawkesi* Cobbold, 1875.

Host. Elephant; Location. Intestines.

Locality. Madras (1923).

Species. *Pseudodiscus collinsi* Cobbold, 1895.

Host. Pony; Location. Intestines.

Locality. Palakol, Godavari District, South India.

Genus. PFENDARIUS Stiles and Goldberger, 1910.

Species. *Pfendarius papillatus* Cobbold, 1882.

Host. Elephant; Location. Intestines.

Locality. Madras (1923).

The *Bacillus anthracis* has been isolated from a colony of spinose ear ticks (*Ornithodoros megnini*) in various stages of development, attached to the ear of a cow dead of Anthrax. This finding indicates that spinose ear ticks from Anthrax carcasses may possibly spread the disease to healthy animals. Tick infested carcasses of animals dead of Anthrax should, therefore, be promptly disposed of, and greater effort should be made by livestock owners to keep their herds free from these ticks.

—*American Journal of Veterinary Research*

The dumb animals do things more by instincts than by real intelligence. The amount of intelligence an animal possesses is not computable because that faculty does not exist, although both domestic and wild animals, high and low, exhibit truly remarkable instincts amounting to intelligence. The two are difficult to differentiate owing to their inseparable relation to the search for subsistence.

ON GROWING A BEARD

BY

SEEGIUS

[*"This article is dedicated to poor 'Pippy,' who is so fond of beard but has little"—Characters are not real.*]

You may well wonder why a veterinarian should be interested in this topic. It is quite a natural curiosity and the explanation is, a man's general interest in all subjects. This subject is no doubt dear to his heart. As yet there is no indication that this topic has been discussed at Potsdam and to me it is no wonder that it escaped discussion at the Simla conference.

I feel pride in thrashing out this problem, a favourite remark of our professor whenever he discusses any topic. My pride is particularly more, because "beard" is the only topic on which man can talk with all authority without in the least expecting a protest, from his opposite sex, on his right to do so. It goes without saying that the other labial appendage, called "Mustaches" must necessarily be included under this head, because a beard without mustaches is just like a house without a portico. Even the most philosophic thinking cannot make one reconciled to such an appearance of his face.

I cannot recommend to you a greater authority to talk on "Mustaches" than my friend Mr. Rao, whom you may all already know to be a great advocate of mustache growing. He can give you a veritable thesis on this subject, provided you have the patience to give complete hearing to his lecture. Mr. Rao can tell a man—everything about him—by the mustaches he keeps. He himself is a great connoisseur in the art and trims his supra labial appendages quite regularly; every second day you can find a new design on his blooming face. Personally I

have become so much accustomed to noticing his frequent change of style that I can almost predict with certainty how those bristles will look like on Fridays, Wednesdays and Sundays. My young friend is such a "Mustache maniac" that he thinks it must be considered a national duty to keep mustaches! Evidently he does not give woman a place under the sun. It cannot be denied that he has got a good following and each one has his own style, "*original*" as they call it, which term only indicates the extent of one's skill in concealing the origin. If you walk round our residence any day morning, you can see these very hard working sincere devotees of our leader, doing their daily penance in front of a looking glass, dressing up their antennæ prior to giving their usual "attendance". Only *one* among them has been seen to shirk all this work, letting his mustaches grow wild on his face and that is "Broncho." He never bothers to trim his pair except when he goes for his "oral" in March and May. Once, with great pride he grew them in the style of the great Stalin and really posed himself as the genuine stuff of the dictator; I am afraid he even believed for a short while in the genuineness of his fake! But it did not last long. Except for this solitary exception all the other advocates adopt variety in style. Particular mention must be made of a young gentle man in his prime of youth who had become delirious with joy at the sight of his budding bristles. He used to make all hasty attempts to keep the mustaches trim; tall, fair, thin and spectacled, he used to show great gusts in all that he did and talked. The poor boy used to relish immensely the good remarks his friends made about his thin long musta-

ches. He nursed that fond child for full one year, washing, trimming, polishing and powdering that dear little babe and was very happy with his daily life. But such pleasures are short-lived. If you have tears to shed, dear reader, shed them now; for, (just in a short time) on a sunny April morning my young friend woke up to find his mustaches missing. He slept too long the previous night and some of his dear friends relieved him of his burden. It was a terrible loss to him and he has not yet recovered from the consequent shock. Never since that unhappy incident have I seen him laugh heartily in company. But, I am sure he will become gay again, for his mustaches will grow again one day; they will, like the eternal sphinx, rise again—not from their ashes but from their stumps:

Quite of another variety was the one which adorned the face of my neighbour. Dark as ebony, he used to have a sprinkling of this adored bristles growing under his very nose, their presence being brought to your notice only by an interesting comment on the same by some companion. In contrast to its scarce appearance on my friend's face, was the threatening pair of mustaches on "Geevee's" face. It used to frighten poor innocent "Pippy" but the obliging good man removed his armour to the great relief of all the little boys who used to frequent that part of our residence.

It must be declared by all nations as an unquestionable freedom of man—to have the liberty to grow a beard, and along with this to go about with unshaven faces. Not much thought has been bestowed on this problem as yet; but just think of it and you will realise into what a labyrinthine monotony of existence our civilisation is leading us. Oh for the days when blades and cut throat razors were unknown in the world, when man could walk about without having to sharpen knives on his God given face! What a sinful deed, that man must convert his own face into a morbid whetstone! I do not know about the origin of this inhuman art of welding a razor

but I must condemn it as a brutal practice. And think into what low depths it has drawn our beings! Lawyers and judges must appear in Courts with clean shaven faces (what a farce) husbands should not grow beards though they may keep mustache, and students must enter class rooms with "blank" faces and also (the pity of pities!) face their examiners without any beard (preferably I mean). It was once the unfortunate lot of my friend to go unshaven for his 'oral' examination. Imagine what a shock he got when the examiner begins his questioning with the remarks.—"Well, my friend, I do not find any reason why you should not have had a shave. In our days, we never used to go about like this." Poor R—felt mother earth sinking under him; his heart came to his throat out of sheer nervousness and he would probably have collapsed but for a timely smile from his professor. But, all those he had mugged up left his memory for a short length of time, which to him seemed an age. Thank God, he mustered enough courage to answer all questions. His beard did not fail him.

You must have no prejudice against beards. But the percentage of bearded men in the world is very small and to some extent longevity has been associated with 'beard.' Invariably all bearded men live long, very long at that. I cannot say the same about mustaches, for we have no statistics. As for beard, well, look around you, cultivate a power of observation (the first lesson my professor taught me while talking about walking on roads) and then say if I am wrong. If you are not convinced even by that turn your thought on Bernard Shaw. Oh, what a mighty old man, full of mellow-age and bearded youth; some may yet say that beard is never the true standard of brains; but 'they invariably make the mistake of thinking that the seat of intelligence is in the chin.'

With so much said in favour of a healthy practice, I now request your co-operation to start an association to promote this habit of

(Continued on Page 37)

ANTISEPTICS

BY

M. K. PATRA, M.Sc., G.M.V.C.

Final Year B.V.Sc.

Life exists invariably everywhere in the world of our's, being manifested in its ever increasing forms, beginning from the unicellular organisms to the highly developed human beings in the animal kingdom. This equally holds good in the sister kingdom of plant origin.

From time immemorial there is being raised a continuous struggle of existence among all forms of life, which is best seen in human beings. In spite of terrible odds human beings try to live. They don't have an easy go in this world where they have to meet at every step thousands of enemies which are of diverse character. One among these is the disease producing factor. Diseases in the animal kingdom are caused by many agents, such as Mechanical, Physical, Bacterial and Parasitic. Man in his battle against these disease producing agents, *e.g.*, Bacteria and parasites has evolved ways and means to defend himself and to march in his life's journey. Man in his utter need of the domesticated animals has also utilized the same means to combat the diseases. The agents used against these, bacteria and parasites come under a broad heading "Antiseptics".

These agents which are fundamentals in surgery, Medicine and Therapeutics, are most common in our everyday use. They are quite simple but most useful.

Antisepsis is the method of preventing infection of wounds and the mitigation and destruction of infection by means of antiseptics. These agents are endowed with the properties of retarding the development of bacteria which set up suppuration, gangrene, Septicaemia and other wound infection.

Inspired by the labours of Pasteur on fermentation, Lord Lister instituted in 1865 the theory of Antisepsis and established the "Germ theory" of wound infection. Until 1865 a great number of surgeons believed that the bad nature of wounds was due to vitiated state of atmosphere which they considered was charged with miasmata of putrefaction. The work of Pasteur and Tyndall seemed to confirm the correctness of the view, by demonstrating that it was not the air itself as many thought but the germs which floated in it that were endowed with the injurious properties. Lister at first believed this theory and then in order to remedy it, he introduced disinfection spray which later he gave up. Although he was not the first to use antiseptics in the treatment of wounds he was the pioneer in using them in methodical manner with a definite object in view. By this he was able to reduce mortality of major operation and other wounds from 50-60% or even more to 6 and even 4%. In 1870 Guérin introduced cotton wool with the object of excluding organisms from the wound, paying little attention to infection of instruments, dressings and hands. Lister in his practice was to destroy the organisms in air by spraying with carbolic acid.

These agents which are described here under the heading. "Antiseptics" can be placed under three groups, *e.g.* :

- (1) Antiseptics.
- (2) Disinfectants.
- (3) Germicides.

These terms though in their true sense are different yet are used technically as synonyms. They are one among each other and

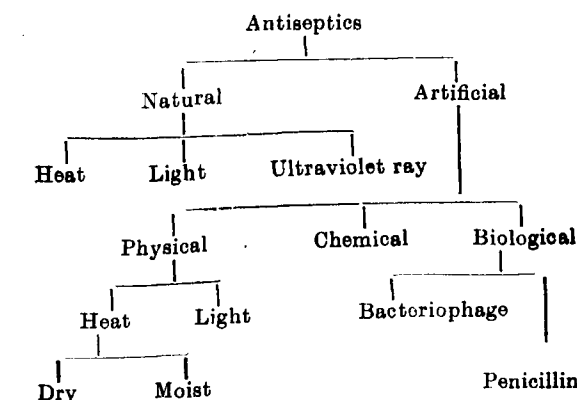
are inseparable. A watertight compartment cannot be created between them.

The three different terms are used as follows :

- (1) Antiseptics:—Agents which prevent bacterial development.
- (2) Disinfectants:—Agents which destroy infective matter.
- (3) Germicides:—Are agents which will kill micro-organisms.

All disinfectants are antiseptics but all antiseptics are not disinfectants. These three terms are somewhat loosely used in the antibacterial sense and as such become synonymous.

Antiseptics can be classified under the following heads.



Heat:—The various species of bacteria have a well defined temperature range with minimum and maximum limits within which is the optimum temperature. This range differs for different organisms. Putrefactive organisms have an optimum of summer heat (20–25°C). So unfavourable temperature may profoundly affect the species *i.e.*, beyond the limit on either direction of the range. Thermal death point of bacteria is the temperature at which death takes place in a given period of time. High temperature is more effective than low temperature on bacteria. Heat can be applied as Dry heat and Moist heat. Dry heat is not so effective as Moist heat. Moist heat will penetrate the organism and kill it at a shorter time. Dry heat is applied in the form of Bunsen flame,

heat of sun, hot air etc., whereas moist heat is applied by boiling in water, exposing to steam under atmospheric pressure and high pressure.

Light:—It has an injurious effect on bacteria as all organisms grow best in the dark. Sunlight, strong electric light and ultraviolet rays are quickly fatal. Sunlight has been found fatal in one and half hours to dry anthrax spores. Diffuse day-light is also injurious to bacteria but requires a longer time to kill than sunlight. The effects of light vary with the species of bacteria and the medium in which they are exposed.

Chemical:—The chemical agents are further classified under the following heads :

- (1) Acids and Alkalis.
- (2) Oxidising agents, *e.g.*, KMnO_4 , H_2O_2 , etc.
- (3) Reducing agents— H_2SO_3 .
- (4) Metallic salts.
- (5) Halogen and their compounds, *e.g.*, Bleaching powder, iodine, chloroform etc.
- (6) Coaltar derivatives—Phenol, Cresol, Lysol, izal, cylline etc.
- (7) Aniline dyes—Crystal Violet, Gentian Violet, Acriflavin, Brilliant green etc.
- (8) Formaldehyde.
- (9) Alcohol and ether.
- (10) Essential oils—*ol. terebinthinae*, *ol. eucalypti* etc.
- (11) Soap.

Biological:—The biological agents are grouped under the following classes :

- (1) Bacteriophage.
- (2) Antitoxins and Antigen.
- (3) Penicillin and Vivicillin.

Mode of action:—These agents act in the following way :

- (1) By oxidising the protoplasm—Permanganate, H_2O_2 , Na-Sulphide etc.
- (2) By coagulating the bacterial protoplasm—Moist heat—Metallic salts like Hg, Cu, Zn, Bi etc.

- (3) By combining with bacterial protoplasm. In this way they act as poison.
- (4) By eating away the bacteria in case of bacteriophage, Penicillin.
- (5) By neutralising the toxin and bacteria—Antitoxins and Antibacterial sera.

Factors modifying the action of disinfectants :

- (1) Concentration of the disinfectant—stronger the solution used the better is the disinfectant action.
- (2) Medium in which it acts—Presence of organic matter interferes with the germicidal action to a great extent.
- (3) Temperature :—The disinfectant action is more effective at higher temperature.
- (4) Time—Longer the time allowed, more effective is the germicidal action.
- (5) Type of bacteria on which it acts. Disinfectant action is less effective on spores and spore bearing bacteria. In this way bacteria vary in their capacity of resisting the germicidal action of disinfectants.

Standardisation :—The various factors modifying the action of disinfectants necessitates the standardisation of disinfectants. There are various methods of finding out the power of disinfectants but the two most commonly used are the (1) Rideal-Walker test and (2) Chick-Martin test.

Rideal-Walker test :—This method aims at comparing the germicidal power of a disinfectant with that of Phenol and expressing it in terms of carbolic acid coefficient or Phenol coefficient. The test requires the finding of dilution of the unknown disinfectant at which it kills the test organisms in 7½ mts, and this is compared with the Phenol dilution under the same condition. The test organism is Eberthella typhi (B. typhosus).

Phenol coefficient = $\frac{\text{The dilution of the disinfectant which kills in } 7\frac{1}{2} \text{ mts.}}{\text{The dilution of Phenol which kills E. typhi in the same time.}}$

- Materials required for the test :—
- (1) Standard carbolic acid solution for

control :—This is a 5% solution made from pure carbolic acid crystals having a solidifying point of 40°·5 C. This should be standardised by titration with decinormal bromine. It keeps indefinitely in stoppered bottles. From this solution, the various working strengths are made up by diluting it with sterile distilled water.

- (2) Dilution of the disinfectant X (unknown) in sterile distilled water.
- (3) Twenty four hours broth culture of E. typhi (test culture). The organism should be subcultured everyday for 7 days and before use it should be shaken and kept aside for half an hour to allow the clumps to settle at the bottom.
- (4) Standard nutrient broth which is poured in 5" × ¾" test tubes in amounts of 5 c.c. each. The composition of broth is as follows :—

Liebig's extract of meat	...	20 gms.
Peptone	...	20 "
Salt	...	10 "
Distilled water	...	1000 c.c.

Apparatus required :—

- (1) A special test tube rack. It contains 2 tiers. The upper one having holes for 20 test tubes of 5" × ¾" size in 2 rows, each row containing 2 sets of five. This is meant for standard broth tubes (containing 5 c.c. in each) which are numbered 1—20 with a grease pencil. The lower tier contains five holes for larger sized test tubes which dip into a copper water bath beneath the rack. This is meant for medication tubes—4 for the disinfectant and one for Phenol.
- (2) Inoculating needle :—This consists of Platinum wire of about 1½" length. One end of which is fixed to a glass rod and the other end is made into a loop of 4 mm. internal diameter.
- (3) Sterile dropping pipette for measuring out 0·5 c.c. of broth culture.
- (4) Sterile pipettes and stoppered measuring cylinders for obtaining suitable dilutions of the disinfectant to be tested.
- (5) Sterile test tubes (large size).

Technique :—A suitable dilution say 1/100 of standard Phenol is made in Sterile distilled water. Four dilutions of the disinfectant X to be tested are also made. The dilutions suitable for an accurate test should be determined beforehand by a rough test. Arrange the test tube rack with the tubes. The temperature of the water bath is regulated at 15°C to 18°C. 5 c.c. of the 4 diluted disinfectants and 1 Phenol solution are added to the respective large test tubes. At intervals of half a minute 0·5 c.c. of the broth culture of the test organism is added to each of the above tubes in succession. When the 5th tube has been added to, the 1st tube is exposed to 2 mts. to the action of the disinfectant. After waiting for another ½ mt., a loopful of mixture from the 1st tube is inoculated into broth tube No. 1. At interval of ½ mt., a loopful of the mixture from the 2nd medication tube is inoculated into broth tube No. 2 and so on. In this way the process is repeated at ½ mt. intervals till all the 20 broth tubes are inoculated. Thus 4 sets of broth tubes are inoculated at intervals of 2½, 5, 7½ and 10 mts. All the broth tubes are then incubated at 37°C for 48 hrs. and examined for growth. The test is represented graphically as follows :

5 c.c. of disinfectant + 0·5 c.c. of test organism		Time of exposure in minutes and number of broth tube inoculated				Incubated at 37°C for 48 hrs.
Disinfectant	Dilution	2½	5	7½	10	
X	1 in 800	1 +	6 -	11 -	16 -	
X	1 in 900	2 +	7 +	12 -	17 -	
X	1 in 1000	3 +	8 +	13 +	18 -	
X	1 in 1100	4 +	9 +	14 +	19 +	
Phenol	1 in 100	5 +	10 +	15 -	20 -	

Result in the broth tubes is recorded by plus and minus basis. The sign + indicates

growth or non killing while - for absence of growth or killing of the organism.

From the above table it will be seen that Phenol 1/100 dilution gives the same result as the disinfectant X in 1/900 dilution.

∴ Phenol coefficient of disinfectant X

$$= \frac{900}{100} = 9.$$

Chick-Martin's Test :—In practice, the disinfectant has to act in the presence of organic matter the amount of which considerably modifies the germicidal activity of the disinfectants used. In the Rideal-Walker method the disinfectant acts in an aqueous solution, the only organic matter present being a culture of E. typhi. In the Chick-Martin's Test however the disinfectant is tested on the organism in the presence of a suspension of 3% dried human faeces at 20°C and instead of varying the time it is allowed to act for a constant time (30 mts.) after which subcultures are made into duplicate glucose broth tubes from each dilution. It should be remembered that the presence of the organic faecal matter definitely modifies the germicidal action of the disinfectant and the high phenol coefficients obtained by the Rideal-Walker method are considerably lower when the same material is tested by Chick-Martin test.

Antiseptics of the different systems of the body :—The body comprises of a number of systems, e.g., Alimentary, urinary, respiratory etc. The different systems require different kinds of antiseptics, though a few of the antiseptics may be common for all the systems. These are called systemic antiseptics.

Alimentary antiseptics :—The different agents used for the different portions of the alimentary system are as follows :

- (1) Mouth washes—Permanganate soln., K-chlorate, carbolic acid (dil.) sulphuric acid (dil.) etc.
- (2) Gastric antiseptics :—Which control excessive fermentation by acting on the yeast cells. They are used in cattle to

prevent excessive fermentation in the rumen and in horses for acute gastric tympany. The agents are Formalin, carbolic acid, oil of turpentine.

(3) Intestinal antiseptics :—These agents diminish the activity of bacteria in the intestine. They are prescribed in conditions such as dysentery, diarrhoea, and allied conditions believed to be caused by bacteria, e.g., Cresol, Phenol, Resorcinol, B-naphthol, formalin, salol etc. KMnO_4 soln. also.

Kaolin and chalk though not antiseptics yet prevent further infection.

(4) Enemata— KMnO_4 soln.—Boracic acid—Saline.

Urinary antiseptics :—These are agents which prevent the multiplication of bacteria in the urine and on the mucosa of the bladder and urinary passages. They are as follows: Benzoic acid, Hexamine, salicylic acid, mandelic acid, cubeb copaiba, oil of Juniper, oil of sandalwood, Hermitol, urea malin. All urinary antiseptics act efficiently if the urine is acidic. Hexamine so to say has no antiseptic action unless the urine is rendered acidic by administering sodium hydrogen phosphate etc. Acids also act as antiseptics. In chronic inflammation of the bladder and urinary passages agents such as copaiba, cubebs, oil of juniper, terebene and buchu are prescribed.

Hexamine (urotropin)—Hexamethyl tetramine—when given per OS is rapidly excreted by the kidneys and when the urine is acid, a portion of the drug is split up, yielding free formaldehyde which acts as antiseptic. This is effective, when the PH value of urine is 6.

The above mentioned drugs are excreted mainly by the kidneys in combination with glycuronic acid and during their passage through the bladder and urethra, exert an antiseptic action on the urino-genital passage.

Respiratory antiseptics :—The following agents serve as respiratory antiseptics:

Volatile oils like, ol. eucalyptus, ol. terebinthinae etc as inhalation, Intra tracheal

injection of Creosote, Phenol, Turpentine, Lugol's iodine etc.

Circulatory antiseptics :—These antiseptics get into the circulatory system and act as general antiseptics. They also act in the blood which contains the bacteria etc. They are as follows: (1) Lugol's iodine, (2) Quinine, (3) Cibazol, (4) N.A.B. etc.

Antiseptics of the Genital System :—These antiseptics are very commonly and frequently used. Irrigation of uterus, vagina and vulva by antiseptic fluids such as KMnO_4 solution, Boric acid, Lugol's iodine, Lysol Chinosol solution etc. Antiseptic pessaries containing iodoform, boric acid etc. are inserted into the uterus in cases of retained placenta, metritis etc. In prolapse of vagina normal saline, KMnO_4 solution are used to clean the portion before it is pushed in.

Intramammary injection of dilute solution of acriflavin 1/10000 in chronic and subacute strepto coccal mastitis.

High doses of sulphanilamide gives a good result in cases of acute mastitis.

Liquid soap is used to clean the sheath of horses.

Skin and external wounds :—Ol. Picis, Tr. Iodine, KMnO_4 , Benzoin, salicylic acid, Icthyol—Mercuric Perchloride—Boric acid—Hydrargyri iodidi rubrum—Spirit—Shark liver oil—Codliver oil—Sulphanilamide—Gentian violet etc.

Eye :—Boric lotion—E.Z.B.—Yellow ointment—Zinc sulphate solution—copper sulphate solution.

Ear :—Spirit—Hydrogen Peroxide.

General disinfectants :—

Litter, bedding and articles of little value—To be burnt.

Blankets—Brushes etc.—Boiled or steamed or put in a strong disinfectant.

Harness and Saddle—Wash with disinfectant lotion and then put in sun.

Wood works and wall—Scrub with a good disinfectant, whitewash and then paint.

Ceiling and Rooms—Fumigation or Spraying.

Fumigation :—This is usually done by burning sulphur to disinfect stables and farm buildings. The method consists in burning sulphur with 1/40 parts of charcoal, proper instruction being given to close all outlets. Generally a pound of sulphur is broken and moistened with methylated spirit, is mixed with the required amount of charcoal. This mixture is burnt in a vessel placed in water contained in another vessel. The active agent is sulphurous acid gas. About 2 lbs. of sulphur will disinfect a room of 1000 cubic ft., Pptd sulphur is better for fumigation because it is more active than flower of sulphur.

Spraying :—The usual agent sprayed is carbolic acid solution. This is usually done in Pasteurising room and Serum institutes.

Cesspools :—Bleaching Powder—Lime—Cresol—Crude oil.

Dead bodies :—Either to burn or bury but the former is better.

Surgical instruments :—Sterilization or put into strong antiseptic lotions such as Lysol, Chinosol, Phenol.

Common antiseptics used, their preparations and various uses.

Mineral.

(1) Perchloride of Mercury :—It is irritating for recent non-contaminated wounds.

Solutions of 1/5000 to 1/3000 may be used for mucous surfaces such as vagina and uterus.

Perchloride of mercury 1 part + Rectified spirit 1000 parts :—Is suitable for Surgeon's hand.

(2) Biniodide of Mercury :—Hydrargyri iodidi rubrum. It is more powerful germicide than the perchloride.

1/10,000 to 1/20,000 :—Suitable for the ocular or uterine m.m. Is non-irritant for hands and wounds and does not alter instruments.

(3) Zinc chloride :—A 5% solution destroys most spores but is a caustic. 10% solution is effective against very septic wounds and fistulae.

(4) Potassium Permanganate :—Is one of the commonest and safest antiseptic. It is a useful non-toxic antiseptic. It acts by parting with oxygen to albumin or other organic matter, but since it rapidly deoxidised its action is very transient.

(a) 1% solution is used as a disinfectant.

(b) It is usually employed in a proportion of 1/1000. This is suitable for all mucous and serous cavities.

(c) 10% for septic wounds.

(d) Powdered KMnO_4 mixed with charcoal and boric acid forms an excellent dressing for septic wound. It is also good for open joints.

(e) In Rinderpest 20 grs. per OS.

(f) Snakebite and stuttgart's disease.

(5) Sodium chloride :—It has long been known as possessing antiseptic properties. It is used for irrigating operating wounds and removing extravasated blood from contused wound.

It is used also to irrigate uterus, vagina, nasal channels and septic wounds. Normal saline (0.9%) is always used.

The saline causes an out pouring of lymph which acts as a bactericide.

(6) Silver Nitrate :—In the form of sticks it is a very useful caustic and antiseptic and stimulant for indolent wounds or one covered with soft unhealthy granulations.

(7) Magnesium chloride :—12 in 1000 is sometimes used.

(8) Halogens :—This group comprises the 3 halogens namely Chlorine, Bromine and Iodine and those compounds of these 3 elements from which they are easily liberated.

The antiseptic action of these can be explained by 2 factors.

(a) They enter very easily into chemical combination with organic matter by

withdrawing hydrogen from it and forming the HCl, HBr and HI acids, which exert usually acid reaction.

(b) By breaking up the water of the tissues they will set free Ozone which is also irritant.

The actions are most marked in Cl₂, less in Br₂ and least in I₂. The action of iodine is much less violent.

The following are the preparations belonging to this group which are used as antiseptics and disinfectants.

(i) Eusol:—It is a filtered solution of 25 gms. Eupod (Boric acid 12.5 gms + Bleaching Powder 12.5 gms) in a litre of water. It contains 0.27% HOCl (hypochlorous acid). It is cheap, slightly irritant, non-toxic and very effective. But it is not suitable for emersion of instruments.

(ii) Dakin's solution—Liq. sodae chlorinate chirurgicallis. This is prepared as follows. 14 gms. of anhydrous or 40 gms. of crystal Na₂CO₃ and 20 gms. of CaCl₂ are dissolved in a litre of ordinary water. The mixture is shaken and allowed to settle for half an hour. The supernatant liquid is then siphoned off and finally filtered. To this filtrate 4 gms. of boric acid is added. This solution contains about 0.5–0.55% of available chlorine. This is an isotonic solution, closely resembling Eusol and its action. It is an antiseptic but is less stable than Eusol. Thus it requires to be freshly prepared and protected from light.

It has a widespread reputation as a reliable antiseptic and non-irritant application for open wounds. Its antiseptic power is 100 times greater than carbolic acid.

(iii) Iodine:—It precipitates proteins and forms easily decomposed compounds with them. Hence it remains for sometime at the point of action. Being volatile it penetrates deeply so it has lasting and penetrating effects. Its irritating action is mild. It seldom produces more than redness and desquamation with some smarting at the point of application. On the skin it leaves a

yellow colour. This stain can be removed by Na-thiosulphate or ammonia.

The preparations of Iodine are the following.

(A) Tincture of Iodine—Liq iodi fortis 10%. Liq iodi mitis 2.5%.

The tincture consists of Iodine—2.5 gms. KI—1.5 gms. + Distilled water—2.5 c.c. alcohol (90%)—upto 100 c.c. + This is strong tincture.

(B) Liq iodi—Lugol's solution—Iodine—2 + KI—3 + Water 40.

(C) Unguentum Iodi—Iodine—4 + KI—4 + Glycerin—12 + Prepared Lard—80. % of Iodine—4.

As a lotion in the form of i–ii drachms of Tincture in Oi of water it is used for irrigating wounds and the uterus after parturition and metritis. Its specific action against actinomycosis has long been established. It has been safely and confidently used in surgery during operation. After suturing a cutaneous wound it is better to paint Tr. of iodine along the course of the wound and sutures. If a coating is painted every day stitch suppuration is prevented. The application of Tr. of iodine to the navel immediately after birth is largely adopted to prevent navel-ill and other infections gaining entrance through the umbilicus. It is frequently injected into sinus wounds in soft tissues, into bursal cysts, haematoma after the clotted blood is removed, hydrocoel and similar conditions.

Iodine in the form of Glycerin of Iodine is an excellent antiseptic for chronic auricular with thickening of the investing membrane of the external ear in dogs and cats.

Iodine in CCl₄ has been used for sterilization of the hands and skin. Lugol's iodine is injected I/T and I/V and acts as circulatory and respiratory antiseptics.

On delicate skin like covering of scrotum the use of iodine should not be repeated daily except after an interval of several days or a painful dermatitis is likely to be set up.

Iodine is handicapped in its use for deeper tissue.

(iv) Iodoform:—Is inferior to Iodine as an antiseptic and it has very little germicidal action in vitro. It acts by its effect of reducing secretion from wounded surface by hindering emigration of leucocytes from the blood vessels and by the fact that Iodine is liberated by contact of Iodoform with the organic matter of the tissue and secretion. It enters at once into combination with proteins acting as a stimulant and facilitating absorption, of the exudate.

It is chiefly used in the following forms (1) Boro-Iodoform—As dusting powder and dry dressing, (2) Iodoform pessaries in case of retained placenta, suppurative metritis etc.

(9) Copper sulphate:—1/1000 strength for infected mm. and certain accidental wound. CuSO₄ solution has been used for irrigating the genital passages after epizootic abortion, specific urethritis and nasal channels affected with chronic catarrh.

(10) Bismuth subnitrate:—This is used in the formula of Beck's Bismuth paste for injection into fistulous tracts, sinuses and abscess cavities.

(11) BIPP—Bismuth Iodoform Paraffinum Paste (Bismuth subnitrate—8 Oz Iodoform—16 Ozs—Liquid paraffin—to form a paste). It is well rubbed by means of dry gauze into the surface wall of recently infected wound after this has been mopped up with Methylated spirit. Then the wound is sutured and covered with sterilized gauze and absorbent pad. Dressing should be renewed if the wound does not progress favourably.

(12) Sodium Hypochlorite:—Chloride of lime—10 + Sodium carbonate—15 water—100. It was first introduced by Berthalett as a disinfectant and deodourant.

(13) Potassium chlorate:—This possesses feeble antiseptic action. When the drug comes in contact with septic matter it undergoes slow reduction with elimination of oxygen and its beneficial effects in septic conditions of the mouth and Pharynx and in cystitis

with decomposition of the urine is thus explained.

(14) Aluminium acetate:—Liq alumin acetatis is known as Burow's solution. 1% solution which is a good non-toxic, non-irritant and astringent antiseptic for the prevention of development of pus forming bacteria. It is a suitable antiseptic in canine practice.

(15) Compound of tin in the form of patent preparations.

Carbon Compounds.

(1) Carbolic acid (Phenol). Is one of the best known antiseptics. Carbolic acid in 1% solution destroys putrefactive and pyogenic organisms while solutions of 5–10% are capable of destroying their spores. Exposure to a 5% solution for 2 days will destroy anthrax spores. The antiseptic action of Phenol is quickly lost in the presence of organic matter. Internally if inhaled with water vapour it is antiseptic and analgesic to the respiratory mm. In medicinal doses it is a gastric and intestinal antiseptic and antizymotic. It is used as an antiseptic agent for general surgical work. The usual strength for this is 1–2% crude carbolic acid for disinfecting animal houses.

In consequence of the susceptibility of the dog to the action of carbolic acid, extreme caution is necessary in the employment in canine practice.

(2) Lysol:—It is prepared by the saponification of one of the tar oils with an alkali and is said to contain 50% cresole. In veterinary practice it is almost an ideal antiseptic, as it is not only cheap but is also efficacious. In consequence of its saponaceous qualities it forms an excellent detergent for the hands, preparing the greasy skin for an operation and for loosening adherent dressings from wounds. It is also a reliable agent for the disinfection of instruments, sutures, dressings and infected wounds.

The other coal tar antiseptics commonly used are Izal, creolin—coflectant—creosote—cresol etc.

(3) Formalin:—This generally consists of a 40% aqueous solution of formaldehyde.

Diluted 400–500 parts of water it is useful disinfectant for the hands, seat of operation and accidental wounds. 5–10% is valuable in the treatment of grease and 30–60% for canker. Strong solution are irritant and caustic.

(4) Chinosol:—It is a mild antiseptic and is largely used in veterinary practice. It is derived from coal tar. It is used in 1% solution as a powerful, nontoxic antiseptic. It may be used in 1/1000 for the hands, irrigating cavities such as uterus, conjunctival sac, orbit after removal of the eyeball, wounds after removal of necrotic tissue.

The powder mixed with kaolin and charcoal makes an effectual dry dressing for granular surfaces where skin has been destroyed by necrosis.

Antiseptics derived from the coal tar dyes.

(1) Acriflavin:—It is a slowly acting antiseptic. 1/20000 kills staphylococcus in 2 hours. It is more powerful in its germicidal action than carbolic acid. Acriflavin exerts effective antiseptic action on wounds in concentrations much more lower than those which produce irritation of the tissues or even interference with phagocytic activity. It is also practically non-toxic and for this is particularly valuable in small animal practice 1 in 2000 solution.

In streptococcal mastitis in cows aqueous solution of acriflavin 1/10000 is employed as mammary infusions.

(2) Gentian violet:—Of late it has been found that gentian violet acts in the same way as that of Tr. Iodine. It is a very good antiseptic for external application. The only defect that it colours the tissue. It can be substituted for Tr. Iodine.

(3) Brilliant green:—This is used in a strength of 1/1000–1/1500 in normal saline. It is a non-toxic and non-irritant antiseptic. It has got a phenol coefficient of 40,000, but its action is markedly reduced in the presence of organic matter. Since it stains damaged tissue more deeply than normal

tissue, it is employed as a means of determining the extent of injury of the wound tissues.

(4) Picric acid:—Is a powerful antiseptic. A 2% solution in alcohol (70%) is a skin antiseptic.

Sulpha drugs:—(1) Sulphanilamide, (2) Prontosil, (3) Prontosil soluble, (4) Proseptasine, (5) Soluceptasin, (6) Uleron, (7) Sulphathiazole, (8) Sulphamido pyridine and sodium sulphamido pyridine.

Sulphanilamide—Is particularly effective against streptococcal infections.

Sulphanilamide is rapidly absorbed from the alimentary canal, absorption being complete in 4 hours. Maximum concentration in the blood is reached in about 3 hours. If one dose only is given, the concentration falls almost to zero in 24 hours. It appears that before results can be obtained in the treatment of disease a concentration in the blood (10 mg. per 100 c.c. of blood) is necessary. Therefore therapeutic action of any single dose provided that it is sufficient to produce the desired concentration in the blood can persist for only 6 hours.

General principles for the use of sulphonamides.

(1) A prophylactic course should occupy 48 hours.

(2) Course of treatment for establishment or developing infections should extend over 10 days, but if not effective by this time an interval of 48 hours should be allowed before continuing treatment.

(3) When an injection appears to be controlled, as judged by the temperature small doses should be continued for a further 3–5 days in order to prevent relapse.

(4) A high blood concentration is to be obtained as rapidly as possible and maintained at an effective level over a period of time. Because the drugs are rapidly excreted, it is necessary to administer them four-hourly, in order to maintain an effective level.

(Continued from Page 27)

Precautions:—Certain individuals are unduly sensitive to the drugs. If patients are severely shocked, treatment with these drugs should be suspended.

Acidosis is produced in the system by these drugs. So it is customary to administer the drugs along with sodium bicarbonate.

Boric acid:—It is slightly irritant and non-poisonous antiseptic. It is useful for irrigation of the bladder, conjunctival sac, nasal channels and other mucous surfaces.

It is used as an antiseptic dressing for simple wounds in the horse and is especially useful for this purpose in canine practice.

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growing a beard. Let it be an All India Association with its many branches. The membership shall be open to all those who grow a beard (without any class or caste war) and all those interested in growing a beard. This is a big cause where we must behave like big hearted men and so let us try to have as many members as possible. I mention this, only that our young friends who have not yet attained the "bearding age" may have an opportunity to join hands with us. I have great hopes that such an organisation will bring all thinking men on a common platform; and then perhaps what San Francisco, Simla and Potsdam failed to achieve we may be able to accomplish!

Imagine a single fraternity of bearded men in a single unified world state! If only we could see this millennium reached sooner.

Oh, unthinking man, why do you shave every morning?

CESTARSOL

In small animal practice there are a few conditions which engage the attention of veterinarians more than tape-worm infestations in dogs and cats. Although several remedies have appeared in the market in the past from time to time, they have been discarded as insufficiently active. The new drug, CESTARSOL, represents the most effective chemical substance which has been used up to the present time. While it is not claimed that CESTARSOL provides the perfect answer for tape-worm infections, it is maintained that until further research in this

field takes place, CESTARSOL will remain the most satisfactory product for the purpose.

Further information regarding this drug will be available on request direct from the manufacturers, Messrs. May & Baker (India) Limited, Post Box No. 693, Bombay.

The streptococcus germ grows in chain-like forms; because the streptococcus germs possess a rigid outer membrane and this membrane continues in an unbroken line from one germ to another.

The Qualities of a Cultured Mind

JUSTICE LAKSHMANA RAO'S ADDRESS

Madras University Convocation ["The Hindu," Madras, dated 31-8-45].

An exhortation to the new graduates to follow the ideal of service and sacrifice in whatever walks of life they found themselves placed was made by the Hon. Mr. Justice K. P. Lakshmana Rao in the course of his address to the new graduates of the Madras University at the Convocation held on 30th Aug. 45 at Banqueting Hall, Government House. Sir A. Lakshmanaswami Mudaliar, Vice-Chancellor presided.

After thanking His Excellency the Chancellor for giving him an opportunity to address the graduates of the year, Mr. Lakshmana Rao said that his first duty was to offer, on behalf of the University and himself, congratulations on their admission to the various degrees for which they had worked hard. The good fortune of a study at a University, he said, and the attainment of an academic distinction was not given to many. They were the custodians of the reputation of the university and it behoved them therefore to so conduct themselves as to reflect credit and glory on their *Alma Mater*.

The University of Madras was one of the oldest in India. It was founded in 1857 as a mere examining University, and very soon it earned a reputation for the high standards of knowledge required of its members. By the Madras University Act of 1923, it was constituted as 'teaching and residential' University with power to establish and conduct institutes of research; and the progress made thereafter in all its diverse functions had been such as to evoke the envy of all her sister-institutions in the country.

High Standard of Madras University

Referring to the opinion of the Sadler Commission appointed to report on matters pertaining to Universities in India, the late Sir V. M. Coutts-Trotter, an eminent Judge and a distinguished man of letters, wrote thus to the then Vice-Chancellor in 1929:

"I am told by the members of the Sadler Commission that the quality of a Degree in the Madras University was no less than 50 per cent higher than in other Universities. That is a thing to be proud of, and I trust that the Madras University will keep up its high standard of efficiency."

That it had more than fulfilled his hopes, said Mr. Lakshmana Rao, was proved by the long list of its illustrious *alumni*. "To-day our University can look with satisfaction on its teaching and research departments. Considerable progress had been made in the matter of the physical and social welfare of the students. Active encouragement is being given to the University Officers' Training Corps; and the University Library stands as a model for the rest of India.

But, of late, there has been a feeling of discontent and frustration among the students of this Province, on the score that they are prevented from prosecuting higher studies of their choice by considerations other than merit and efficiency. Whatever justification one might find for such discrimination in other walks of life, there can be none in the field of education.

Facilities for Education of Students

Proceeding, Mr. Lakshmana Rao said: "It is an evil day that finds the fountain

of learning denying its gifts to people who devoutly seek for them and it is up to the University to provide for education for all qualified students without distinction of class, caste, creed or colour. To achieve this noble task large endowments from the public-spirited citizens of our country are necessary. The State, by itself, cannot cope with the immensity of the problem without the plentiful aid of private munificence. It is gratifying to note that in very recent times we have had such examples of such generosity and public spiritedness on the part of some of the great philanthropists of our province. What our University needs now is more Nuffields and more Tatas. And here I must refer to the great interest evinced by His Excellency in the advancement of education in this province and his substantial contribution to it, evidenced by the starting of new colleges of technology, engineering, agricultural and arts during his term of office.

"You have all reached a stage in your lives whence you can look back with pride and satisfaction. You have had, I trust, no glimpses of the 'vale of tears' nor have you had any reason to doubt that 'God's in His heaven, All's right in the world.'"

Mr. Justice Lakshmana Rao continued: "The world you are going to enter is one, which has been transformed beyond all recognition by World War II, which, happily, has come to a victorious end. In this new world, you will find great concern for the common man—his rights and duties, pains and pleasures; there will be idealists planning for Utopias, under various labels of political thought. But one thing you will not find, even as the young men after the last great war did not find and that is 'the normal and accustomed values of life.' In their place, you will find tradition laughed at, cynicism practised as a fine art, and altruism greatly discounted. Yet, in spite of all these, or, rather, in the face of all these, yours is not to despair; for, full-blooded enthusiasm, great idealism and determined courage are all the peculiar possessions of

youth. To you, there is no cloud, however black, but has a silver lining. All these virtues your *Alma Mater*, your 'bounteous mother' has given you.

"All of you, excepting those that would continue further in their search for knowledge, would be anxiously thinking of your careers in life. Our country, with many others, has embarked upon a gigantic scheme of post-war reconstruction; great strides in industrialisation, on a country-wide scale, will be made. And many of you, in consequence, would be able to find employment, in great numbers, in your respective vocations.

Development of Culture

"Amidst all this, there is bound to be a tendency to belittle the value of scholarship and erudition, and to underrate 'arts' and 'Humanities' in favour of 'Sciences'. Against this, I hasten to warn you: for, the first quality that the University has the right to expect in you is 'culture', by which is meant the refinement of mind and manners. A high education, without good tastes and good manners, is a contradiction in terms. The ability to see the other man's point of view, the absence of intellectual arrogance, the thirst for knowledge for its own sake, the attitude towards others that could never be construed as offensive in words, gestures, or deeds; all these are the qualities of a truly cultured mind. Above all, a sense of humour, that is, the ability to laugh at one's own faults and idiosyncracies, to look at one's self as others would look at one, is the hall-mark of a cultured mind. Dogmatism, and the uncompromising adherence to one set of ideas to the entire exclusion of others, are qualities which only a boor can emulate.

Mr. Lakshmana Rao advised the graduates not to discontinue the reading habit but by its assiduous cultivation they should know something of everything in the vast realm of knowledge. They should also devote a portion of their day to physical exercise. Another quality expected of them was

'character' or 'integrity'. "It is a truism to say", he said, "that integrity is the touchstone of true greatness. For, it means nothing more than a faith in the higher moral values; a faith that needs courage to support it at times of temptation and trial, a faith that keeps to the straight and narrow path." He quoted what Mr. H. C. Papworth said on a similar occasion elsewhere, "Your promises are sometimes forgotten. There is nothing more tragic than to see a professional man in disgrace, or to see a gifted man in power or position, using his gifts, his power or his patronage unrightfully."

Need for Spirit of Service

Mr. Lakshmana Rao added: "Your University also expects of you a 'spirit of service'. It has been dinned into our ears that ours is a land of poverty, illiteracy and disease. It is your duty to take a leading part in eradicating these three pests. Ours is a country in which have lived saints and sages, who have all taught the gospel of selflessness and social service. I would, therefore, ask you to follow the ideal of service and sacrifice in whatever walks of life you find yourselves placed. The country and the people at large look to you to take the lead in all movements of social reform."

Continuing Mr. Lakshmana Rao addressed a few words to the lady graduates. "Year after year," he said, "the number of lady graduates entering our colleges is steadily growing and this augurs well for the future of the country. It is you who are best fitted to bring wisdom and happiness to the country by your qualities of gentleness, patience and persuasiveness; qualities with which nature has richly endowed you. In your enlightened hands, the destiny of our coming generations of men and women is safe indeed."

In conclusion, Mr. Lakshmana Rao said that the graduates carried with them the heavy responsibility of maintaining the honour and glory of their *Alma Mater* who was sending them into the wide world. "I cannot do better" he said "than invoke the sacred sayings of the Lord in the 'Bhagavad Gita' to serve as your ideal: 'Treating alike pleasure and pain, gain and loss, success and defeat prepare for the battle; thus wilt thou not incur sin.' 'Thy concern is with action alone, never with its fruits. So let not the fruits of action be thy motive, nor be thou attached to inaction'."

ATTACK DOGS OF THE K-9 CORPS

In addition to the usual class of dogs trained for modern warfare (patrol, dispatch, transport, medical corps), the U.S. Army Remount Division of the Quartermaster Corps has trained ferocious dogs to make direct assaults on the enemy. Though few reports on the offensive value of attack dogs have been released, the Publications Branch of the Bureau of Public Relations, U.S. Army, gives an account of a ferocious attack on a

Japanese sniper by an attack dog in pitch darkness, which led to the sniper's capture. Captain Fallon also reports outstanding work in mop-up operations by two other dogs of his command. The attack dog is announced to be valuable in locating enemy forces attempting infiltration of occupied ground.

U.S. War Department Release :
November 1-14, 1944)

Some Essentials of a National Dairy Programme

BY

V. RATHNASABAPATHY, G.M.V.C., B.V.Sc.

Milk and dairy industry are inseparably linked with a nation's health and the normal growth and development of its people. Upon this industry, more than any other of the food industries, depends not alone the problem of public health, but there depends upon it the very growth and virility of the races. For the feeding of these masses of undernourished children this commodity is absolutely essential for the restoration of health and maintenance. The Nation's prosperity as well as its health depends upon the consumption of more dairy products. An increase in the consumption of dairy products means, better health and nutrition to the consumer and more prosperity to the farmer. Prosperity to the farmer means money to purchase those things which will add to the well-being and comfort of himself and family and provide markets for the products of our factories.

It was once generally thought that the size of peoples of the various races was due to the climate in which they lived. It is now believed, by scientists, that difference in diet is largely responsible for the fact that people grow at different rates and eventually attain different weights and statures. That the food which a people eat particularly in early childhood, at a time when most rapid growth is expected, has a lasting effect upon the size of an entire race of people is evidenced by studies made upon the Oriental races, particularly the Japanese. A Japanese investigator noticed that the Japanese children born and reared in the United States where they make good the deficiencies of their native diet were both taller and heavier than those born in Japan.

An analysis of this problem in India will indicate that we are yet far below the intake of dairy products, which would maintain the maximum results in health and the development of our children. In fact the milk shortage in India is not a war condition—though war time inroads on the country's livestock have no doubt aggravated it—and will not disappear with the advent of peace. According to the Indian delegation to the Hot Springs Conference on nutrition, held at Virginia from 18th May to 3rd June 1943, only 6.3 million tons of whole milk is normally available for consumption in India against the minimum nutritional requirement of 32 million tons, which means the shortfall is of the order of 80 per cent. Even accepting the Indian Farming's conclusion that the output is 800 million maunds per year and that the shortage is only 66-2/3 per cent, the position is far from satisfactory as it allows but an average per capita consumption of 6 to 7 ounces as against the nutritional minimum of 21 oz. (The comparative figures for other countries are 56 oz. in New Zealand, 45 oz. in Australia, 39 oz. in Great Britain and 35 oz. in the U. S. A.) With the advent of war and difficulties arising therefrom, even this inadequate consumption allotment has further fallen to 4 to 5 oz. in India, and the situation seems to have become acute in great cities like Calcutta, Delhi, Bombay and Madras. The result of the scarcity being the enhancement of prices, it has virtually placed milk beyond the poor man's reach. The authorities are tinkering with the problem here and there, but the steps taken so far have only touched the fringe of the problem.

The health of the Nation is at stake, and more effective remedies have to be evolved to augment milk supply and to reduce the prices, if it is not to be permanently damaged.

Far reaching adjustments in the dairy industry are essential. The various leaders of the Industrial planning committees should recognize the immediate need of a National dairy programme upon which all can unite. In establishing a National programme, individual dairy man must weigh the declines in the prices of his products against the decline or increase in prices of things he buys, particularly feeds. Further he must compare the income he can derive from dairying with the incomes he might obtain from alternative enterprises. More important still, the dairyman needs a clear appreciation of the conditions that are likely to prevail in the next few years, for he should adjust to the future and not to the past.

The outlook is for continued high dairy production. A steady increase in the number of milch cows every year will make it comparatively easy to expand the dairy production. The minimum requirements of India cannot be met without a treble increase in her milk output. It may not be possible to increase her cattle three times but surely something can be done to improve the yield. Why should this country, with 18 times the number of Canada's cattle, produce only four times more milk than Canada and, with seven times the number of Germany's cattle, even less than Germany does? It has been computed that the average annual yield in India is about 625 lb. per producing cow whereas the corresponding figures for Canada, United States and Britain vary between 3,500 and 4,000 lb. and in Denmark it is over 8,000 lb. a year. An improvement is therefore quite possible, as it is necessary and the efforts of the Government and local bodies must be bent towards this end. Production of more cattle feed and an increase in the efficiency of milk producing animals must be their objective. It is patent fact

our cattle are fed about, if not less than, one-fourth enough as it is: their valuable daily per capita consumption of valuable concentrates being less than 4 oz. as against 2 lb. available to European cattle. The general adoption of mixed farming and scheduled crop rotation, economic exploitation of the existing pastures through controlled grazing and development of new resources like fresh pastures and fodder-bearing trees, improved method of hay and silage making and selective breeding must be incorporated in the Government's programme. And since the bulk of grazing lands is under the Revenue authorities or in private ownership, even fresh legislation may have to be devised to ensure their proper utilisation. Regulation of fodder prices, exemption of milch-cattle from taxes, etc., will further help to relieve the situation.

The principal cause of the present low prices of dairy products, is the reduced buying power of consumers, resulting from the economic depression of India. With the recovery of our Sterling balances and introduction of new industries an increase in demand and improvement in prices is to be expected. Low prices have a tendency to discourage production, causing some to leave the business and others to curtail drastically. Where labour is cheap, dairying will probably continue to be a strong competitor among farm enterprises.

Some of the important factors like those mentioned above, the protective measures on the farm combined with more efficient methods of transportation and pasteurization of general milk supplies in cities which will put our milk supply on a safer and higher plane than that existing at present etc., will be dealt with in detail hereunder.

Number of cows:—The expansion in dairying is closely accompanied by a relative increase in the number of heifers (1 to 2 years) kept per 100 milch cattle. This determines what is going to be the population of milch cows after a few years. Thus in South

atlantic States—in U.S.A.—a decline from about 19 heifers per 100 milch cows in 1924, to 16 in 1926 was followed by a considerable decrease in the number of cows. Since 1926 the number of heifers have been increasing relatively, and this has been followed by an increase in the number of cows. On an average 18 to 24 heifers per 100 milch cows will keep up the milch cow population at a definite standard level. The indiscriminate slaughter of productive cows, the destruction of cows and calves in the cities when dry, must be prohibited by legislation. In this connection the steps taken by the Madras Co-operative Society for the salvage of dry cows are to be much appreciated. There is a school of thought according to which because India is rich in numbers of cattle, we can afford to stand a little depletion. This, as one of our well known Directors-General of Veterinary Services has pointed out, is a foolish notion. The safety of a country like India susceptible to frequent outbreaks of cattle diseases lies in the numbers of its cattle. Hence the Government and local bodies should encourage breeding in all ways.

Production and sale of milk per cow:—The quantity of milk and butter fat appearing in commercial channels depends not only on the number of milch cows on farms but on the quantity of milk produced per cow and the total production that is sold. By improved methods of breeding the production of milk per cow is certain to increase and as there continues to be an increase in the number of heifers of improved dairy breeds this upward trend will probably continue to be important; besides low price of grain, which encourage feeding, especially in sections that have a surplus of grain, improved pastures, ensilage and storage of fodder contribute much to the high yield of milk per cow.

In the production of milk the four economic factors that may directly influence the quantity of milk produced are: (1) reduction in the cost of production, (2) reduction of

losses in sour and unmarketable milk, (3) increased markets, and (4) increased prices for milk.

The experiments conducted and the research work done by the United States department of Agriculture show that there is a direct relation between the milk production per cow and income and that the dairy man who uses modern methods in elimination of the low producing cows in his herd has the highest income. In other words the income increases according to the ability of the cows to convert feed into milk and butter fat. Studies and investigations should be made for providing effective means for discovering low producing cows and eliminating them from the farm, and also for the purpose of increasing efficiency in the production of milk and there is no question but that milk can be produced at a lower cost by using the best known methods. This would mean that fewer cows would be required for producing the Nation's milk supply.

It is well known that the dairy cows worth keeping must possess marked ability to consume feed and manufacture it into milk. The equally fundamental truth, often not so well considered is that dairy crops grown upon every acre of land must produce a large amount of feed suitable for making milk.

Dairy farming should be based as much as possible upon the same principle as grain farming, that is milk should be produced from the land the same as grain is produced from the land.

Favourable conditions:—Condition favourable to dairy farming include; climate and soil suitable for growing corn for silage and legumes, especially of alfalfa and its proper curing; large fields of a contour that permits tilling with tractors; proximity to centres of population and to good markets and yet far enough removed so that higher wages or better opportunities for recreation in the cities will not produce a scarcity of labour on the farm. Good pastures with plenty of rain fall are also favourable to dairying. These

factors exert a great influence on the trend of dairying and account to a considerable extent for the development of dairying in Denmark, Finland and other countries.

Factors influencing rate of production :— The quantity of milk produced responds more quickly to increases in profits than does the supply of some of the other livestock products. Variations in the total amount of milk produced that result from the increases or decreases in the number of dairy cattle are much slower than those due to other factors mentioned, and occur gradually in response to protracted periods of relatively high and low prices. A normal variation in milk sales per farm may be regarded as an approximate measure of the effect of various economic influences upon dairying. Not only increased numbers of producing animals increase the production per farm, but lower feed prices, together with the adoption of better production methods, increase the rate of production per animal.

Marketing :—Now we shall pass on to consider, how a constant supply of safe milk of uniform quality and reasonable price can be made available to the consumers both in villages and cities, and how the rural producer can be benefited from a regular and fair market for his milk. This can only be done by careful management of all steps, and maintenance of economic units for working. A portion of the milk can be sold and delivered by the producer direct to the consumer. The rest of the milk can be dealt with by co-operative organization of producers. These associations—Fluid Milk Marketing Associations—are of two types. (i) The bargaining type has neither plants nor facilities for physically handling milk, but as the name suggests negotiates with the milk dealers with regard to price and terms of sale. This type also performs other economic services for the producer and distributor, insuring producer payment for milk sold, testing milk for butter fat and quality, equalizing supplies to distributors, increasing the consumption of milk

and representing producers before legislative bodies.

(ii) The operating or marketing associations, in addition to bargaining for the sale of milk, have facilities for the physical handling of milk. These can have receiving stations in the country, where the milk is received from the farmers, cooled and shipped to milk dealers in the cities in the quantities needed. Such stations may have facilities for manufacturing surplus milk into various dairy products. They may have city plants equipped to handle milk and sell it either wholesale or retail.

Adjusting the production of milk to consumer demand is one of the most difficult problems connected with the marketing of milk. Various buying plans have been worked out for the purpose of equalizing production throughout the year. One of these the 'Basic surplus' or 'Basic-rating' plan has had many exhaustive tests. Under this plan each producer is assigned a definite volume of production and for all milk produced in excess of this basic volume he receives a surplus or lower price. The base for any producer is determined by the quantity of milk which he produces during those months when production and fluid sales most nearly balance. For instance if a producer produces say, an average of 3000 lb. of milk a month, during any three consecutive months taken, then the 3000 lb. represent the base for this producer for the year, and he will receive market milk prices for all the milk delivered each month up to his basic 3000 lb. For the milk delivered up to twice the basic quantity, that is between 3000 and 6000 lb. the producer receives what is called the 'first surplus' price. For any quantity of milk above the first surplus quantity, that is, in the case, any milk over and above 6000 lb. this producer would receive "second surplus" price.

The 'contract plan' is a modification of the basic surplus plan designed to equalize the supply of milk throughout the year. Upon signing the contract with the association on a particular date, say March 31st, of

any year the producer states the quantity of milk which he proposes to deliver daily for next twelve months, beginning April 1st. He may state any quantity in excess of his previous year's contract, the same quantity, or a smaller quantity. Penalties are provided for any excess production above the contracted quantity, or for any shortage if production is below the contract. Penalties are not exacted on the basis of each day's deliveries, but on the average for each payment period, which is usually 30 or 31 days; that is if a producer contracts to deliver 40 qts. a day and his deliveries for the thirty-day period from September 1st to 30th are 1,500 qts. he is penalised for over delivery of 300 qts.

The penalties for variation in deliveries from the contracted quantity do not go to the distributors to lessen their cost, but are pooled by each distributor and prorated back to the producers so that whose production most nearly meets their contracts receive the greatest share in these penalties. All producers share in the penalty pool and, since it is highly improbable that any producer can exactly meet his contract, all producers pay penalties. However if a member's production varies little from this contracted quantity, he pays only a small penalty and receives a much larger share, the net effect of which is a bonus for even production.

Both these plans have proved effective in adjusting production. It is probable, however that the principles of either plan may be applied successfully in any area. The greater the production, in excess of fluid consumption in the market, in the milk shed and surrounding territory the more difficulty will be experienced in operating the plan. The most important factor in its success under any circumstances is probably the whole-hearted co-operation of the distributors who handle the greater part of milk. Prices of milk should be fixed according to butter fat percentage. Premiums should be paid to producers for sanitary and healthy conditions as deter-

mined by the score-card method. This will encourage pure milk production.

Transportation, processing and delivery :— The increased demand for better milk and the economy of space and labour, and health conditions necessitate the producing dairy farms farther and farther away from cities. The suburban stations and villages should have a close net work of roads, and every prosperous farming section should be connected with the cities by hard surfaced roads to enable the quick and safe transportation of milk by improved tank trucks and tank cars. Country stations should be established in a good dairy section producing large quantity of milk of the same grade. These stations receive the milk from the farmers as soon as it is produced, cool the milk and cream, permit more practical use of tank cars for quick transportation of milk to city plants and manufacture surplus milk into dairy products in the country and save transportation cost to the city.

Of greatest importance is the time factor in transport and its effect on the product and this is accentuated in India owing to high atmospheric temperatures during the day almost throughout the year. The most economical method of transportation of milk from receiving station to city stations is by the use of motor tank cars and trucks which are made of glass-lined steel, tin lined copper, nickel or stainless steel and are usually covered with some form of insulation to protect the milk from heat in summer and cold in winter. These tanks which have a varying capacity from 500 to 2,000 gallons can carry milk safely for long distances as 60 to 65 and even 300 miles. These offer great possibilities for extending the city's milk sheds beyond the 300 to 500 miles zone, maintaining the quality of milk without extra expense enroute. For smaller distances of 25 to 30 miles milk can be hauled by motor trucks; or by cans in local trains or electric trains.

City milk plants :—The function of the city milk plant is to receive, grade, pasteurise

and bottle milk, and store it at proper temperatures until it is delivered to consumers. Two general methods can be used for distributing milk (i) direct to consumer (ii) wholesale to stores, hotels and restaurants for reselling to the consumer. The delivery of milk through stores has recently attracted considerable attention, and has been pointed by some investigators, as one of the means available for reducing the cost of milk distribution.

The chief function of the store in handling milk is an accommodation to customers in case of emergency. Often the house-wife finds case that she needs an extra quart of milk after the milk-man has gone, and the store then provides an important service. In this way it also helps to increase the consumption of milk, as in many cases the extra quart of milk would not be purchased, if it were not for the store. Another important function of the milk store is to provide refrigeration for the milk. Many poor families cannot afford to have a refrigerator and they depend on the milk store to large extent for their milk.

Quality and cost:—If only milk of the finest quality were produced the dairy industry can add millions of rupees to its annual receipts. Conditions should improve and improvement is to be brought in a number of ways. The forms and milk plants should reach a higher degree of sanitation. A maintenance of a high standard of quality for dairy products is essential. The local milk inspecting departments, dairy farmers and manufacturers should be given expert assistance on the solution of production, factory and trade problems. The maintenance of complete and reliable statistical records on the various phases of dairying, by the milk inspecting departments, is of tremendous importance in studying areas of production and consumption in their relation to supply and demand as well as sanitation. Suitable places should be cited in each district for establishing demonstration dairy farms where the best known methods for economical and

sanitary production and processing of dairy products are demonstrated.

Active steps should be taken in outlining a programme of quality improvement and latest informations concerning dairy industry should be printed and distributed to the public. The quality control work includes the routine inspection of dairy farms and instruction of dairy men in methods of producing milk of better quality. It also involves laboratory tests to determine the quality of the milk delivered by individual farmers. Besides these, legislation will help a little in quality production.

It would be of interest for the readers to know that in one of the producer's association in U.S.A. 69 fieldmen were employed for farm and country work. In addition the same organisation employed 7 Veterinarains and 16 laboratory workers. The cost of quality-control work by dairy organisations ranges from 6,000 dollars a year to over a quarter of a million dollars for each organisation.

Cattle diseases and dairy industry:—Systematic work should begin immediately to control diseases of cattle like contagious bovine abortion, rinderpest, black quarter, bovine tuberculosis etc., which take a heavy toll in every year in India. Eradication of these diseases from the dairy herds has a tremendous bearing on the economy of milk production and livestock raising as well as upon the public health. Elimination from the herd of cows infected with diseases communicable to man, say T.B. will remove the source of danger to human family. Pasteurisation also does good, but only secondary, in warding the danger to human beings.

Education:—Increasing the consumption of milk in the future depends largely on the education of the consumer. This education should begin with the formation of the milk drinking habit in the young child. The work which is to be done in the public schools is one of the most constructive ways of educating consumers. When the school children

learn about the value of milk and dairy products, it not only makes him consume more, but it also provides a prominent place for the milk and dairy products on the table of the home which the child will establish when grown. Scientific workers of U.S.A. claim that boys are more readily persuaded than girls to consume the requisite quantities of milk. The scientific value of milk appeals to boys more than to girls. Boys also want to develop muscle and vitality more than girls do. People should grow up to be milk minded as well as informed as to the constituents in milk and their relation to proper nutrition and health. Records of consumption should be maintained to value the effect of propaganda.

Conclusions:—The consumption of milk in India is too low for proper and economical human nutrition. The daily consumption of milk for the normal child is far below the optimum. Every educational facility should be used to acquaint both adults and children with the desirability of consuming milk and dairy products in adequate amounts.

The future fluid-milk supply may come from greater distances from the point of consumption. Cheaper land labour and foods are usually available in sections distant from large industrial centres. Local production should be encouraged to meet local demands, but where this is impossible, arrangements should be made for the proper shipment of high quality milk from a distance. To meet such demands dairy manufacturing plants in strategic locations should be equipped to receive, cool and to ship milk and cream in a sanitary manner.

Every effort should be made to stimulate more economical and efficient milk production.

In order to eliminate waste and to improve quality greater attention should be given to methods of transportation, terminal facilities and ware housing of dairy products.

The production and processing of milk usually is most sanitary and most economical

in those plants which handle sufficient volumes of milk to enable them to have ample equipment of the best machinery and to employ skilled technicians and labour. Such a plant should use the best methods and operate at or near capacity. The centralization of milk industry makes it easier to carry on the work of inspection and control.

The supervision of milk and other dairy products is of vital importance, and should receive co-ordinated attention of all state and local agencies, including public health authorities, Veterinary agricultural departments, educational and extension organizations within the state or community.

The first cause of hunger and malnutrition is poverty. The primary responsibility lies with each nation for seeing that its own people have the food needed for life and health.

The man's increasing demands upon the soil can be met only by the increase of knowledge. Each Nation should adopt a policy for rural education, the training of scientific workers and rural leaders and rural adult education. It is necessary to accentuate research in all branches of science, including economics, which relate to feed and agriculture and to this end an active international co-operation by the exchange of knowledge, materials and personnel. In education and research India made some progress but it may be of interest to make comparison with U.S.A. India spends half a million dollars on agricultural research, while the U.S.A. through federal agencies alone spend 30 million dollars. The greater part of money is spent on personnel. The federal research staff alone number 8,000 as compared with India's 150 gazetted officers employed on agricultural research.

India is the home of a fifth of the human race. The population nearly 400 millions, is increasing at the rate of 5 millions a year. Though the country is ahead of many others in the study of nutrition problems, the level

of food consumption by people is very low and can be corrected only by the increase of the purchasing power and the production of an abundance of food. Importance should be stressed on increasing agricultural production bringing new lands under cultivation wherever possible and undertaking works of public utility and the development of public services. It is only by an all round increase in productivity—and not by juggling with monetary counters—that the terms of trade can be established between agriculture and industry which will enable supply and demand to be equated at the highest possible level of food supply. In the post-war years when the country will no longer be distracted by military necessities, the policy of development will no doubt be carried forward to secure freedom from want for the people of India.

The application of science make abundance of food for all, and the economic and political obstacles which impede the enormous potential expansion of production can in the long run be overcome by resolute and concerted action. It is these facts and possibilities which should guide and inspire Governmental action both national and international, and not political, economic and financial expediencies of the moment; And this essay is one of hope in the scientific and orderly development of the world's food resources, chiefly the dairy industry, for the benefit of its population.

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PENICILLIN IN ANTHRAX

The success attained in the treatment of human cases of cutaneous anthrax with penicillin at the Pennsylvania Hospital for Contagious Diseases is of interest in veterinary medicine. Although the characteristic and almost universal bacteremia of anthrax in animals was absent, the rapid disappearance of the specific agent (*Bacillus anthracis*) from the local lesion established its sensitivity to the microbicide action of the drug. The study also revealed the strange contrast that in vitro *B. anthracis* was 100 times more

resistant to penicillin than *Staphylococcus aureus*. In three cases favourable response to penicillin was evoked from the injection of 100,000 to 475,000 units. At least a total of 200,000 to 400,000 units of penicillin, given at the rate of 100,000 units in 24 hours, should be administered to the average adult to obtain prompt and satisfactory therapeutic response.

(*Journal of the American Medical Association*, December 9, 1944).

College Sports

BY

DOSHEEY

The annual sports day is looked forward to by every student of the College with great expectation. It is probably the only day during the whole academic year when all the teachers and the taught are present and meet each other stripped of the class-room formalities. Fourteenth of February saw the dawn of that long awaited day. It was an unique day for the College because no less a personality than of Sir A. Laxamaswamy Mudaliar, Vice-Chancellor of the University of Madras presided and gave away the prizes.

The events of the day commenced in the noon. The mile-race which was run the day before attracted a good number of competitors and presented the greatest surprise. Sa-

bhaphathy the twice unbeaten winner of that long track race was completely beaten by the lean and fair new find, Karumbiah who triumphantly galloped in fine speed and style. This young man who was a dark horse till now (probably shyness kept him back) has great future before him on the track if only he carefully looks to his practice. Contrary to the usual rule, he also finished next best in the sprints. He promises to be a hot favourite for championship next year.

A happy point to note was the presence of the sportsmen of the 5th year class whose

love for sports brought them here all the way from Hosur Cattle Farm. A fine team of people these they never let their old reputation down. Almost every one of them knocked away atleast one win. Sivados was invincible in his high jump; Sundaram crossed the Hurdles in good time; Raja Ram jumped the longest and Neelakantan created a new college record in shotput. Sreenivasa Rao and Chandran the moral supporters of the team should have received a souvenir each for their enthusiastic encouragement to their class fellows.

Mr. M. K. Patra, the promising dasher won both the sprints in fine form and style. A wrong start in 400 meters found him only next best to Lingayya, the Inter-University



Mr. M. K. PATRA,
College Champion

goal-keeper, who was not found wanting to avail of the opportunity.

Tea was announced at 4.30 p.m., and it was made more interesting by the Fancy dress item. Mr. Rama Mohan Roy as "the Indian Drummer" was very much appreciated and won the laurels. Mr. Rangamannar as "The Postman" was really unrecognisable. He was adjudged the next best.

Then followed the funnier items of the day. The obstacle race attracted a large number of competitors but the obstacles kept most of them back and only a few could reach the

winning-post jumping the hurdles, crawling on the tummies between the folds of matting, wriggling thro' low bridges, straining thro' narrow passages, climbing rope posts and finally finishing by walking in the gunnies. It was a real treat to see them hopping in the gunnies!

The staff races were the novel features of the day. Two races were run—one for those on the wrong side of forty and the other for those in their twenties and thirties. The former was naturally the more interesting since even our Principal took part in it. The laurels went to Mr. Vaidyanathan and Mr. Mangrulkar, the hockey enthusiast, who finished first and second respectively. In the younger staff race, the distance was doubled. In this Mr. Parthasarathy the physical Instructor naturally finished first leaving a big gap to Mr. Ganapathy who after a keen rivalry finished second.

The final event of the day was the Tug-of-war and as usual the staff dragged away the students in no time. Whether it was the superior grey matter in their brains or the

extra storage of fat and protein in their bodies which helped them to pull like Gulliver, is still a matter of mystery to me.

The prize distribution then followed. The rolling cups for the field games were not the sole monopoly of a single class like last year but were equally distributed among all classes. The "Mantramurti Championship Cup" was won by Mr. M. K. Patra who deservedly annexed it though by a surprisingly small margin.

The day ended after a short speech by the President. He advised the students to maintain a healthy and cheerful outlook on life. He opined that we have a great future before us and a definite part to play in the post-war plans for improving agriculture. He felt confident that the training which we received at the College would fit us for that great role.

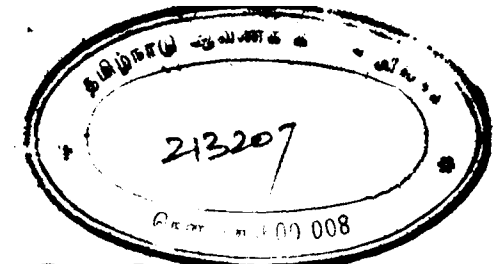
In honour of the visit of the Vice-Chancellor and at the request of the students who were naturally tired after the exacting track work, our kind Principal declared Fifteenth a holiday.

A GREAT REPLY

One does not know whether to admire most the fun or the searching truth of the reply recorded by Lord Lyms, who had called on President Abraham Lincoln and found him blacking his boots. He expressed a not unnatural surprise at the occupation, and

remarked that people in England did not black their own boots. "Indeed", said the President, "then whose boots do they black?"

—Mahendrakumar Doshi



HEREDITY AND DISEASE

BY

C. SAMBASIVA RAO, G.M.V.C.

It has been well said that all sciences contribute to the science of medicine and it is true that the student of medicine has to invoke the aid of this aspect of biological science to a proper understanding of how diseases are inherited. We very often hear of diseases like Tuberculosis, cancer, night blindness, mental diseases, gout, roaring, foot conformations and sex linked diseases like haemophilia, colour blindness as being inherited. It is better to consider the reality of the same.

Any deviation from normality is called disease. This may be latent or apparent. Heredity is the organic resemblance based on decent and inheritance is defined as "All that any organism is or has to start with by reason of its hereditary relations." (Thomson) Mendalism has a practical bearing upon the problems of heredity and we can prove the law taking any two contrasted characters.

Etiology of diseases is divided into two main factors, one is environment and the other is hereditary. Bacteria, parasites, trauma, physical irritants, chemical poisons come under environment and all others hereditary. Before we think of a particular disease being inherited we must distinguish between diseases which are of the nature of acquired characters or bodily modifications and as such not transmissible and diseases which are of the outward expression of true germinal variation and as such transmissible.

"There are two great classes of cells in animals and plants. Somatic or body cells which take part in the growth of the body and form temporary covering and shelter to the other variety namely the germ cells which take part in reproduction and trans-

mission of heredity" and the mechanism is situated in the chromosomes of germ cells. The body of a particular plant or animal always contain the same number of chromosomes. In all those which reproduce sexually the number is even. The number of chromosomes vary in number from two in some worms to two hundred in cray fish. They are in pairs. The unit characters are situated as genes in these chromosomes and a particular character has a particular gene. These genes have a particular place and position in the chromosome. Every character of the plant or animal is represented in the chromosome. There are thousands of genes in each chromosome and they are arranged in rows along the chromosome.

We all know that man has 24 pairs of chromosomes. "Each cell of the future offspring will have 12 pairs paternal and 12 pairs of maternal chromosomes. The mature sperm cell of the father has 12 pairs of chromosomes having lost the other half in the process of maturation but it does not necessarily that 6 pairs of them were derived from grandfather and 6 pairs from grandmother. The reduction of paternal chromosomes from 24 pairs to 12 pairs takes place more or less at haphazard and the final number 12 pairs is always attained irrespective of the number of pairs of chromosomes contributed by grandmother or grandfather and the offspring resembles his preceding generations depending upon the chromosomes inherited from his parent and grand parent (thro' father). So is the case on the maternal side. As the production is not regular a very great number of possible arrangements may occur and it becomes easy to understand how any particular heritable quality making for health or

for disease may disappear from inheritance of any particular individual. The point of importance of any individual some of whose near ancestors have suffered from so-called heritable diseases, is what proportion do the tainted chromosomes bear to the untainted. The greater the proportion of course, the greater will be the chance of inheriting tendency to the disease and a similar taint on both sides of the ancestry will naturally be a double source of danger." So diseases are inherited in addition to the healthy characters like colour, shape, size, fertility, vigour, length of life etc.

"Distinction must be made between 'familial' and 'hereditary' diseases. There is no clear cut demarcation, for familial diseases are hereditary. When both parents must transmit the defect before it becomes recognisable we have the so-called familial cases but this is an example of recessive character. The parents need not and generally do not exhibit the defect themselves as is evident to anyone familiar with the principles of genetics. If the pathological character is a recessive one it is 'familial' disease and 'hereditary' if dominant. A recessive character may be transmitted indefinitely in the germ plasm without coming to light until it meets a similar recessive from another strain. Disease factors in man are generally dominant but they may be recessive or sex-linked. A disease like 'Diabetes mellitus' may be in one family appear hereditary and in another familial depending on the distribution of genes for Diabetes in the chromosomes. A congenital defect or disease is one which is present at birth although it may develop later sufficiently to be detected clinically, e.g., Congenital cystic kidney, congenital cerebral aneurysm. This defect may be hereditary but frequently it is acquired in utero, congenital syphilis should not be called hereditary for it is not transmitted by germ plasm." This is rare in tuberculosis (as calves born to T.B. parents do not react to tuberculin test).

Though inheritance of unit characters is

placed under two groups (1) Mendelian, (2) Sex-linked, Crew classifies them in a most useful manner (1) Simple dominant autosomal inheritance, (2) Simple autosomal recessive inheritance, (3) Sex-linked inheritance.

In simple autosomal inheritance the affected individual has an affected parent or grand parent. The term simple is used because a character may be due to the action of a number of genes and environment may affect its development. The same disease may in some families be transmitted as a dominant (i.e.) it does not appear in children unless one of the parents is similarly affected, while in other families it behaves as a recessive (i.e.) it is passed on by those who show no trace of the defect. M. T. Maklin gives the following example. If Diabetes mellitus depends upon the presence of say 50 genes in a chromosome and if any of these is lacking there will be no disease; if they are all present diabetes will be transmitted as a dominant character. In another family there may be only 40 of the genes in chromosome A and of course there will be no diabetes. But if a member of this family be mated with a person who has 10 of the specific genes in chromosome A and if the proper combination be made, the offspring will have the Diabetes though parents are normal. Here Diabetes is recessive. In this family a person with the disease cannot pass it on as both the chromosomes with 40 and 10 genes respectively belonging to one chromosome pair cannot go into the same germ cell. If the 50 genes present in two chromosomes which are not mated in a pair the mode of transmission will again be different. From these considerations it becomes apparent that a disease may be hereditary in the sense that it is due to a defect in the germ plasm, yet this fact may entirely escape the notice of the physician.

In simple recessive autosomal inheritance it is difficult to recognise a simple recessive heredity from the family history than a simple dominant. The factor must be

present in a duplex condition from both parents in order that the individual may show it. The affected individual results from the mating of two parents who are outwardly normal but are really heterozygotes or hybrid carriers $(DR + DR) = DD + 2DR + RR$. RR being the only one to exhibit the disease. The one goodness of recessive character is that normality is nearly always dominant over defectiveness. A recessive lethal gene may be paired with a normal dominant gene but its possessor goes through life unconscious of the fact that genetically he is half dead. The factor for the defect may be handed down through many generations of normals until a chance of mating of two heterozygotes occurs. It is in breeding which is likely to bring out a recessive character. Inbreeding is only bad when hidden harmful characters as diseases exist in the stock. It is advisable when hereditary constitution of the stock is sound.

"Twins give us an opportunity to study the effect of heredity and constitution on disease. In the case of identical twins (monozygotic) one serves as a control over the other. It is as if we were watching one individual leading two physical existences, Margolis and Eisenstein give the following example of production of diseases more or less simultaneously in twins (1) Tumours—Twins developed retinoblastoma of the left eye within a few months of each other. Cancer of the right testicle occurs in both at the same time. (2) Mental disease and nervous disease developed at the same time. (3) Non-infectious systemic disease—at the age of sixty twin brothers developed diabetes with the same set of symptoms and died within a few months of each other. Other diseases which have developed simultaneously in twins are lymphatic leukaemia, nephritis, asthma, bronchiectasis, cataract and Hodgkin's disease (4) Infections—Twin Sisters developed T.B. of the right kidney within 7 months of each other. This illustrates us the origin of a common germ plasm has, on the development of disease.

Now coming to sexlinked hereditary diseases like haemophilia, night blindness, we know that sex is also a unit character and is carried by the chromosomes of the germ cell. They are called sex chromosomes or X chromosomes. These are two X chromosomes in female and only a single X chromosome and a rudimentary one or the 'Y' chromosome in male which plays part in sex determination. So male inherits his sex from his mother and the female both from father and mother. The X chromosome carries many more determiners than that of sex and some of these sex linked characters may be in the nature of defects which constitute disease and the inheritance of these sex linked diseases are true of Mendelian Principle. The characters carried by X chromosome may be dominant or recessive. Very few diseases are sex linked and recessive in type and can be very readily recognised in distinction to the simple recessive autosomal form. In haemophilia or loss of power of clotting of blood present in royal families, the defect being carried by X chromosome will pass from mother to son and never from father to son. The males alone exhibit the disease and the females acting as heterozygous carriers. The male who has only one (affected) X chromosome will exhibit the defect. The female has only one affected chromosome but is held recessive by the other normal X chromosome. She is therefore heterozygote or carrier. If by rare chance she should inherit two affected X chromosomes one from each parent she should probably show the defect. The carrier female transmits the disease to half of her sons and half of her daughters will be carriers (heterozygotes). If both parents are affected all of the offsprings will be affected. There is every possibility that the tainted X chromosome being lost in the process of maturation and so there is a chance of a healthy daughter. The criss-cross inheritance of the sex linked diseases the defect travelling by the route father to daughter and to grandson is due entirely to the movement of X chromosome.

Heredity has got some bearing on that undecided question, causation of neoplasms. It is much easier to determine the relation of heredity to cancer in animals than in man. "Mandshye by selective breeding has obtained strains of mice in which hundred of individuals have never developed cancer and other strains in which the cancer was the sole cause of natural death. When a pure cancer strain is crossed with a pure cancer free strain the hybrids of F never show cancer. When these hybrids are interbred the result is (1) Pure cancer mice (2) Pure cancer free mice (3) heterozygous (hybrid) strains as with any other unit characters." These results indicate resistance to cancer behaves as a Mendelian dominant character and susceptibility as a recessive one. Here incidence of cancer, its site and its character were all influenced by heredity. One of the neoplasms in which the influence of heredity is best seen is Polyposis of the rectum and colon with its marked tendency to become malignant. Dukes records the case of a man who died of rectal cancer at the age of 42 years. He had 9 children—7 of whom developed rectal cancer; 5 were already dead and one at the age of twenty-seven. This disease is also appeared in next generation. A man and his wife had cancer of the stomach and 6 of their 7 children died of the disease. The seventh was killed at the age of 28 years in an accident. In *Drosophila* the larval stage suffers from an ectodermal tumour which kills one quarter of the males and is transmitted by the unaffected females. Sometimes in cancer production the hereditary factor is lost sight of and transmitted thro' a son incapable of showing that character. A woman with cancer of uterus may transmit that gene to her son but it cannot manifest itself; it may be transmitted in the same way to a grandson and the fatal character may finally appear in his daughter.

When we think of a disease we must also naturally consider resistance, susceptibility and immunity (*i.e.*) whether they can be inherited as diseases, as disease process

includes them also. These are also true of unit characters and are inheritable and this is experimentally supported. It is only a reverse of the question which we are dealing with. This has been proved by taking a certain strain of wheat liable to be attacked by a fungus disease 'rust' and other strains which are resistant. We know that certain breeds of sheep are resistant to Anthrax and zebu cattle to Rinderpest. We must distinguish between acquired and natural immunity. Certain individuals are born with immunity as their mothers are artificially given immunity when pregnant. In this the antibodies travel thro' foetal blood. No acquired immunity can be inherited or transmitted. Hagedoorn—La Brand made an interesting accidental observation on the hereditary transmission of resistance. A colony of mice consisting of Japanese mice, large albinos and hybrids of these was attacked by an epidemic staphylococcal infection. All Japanese mice died but none of the albinos. The important fact is that none of the hybrids (F_1) was affected; but in F_2 1 out of 4 succumbed. Thus the resistance of albinos depend on a single dominant genitic factor.

There is the otherside of this debatable question, how far these diseases true of heredity, as we know that bacteria cannot be transmitted from generation to generation thro' the germ plasm. In every animal foetal Placenta acts as a filter though not of a perfect type and the bacteria which have escaped the natural filter produce the disease in the foetus of congenital nature which we have already mentioned. After all diseases are accidental, they are injurious modifications which affect the body cells of parents but they cannot be supposed to be superficially affect the parental germ plasm and it is therefore impossible that there should be any specific inheritance of them. Now there may be a transmission of what may be called secondary effects, the consequences of microbial disease. The germ plasm cannot be specially affected by microbial disease in the parents, it must be granted that the general

well being, its vitality may be injuriously affected by poisoning of health of the parents, probably the ovum with its larger amount of protoplasm is more likely to suffer than spermatozoon. But this indirect affect of parental constitution is not true specific inheritance. What is transmitted is more than the predisposition for that particular disease or other conditions of disease to be developed later on provided suitable environment is furnished for it (*i.e.*) it is the predisposition that is inherited and not the disease with its specific causal organism.

Secondly "the recurrence of disease may be to the recurrence of a changed or a morbid environment of a changed or morbid functioning. For example the recurrence of anthracosis in generation after generation in colliers is no example of heredity but simply of the power of a morbid environment to impress a diseased modification upon the organism and so the case with scrotal carcinoma of chimney sweepers.

Again thinking over transmissibility of disease we must distinguish between acquired and innate disease. A man in whom there is a tendency to drink to excess is innate and has a chance of transmitting like tendency or some other related psychosis to his offspring, but such a parent is quite unable fortunately to transmit the cirrhotic liver which he has acquired thro' his indulgence in alcohol.

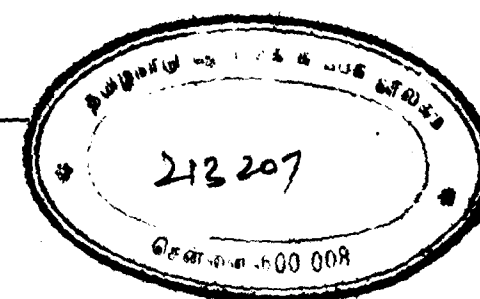
Whether it be a predisposition of the disease to be developed later on by environmental affects or the disease process itself that is inherited or transmitted, it is a fact

that there are diseases of hereditary nature and we have to pay some attention to this particular aspect as clinicians. Many of the hereditary diseases are relatively rare as health is a dominant character over disease and recessive characters are masked. Very often medical profession try to minimise the importance of heredity and always investigate upon environment. This particular aspect of question is lost sight of medical men especially veterinarians as they cannot get adequate information from the patient or patient owner. Man always try to conceal the bad side of himself and never reveals his ancestry in this particular direction (*i.e.*) disease. We can never alter the constitution of germ plasm that each one of us has received from the parents and we transmit the same to our sons or daughters. Now can we think of changing environment and get over a particular disease if we know that we have inherited the predisposition of that particular disease.

Why all this? Let us all make efforts towards the rising of general health of the race and should be directed towards improving the environment and provide for proper functioning. Heredity, function and environment are three things which help us to get over all these morbid conditions.

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Sports Club

FOOTBALL

The standard of football this year was decidedly better than that of the previous years. Our success will make the game more popular among the students. In addition to the Inter-Collegiate matches, we played a few friendly games.

Our College came to the lime-light this year by our contribution of Mr. S. Lingayya to the Madras University football team. He did well both at Madras and Lahore, and brought credit to our College.

The end of the year saw our team considerably weakened, because some of our good players, such as Messers. Rajaram, A. Khan, K. C. Menon and Nilakanthan, left the college after taking the degree. The team wishes them the best of lucks in their career.

The success we had this year is mainly due to the splendid play of Mr. S. Lingayya as goal-keeper, Messers. G. Venkateswaralu and P. Panduranga Rao as Backs, Messers. Bappa Reddy and Rama Gowda as Half-backs, Mr. Rajaram at the right wing and Messers. A. Khan and K. C. Menon at the forward lines. Messers. Sanmugham and Narayanmurthi Rao also played well. The enthusiasm of our Physical Instructor Mr. A. D. Parthasarathi has also contributed a good deal to our success.

Thanks are also due to the Sports Secretary, all the members of the team and to the Vice-Captain Mr. P. Panduranga Rao.

M. K. PATRA,
Captain.

VOLLEY-BALL

It is with very great pleasure I record the success of our team in the Inter-Collegiate tournament this year. Our team occupy the second place in the Inter-Collegiate tournament. The success of the team is mainly due to the perfect understanding and combination among the players.

The opening of a Volley-ball Court within the Hostel compound is a clear indication of the enthusiasm and interest of our friends in this game. I take this opportunity to thank all those who helped me in opening this Court.

It is a pity that we were not able to enter in "The Betram Memorial Tournament." This was mainly due to want of funds.

In conclusion I can assert with confidence that with an increased number of practice

matches, and a better response from some of our players we can raise our standard still further. I leave this task to my successor.

R. H. SUNDARAM,
Captain.

HOCKEY

This year the hockey team exhibited itself splendidly well in all the matches played including the Inter-collegiate matches. There were many practice matches with the local teams. This year the members of the team were 'at home' to the outgoing members of the team.

We are fortunate enough to have Dr. Mangrulkar as a member of the team this year. Along with Narasimhamurthi our invincible defence at the back line he played skilfully and put up a strong defence and dissipated the attack by the opponents. Our goal keeper Rozario played well and brought off many a good saves. Narayan and Doshi defended very well in the half line. Especially the latter was very good at it and put up a hard fight. Sivadas the pivot of our team played brilliantly in all the matches. He is a tireless tackler and a clever and sincere player.

In the forward line Sundaram, Venkatachalam and Rangamannar played a clever game and helped in getting many of the goals. Karumbia the vice-Captain of the team displayed his skill brilliantly in the forward line and was mainly responsible for the score. Narayana Rao played well in all the matches as the right inner of the team. He is a promising player and has a good scope for improving his game to a great extent in the coming years of his stay in the college. Natarajan and Kantha Rao played well many times as the reserve players of the team.

Our standard of the game of Hockey can really be improved if the ground is repaired and made fit for playing and also by encouraging the team by providing much more materials needed for the game. Anyway I leave it to the captain of the coming year to keep up the great name of the hockey team.

I thank sincerely all the players of the team for the kind co-operation they have extended to the team under my Captaincy.

BALAPRAKASAM, R.A.,
Captain.

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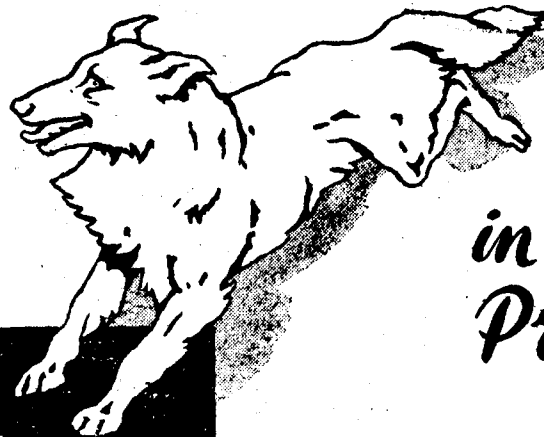
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